XINJE

DF3E series servo driver
User manual

Wuxi Xinje Electric Co., Ltd.

Data No. SF3 01 20210607 1.0

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

Get the manual

- Please consult the supplier, agent and office who purchased the product.

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.

Contact information

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Safety Precautions

Be sure to review this section carefully before use this product. In precondition of security, wire the product correctly.

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.

The problems that may arise during the use of the product are basically listed in the safety precautions, and all are indicated by the two levels of attention and danger. For other unmentioned matters, please follow the basic electrical operation rules.

Caution	When used incorrectly, there may be danger, moderate injury or minor injury, and property loss.
Danger	When used incorrectly, it may cause danger, personal casualties or serious injuries, as well as serious property losses.

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. Please connect AC power to LN or L1/L2/L3 or R/S/T on the dedicated power terminal of the driver. Do not connect the output terminals U, V, W of the driver to the three-phase power supply.
2. Please connect the ground wire correctly. Poor grounding may cause electric shock. Please use $2mm^2$ wire to ground the ground terminal of the driver.
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

Code	Product name
DF	Servo driver

Code	Product series
3	Series number

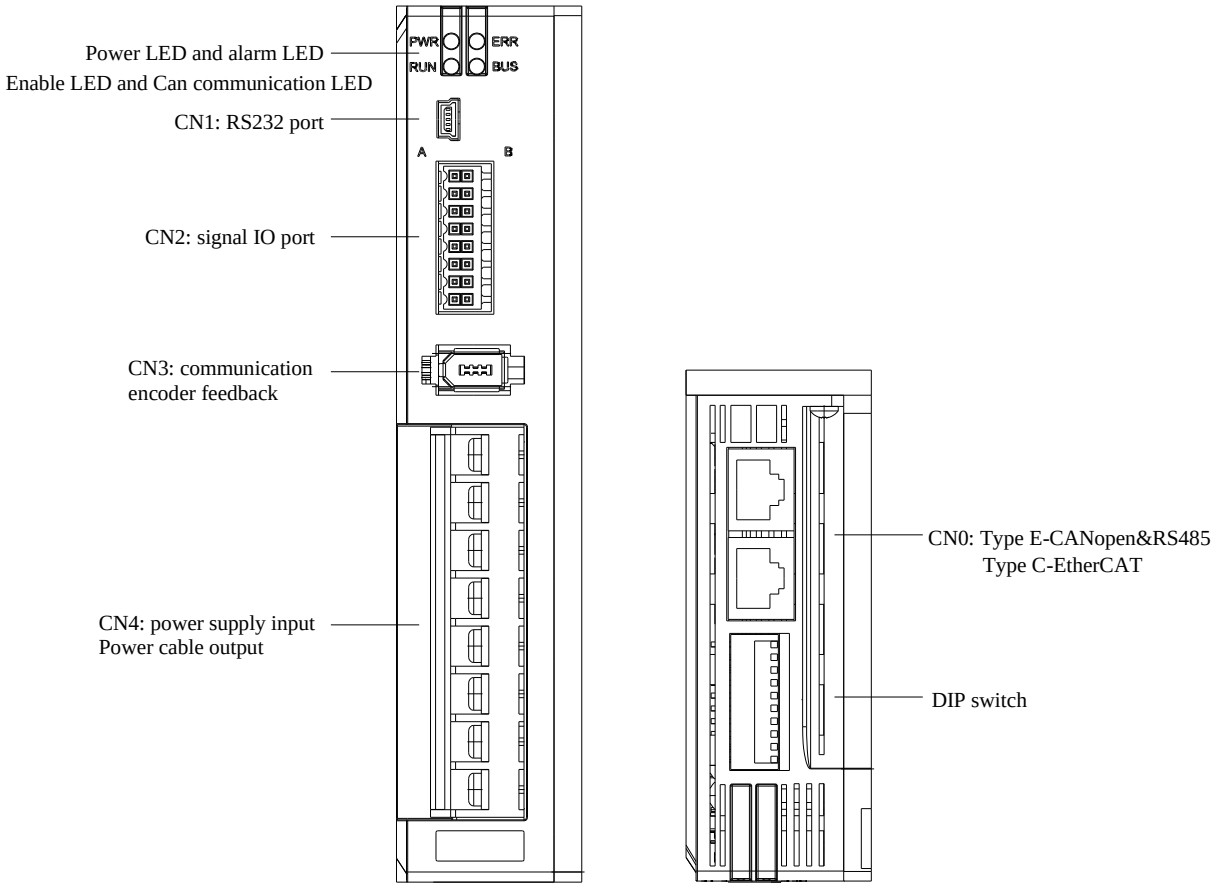
Code	Control function
E	Pulse, RS485, Canopen
C	EtherCAT

Code	Rated output power
01	100W
02	200W
04	400W
07	750W

Code	Rated output current
05	5A
10	10A
20	20A

Code	Specification
Z	Servocan drive the brake
	Servo cannot drive the brake

1.1.2 Description of each part



Note: 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:

- Left upper power indicator: after power on, green is always on;
- Left lower enable run indicator: after enable, green is always on;
- Upper right alarm err indicator: after alarm, red is always on; Red flashing, need to power on again;
- Lower right can communication indicator: green flashing after CAN communication.

1.1.3 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 humidity	Below 90％RH (no condensation)
	Vibration resistance	4.9m/s^2
Structure		Vertical or horizontal installation

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
MF3G	Medium inertia
MF3H	High inertia

Display	Base No.
40	40 flange
60	60 flange
80	80 flange

Display	Encoder type
C	Magnetic encoder
T	Photoelectric encoder

Display	Encoder resolution
S	Single turn 17 bits
M	Multi-turn 17 bits
L	Multi-turn 23 bits

Display	Rated speed(rpm)
15	1500
20	2000
30	3000

Display	Shaft
A	With key, no oil seal
B	With key and oil seal
C	No key, no oil seal
D	No key, with oil seal

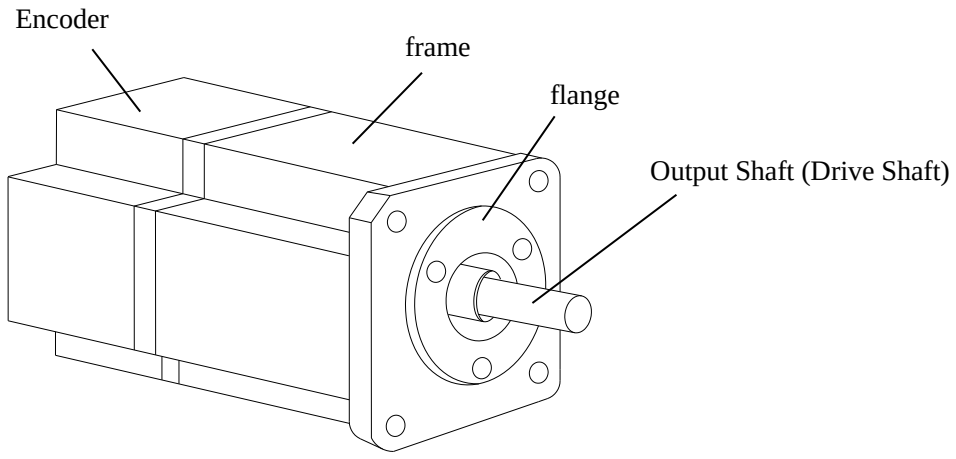
Display	Brake
	No brake
Z	With brake

Display	Plug type
1	AMP plug
2	Aviation plug

Display	Voltage level
2	24V
5	48V
6	60V

Display	Power
01	100W
02	200W
04	400W
07	750W
15	1.5KW

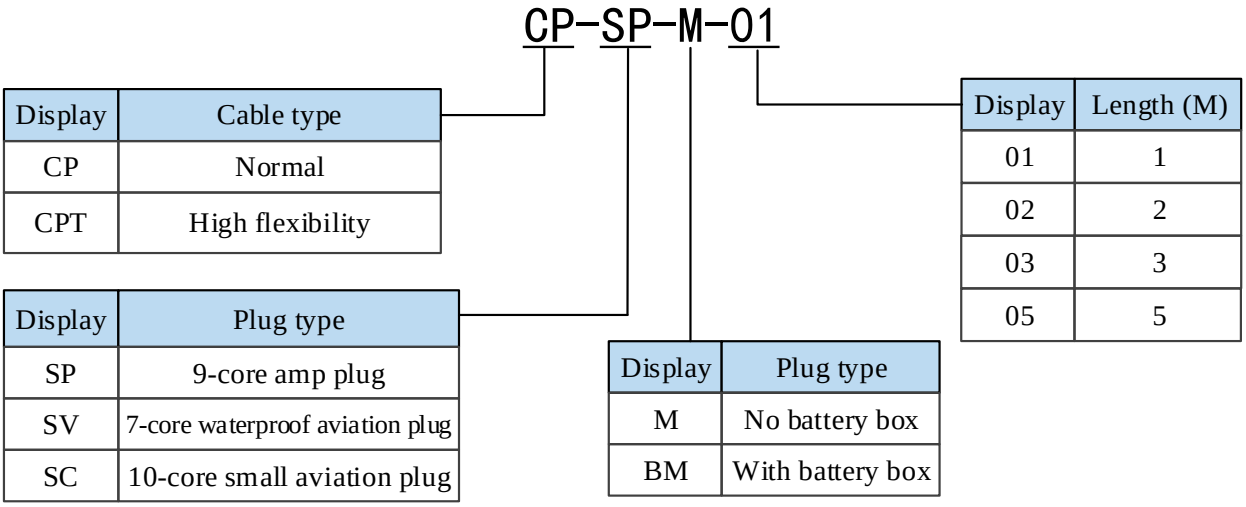
1.2.2 Description of each part



1.3 Cable selection

1.3.1 Model name

■ Encoder cable



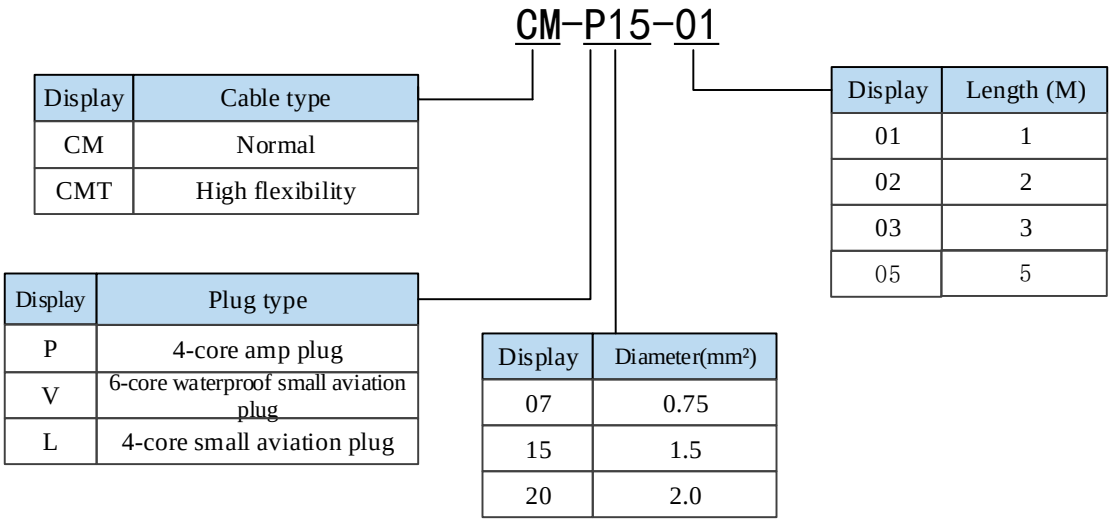
Display	Cable type
CP	Normal
CPT	High flexibility

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



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

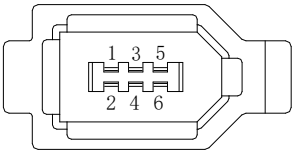
■ Brake cable explanation

- The cable model for motor/brake motor: CB-P03-length (common material) /CBT-P03-length (high flexible material).
- The standard wiring length of Xinje cable is 1m, 2m, 3m and 5m.

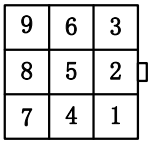
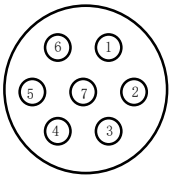
1.3.2 Description of each part

■ Encoder cable

(1) Pin definition of encoder on servo driver side

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

(2) Cable connection of encoder on motor side

Connector pins	Pin definition		Suitable model
	No.	Definition	
	1	Battery +	60 flange
	2	Battery -	
	3	Shielded cable	
	4	485+	
	5	485-	
	6	/	
	7	5V	
	8	GND	
	9	/	
	No.	Definition	80 flange
	1	GND	
	2	Battery +	
	3	Battery -	
	4	485+	
	5	485-	
	6	5V	
	7	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.

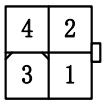
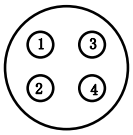
(2) Only the cable of absolute value motor has external battery box, which contains a 3.6V/2.7Ah large capacity battery, and has the function of replacing batteries when power cut. The using life is more than two years. Please refer to chapter 4.6.2 change battery.

■ Power cable

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

Connector appearance	Pin definition	
	Color	Definition
	Brown	U
	Black	V
	Blue	W
	Yellow-green	PE

(2) Power cable connection on motor side

Connector pins	Pin definition		Suitable model
	No.	Definition	
	1	U	60 flange
	2	W	
	3	V	
	4	PE	
	No.	Definition	80 flange
	1	PE	
	2	U	
	3	V	
	4	W	

(3) Brake cable connection

Connector pins	Pin definition		Suitable model
	No.	Definition	
	1	BK+	Motor with brake
	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

1.4.1 Selection of regenerative resistance

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.

Servo driver model	Regenerative resistance connection terminals
DF3E-□□□□	Use external regenerative resistance, connect regenerative resistance to RB+ and RB- terminals, P0-25 = power value, P0-26 = resistance value.

The following table is the recommended specifications of external regenerative resistance for each type of motor.

Servo driver model	Rmin (Not less than this value)	External regenerative resistance (Recommended power values)
DF3E-0103	27Ω	Above 100W
DF3E-0410	10Ω	Above 100W
DF3E-0720	5Ω	Above 100W

Note:

(1) The smaller the resistance is, the faster the discharge will be, but the smaller the resistance is, the easier the breakdown resistance will be. Therefore, please close to the the lower limit but not be less than the lower limit when choosing the type.

(2) When wiring, please use high-temperature flame-retardant wire, and the regenerative resistance surface can not contact with the wire.

1.4.2 Fuse selection

The role of fuse in the circuit is over-current protection, also known as short-circuit protection.

When there is a short circuit, the current in the circuit is the largest, which undoubtedly far exceeds the rated current of the equipment. If the circuit breaker is not cut off in time, the electrical equipment will soon be burned due to the high current. Therefore, in order to cut off the circuit in time and protect the equipment from damage, the fuse is used, the principle is that the fuse can be fused quickly before the equipment is damaged at the moment when a large current is generated in the circuit, so as to cut off the circuit.

Fuse selection		
Driver model	Driver power (W)	Fuse specification
DF3E-0103	100	20A/58VDC
DF3E-0410	400	20A/58VDC
DF3E-0720	750	40A/58VDC

2 Installation of servo system

2.1 Servo driver installation

2.1.1 Installation site

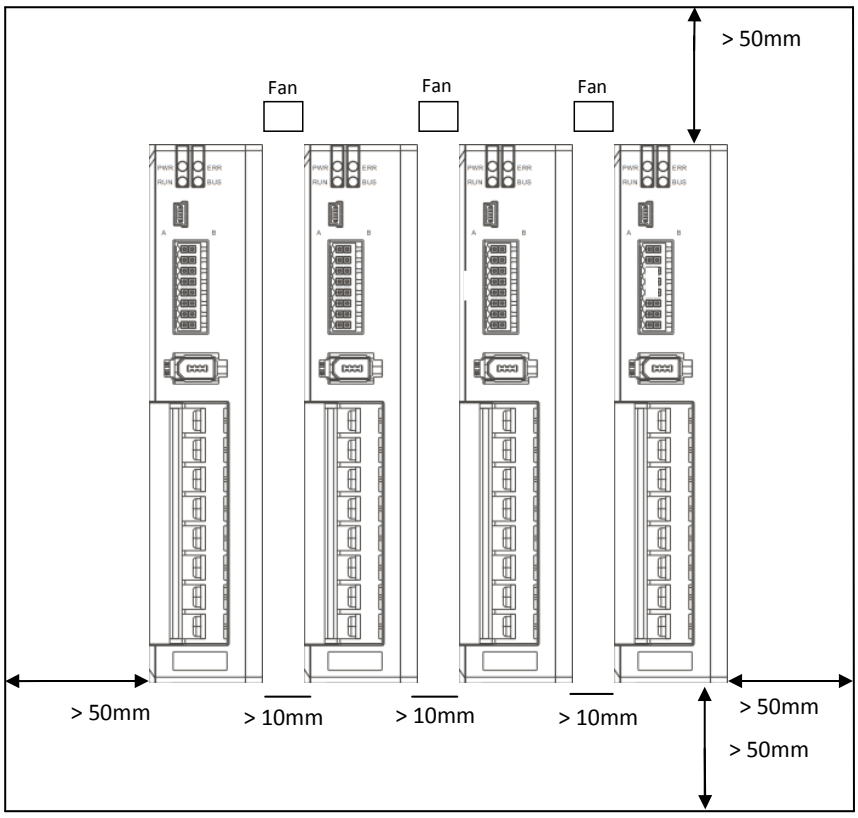
- Please install it in the installation cabinet without sunshine or rain.
- Do not use this product near corrosive and flammable gas environments such as hydrogen sulfide, chlorine, ammonia, sulfur, chlorinated gas, acid, alkali, salt, etc.
- Do not install in high temperature, humidity, dust, metal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

2.1.2 Environment condition

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

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

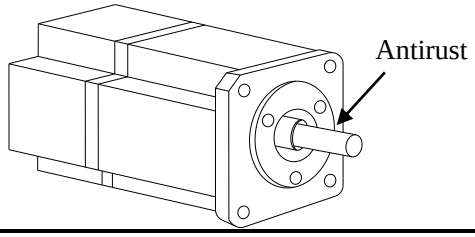
Note: when installing horizontally (mask facing the operator), it needs to use the frame provided by our company (see chapter 2.4 the outline dimensions of servo driver).

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.

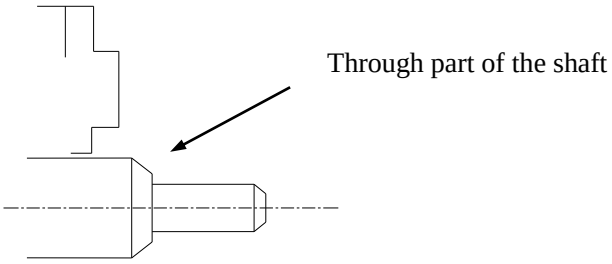
CAUTION

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

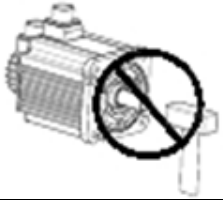
When used in places with water droplets or oil droplets, the protection effect can be achieved through the treatment of motors. However, in order to seal the through part of the shaft, please specify the motor with oil seal. Connectors should be installed downward.

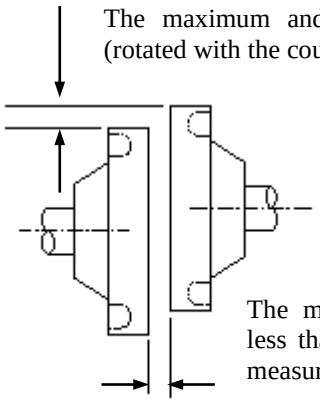


MS series servo motors are for indoor use. Please use them under the following installation conditions:

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.
Encoder cautions	◆ It is forbidden to impact the extension end of the shaft during installation, otherwise the internal encoder will be broken. 

Item	Description
	◆ 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.
Centering	◆ 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.  The maximum and minimum deviations are less than 0.03mm (rotated with the coupling) measured at four locations in a circle. The maximum and minimum deviations are less than 0.03mm (rotated with the coupling) measured at four locations in a circle.
Installation direction	◆ Servo motor can be installed in horizontal or vertical direction.
Oil and water solutions	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. ◆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

Item	Description
	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

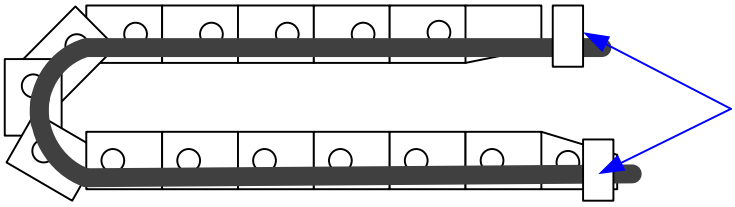
40mm diameter galvanized steel pipe;

- 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.

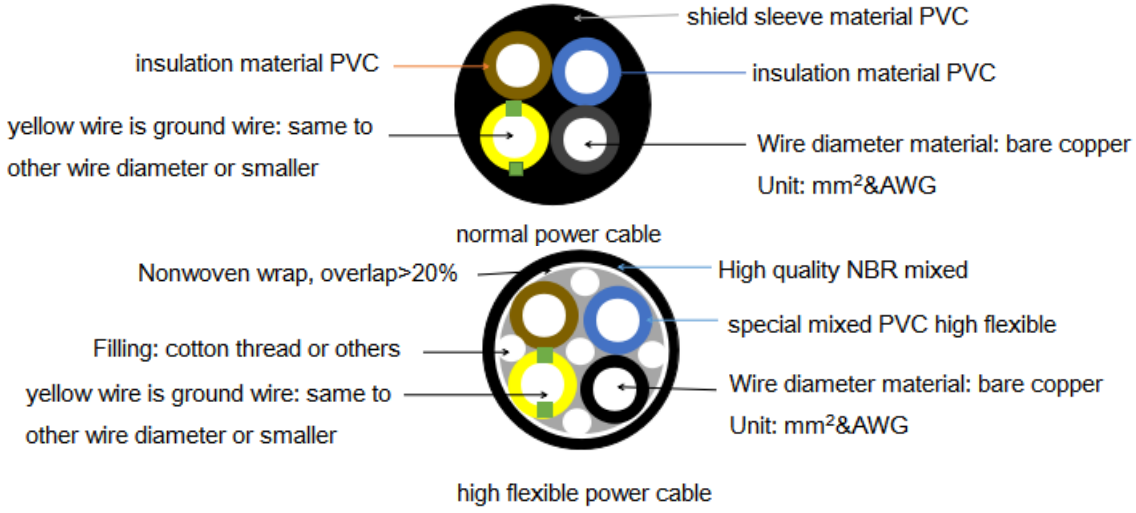
(4) Low / high temperature

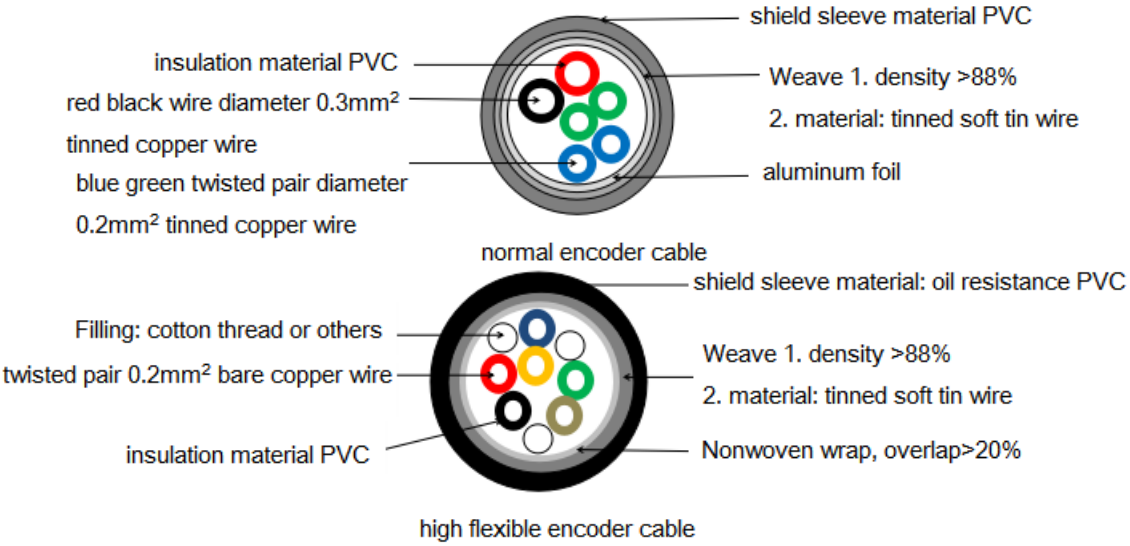
- Select cables (special cables) that meet the use conditions.

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

Performance		Normal cable	High flexible cable
Ordinary temperature resistance		-20℃~80℃ (relative humidity)	-20℃~80℃ (relative humidity)
Encoder cable withstand voltage		1000V	1000V
Power cable withstand voltage		3000V	3000V
Mobile installation	Bending radius	Travel＜10m，7.5*D； Travel ≥10m，10*D；	Travel ＜10m，7.5*D； Travel ≥10m，10*D；
	Bending resistance times	Travel ＜10m, ≥1 million times； Travel ≥10m, ≥2 million times；	Travel ＜10m, ≥3 million times； Travel ≥10m, ≥5 million times；

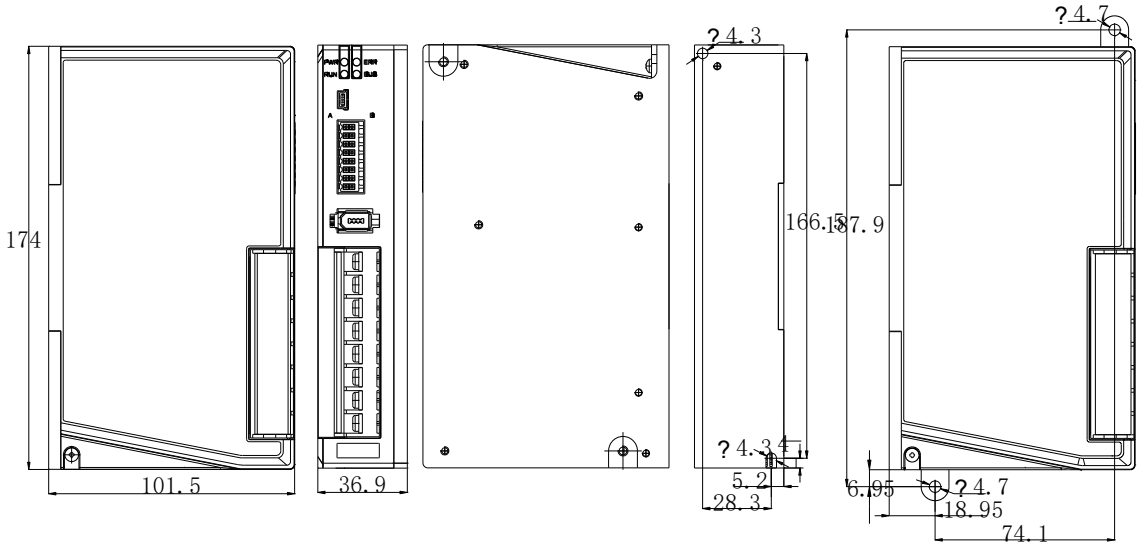
Fixed installation	Bending radius	5*D	5*D

Note: D represents the finished product cable diameter.

2.4 Servo driver dimension

DF3E-0103, DF3E-0410, DF3E-0720 Unit: mm

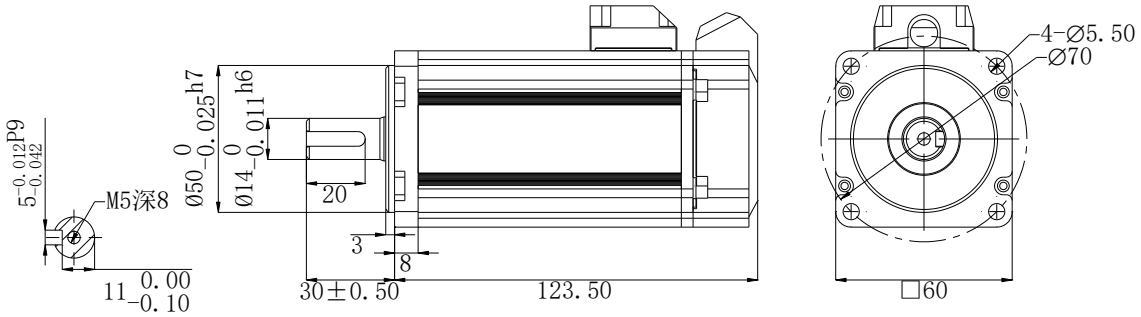
Left Front Right Installation hole Frame installtion



2.5 Servo motor dimension

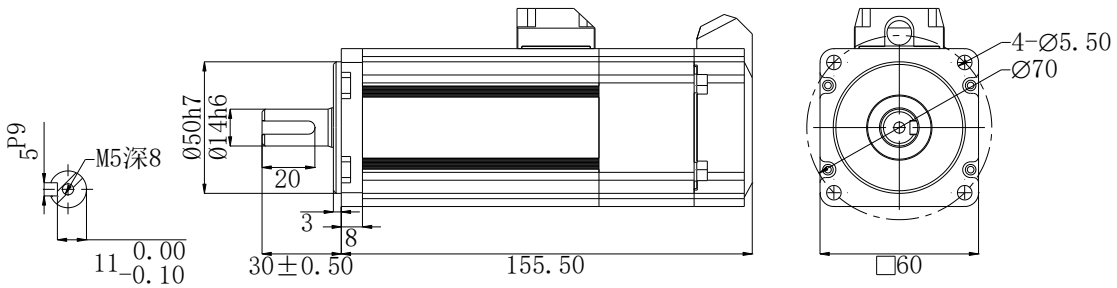
■ 60 series motor without brake installation dimensions Unit: mm

■ mm



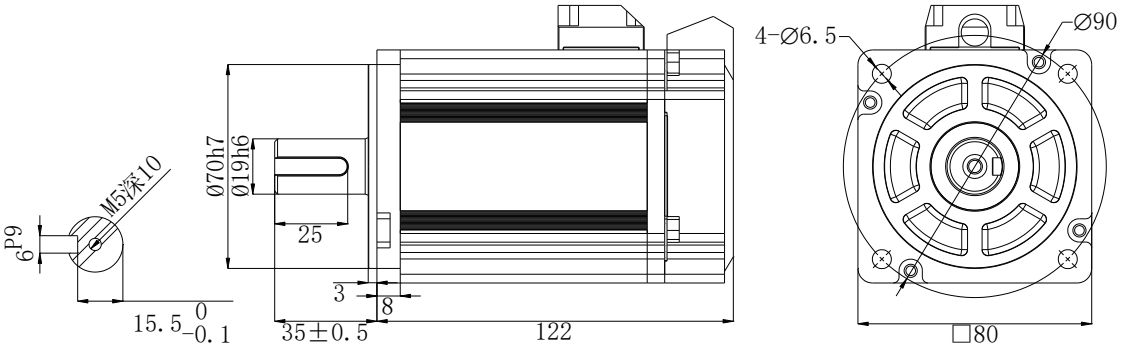
Motor model	Inertia	Matched driver
MF3S-60CS/CM30B1-504	Low inertia	MF3S series

■ 60 series motor with brake installation dimensions Unit: mm



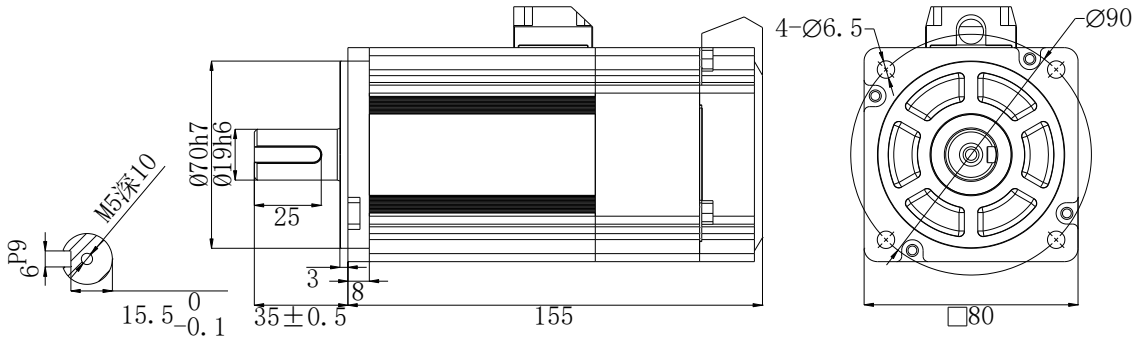
Motor model	Inertia	Matched driver
MF3S-60CS/CM30BZ1-504	Low inertia	MF3S series

■ 80 series motor without brake installation dimensions Unit: mm



Motor model	Inertia	Matched driver
MF3S-80CS/CM30B2-507	Low inertia	MF3S series

■ 80 series motor with brake installation dimensions Unit: mm



Motor model	Inertia	Matched driver
MF3S-80CS/CM30BZ2-507	Low inertia	MF3S series

3 Wiring of servo system

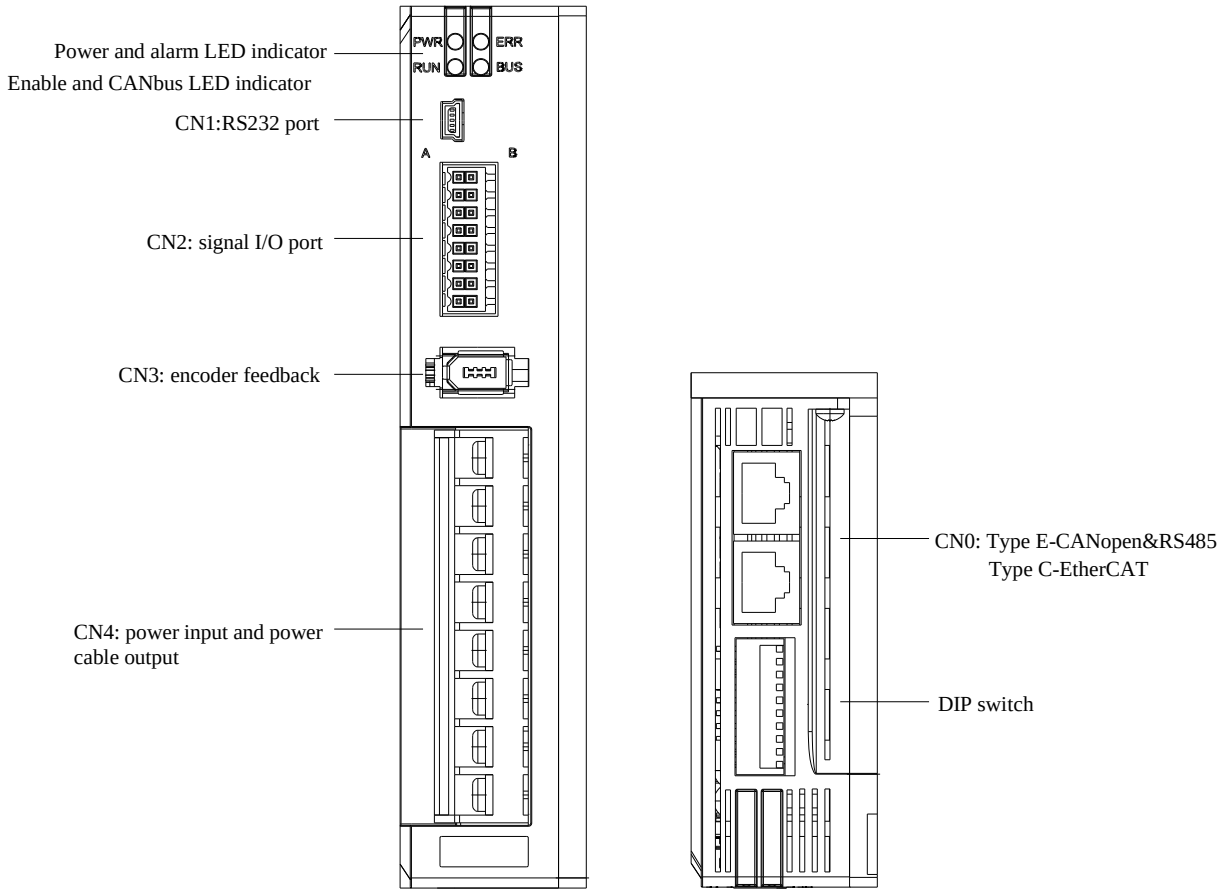
Servo driver interface wiring recommended wire, as shown in the following table:

Servo driver model	Power cable diameter mm²	UVW power cable diameter mm²	Encoder cable diameter mm²	Grould cable ⏚ diameter mm²
DF3E-0410	2.0	1.5	0.2（9芯）	2.0
DF3E-0720	2.0	2.0	0.2（7芯）	2.0

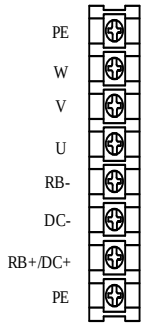
Note:
(1) Please do not cross power wires and signal wires from the same pipeline, nor tie them together. When wiring, please keep the power wire and signal wire more than 30 cm apart.
(2) For the signal wire and the feedback wire of the encoder (PG), please use the multi-stranded wire and the multi-core stranded integral shielding wire.
(3) For wiring length, the longest instruction input wire is 3m and the longest PG feedback wire is 20m.
(4) 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-0410/0720

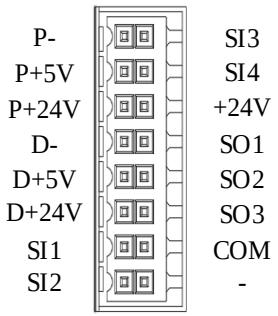
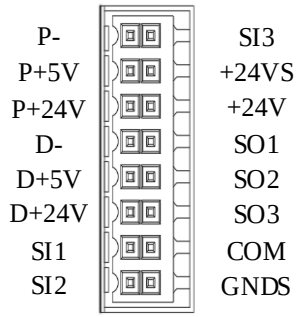
According to the order from top to bottom, the main circuit terminal functions are as follows:

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

3.1.3 CN2 terminals and DIP switch

3.1.3.1 CN2 terminals

■ CN2 terminals

CN2 (model without brake)	CN2 (model with brake)
	

Name	Explanation	Name	Explanation
P-	Pulse -	SI3	Input terminal
P+5V	Pulse +5v	SI4/24VS	Input terminal/brake output +24VS
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	Vacant/brake output V-

3.1.3.2 DIP switch

Adjust the communication station number of low-voltage servo by DIP switch SW1-SW6

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

SW7 and SW8 control whether the RS485 internal terminal resistance is on:

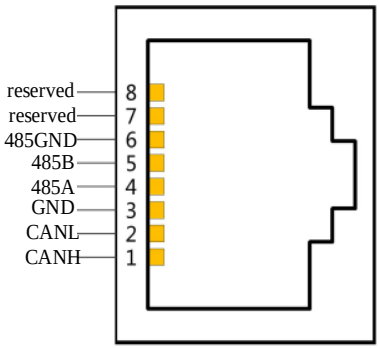
RS485 internal terminal resistor		
SW7=ON	SW8=ON	ON
SW7=OFF	SW8=OFF	OFF

SW9, SW10 control whether CAN internal terminal resistor is on:

CAN 内部终端电阻		
SW9=ON	SW10=ON	ON
SW9=OFF	SW10=OFF	OFF

3.1.4 Communication port

■ CN0 port

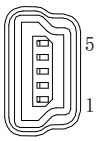


LAN port

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

CANopen default communication parameters: baud rate500kbps.

■ RS-232 port



Driver side -5-pin trapezoidal interface

Pin	Name	Explanation
1	TXD	RS232 send
2	RXD	RS232 reveive
3	GND	RS232 ground

Note: please use the special cable provided by Xinje company.

RS232 port default communication parameters: baud rate 19200bps, data bit is 8-bit, stop bit is 1-bit, even parity.

Modbus station no.

Parameter	Function	Default setting	Range	Modification	Effective
P7-10	Modbus station no.	1	1~255	Servo bb	At once

Note: it supports standard Modbus RTU protocol and is used as Modbus RTU slave.

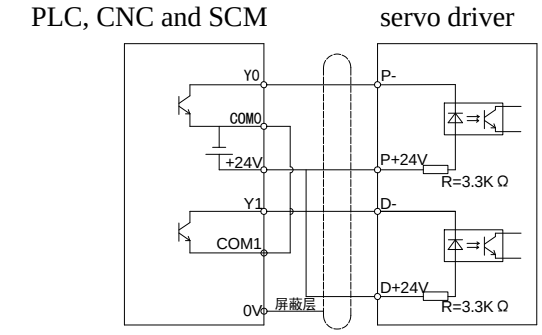
3.2 Classification and function of CN0 signal terminals

3.2.1 Pulse signal

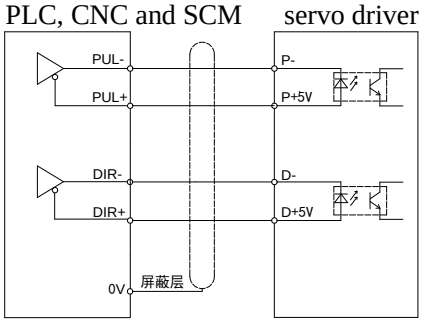
Instruction form	Option	Meaning	P-input signal	D-input signal	Chapter
P0-10 xxx□	0	CW/CCW dual-pulse mode	CW	CCW	4.3.2.2
	1	AB phase mode	A phase	B phase	
	2	Pulse+direction mode	pulse	direction	
Open collector (24V voltage) input signal is P+24V/D+24V					

The wiring diagram of P + D, CW, CCW and AB phase interface circuit is as follows:

Open collector (24V voltage)



Differential mode (5V voltage)



Note:
(1) The power supply voltage range of P-/P+24 V and D-/D+ 24 V is 18V ~ 25V. The supply voltage range of P-/P+ 5V and D-/D+ 5V is 3.3V ~ 5V. If it is lower than 18V/3.3V, there may be abnormal pulse and direction.
(2) In order to enhance the anti-interference, it is recommended to use twisted pair shielded wire.
(3) The servo pulse input port is on at 10mA.
(4) If the controller is Xinje PLC and the rated current of pulse output port is 50mA, according to this data, it can be judged that theoretically one pulse can drive five servos at most. It is recommended that the maximum number should not be more than 3.

3.2.2 SI input signal (without brake)

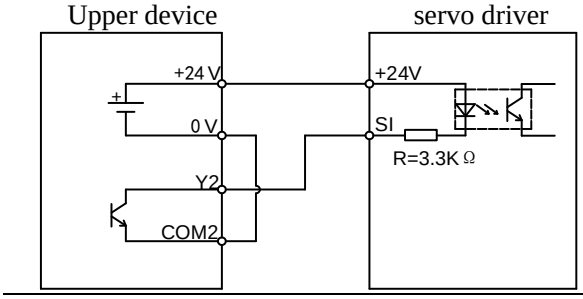
Please use a relay or an open collector transistor circuit to connect. When using relay connection, please select the relay for small current. If the relay is not small current, it will cause bad contact.

Type	Input terminal	Function
Digital input	SI1~SI4	Multifunctional input signal terminal

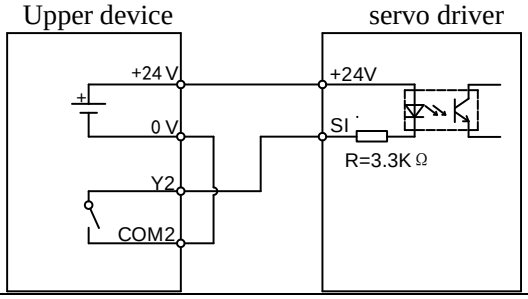
Defaulted assignment of input terminals

Terminal	SI1	SI2	SI3	SI4 (without brake)
Function	S-ON/ enable	ALM-RST/alarm reset	P-OT/forward run prohibition	-

Open collector (power supply is 24V)



Relay type (power supply is 24V)



Note: the maximum allowable voltage and current capacity of open collector output circuit are as follows:
Voltage: DC 30V (maximum)
Current: DC 50mA (maximum)

3.2.2.1 SI input signal (with brake)

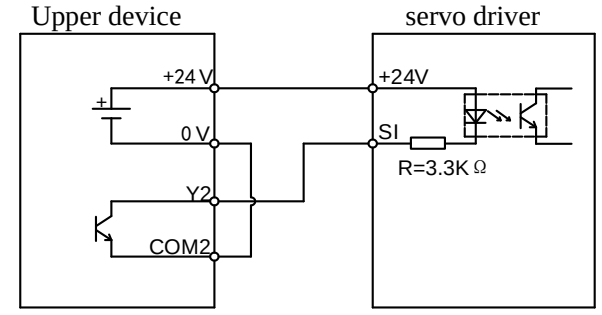
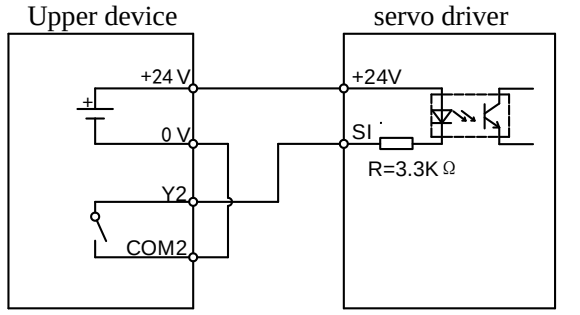
Please use a relay or an open collector transistor circuit to connect. When using relay connection, please select the relay for small current. If the relay is not small current, it will cause bad contact.

Type	Input terminal	Function
Digital input	SI1~SI3	Multifunctional input signal terminal

Defaulted assignment of input terminals

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

Note: the usage of SI4/+24VS is to provide +24V voltage internally and the maximum output current is 1A.

Open collector (power supply is 24V)	Relay type (power supply is 24V)
	

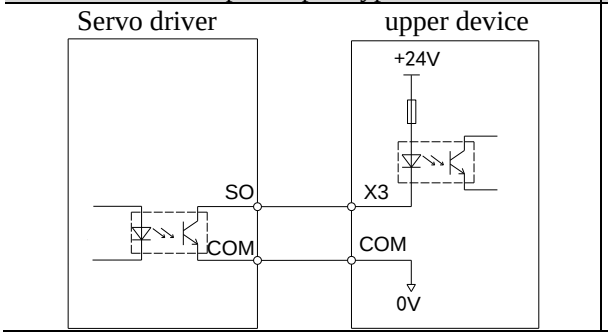
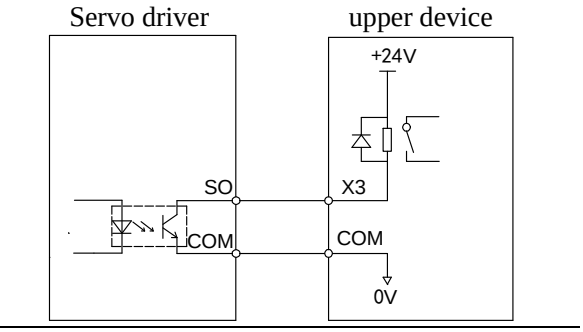
Note: the maximum allowable voltage and current capacity of open collector output circuit are as follows:
Voltage: DC 30V (maximum)
Current: DC 50mA (maximum)

3.2.3 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
	

Note:
(1) It can't be used as power supply of holding brake directly, so external relay is needed.
(2) The maximum allowable voltage and current capacity of open collector output circuit are as follows:
Voltage: DC 30V (max); Current: SO1 DC 500mA (max)
SO (others) DC 50mA (max)

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

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 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

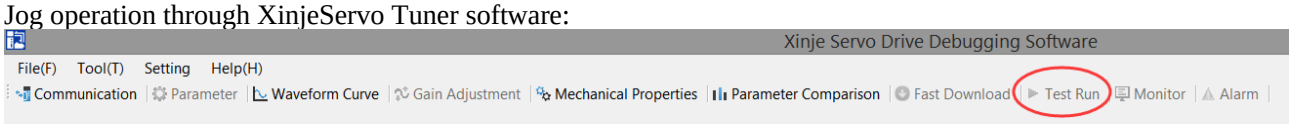
Inching operation needs to be completed after the power supply is connected and before the online commissioning operation. Its purpose is to ensure that the servo system can operate normally without abnormal vibration, abnormal sound and other problems. Inching operation can be carried out by panel group 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

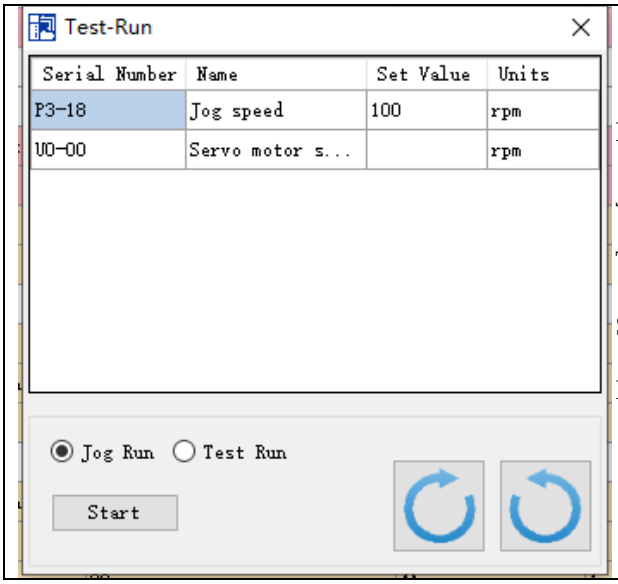
parameter	Meaning	Default setting	Unit	Range	Modify	Take effect
P3-18	JOG speed	100	1rpm	0～1000	Servo bb	At once

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:



P3-18: jog speed

Jog Run: closed-loop jog operation

Test Run: open loop jog operation

Start: enable in jog mode

Forward/Reverse: Jog forward or reverse

The steps of inching through Xinje servo tuner

Open the software XinjeServo Tuner, set the jog speed P3-18, select test run/jog run button, click ON. Then click forward or reverse button to run.

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(default)	I/O enable /S-ON		
		2	Software enable (F1-05 or enabled by software)		

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.

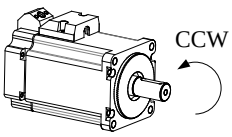
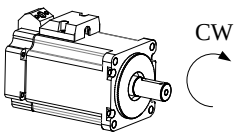
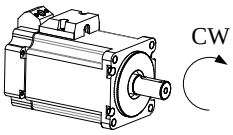
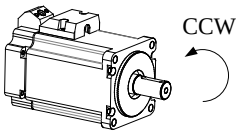
Prerequisite	Parameter setting status	signal/S-ON terminal input status	signal/S-ON terminal logic	Servo status
P0-03=1	P5-20=n.000□	SI□ terminal NC signal input	Invalid	Enable LED not light, servo not enable
	P5-20=n.001□	SI□ terminal NO signal input		
	P5-20=n.000□	SI□ terminal NC signal input	Valid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

4.2.3 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
P3-32	braking torque	300	1%	0~1000	Anytime	At once
P5-03	Rotation detection speed	50	rpm	0~10000	Anytime	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
P0-31	Deceleration stop time	25	1ms	0~5000	Servo bb	At once

Parameter	Value	Meaning
P0-27/ P0-29	0	inertia stop and maintain the inertia operation state after stop.
	2	deceleration brake stop and maintain the inertia operation state after stop.

Note:

(1) P0-27 / P0-29 = 0, inertia stops, and maintains inertia operation state after stopping.

When the servo is off and the alarm occurs, the motor starts to stop by inertia until the speed is less than P5-03, and then it turns to free stop. The servo will time the inertia stop process. In the process of inertia stop, if the timing time has been greater than P0-30, and the motor speed has not dropped below P5-03, the servo will directly free stop, and give the stop timeout alarm E-262.

(2) P0-27 / P0-29 = 2, deceleration braking stops, and maintains inertia operation state after stopping.

When servo off and alarm occur, the motor will generate a braking torque of P3-32. The motor will start braking and stop until the speed is less than P5-03 (rotation detection speed), and then it will turn to free stop. At the same time, the servo will timing the braking stop process. In the process of inertia stop, if the timing time has been greater than P0-30, and the motor speed has not dropped below P5-03, the servo will directly free stop, and give the stop timeout alarm E-262.

(3) The so terminal of servo driver is equipped with holding brake function. No matter P0-27 / P0-29 = 0 or 2, it

stops in deceleration mode.

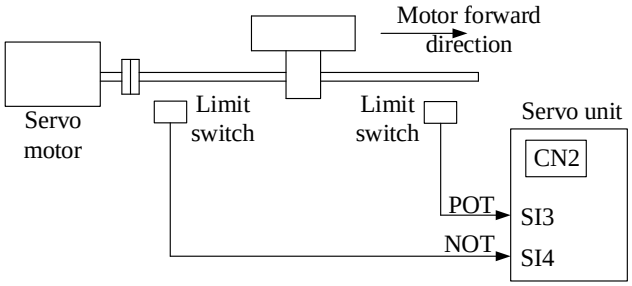
(2) Stop mode in case of over travel

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	

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)

Note:

(1) 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.

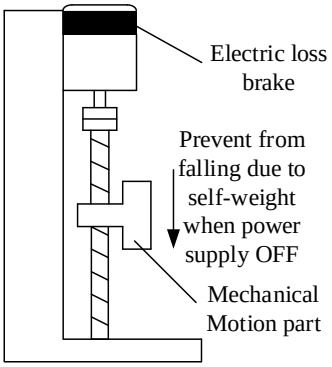
(2) During position control, when the motor is stopped by over travel signal, there may be position deviation pulse. To clear the position deviation pulse, the clear signal /CLR must be input. If the servo unit still receives pulses, they will accumulate until the servo unit gives an alarm.

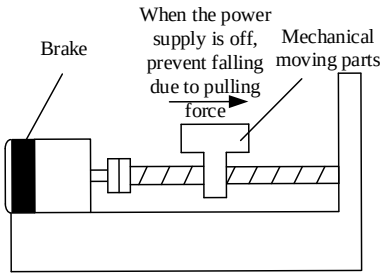
(3) During torque control, the SO terminal of servo drive has the function of holding brake, which can't be distributed through the overtravel signal terminals P5-22 and P5-23.

(4) Servo driver SO terminal is assigned with holding brake function, P0-28 is automatically set to 2.

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.



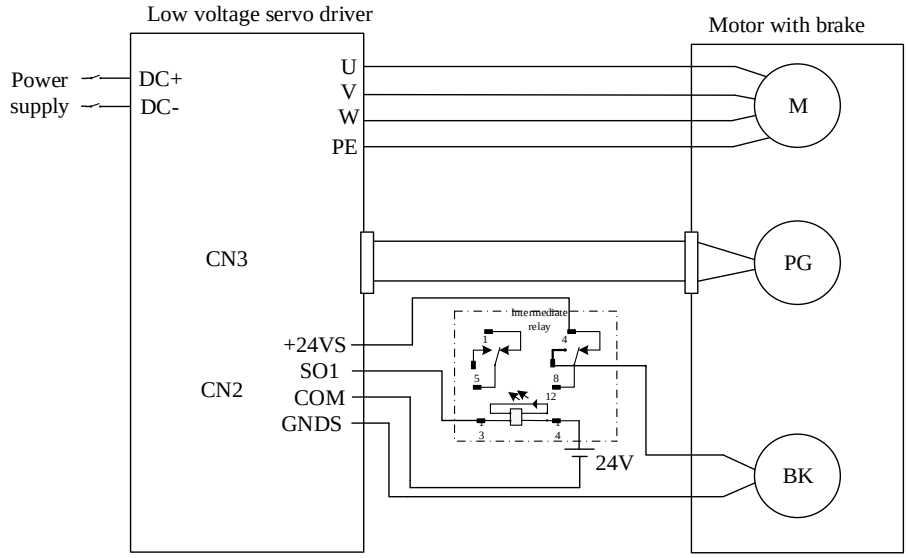


Note: The brake built in the servo motor is a fixed special brake without excitation. It can not be used for dynamic braking. Please use it only when the servo motor is in a stop state.

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.



Note:

(1) The excitation voltage of the power-off brake is 24V.

(2) 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

Note:

(1) 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;

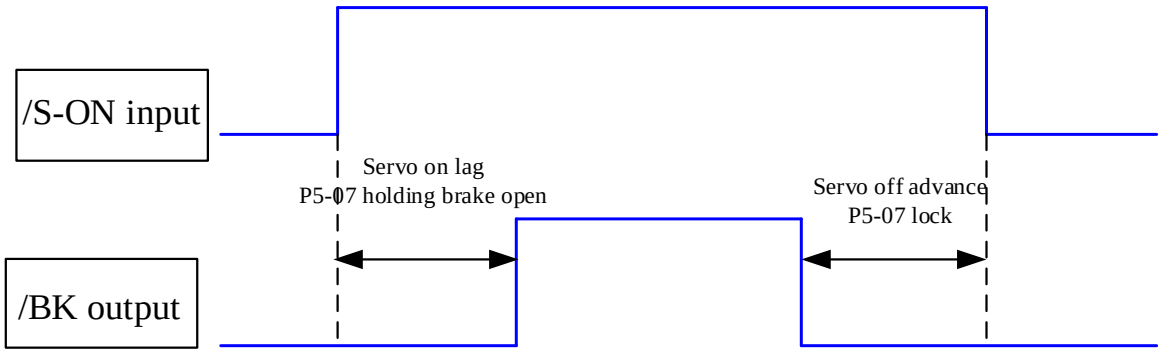
(2) If the motor fails to rotate during the debugging of the new machine, please confirm whether the holding brake is open.

(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.

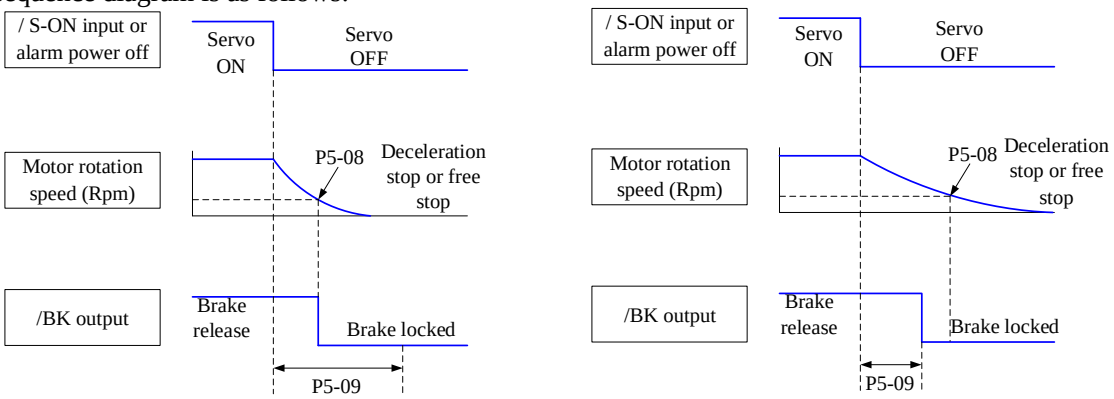
When setting the servo motor with brake, the output signal "/ BK" of control brake and the time of servo SON signal on/off action are shown in the figure below. That is to say, before the /BK signal outputting and brake is opened, the servo motor has entered the power on enabling state; after the / BK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



Note: 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.

4.2.6 Braking setting

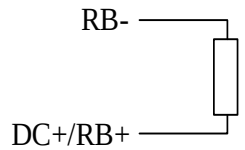
When the servo motor is driven by the generator mode, the power returns to the servo amplifier side, which is called regenerative power. Regenerative power is absorbed by charging the smoothing capacitor in the servo amplifier. After exceeding the rechargeable energy, the regenerative resistance is used to consume the regenerative power.
The servo motor is driven by regeneration (generator) mode as follows:

- Deceleration stop period during acceleration and deceleration operation;
- When the vertical axis is running downward;
- When the external load drives the motor to rotate.

■ Related parameter

Parameter	Meaning	Default setting	Unit	Setting range	Modify	Effective
P0-24	Power protection mode of discharge resistance 0 - cumulative discharge time 1 - average power mode 1	0	-	0~1	Servo bb	At once
P0-25	Power value of discharge resistance	Set as model	W	1~65535	Servo bb	At once
P0-26	Discharge resistance value	Set as model	Ω	1~500	Servo bb	At once

1. Hardware wiring

Power	Hardware terminal	Notes	
Below 750W	DC+/RB+, RB-	External resistor	

2. Recommended brake resistance specifications

Servo driver model	External regeneration resistance (recommended resistance)	External regeneration resistance (recommended power value)
DF3E-0103	27Ω	Above 100W
DF3E-0410	10Ω	Above 100W
DF3E-0720	5Ω	Above 100W

Note:

(1) The smaller the resistance is, the faster the discharge will be, but it is easy to break down the resistance if it is too small. Therefore, the lower limit should be as close as possible but not less than the lower limit when selecting the type.

(2) When wiring, please use high temperature resistant and flame-retardant wires, and pay attention that the regenerative resistance surface does not contact with the wires.

4.3 Position control

4.3.1 General position control

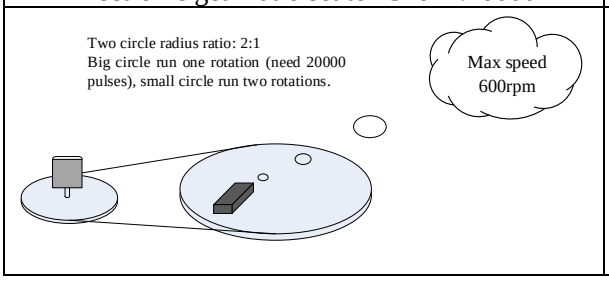
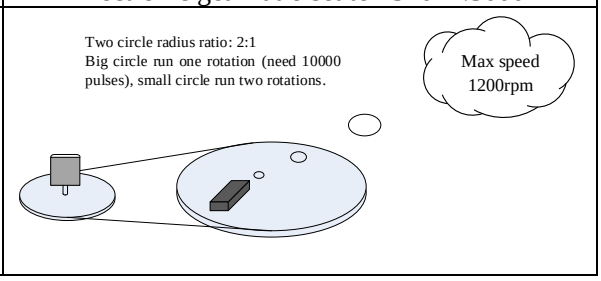
4.3.1.1 Electronic gear ratio

1. Overview

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

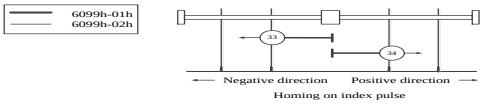
(1) Determine the number of command pulses needed to rotate the motor for one revolution to ensure that the motor speed can reach the required speed.

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 (numerator) high bit*10000	0	-	1～65535	Servo bb	At once
P0-94	Group 2 Electronic gear ratio	1	-	1～9999	Servo bb	At

	(denominator) low bit*1					once
P0-95	Group 2 Electronic gear ratio (denominator) high bit*10000	0	-	1～65535	Servo bb	At once

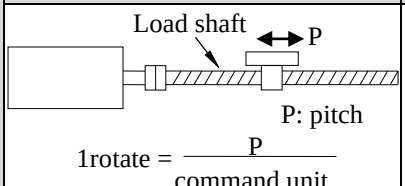
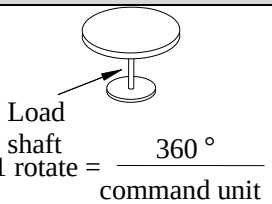
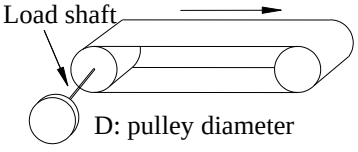
Note:
(1) P0-11~P0-14 is all about the parameters of electronic gear ratio, P0-11, P0-12 is group 1, P0-13, P0-14 is group 2, but the priority of P0-11 and P0-12 is higher than that of P0-13 and P0-14. Only when P0-11 and P0-12 are set to 0, the ratio of electronic gear P0-13 and P0-14 will take effect.
(2) 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.

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 $\frac{P0-13}{P0-14}=\frac{encoder\ resolution}{M}=\frac{encoder\ resolution}{N\times n}\times m$	priority ↓

Note:
(1) 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.
(2) 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.
(3) The resolution of DS5 series servo motor encoder is 131072 (17 bits) and 8388608 (23 bits).
(4) 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	Encoder resolution 131072	Encoder resolution 131072	Encoder resolution 131072

	pulses			
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 mode	0	-	0～3	Anytime	At once
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.						

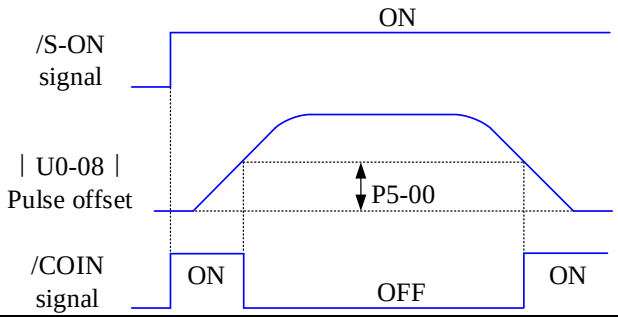
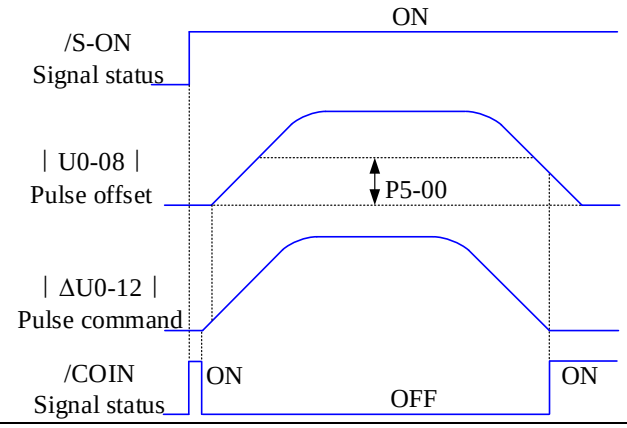
1. Conditions for positioning completion signal output

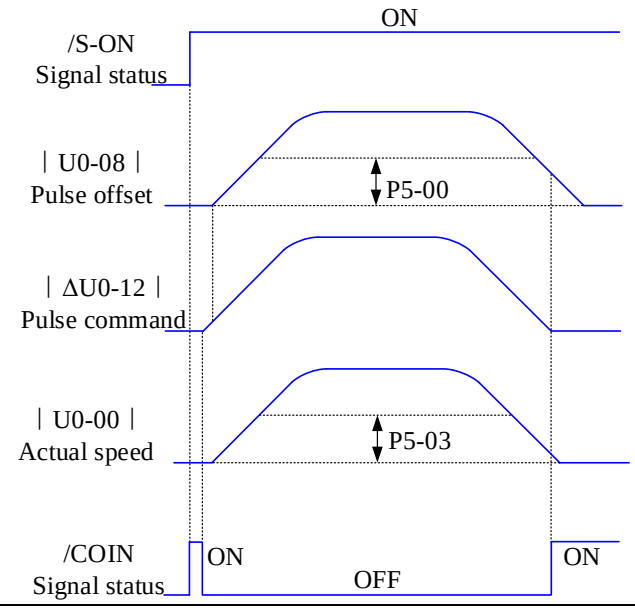
(1) /COIN-HD signal output conditions

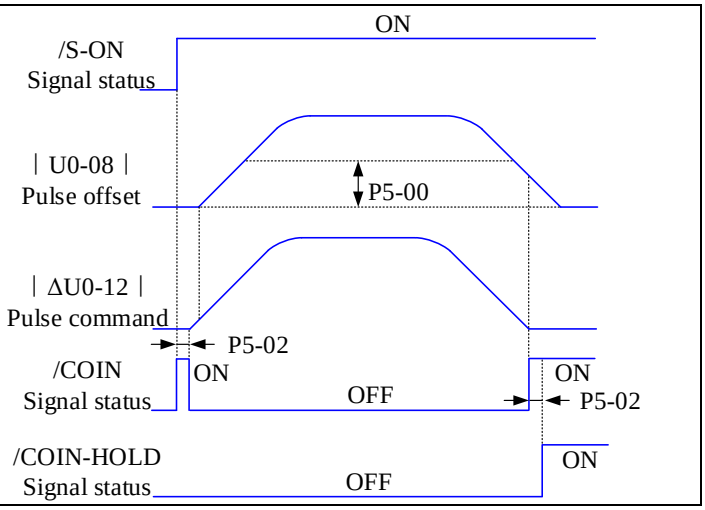
When the positioning completion detection mode P5-01 is set to 3, the positioning completion holding /COIN-HD signal can be output. When the /COIN signal holds P5-02 time, the COIN-HD signal can be output.

(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.

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.

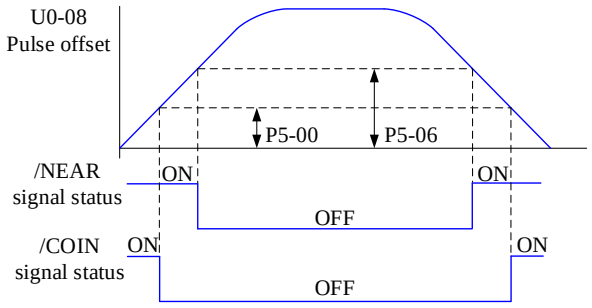
■ Related parameters

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.

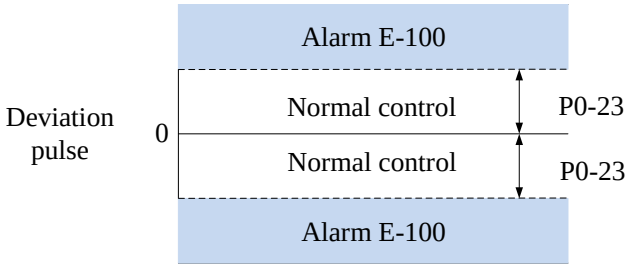
4.3.1.6 Position pulse deviation

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

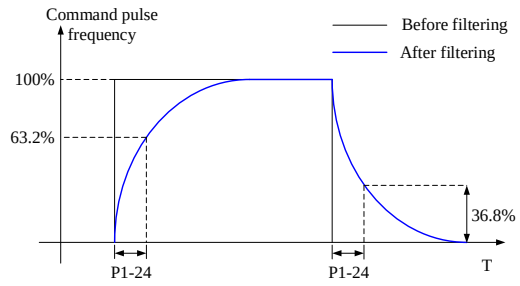
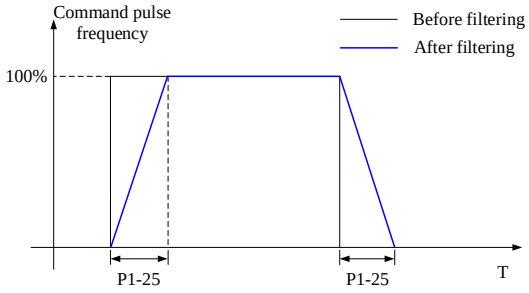
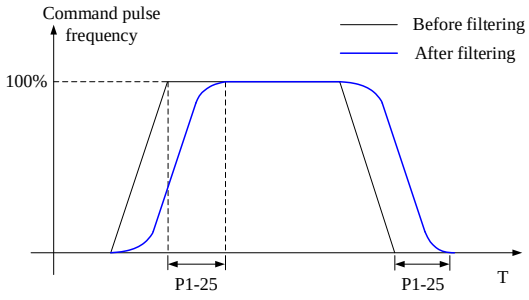
When the deviation pulse limit is 0, the deviation pulse will not be detected.



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

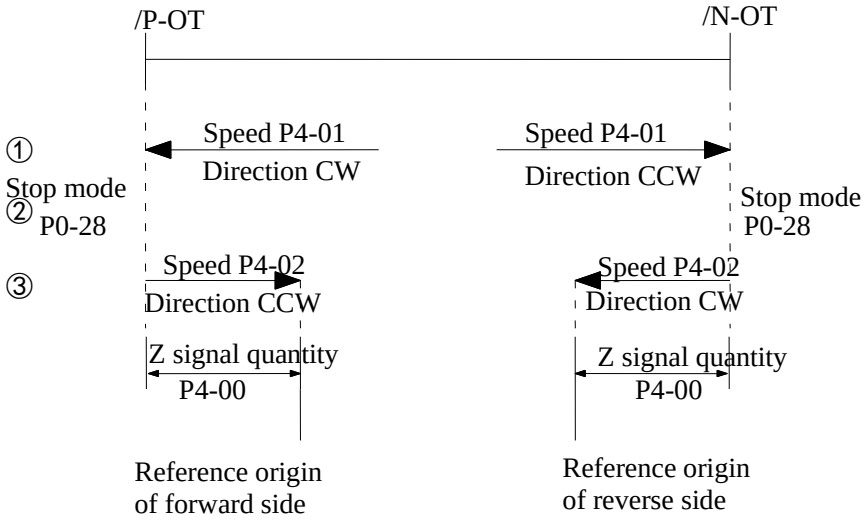
Parameter	Signal	Default	Meaning	Modify
P5-28	/SPD-A	n.0000	Mode 3: internal speed selecting signal Mode 5: find origin point at forward direction	Range: 0000-0014, distributes to input terminal through P5-28. When it set to 0001, it means input signal from SI1.
P5-29	/SPD-B	n.0000	Mode 3: internal speed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

Parameter	Signal	Default	Meaning	Modify
			reverse direction	input signal from SI1.

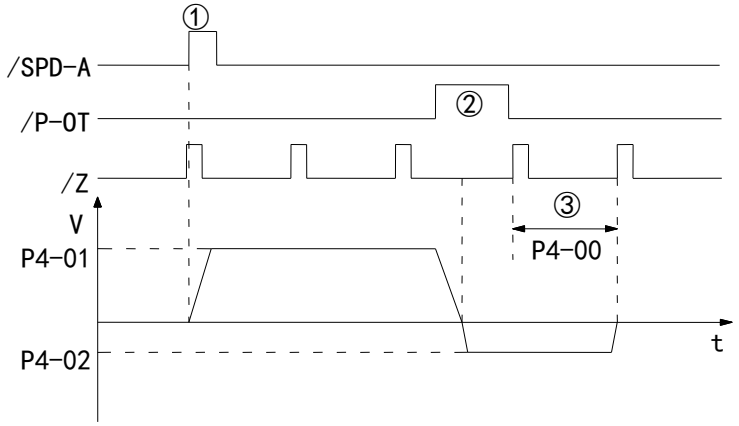
Related parameter setting:

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 the proximity switch	100	rpm	0～65535	Servo OFF	At once
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.

4.3.2 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.						

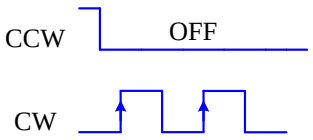
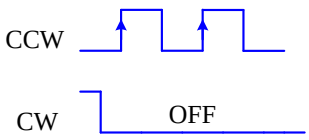
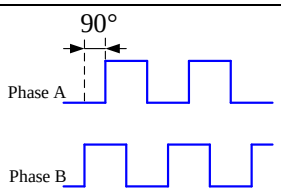
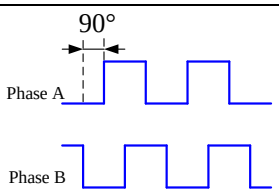
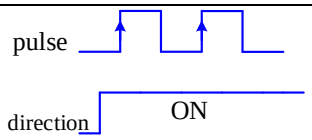
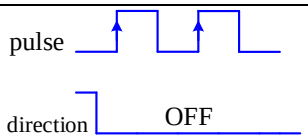
Parameter	Meaning	Default setting	Unit	Range	Change	Effective
P0-09.2 n.x□xx	Low speed pulse command filter time	F	4.167ns	0~F	Servo bb	Re-power on
P0-09.2 is pulse filter time. It can enhance the anti-interference ability of low-speed pulses (less than 200K). When the input is less than 700K, the maximum 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

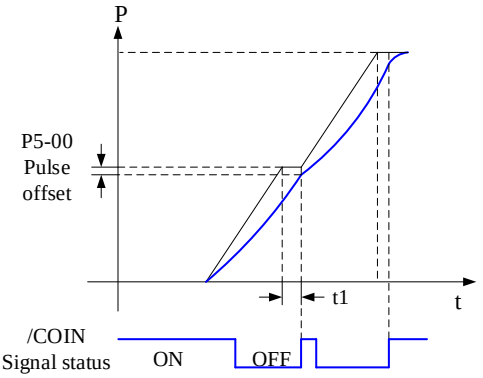
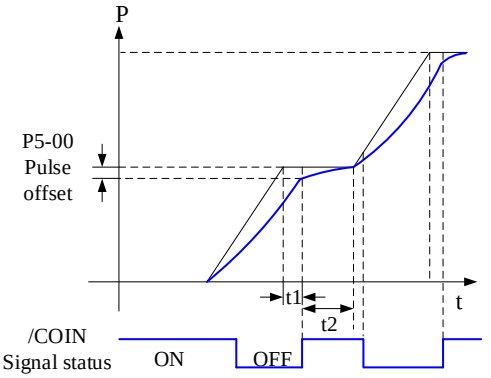
4.3.3.2 Internal position mode setting

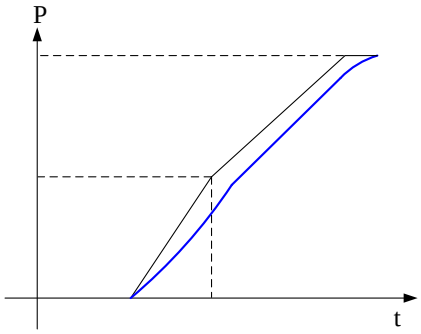
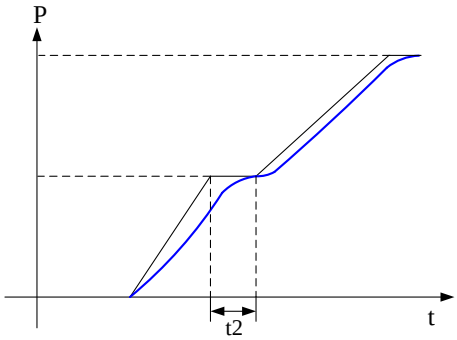
Parameter	Function	Unit	Default setting	Suitable mode	modify	Effective
P4-03	Internal position mode setting	—	n.0000	5	Servo bb	At once
	Parameter setting	Meaning	Default setting	Setting range		
	n.□xxx	No meaning				
	n.x□xx	Waiting mode	0	0～1		
	n.xx□x	Change step mode	0	0～6		
	n.xxx□	Positioning mode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

1. waiting mode

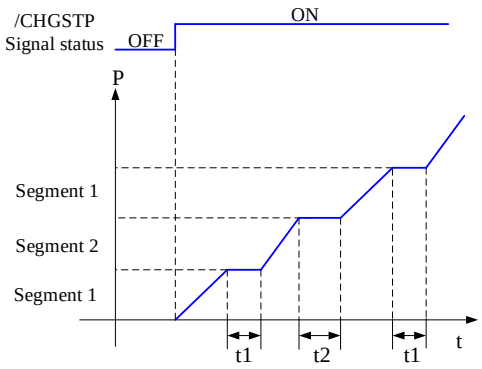
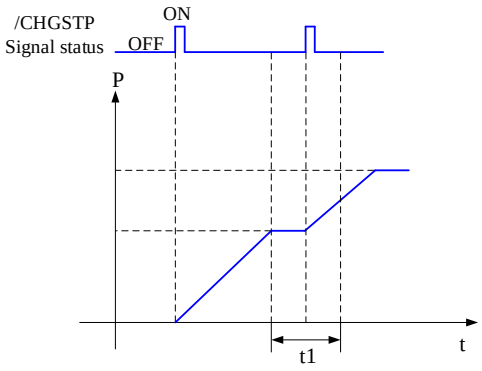
n.x□xx	Meaning
0	Wait for positioning completion
1	Not wait for positioning completion

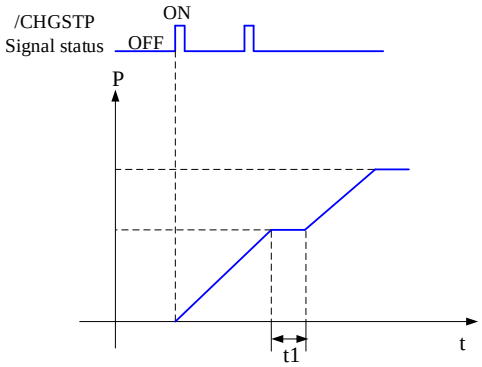
Note: Waiting mode refers to whether the driver waits for the motor to be positioned after outputing a position instruction in internal position mode. It takes effect in all Step-Changing modes.

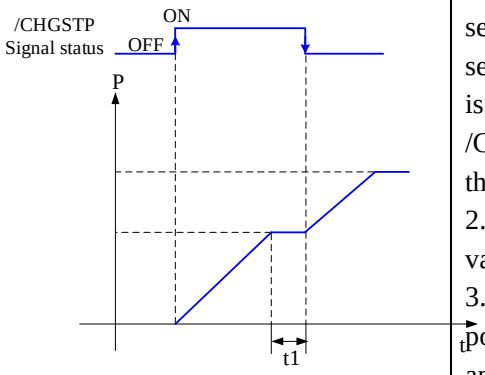
Waiting mode=0, adjust time =0ms	Waiting mode =0, adjust time >0ms
	
After the drive output 1-segment position command, it will wait for the completion of motor positioning, and then start the next position command at once. T1 is positioning time, which means the time from pulse output complete to the 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, 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,

n.xx□x	Description	
		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.	

4: /CHGSTP double edge triggering		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

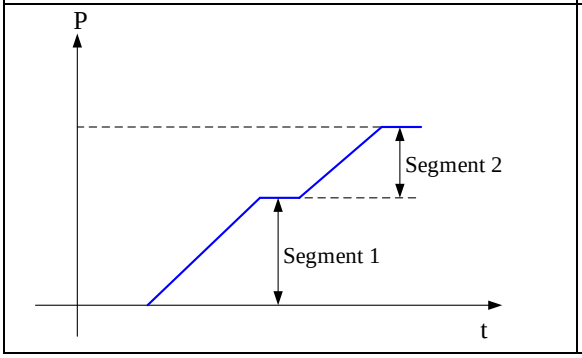
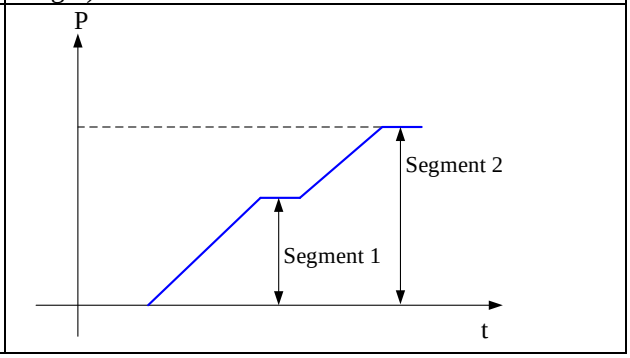
<table>
<tr><td></td><td></td><td>according to the servo off shutdown mode. After the shutdown, the positioning is invalid.
5. The adjustment time is not valid in this mode.
6. Before using this mode, p5-35 terminals need to be allocated first, but not when using this mode.</td></tr>
<tr><td>5:
/PREFA(P5-57)
/PREFB(P5-58)
/PREFC(P5-59)
Choose the segment through terminal, the range is segment 1~3</td><td>
<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.
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><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>
<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.</td></tr>
</table>

	5. Segment number selection terminal logic is voltage level valid. Input high voltage level is valid, input low voltage level is invalid.

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

n.xxx□	Meaning
0	Relative positioning
1	Absolute positioning
0: relative positioning	1: absolute positioning (take the reference origin as the absolute positioning origin)
	

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).						

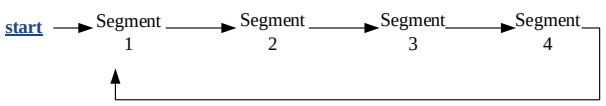
2. In formula P4-10+(n-1)*7, n is the segment no. of internal position; the range is 1~35. Segment 1~12 can be set through the operate panel, segment 13~35 needs to write in parameters through communication (RS232 or RS485).
3. In the relative positioning mode, if the pulse high bit is set to 9999, the 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.

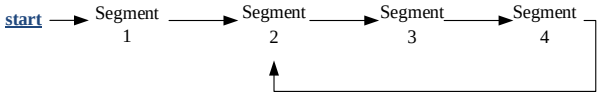
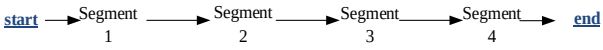
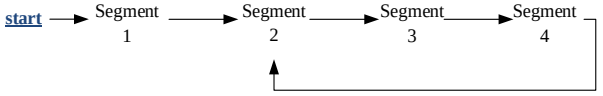
Parameter	Meaning	Default setting	Range	Change	Effective
P4-04	Effective segment	0	0～35	Servo bb	At once

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.

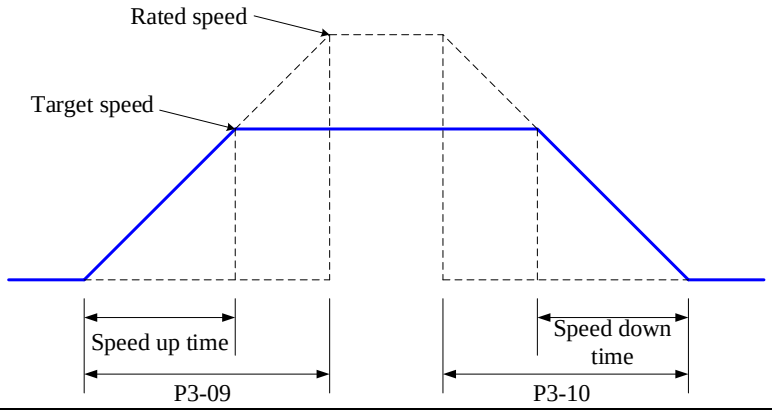
4.4 Speed control

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)

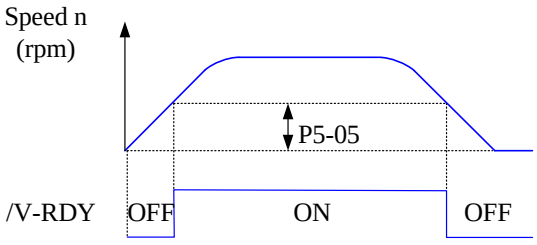
■ Related parameter

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).

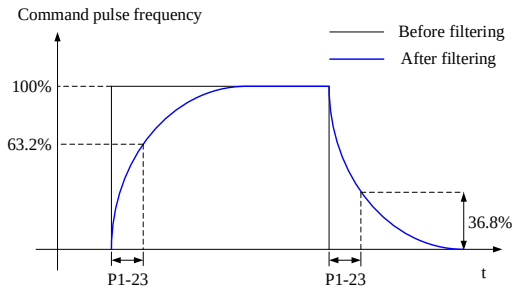
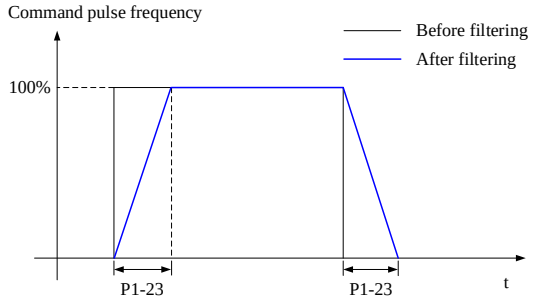
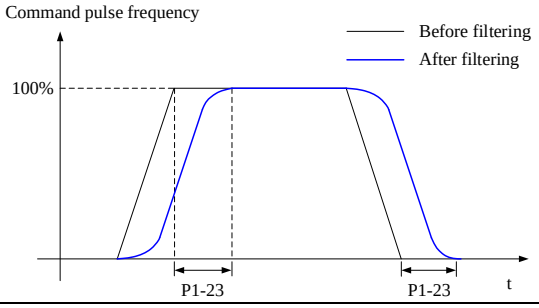


4.4.1.4 Speed command filter

■ 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

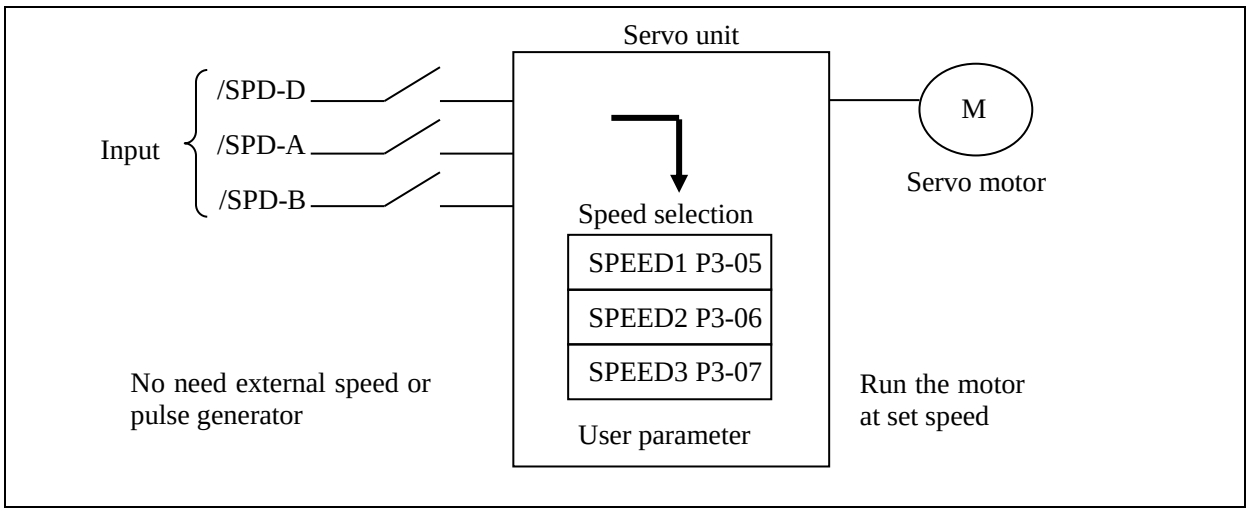
Position command acceleration and deceleration filter	Smooth filter of position instruction
	
	

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
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
	1	0	P3-07: SPEED3

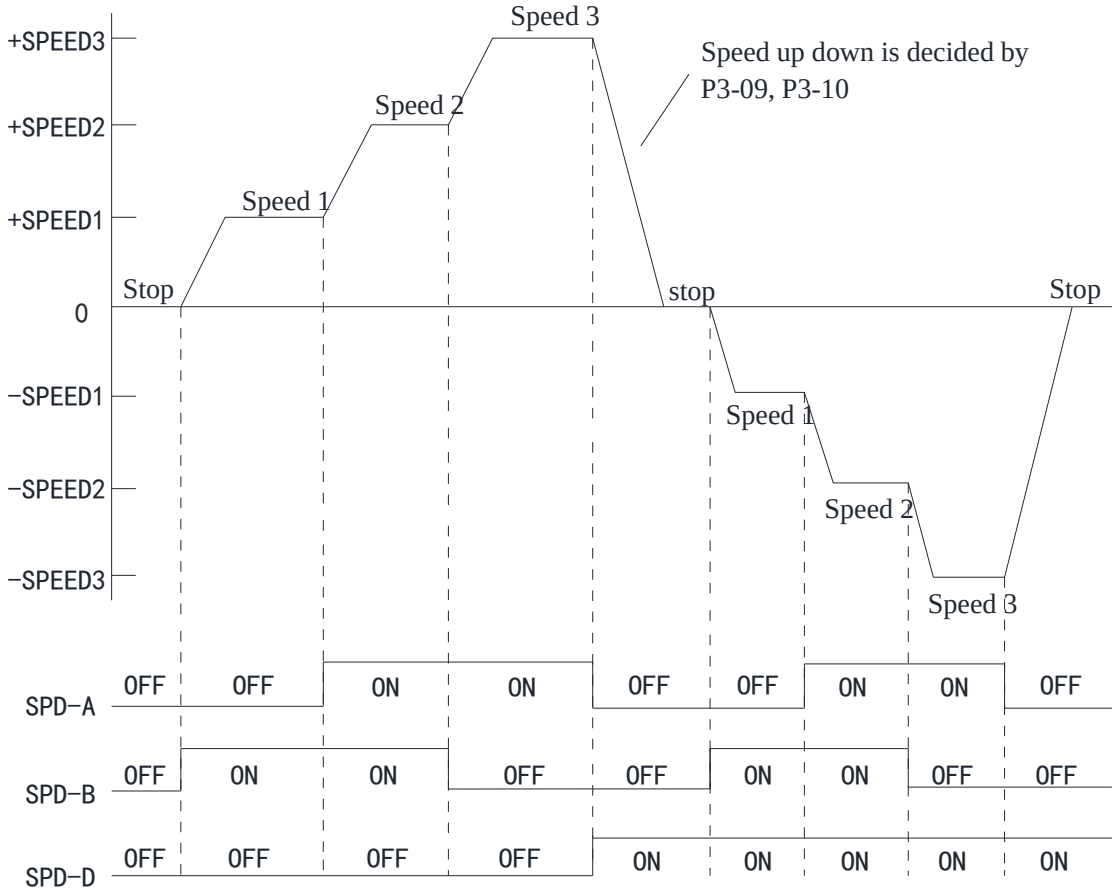
Note:
(1) /SPD-D signal is direction control, input SI terminal can be changed according to P5-27. The validity of the terminal signal determines the direction of the motor.
(2) The combination of /SPD-A and /SPD-B input terminal effectiveness determines the multi segment speed
(3) 0/1 of the above table 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

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
……		……
205F		P0-95
2100	Group P1 parameters	P1-00

Object dictionary index	Corresponding panel parameters	
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「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				

Index	Sub-Index	Type	Name/Description	DateType	Access	PDO	Op-mode
			「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 current.				
6079h	00h	VAR	DC Link Circuit Voltage	U32	ro	YES	All

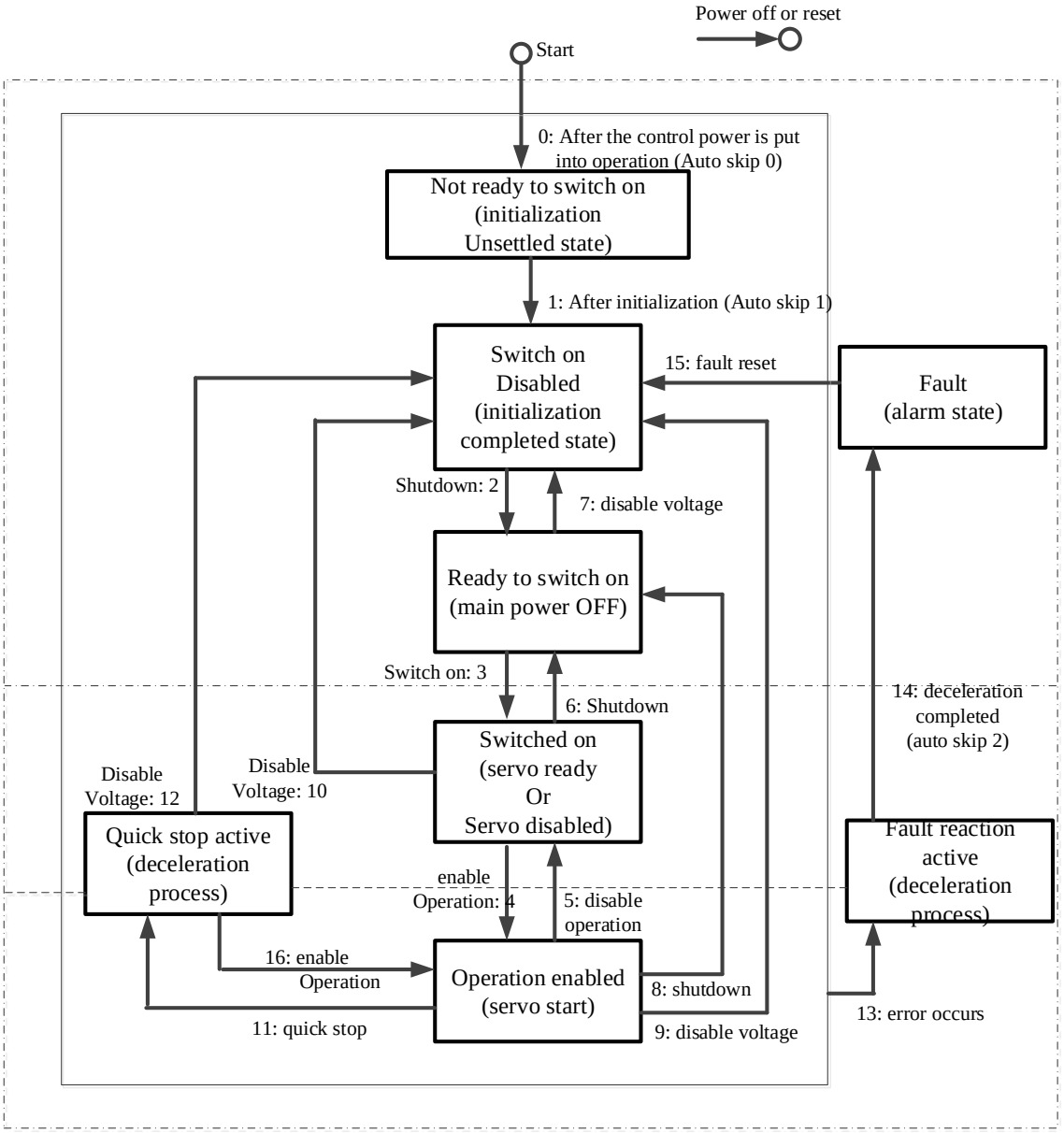
<table>
<tr><th>Index</th><th>Sub-Index</th><th>Type</th><th>Name/Description</th><th>DateType</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td></td><td></td><td></td><td colspan="5">DC bus voltage of servo driver, the unit is 0.001V.</td></tr>
<tr><td rowspan="2">607Ah</td><td rowspan="2">00h</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 mode. The default value is 20000.</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 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) fr = fault reset
oms = operation mode specific eo = enable operation
(control mode based on bit) qs = quick stop
h = halt 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) sod = switch on disabled
oms = operation mode specific qs = quick stop
(control mode based on bit) ve = voltage enabled
ila = internal limit active f = fault
tr= target reached oe = operation enabled
rm = remote 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

U0-99	Description
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.

Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
605Ah	00h	Quick stop option code	0-7	I16	rw	NO	All

Sets the timing of Quick stop. It is different according to the definition of control mode.

Set prohibition outside of the following values.

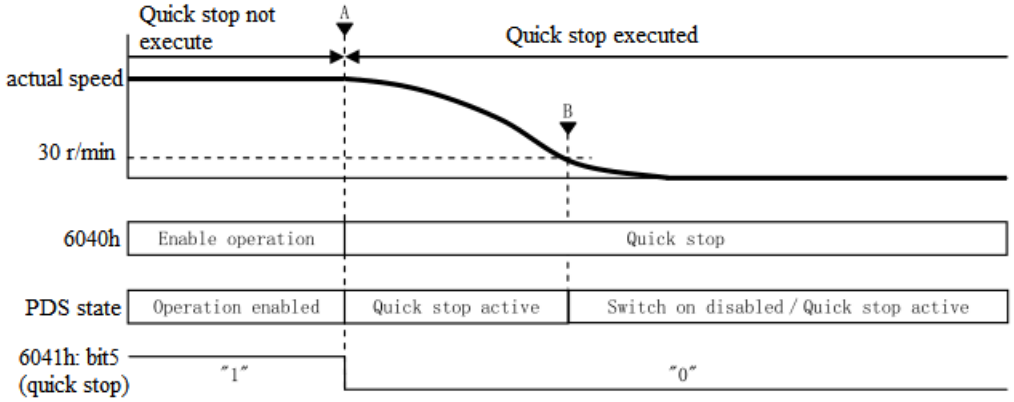
Value	Definition
0	Stop immediately and migrate the PDS state to Switch on disabled
1	Control mode is PP, PV: after motor stop through 0x6084 (Profile Deceleration), PDS state migrates to Switch on disabled
	Control mode is HM: after motor stop through 0x609A (Homing Acceleration), PDS state migrates to Switch on disabled
	Control mode is TQ: after motor stop through 0x6087 (Torque Slope), PDS state migrates to Switch on disabled
2	Control mode is PP, PV, HM: after motor stop through 0x6085 (Quick Stop Declaration), PDS state migrates to Switch on disabled
	Control mode is TQ: after motor stop through 0x6087 (Torque Slope), PDS state migrates to Switch on disabled
3	Control mode is PP, PV, HM: after motor stop through 0x60C6 (Max Deceleration), PDS state migrates to Switch on disabled
	Control mode is TQ: after motor stop through torque 0, state migrates to Switch on disabled
5	Control mode is PP, PV: after motor stop through 0x6084 (Profile Deceleration), PDS state migrates to Quick stop active
	Control mode is HM: after motor stop through 0x609A (Homing Acceleration), PDS state migrates to Quick stop active
	Control mode is TQ: after motor stop through 0x6087 (Torque Slope), PDS state migrates to Quick stop active
6	Control mode is PP, PV, HM: after motor stop through 0x6085 (Quick Stop Declaration), PDS state migrates to Quick stop active
	Control mode is TQ: after motor stop through 0x6087 (Torque Slope), PDS state migrates to Quick stop active
7	Control mode is PP, PV, HM: after motor stop through 0x60C6 (Max Deceleration), PDS state migrates to Quick stop active
	Control mode is TQ: after motor stop through torque 0, PDS state migrates to Quick stop active

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」.

Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
605Bh	00h	Shutdown option code	0-1	I16	rw	NO	All

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.

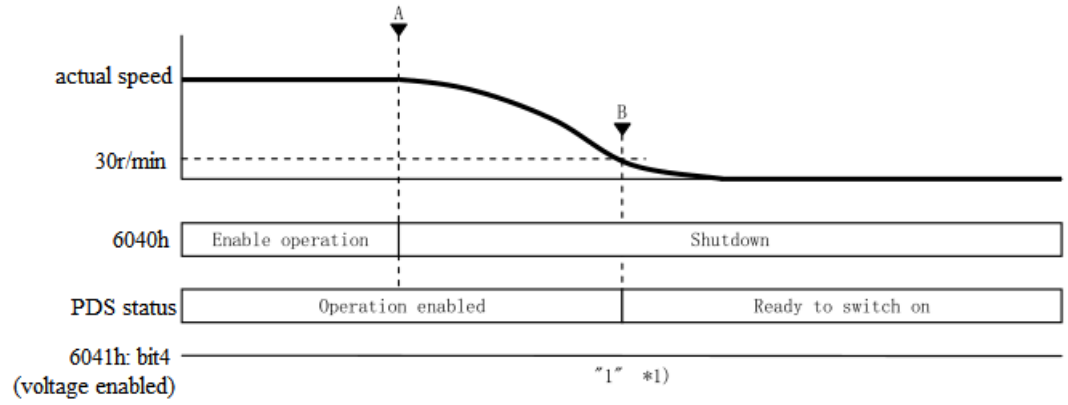
(1) PDS command「Shutdown」is receiving

Value	Definition
0	Stop at once, PDS state migrates to Ready to switch on.
1	The control mode is PP, PV: motor stop through 0x6084 (Profile deceleration), PDS state migrates to Ready to switch on.
	The control mode is HM: motor stop through 0x609Ah (Homing acceleration), PDS state migrates to Ready to switch on.
	The control mode is TQ: motor stop through 0x6087 (Torque Slope), PDS state migrates to Ready to switch on.

(2) PDS command「Disable voltage」is receiving.

Value	Definition
0	Stop at once, PDS state migrates to Switch on disabled.
1	The control mode is PP, PV: motor stop through 0x6084 (Profile deceleration), PDS state migrates to Switch on disabled.
	The control mode is HM: motor stop through 0x609Ah (Homing acceleration), PDS state migrates to Switch on disabled.
	The control mode is TQ: motor stop through 0x6087 (Torque Slope), PDS state migrates to Switch on disabled.

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.



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

3. Disable operation option code (605Ch)

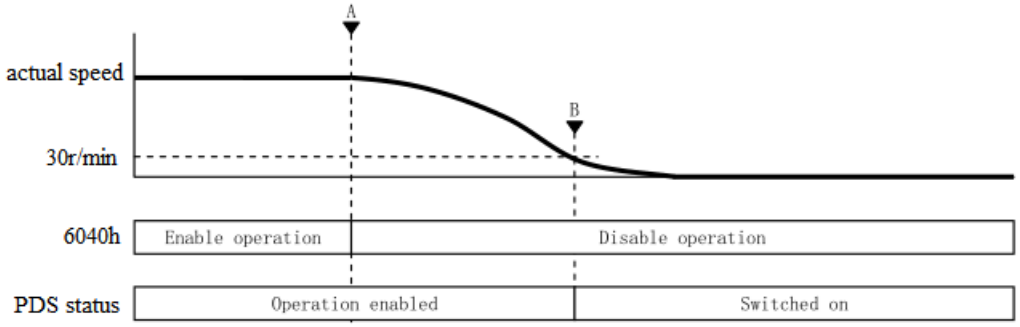
Set the motor deceleration stop mode when receiving PDS command「Disable operation」.

Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
605Ch	00h	Disable operation option code	0-1	I16	rw	NO	All
		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.

Value	Definition
0	Stop at once, PDS state migrates to Switch on.
1	The control mode is PP, PV: motor stop through 0x6084 (Profile deceleration), PDS state migrates to Switch on.
	The control mode is HM: motor stop through 0x609Ah (Homing acceleration), PDS state migrates to Switch on.
	The control mode is TQ: motor stop through 0x6087 (Torque Slope), PDS state migrates to Switch on.

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.

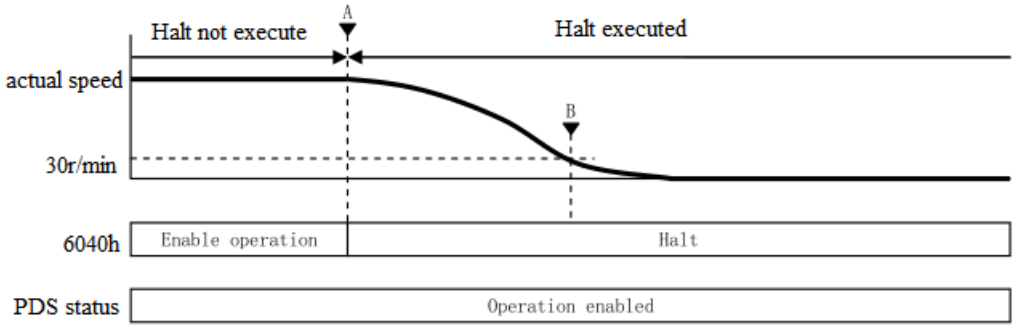
Index	Sub-Index	Name/Description	Range	Date Type	Access	PDO	Op-mode
605Dh	00h	Halt option code	1-3	I16	rw	NO	All

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

Value	Definition
1	The control mode is PP, PV: motor stop through 0x6084 (Profile Deceleration), PDS status migrates to Operation enabled
	The control mode is HM: motor stop through 0x609A (Homing Acceleration), PDS status migrates to Operation enabled
	The control mode is TQ: motor stop through 0x6087 (Torque Slope), PDS status migrates to Operation enabled
2	The control mode is PP, PV, HM: motor stop through 0x6085 (Quick Stop Declaration), PDS status migrates to Operation enabled
	The control mode is CST, TQ: motor stop through 0x6087 (Torque 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)

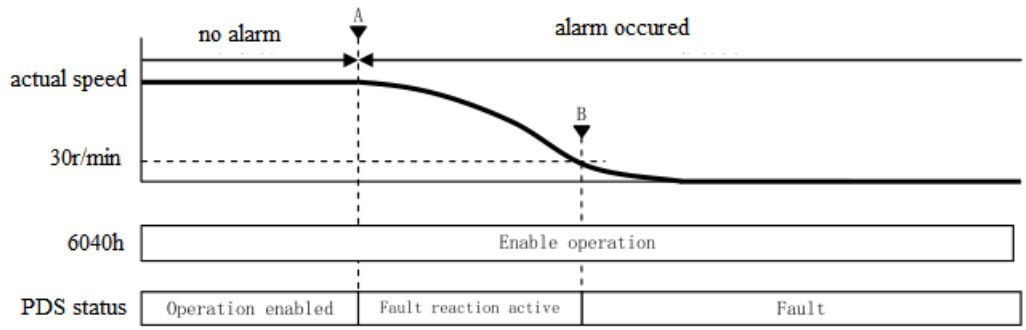
Set the motor stop method when the alarm occurs.

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

Note:

(1) 6081h (Profile velocity) is limited by the smaller one of 607Fh (Max profile velocity) and 6080h (Max motor speed).

(2) 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>6040h</td><td>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="8">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) fr = fault reset
oms = operation mode specific eo = enable operation
(control mode based on bit) qs = quick stop
h = halt 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>

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 set- point acknowledge	ila	oms Target Reached	rm	r
7	6	5	4	3	2	1	0
w	sod	qs	ve	f	oe	so	rsto

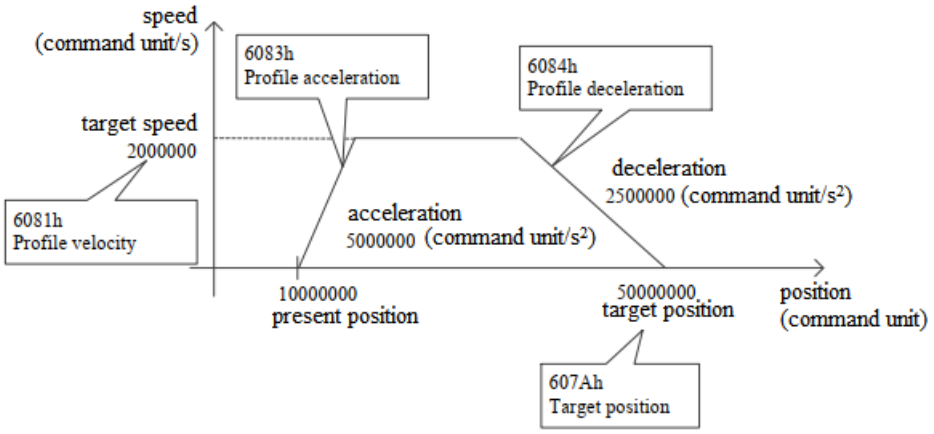
r = reserved (Not corresponding)
w = warning
sod = switch on disabled
oms = operation mode specific (control mode based on bit)
qs = quick stop
ve = voltage enabled
ila = internal limit active
f = fault
oe = operation enabled
rm = remote
so = switched on
rtso = ready to switch on

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

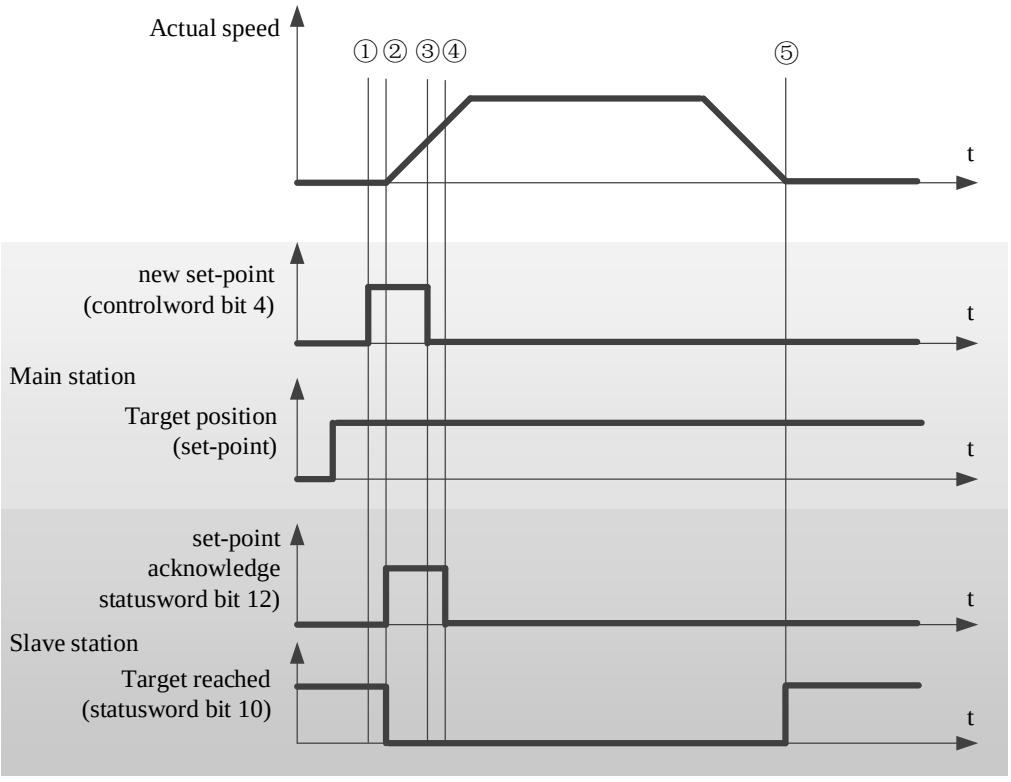
The working principles of object dictionary 0x607a, 0x6081, 0x6083 and 0x6084 are as follows:



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).
Motor has no action when 6081h (Profile velocity) is 0.
② 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.
③ Main station: confirm 6041h (Statusword) bit12 (set-point acknowledge) is 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 (status word) bit12 (set-point acknowledge) becomes to 0.
⑤When reaching the target position, 6041h (Controlword) bit10 (target reached) changes from 0 to 1.

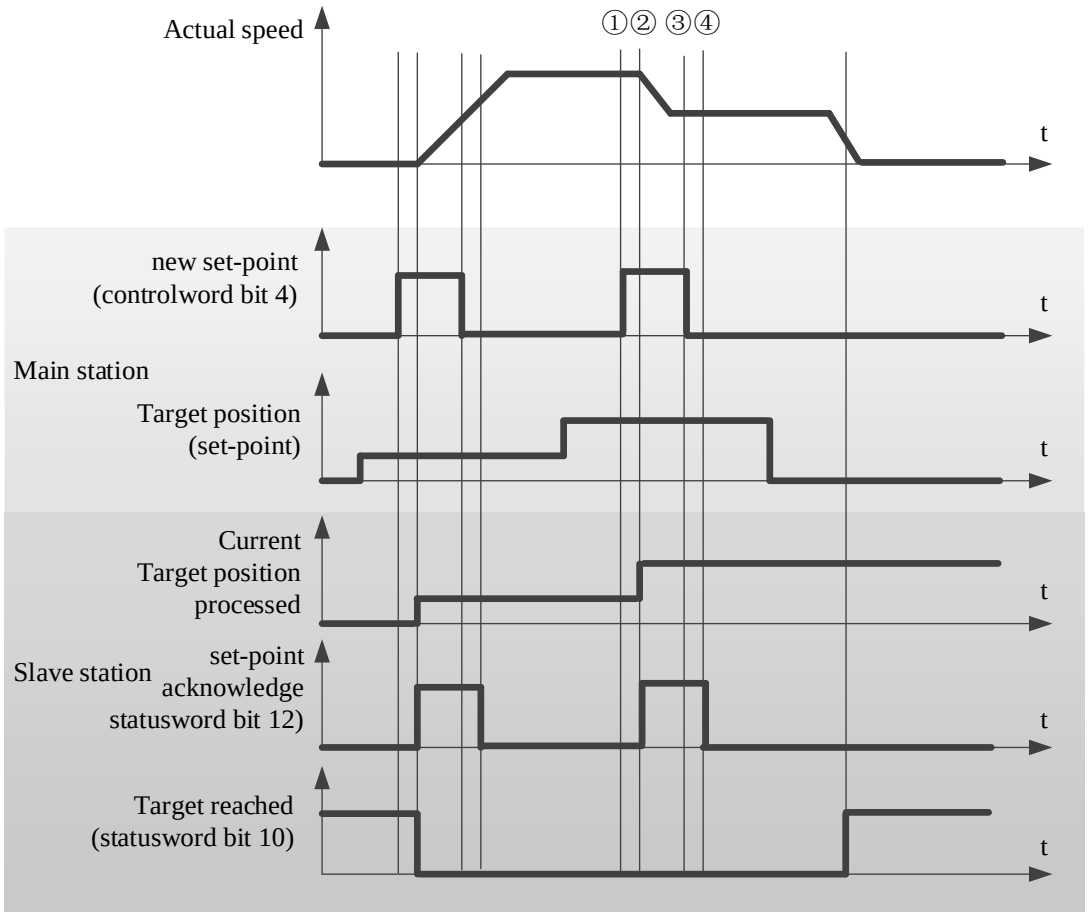


< Set-point example >

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.
Note: 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.



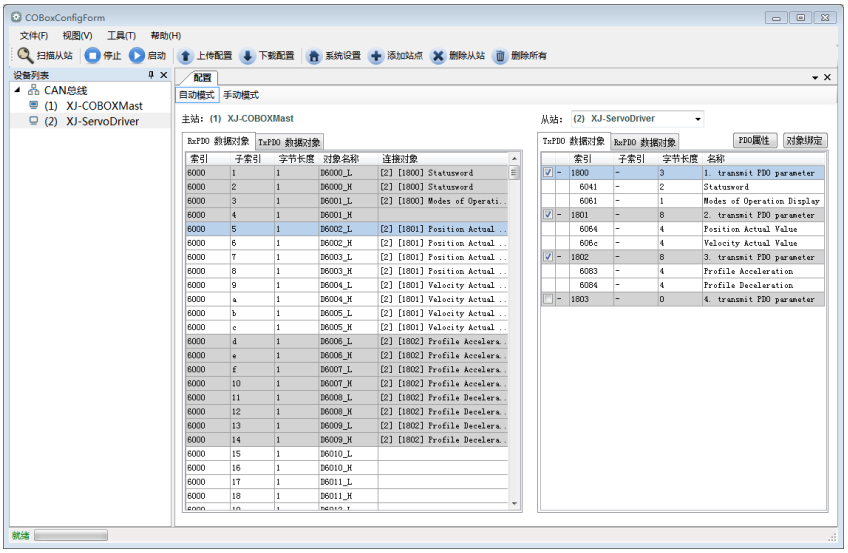
< handshaking procedure for the single set-point method >

5. Operation examples

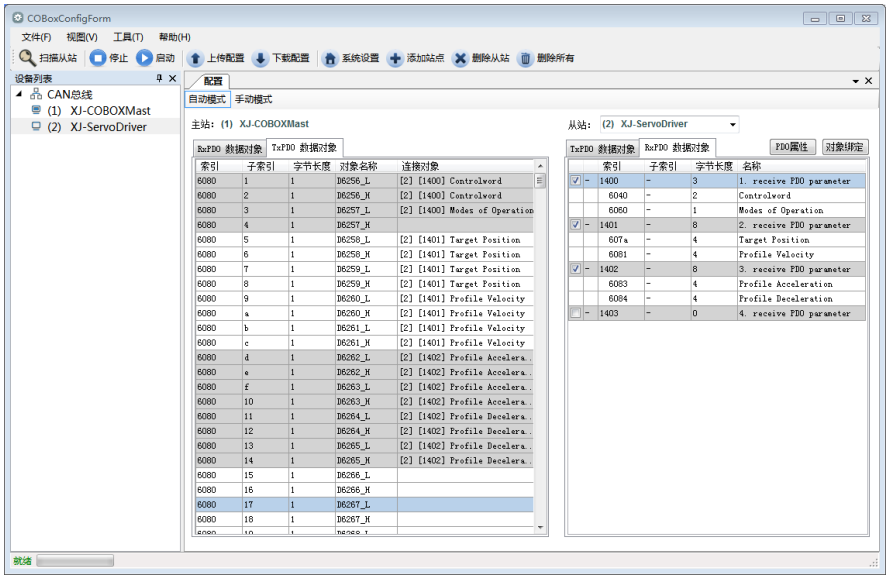
Taking the low-voltage servo of Xinje DF3E as an example, the configuration and control process of PP mode are introduced. Please refer to Appendix 10 for the specific usage method of servo software.

① click [scan] or [add slave station] in CANopen configuration interface, configure the object binding of TxPDO and RxPDO. Here, several common objects of PP mode are bound. If you have other requirements, you can add them by yourself and enable the configured PDO. The specific configuration is shown in the figure below.

TxPDO (monitor parameters):



RxPDO (control parameters):



② Download configuration, slave station state machine automatically switches from PreOp to OP state, SDO and PDO can receive and send messages at this time. XDPPro software can monitor or modify the mapping of object dictionary. The specific correspondence is as follows:

PLC1-自由监控1

监控窗口 | 添加 修改 删除 删除全部 | 置顶 置底

寄存器	监控值	字长	进制	注释
D6000	0000	单字	16进制	状态字
D6001	0	单字	10进制	模式查询
D6002	0	双字	10进制	位置反馈
D6004	0	双字	10进制	速度反馈
D6006	0	双字	10进制	加速度
D6008	0	双字	10进制	减速度
D6256	0000	单字	16进制	控制字
D6257	0	单字	10进制	模式设定
D6258	0	双字	10进制	位置给定
D6260	0	双字	10进制	速度给定
D6262	0	双字	10进制	加速度给定
D6264	0	双字	10进制	减速度给定

③ First, set P0-00 to 1 to start CiA402 motion control function, then modify D6257 (6060h is 1) to PP mode, modify D6256 (control word 6040h is 0x06 → 0x07 → 0x0f) to enable the slave station, and then modify the control word 0x4F → 0x5F to realize relative position movement and 0x0F → 0x1F to realize absolute position movement after setting position, speed, acceleration and deceleration parameters through D6258-D6264. Other monitoring parameters are monitored through D6000-D6008.

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
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 >

Index	Sub-Index	Name/Description	Range	Date Type	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	r		r				

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

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>6041h</td><td>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="8">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="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>
</table>
r = reserved (No correspondence) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
(control mode based on bit) ve = voltage enabled
ila = internal limit active f = fault
oe = operation enabled
rm = remote so = switched on
rtso = ready to switch on</td></tr>
</table>

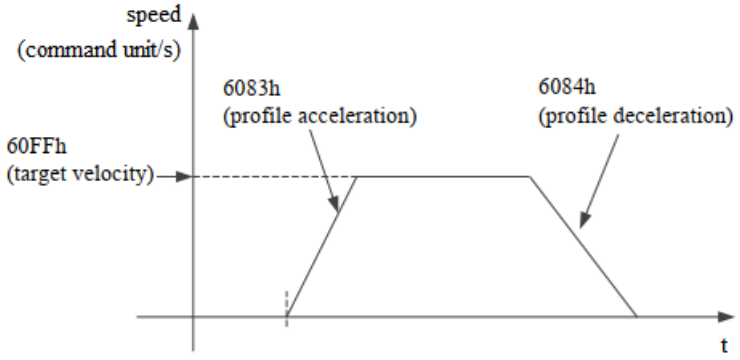
bit10 (target reached (Velocity reached)):
The difference between the total value of 60FFh (target velocity) and 60B1h (velocity offset) and 606Ch (velocity actual value) is within the range set by 606Dh (velocity window). If the time set by 606Eh (velocity window time) passes, bit10 of 6041h (status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

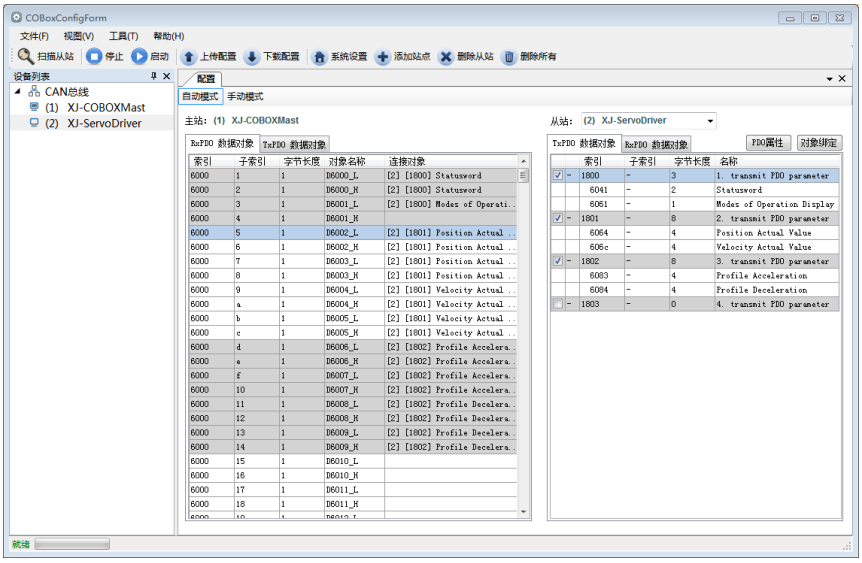
Turn off motor enable, set object word 6060h to 3, set target speed 60FFh, acceleration and deceleration 6083h and 6084h, speed 6080h and torque limit 6072h. The target speed is 60FFh, the maximum speed is limited by 6080h (max motor speed), and the torque is limited by 6072h (max torque). Turn on the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



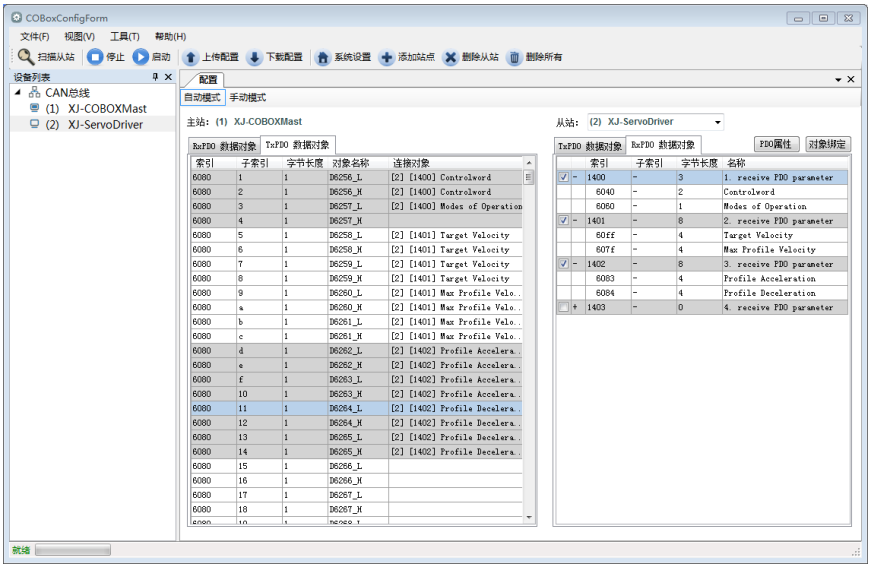
5. Operation example

Taking Xinje DF3E low-voltage servo as an example, the configuration and control process of PV mode are briefly introduced. The specific use method of servo software is shown in Appendix 10.
① click [scan] or [add slave station] in CANopen configuration interface, configure the object binding of TxPDO and RxPDO. Here, several common objects of PV mode are bound. If you have other requirements, you can add them by yourself and enable the configured PDO. The specific configuration is shown in the figure below.

TxPDO (monitor parameters):



RxPDO (control parameters):



② Download configuration, slave station state machine automatically switches from PreOp to OP state, SDO and PDO can receive and send messages at this time. XDPPro software can monitor or modify the mapping of object dictionary. The specific correspondence is as follows:

PLC1-自由监控1

监控窗口 | 添加 修改 删除 删除全部 | 置顶 置底

寄存器	监控值	字长	进制	注释
D6000	0000	单字	16进制	状态字
D6001	0	单字	10进制	模式查询
D6002	0	双字	10进制	位置反馈
D6004	0	双字	10进制	速度反馈
D6006	0	双字	10进制	加速度
D6008	0	双字	10进制	减速度
D6256	0000	单字	16进制	控制字
D6257	0	单字	10进制	模式设定
D6258	0	双字	10进制	速度给定
D6260	0	双字	10进制	最大速度
D6262	0	双字	10进制	加速度给定
D6264	0	双字	10进制	减速度给定

③ First, set P0-00 to 1 to start CiA402 motion control function, then modify D6257 (6060h is 3) to PV mode. After setting speed and acceleration deceleration parameters through D6258 (60FFh), modify D6256 (control word 6040h is 0x06→0x07→0x0F) to enable the slave station, start to run in speed mode. Other parameters are monitored through D6000-D6008.

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
		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) fr = fault reset
oms = operation mode specific eo = enable operation
(control mode based on bit) qs = quick stop
h = halt 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)

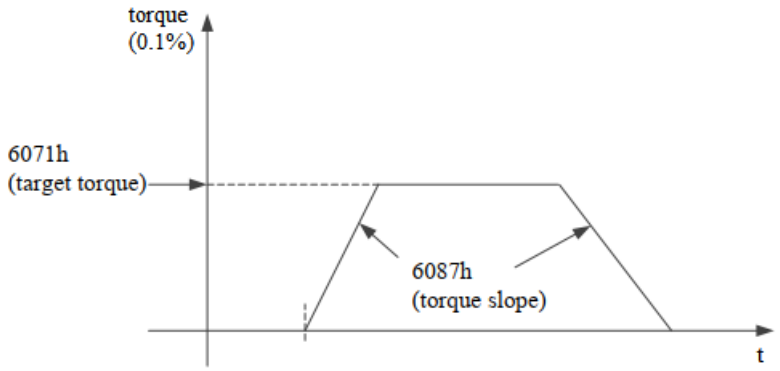
Torque slope (6087h)

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.

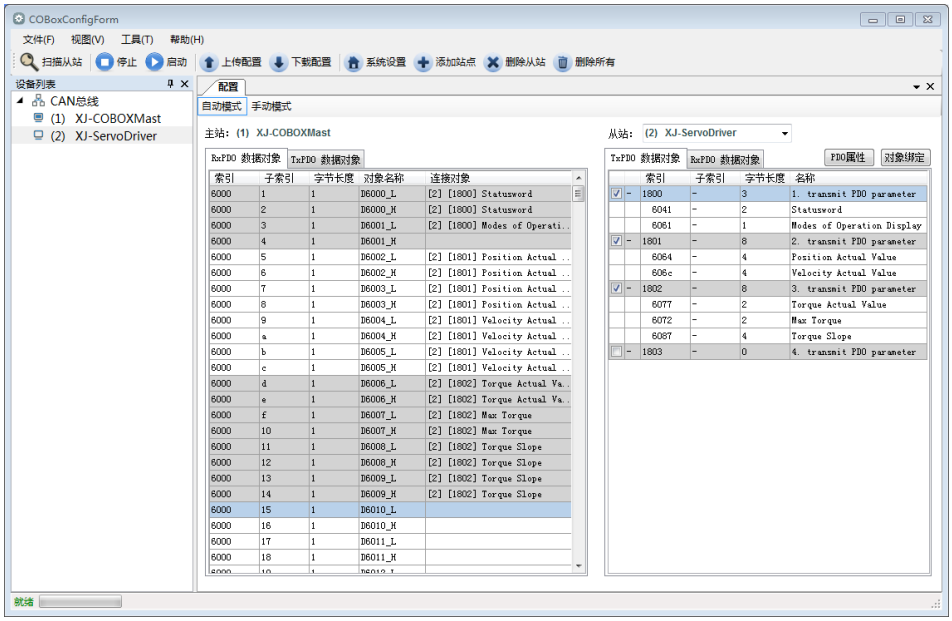


5. Operation example

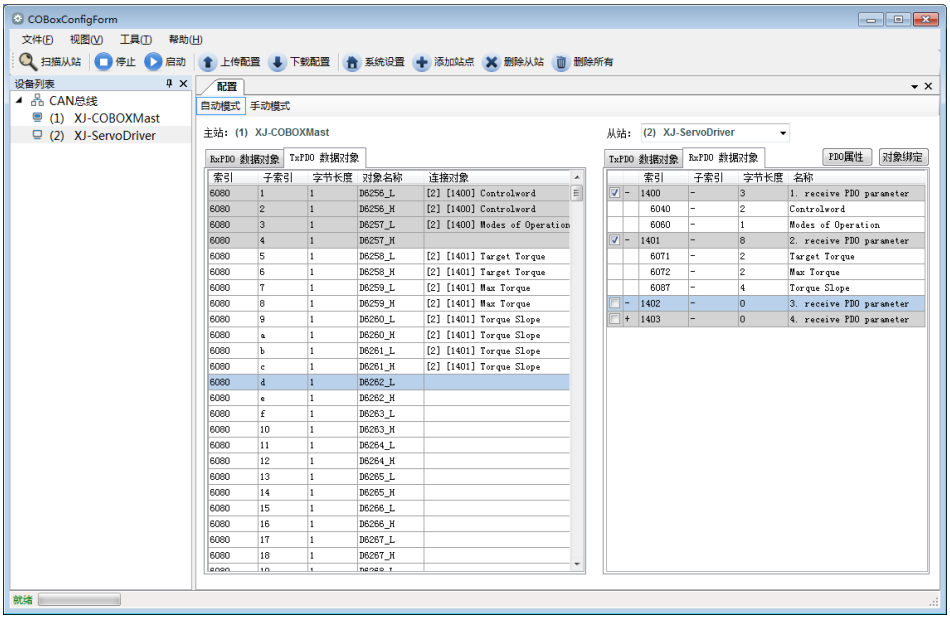
Taking Xinje DF3E low-voltage servo as an example, the configuration and control process of TQ mode are briefly introduced. The specific use method of servo software is shown in Appendix 10.

① click [scan] or [add slave station] in CANopen configuration interface, configure the object binding of TxPDO and RxPDO. Here, several common objects of TQ mode are bound. If you have other requirements, you can add them by yourself and enable the configured PDO. The specific configuration is shown in the figure below.

TxPDO (monitor parameters):



RxPDO (control parameters):



② Download configuration, slave station state machine automatically switches from PreOp to OP state, SDO and PDO can receive and send messages at this time. XDPPro software can monitor or modify the mapping of object dictionary. The specific correspondence is as follows:

寄存器	监控值	字长	进制	注释
D6000	0000	单字	16进制	状态字
D6001	0	单字	10进制	模式查询
D6002	0	双字	10进制	位置反馈
D6004	0	双字	10进制	速度反馈
D6006	0	单字	10进制	当前转矩
D6007	0	单字	10进制	最大转矩
D6008	0	双字	10进制	转矩加减速
D6256	0000	单字	16进制	控制字
D6257	0	单字	10进制	模式设定
D6258	0	双字	10进制	转矩给定
D6259	0	单字	10进制	最大转矩
D6260	0	双字	10进制	转矩加减速

③ First, set P0-00 to 1 to start CiA402 motion control function, then modify D6257 (6060h is 4) to TQ mode. After setting torque and torque slope parameters through D6258 (6071h), modify D6256 (control word 6040h is 0x06→0x07→0x0F) to enable the slave station, start to run in speed mode. Other parameters are monitored through D6000-D6008.

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 >

Index	Sub-Index	Name/Description	Range	Date Type	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	r	sh				

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

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) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
(control mode based on bit) ve = voltage enabled
ila = internal limit active f = fault
oe = operation enabled
rm = remote so = switched on
rtso = ready to switch on

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:

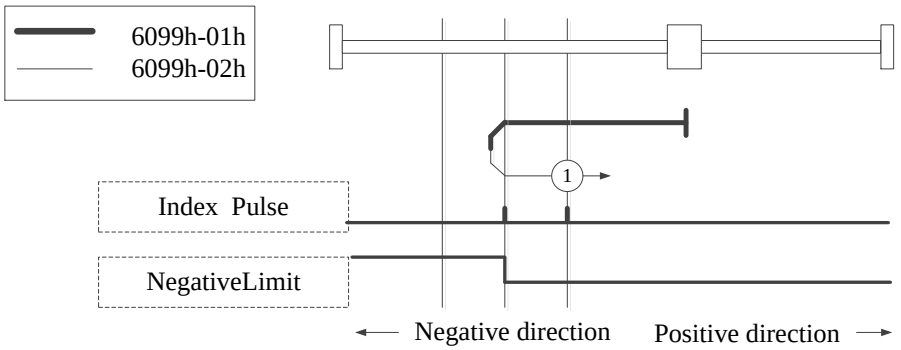
Bit13	Bit12	Bit10	Definition
0	0	0	Zero return is in progress
0	0	1	The return to zero action has not started, or is interrupted
0	1	0	The return to zero action has been completed, but the target position has not been reached
0	1	1	The return to zero action has been completed and the target position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

4. Return to origin mode (6098h)

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

- Mode 1:

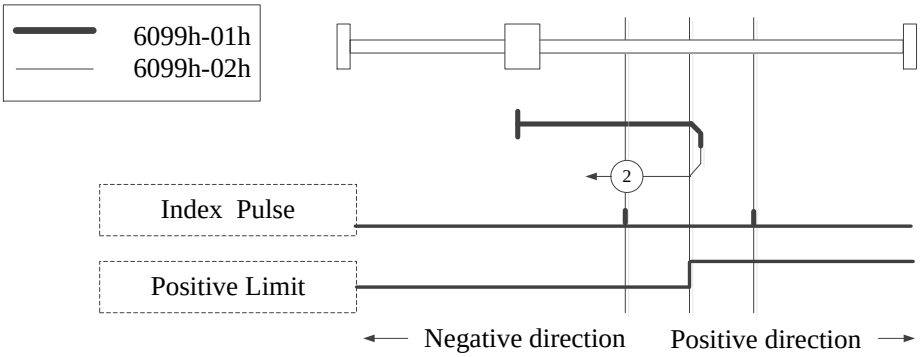
When using this method 1, if the reverse limit switch is not triggered, the initial moving direction is left. The origin position is at the first Z phase pulse one the right side of the position where negative limit switch becomes invalid.



Homing on negative limit switch and index pulse

- Mode 2:

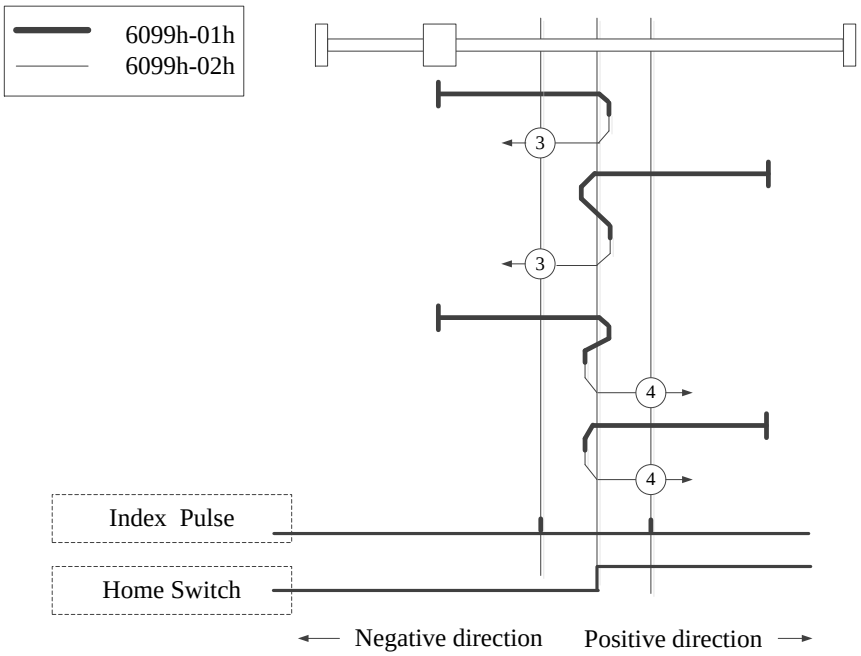
When using method 2, if the forward limit switch is not triggered, the initial movement direction is to the right. The origin position is at the first z-phase pulse on the left side of the position where the forward limit switch becomes invalid.



Homing on positive limit switch and index pulse

- Mode 3, 4:

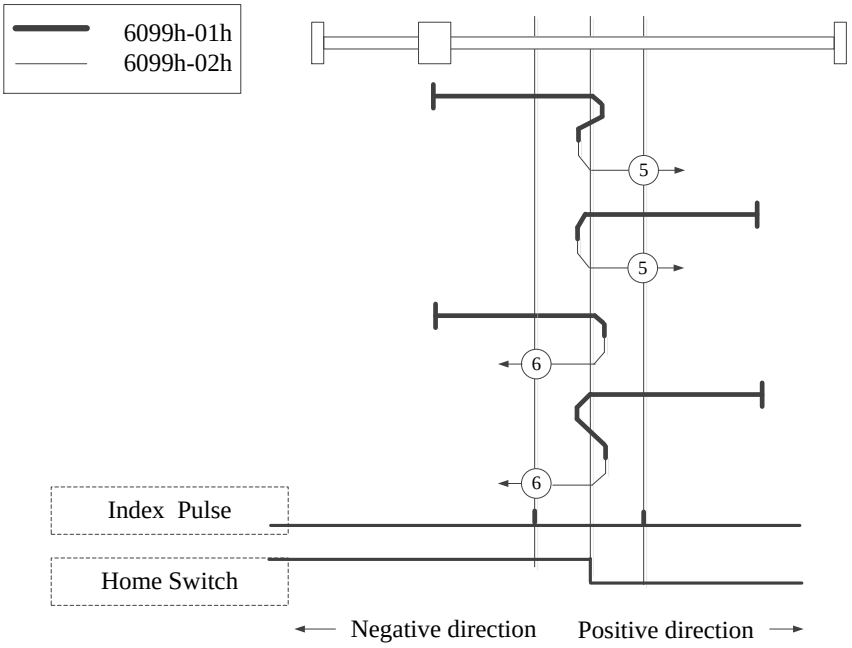
Using method 3 or 4, the initial direction of movement depends on the state of the origin switch. The origin position is on the reverse side of the origin switch or on the initial detected z-phase position in the forward direction.



Homing on positive home switch and index pulse

- Mode 5, 6:

Using method 5 or 6, the initial direction of movement depends on the state of the origin switch. The origin position is on the reverse side of the origin switch or on the initial detected z-phase position in the forward direction.



Homing on negative home switch and index pulse

- Mode 7~14:

The origin switch and z-phase signal are used in 7-14.

The initial action direction of mode 7 and 8 is negative if the origin switch has been activated at the beginning of action.

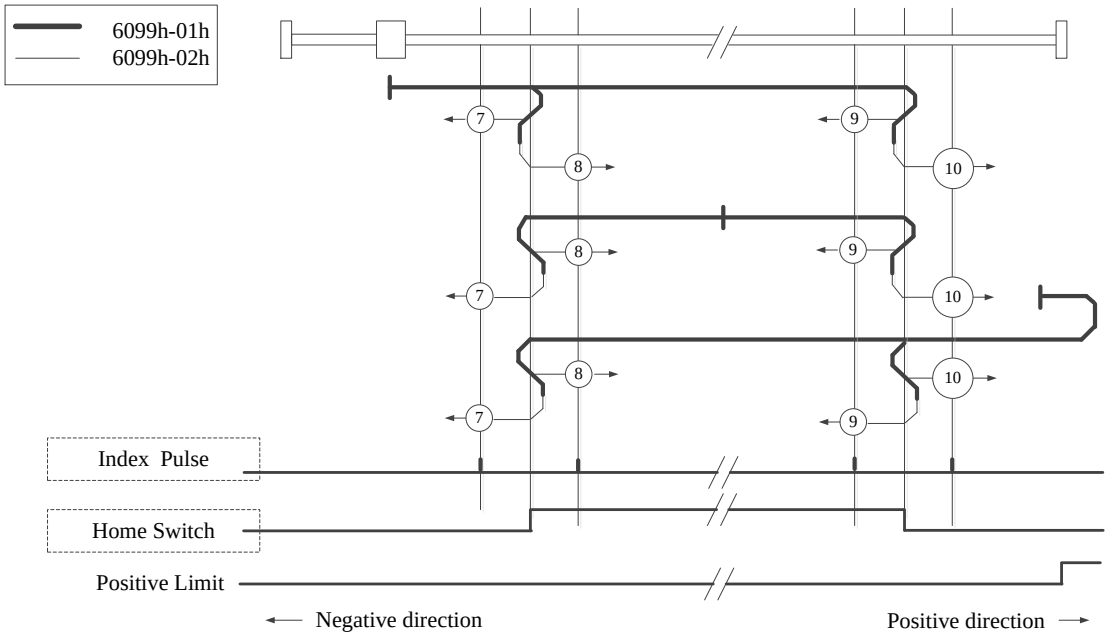
The initialization action direction of mode 9 and 10 is positive if the origin switch has been activated at the beginning of the action.

The initialization action direction of mode 11 and 12 is positive if the origin switch has been activated at the beginning of the action.

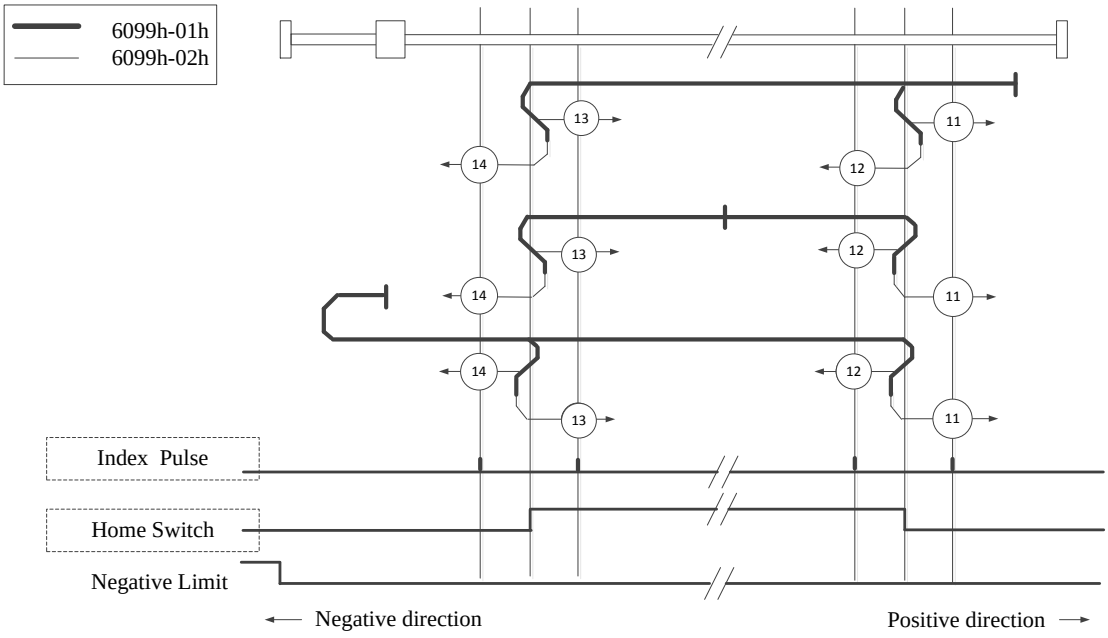
The initialization action direction of modes 13 and 14 is negative if the origin switch has been activated at the beginning of the action.

The position of the final return to the origin is the Z phase signal near the rising or falling edge of the origin

switch.



Homing on home switch and index pulse – positive initial motion



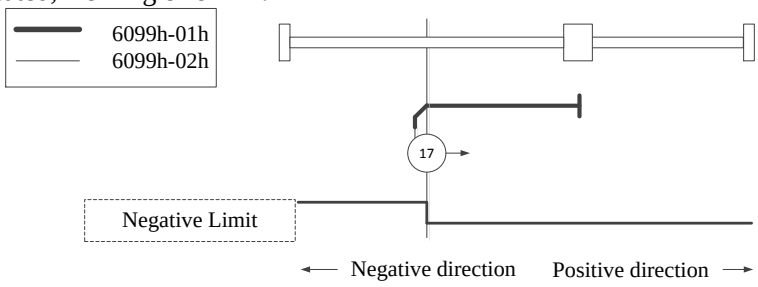
Homing on home switch and index pulse – Negative initial motion

■ Mode 17

This method is similar to mode 1.

The difference is that the location of origin detection is not Index pulse, but the location of Limit switch changed. (please refer to the figure below)

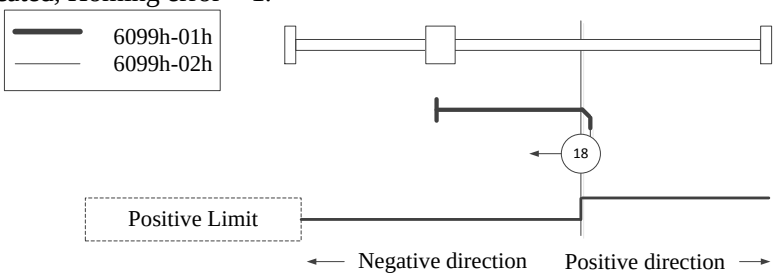
When NOT is not allocated, Homing error = 1.



Homing on negative limit switch

■ Mode 18

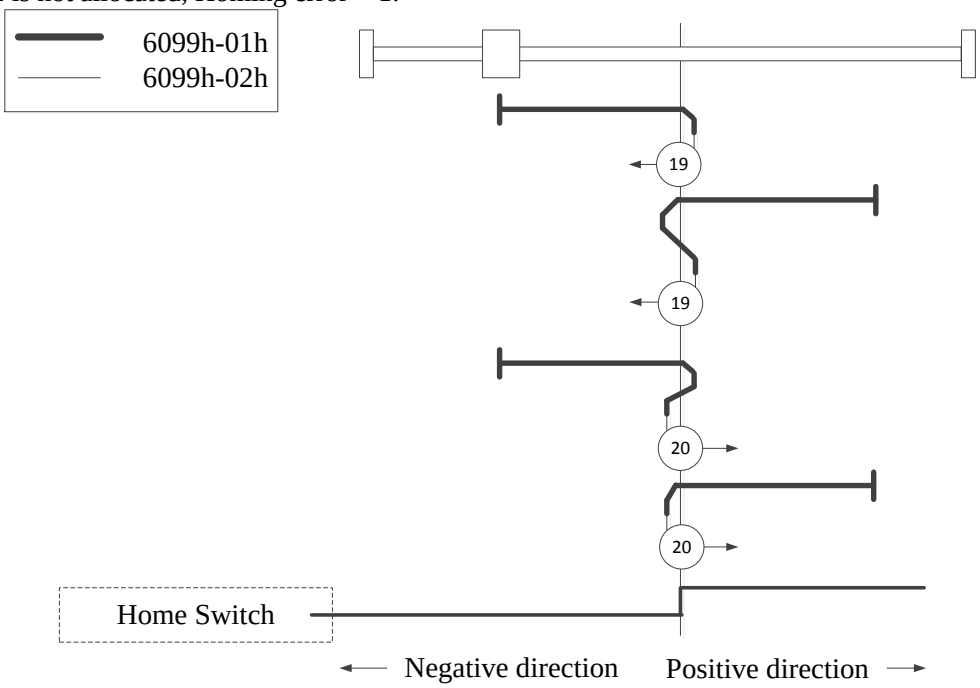
This method is similar to mode 2.
The difference is that the location of origin detection is not Index pulse, but the location of Limit switch changed.
(please refer to the figure below)
When POT is not allocated, Homing error = 1.



Homing on positive limit switch

■ Mode 19, 20

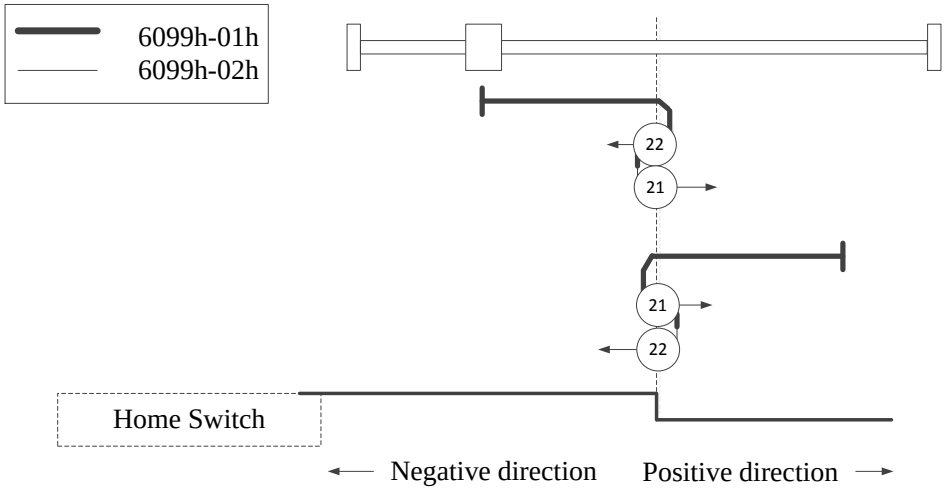
This method is similar to mode 3, 4.
The difference is that the detection position of the origin is not the Index pulse, but the changed position of the Home switch.
(please refer to the figure below)
When HOME is not allocated, Homing error = 1.



Homing on positive home switch

■ Mode 21, 22

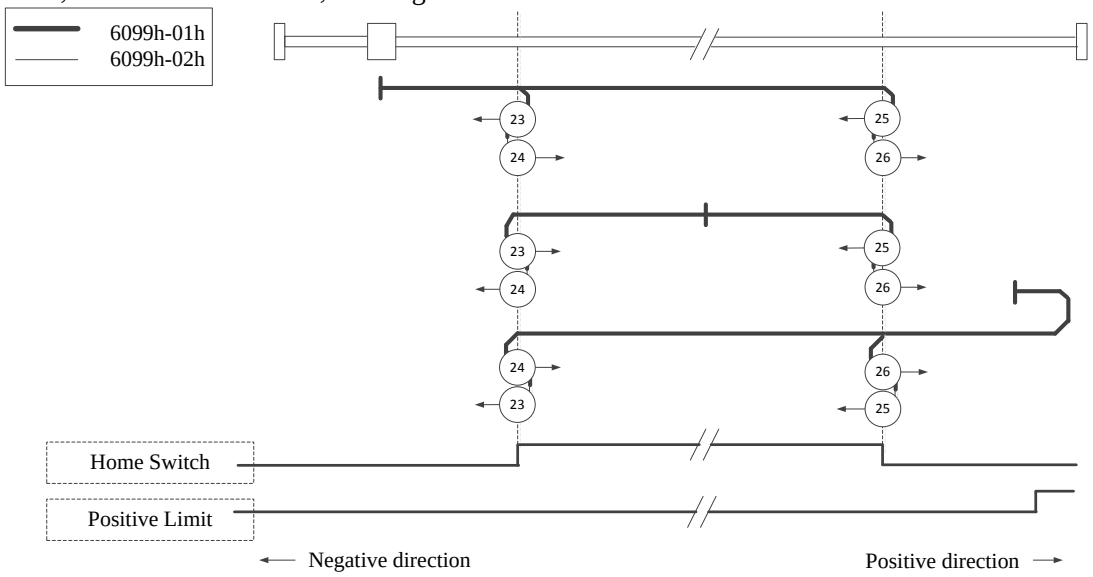
This method is similar to mode 5, 6.
The difference is that the detection position of the origin is not the Index pulse, but the changed position of the Home switch.
(please refer to the figure below)
When HOME is not allocated, Homing error = 1.



Homing on positive home switch and index pulse

- Mode 23, 24, 25, 26

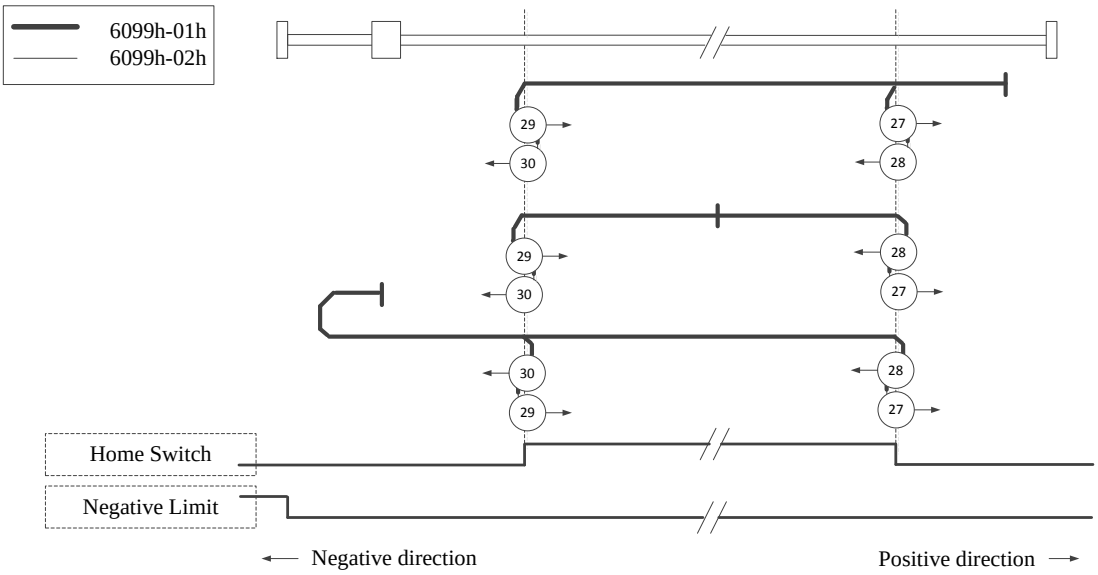
This method is similar to mode 7, 8, 9, 10.
The difference is that the detection position of the origin is not the Index pulse, but the changed position of the Home switch.
(please refer to the figure below)
When HOME, POT are not allocated, Homing error = 1.



Homing on home switch and index pulse – positive initial motion

- Mode 27, 28, 29, 30

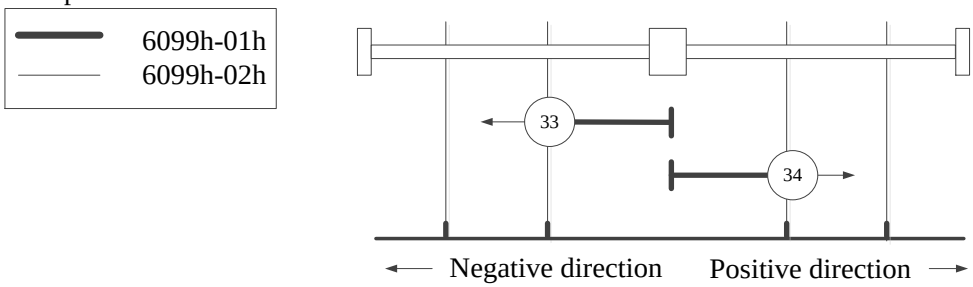
This method is similar to mode 11, 12, 13, 14.
The difference is that the detection position of the origin is not the Index pulse, but the changed position of the Home switch.
(please refer to the figure below)
When HOME, NOT are not allocated, Homing error = 1.



Homing on home switch and index pulse – Negative initial motion

- Mode 33, 34:

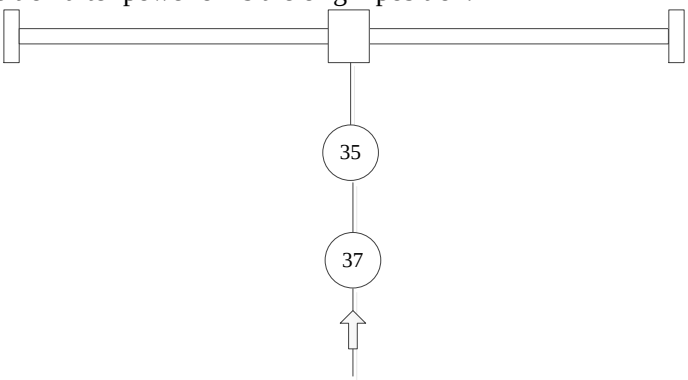
Using method 33 or 34, the return to origin direction is negative or positive, respectively. The original position is located near the z-phase of the selected direction.



Homing on index pulse

- Mode 35, 37

In mode 35 and 37, the position after power on is the origin position.

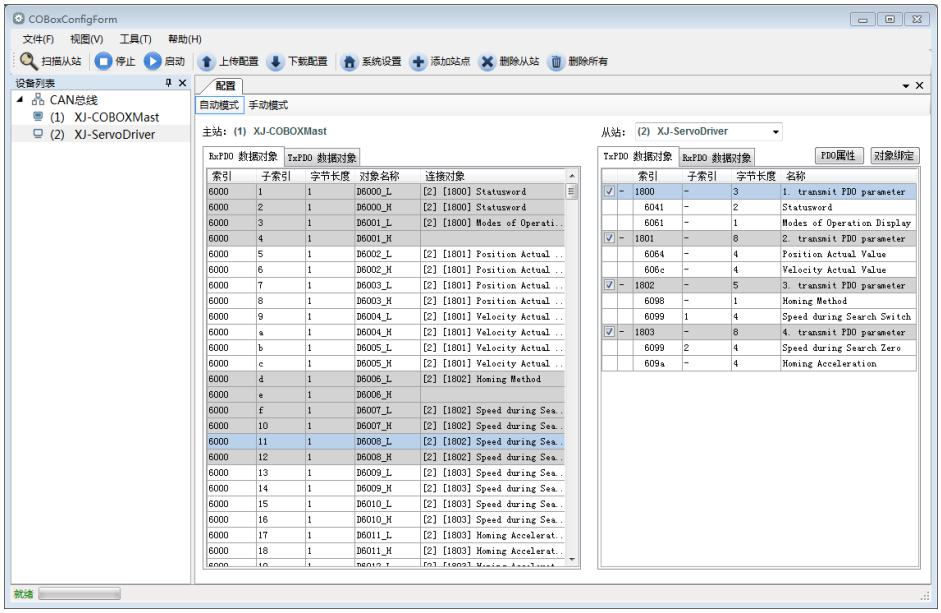


5. Operation example

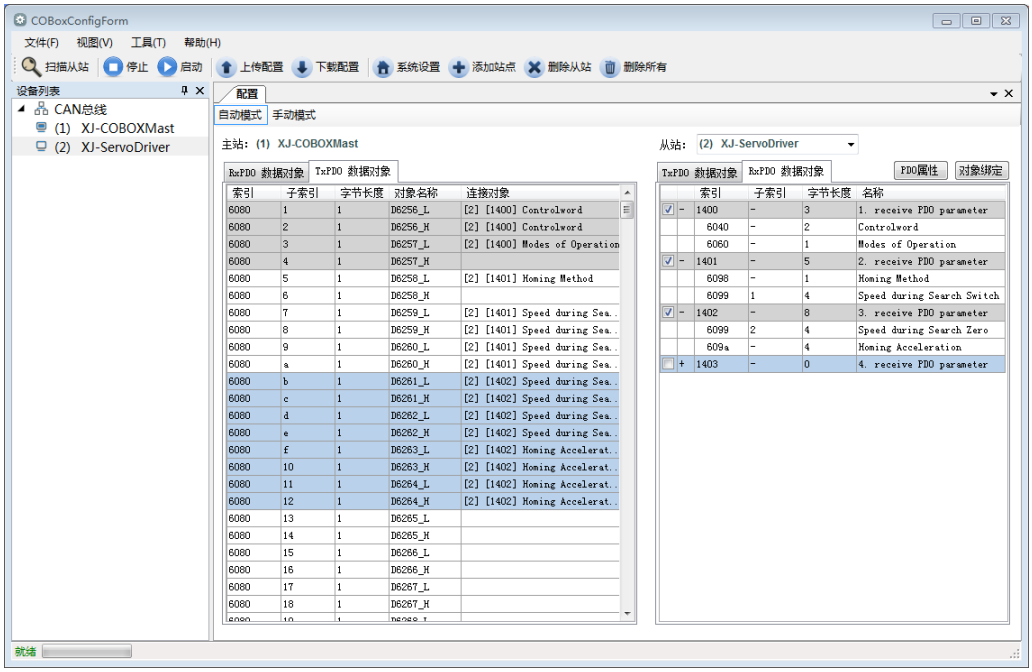
Taking the connection of Xinje DF3E low-voltage servo as an example, the configuration and control process of HM mode are briefly introduced. The specific use method of servo software is shown in Appendix 10.
Make terminal assignment. Modify P5-22, P5-23, P5-27 through the servo software or configure P-OT, N-OT, SPD-D signal for index 2516,2517,251B through SDO read-write command. If the assignment is not correct, then Homing error = 1.

① click [scan] or [add slave station] in CANopen configuration interface, configure the object binding of TxPDO and RxPDO. Here, several common objects of HM mode are bound. If you have other requirements, you can add them by yourself and enable the configured PDO. The specific configuration is shown in the figure below.

TxPDO (monitor parameters):



RxPDO (control parameters):



② Download configuration, slave station state machine automatically switches from PreOp to OP state, SDO and PDO can receive and send messages at this time. XDPPro software can monitor or modify the mapping of object dictionary. The specific correspondence is as follows:

寄存器	监控值	字长	进制	注释
D6000	0000	单字	16进制	状态字
D6001	0	单字	10进制	模式查询
D6002	0	双字	10进制	位置反馈
D6004	0	双字	10进制	速度反馈
D6006	0	单字	10进制	回原点模式查询
D6007	0	双字	10进制	近原点速度
D6009	0	双字	10进制	回原点速度
D6011	0	双字	10进制	回原点加速度
D6256	0000	单字	16进制	控制字
D6257	0	单字	10进制	模式设定
D6258	0	双字	10进制	回原点模式设定
D6259	0	单字	10进制	近原点速度
D6261	0	双字	10进制	回原点速度
D6263	0	双字	10进制	回原点加速度

③ First, set P0-00 to 1 to start CiA402 motion control function, then modify D6257 (6060h is 6) to HM mode. Set the return to origin mode through D6258 (6098h), after setting return to origin speed through D6259-D6263 (6099h, 609Ah), modify D6256 (control word 6040h is 0x06 → 0x07 → 0x0F) to enable the slave station, and then modify D6256 (control word 6040h is 0x0F → 0x1F) to start the return to origin mode. Other monitoring parameters are monitored by D6000-D6011. In the process of returning to the origin, if the origin signal is triggered, it will decelerate and stop according to the corresponding way of returning to the origin. If you need to return to the origin again, first change 6040h to 0x06, and then repeat the above operation.

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.

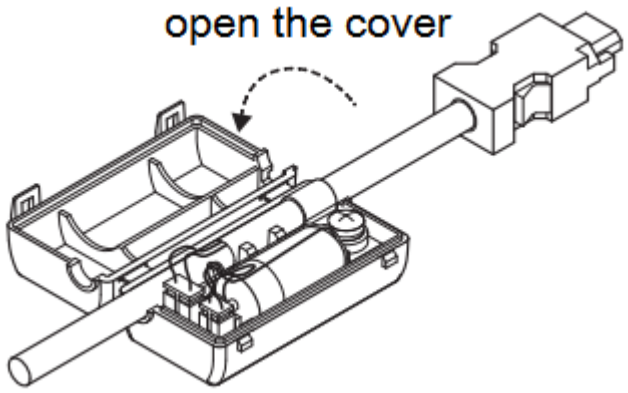
Pararmeter	Name	setting	Meaning	Range
P0-79	Absolute encoder battery undervoltage alarm switch	0	Normally use absolute encoder and use battery to memorize position.	0~2
		1(default)	Use multi-loop absolute encoder as incremental encoder and no longer remember position	
		2	Use as absolute encoder, ignore the multi-loop overflow alarm	

4.7.2 Replace the battery

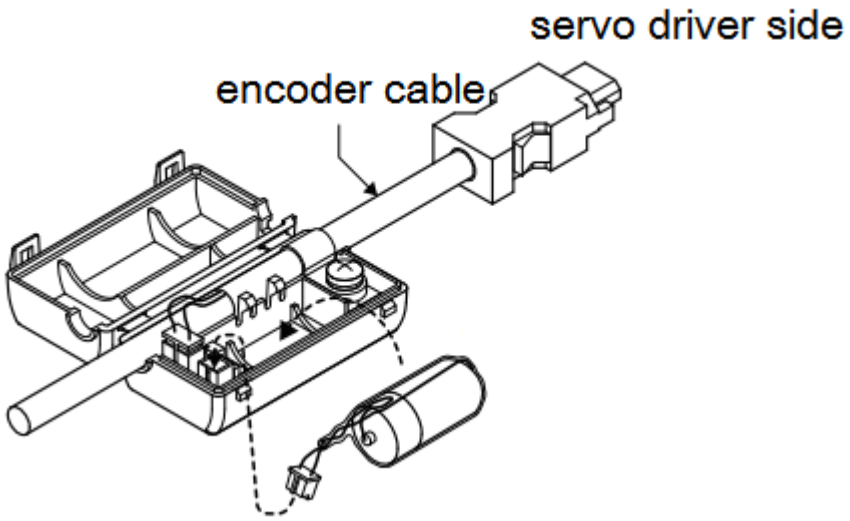
When replacing the battery, please replace the battery while keeping the driver and motor connected well and the control power is connected. If the battery is replaced when the control power between the driver and the motor is closed, the data stored in the encoder will be lost.

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

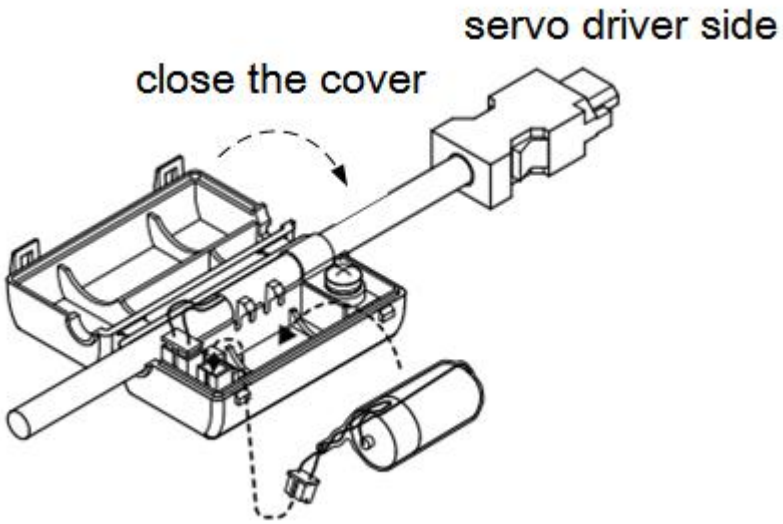
Battery replacement steps
When using encoder cable with battery unit
(1) Only the control power of the servo unit is connected;
(2) Open the cover of the battery cell;



(3) Take out the old battery, install the new one.



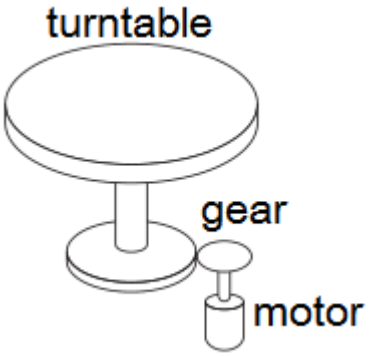
(4) Close the cover of the battery unit



(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.

4.8 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.

(3) 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.	Anytime	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.	Anytime	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,	Anytime	At once

				P3-29.		
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.						

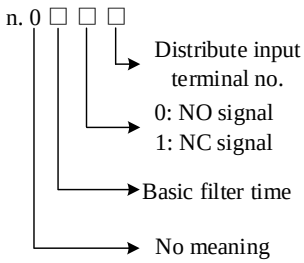
4.8.3 Speed limit

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

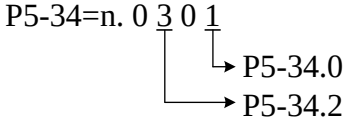
■ Related parameter

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. 0 □ □ □ Distribute output terminal no. 0: NO signal 1: NC signal No meaning No meaning	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

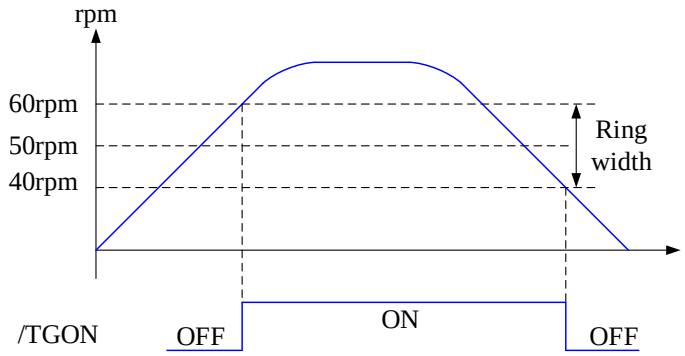
Parameter	Meaning	Default value	Unit	Range	Modify	Effective
P5-03	Rotating detection speed /TGON	50	rpm	0～10000	Anytime	At once
If the speed of the servo motor exceeds the set value of P5-03, it is judged that the servo motor is rotating and the output of the rotation detection (/TGON) signal.						

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	Motor	rpm	0～65535	Servo bb	At once

	speed	related				

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:

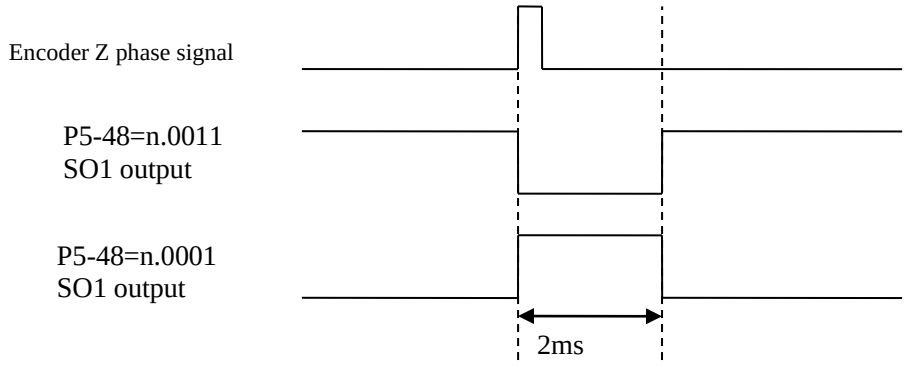
(1) When an alarm occurs, the servo unit is forced to set OFF, and the motor will move with external forces (including gravity). If you need to keep the motor in position, please select the motor with power loss brake (also known as brake) and use / BK signal. Refer to Section 5.2.5.

(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

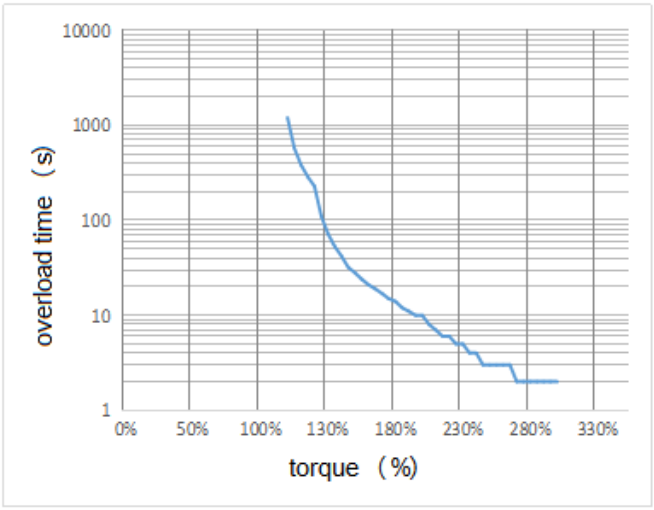
1. The parameter range is 0000-0014, which is allocated to other input terminals through parameter P5-24.
2. When an alarm occurs, find out the cause of the alarm and remove it, then clear the alarm by setting the signal to be effective.
3. /ALM-RST signal can be assigned to other terminals through this 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).

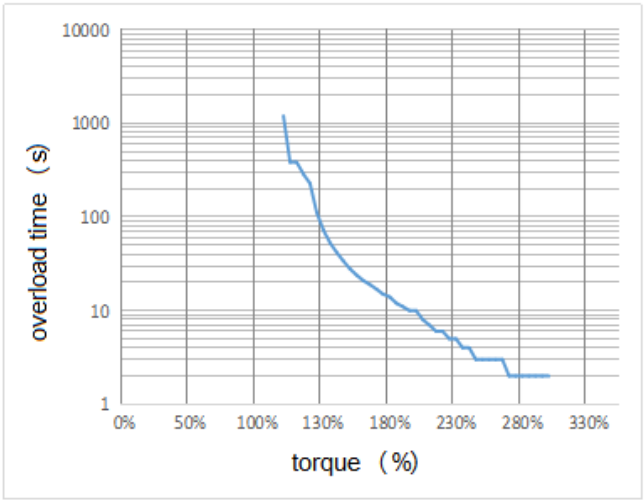
4.8.6.3 Other SI terminal function

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	

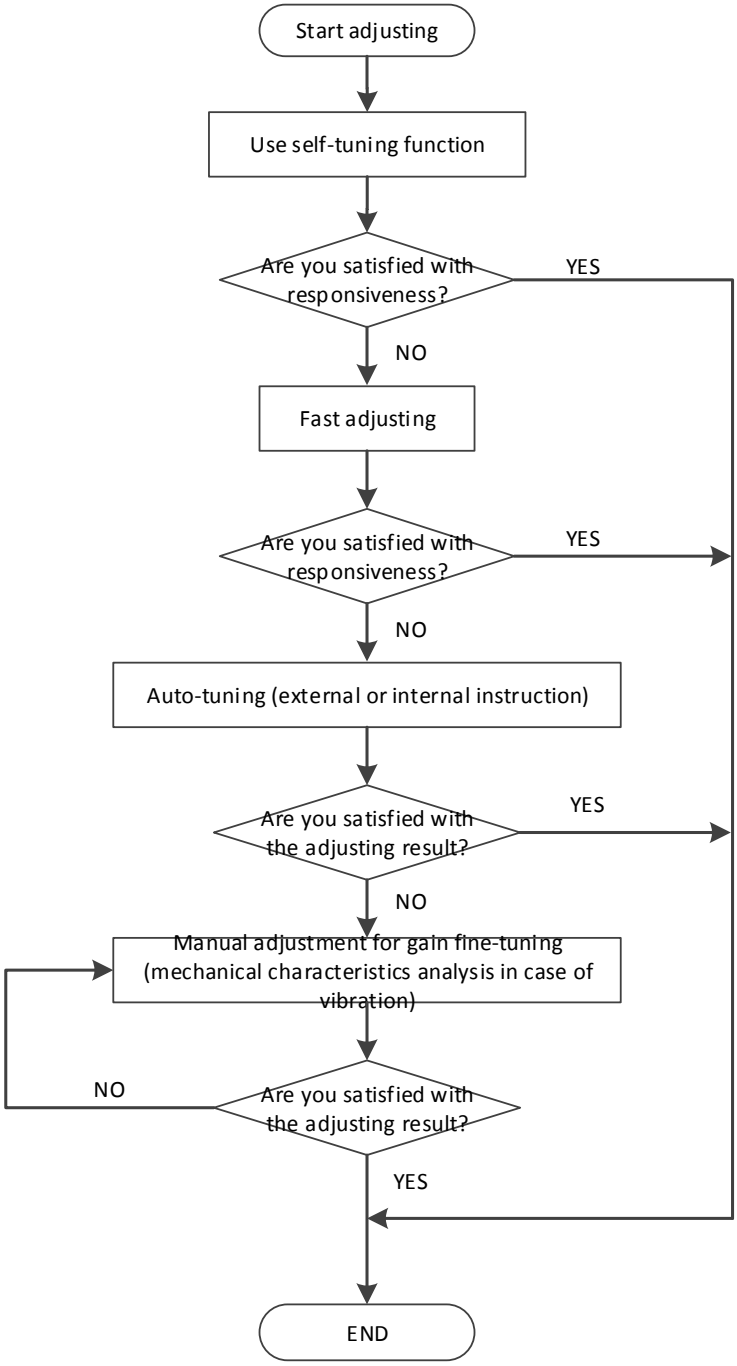
750W suitable model (motor code)	
50F7 58F7	

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	

5.1.3 Model loop control

In the auto-tuning mode, besides the gain of speed loop and position loop, there is also the gain of model loop, which has a great influence on the servo responsiveness. When the model loop is not open, the servo responsiveness is determined by the gain of the position loop, and when the model loop is open, the servo responsiveness is determined by the gain of the model loop. The model loop is equivalent to feed-forward function in the driver control loop, and its specific function refers to chapter 5.5 manual adjustment.

When the auto-tuning mode is soft, the function of the model loop will automatically turn off; when the auto-tuning mode is fast positioning or fast positioning (control overshoot), the function of the model loop will automatically turn on.

Auto-tuning mode

Parameter		Meaning	Default setting	Modification	Effective
P2-02	n.□□□1	Soft	n.□□□3	At anytime	at once
	n.□□□2	Fast positioning			
	n.□□□3	fast positioning (control overshoot)			

Selection of auto-tuning mode:

① Soft (P2-02.0 = 1):

This method does not turn on the gain of the model ring, and is suitable for the occasion of insufficient mechanical rigidity and low response requirements.

② Fast positioning (P2-02.0 = 2):

In this way, the response of setting parameters is the fastest, but there is no special suppression to overshoot.

③ Fast positioning (control overshoot) (P2-02.0 = 3):

In this way, the response of setting parameters is fast, and the overshoot is restrained.

Load type	Explanation
Synchronous belt	The adjustment is suitable for the mechanism with lower rigidity such as synchronous belt mechanism.
Lead screw	It is suitable for the adjustment of high rigidity mechanism such as ball screw mechanism. Please select this type when there is no corresponding structure.
Rigid connection	The adjustment is suitable for rigid body system and other mechanisms with high rigidity.

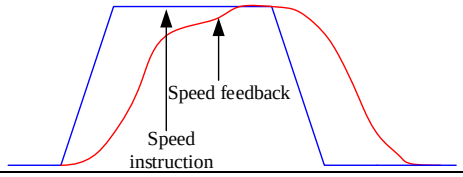
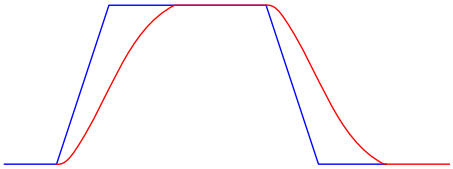
Auto-tune mode	Explanation
Soft	Soft gain adjustment. In addition to gain adjustment, the notch filter is also adjusted automatically
Fast positioning	Make special adjustment for positioning purpose. In addition to gain adjustment, the model loop gain and notch filter are also adjusted automatically
fast positioning (control overshoot)	Pay attention to the adjustment of no overshoot in the positioning purpose. In addition to gain adjustment, the model loop gain and notch filter are also adjusted automatically

Model loop function

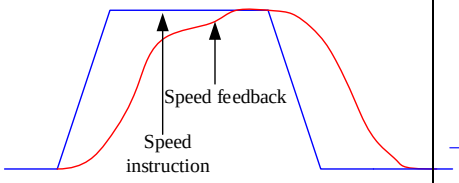
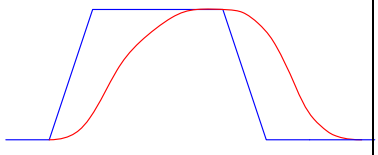
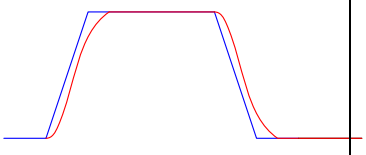
Parameter		Meaning	Default setting	Modification	Effective
P2-47	n.□□□0	Model loop turn off	n.□□□0	At anytime	At once
	n.□□□1	Model loop turn on			

Taking DF3E series servo auto-tuning mode and using 750W servo 5 times load inertia as an example:

■ Model loop function turns off (soft mode)

Low Rigidity and Low Response	High Rigidity and 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: Running jitter, slow response	Phenomenon: smooth operation and fast response

■ Model loop function turns on (fast positioning or fast position(control overshoot))

Low Rigidity and Low Response	High Rigidity and Low Response	High Rigidity and 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: Running jitter, slow response	Phenomenon: smooth operation and slow response	Phenomenon: smooth operation and fast response

Note: The above curves only show the effect of the parameters, not the real running curves.

5.1.4 Torque disturbance observation

Disturbance observer can reduce the influence of external disturbance on servo system and improve the anti-disturbance ability by detecting and estimating the external disturbance torque of the system and compensating the torque command.
If the soft mode is selected in the auto-tuning mode, the disturbance observer will be closed automatically, and the gain of the disturbance observer will not change. If the fast positioning or fast positioning (control overshoot) is selected, the disturbance observer will be opened automatically, and the gain of the disturbance observer will be modified to 85. The relevant parameters of this function no need to be set manually by users.

Parameter		Meaning	Default setting	Modification	Effective
P2-00	n.□□□0	Turn-off of disturbance observer	n.□□□0	Servo bb	At once
	n.□□□1	Turn-on of disturbance observer			

Parameter	Meaning	Default setting	Unit	Setting range	Modify	Effective
P2-41	Disturbance observer gain	85	%	0～100	Anytime	At once

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

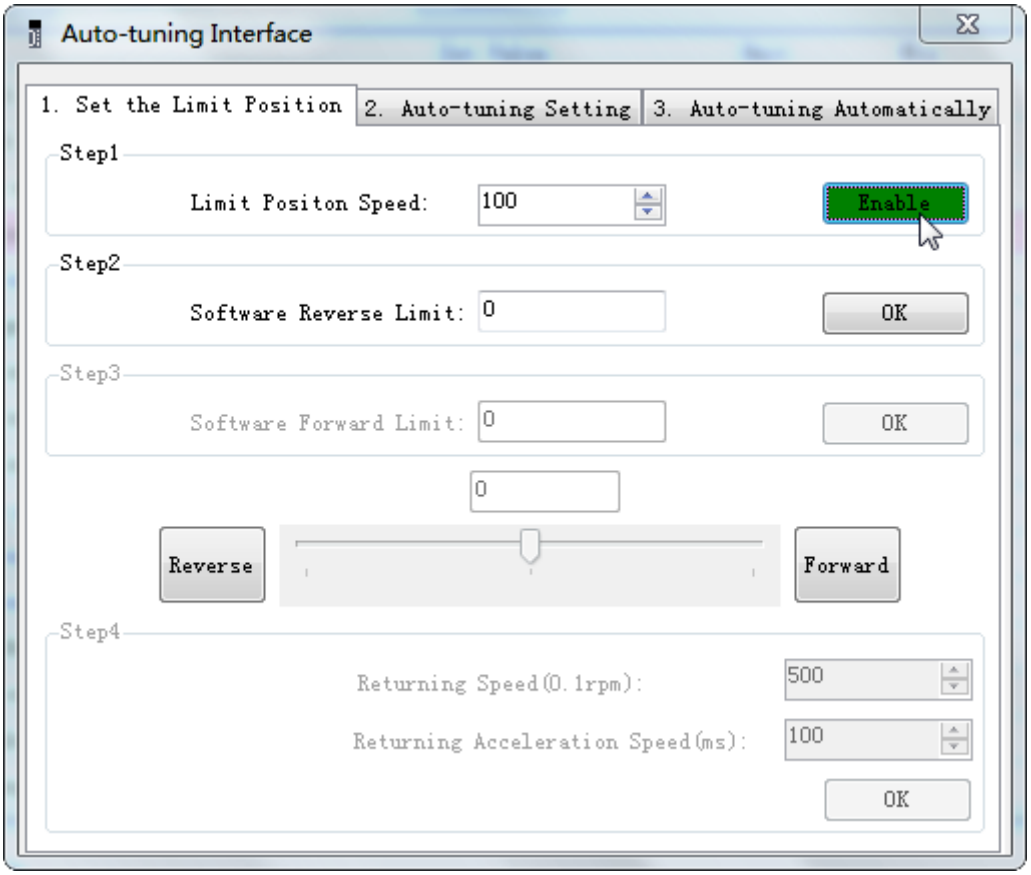
The presumptive tools of load moment of inertia are driver panel and XinjeServo software.

Operation tool	Description
XinjeServo software	All versions of software supported

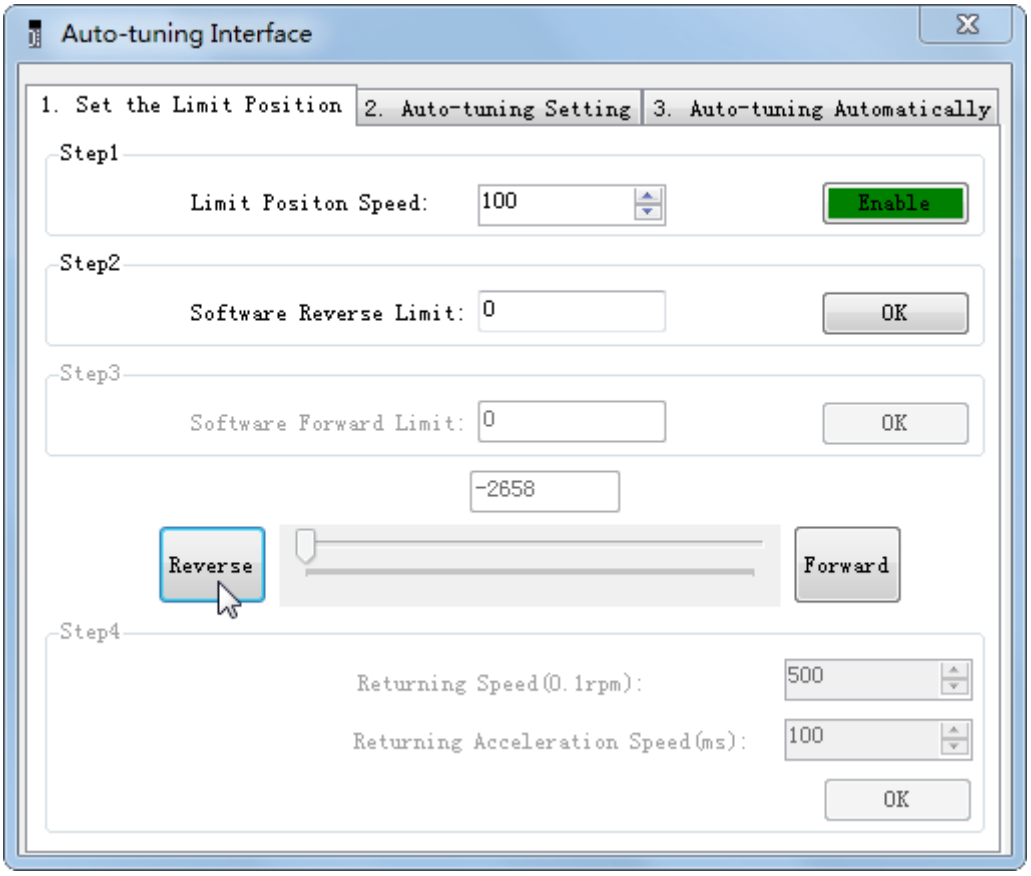
Note: driver firmware version can be checked through U2-07.

5.2.4 Operation steps

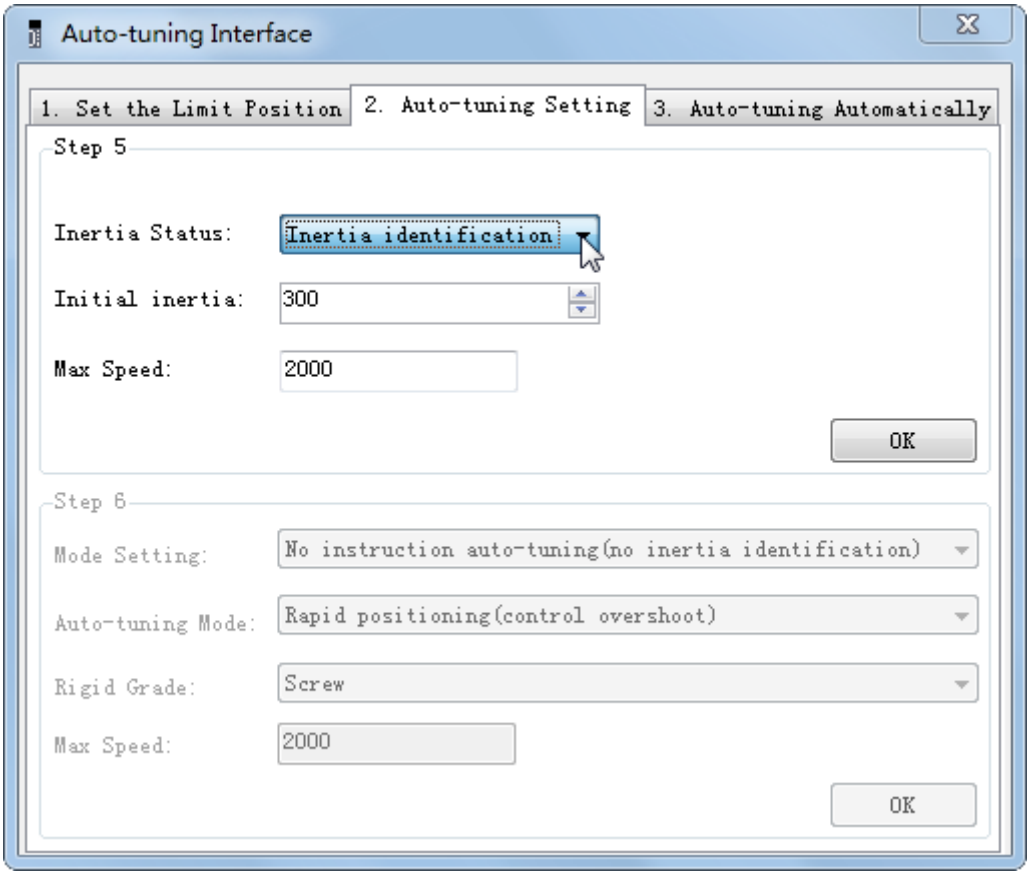
1. Click auto-tuning on the main interface of XinJeServo



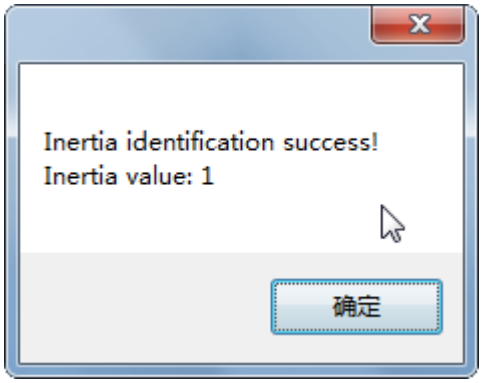
2. select jog setting or manual setting to configure the inertia estimation trip



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

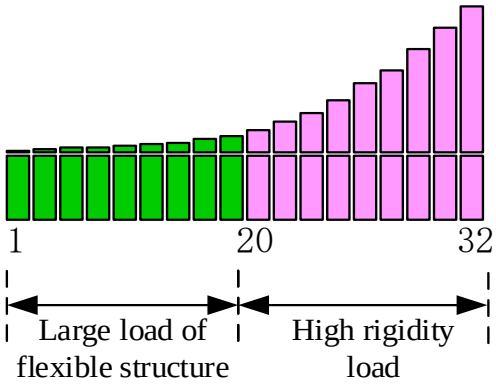
P2-01=n. 0 0 1 0
↳ P2-01.0

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
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

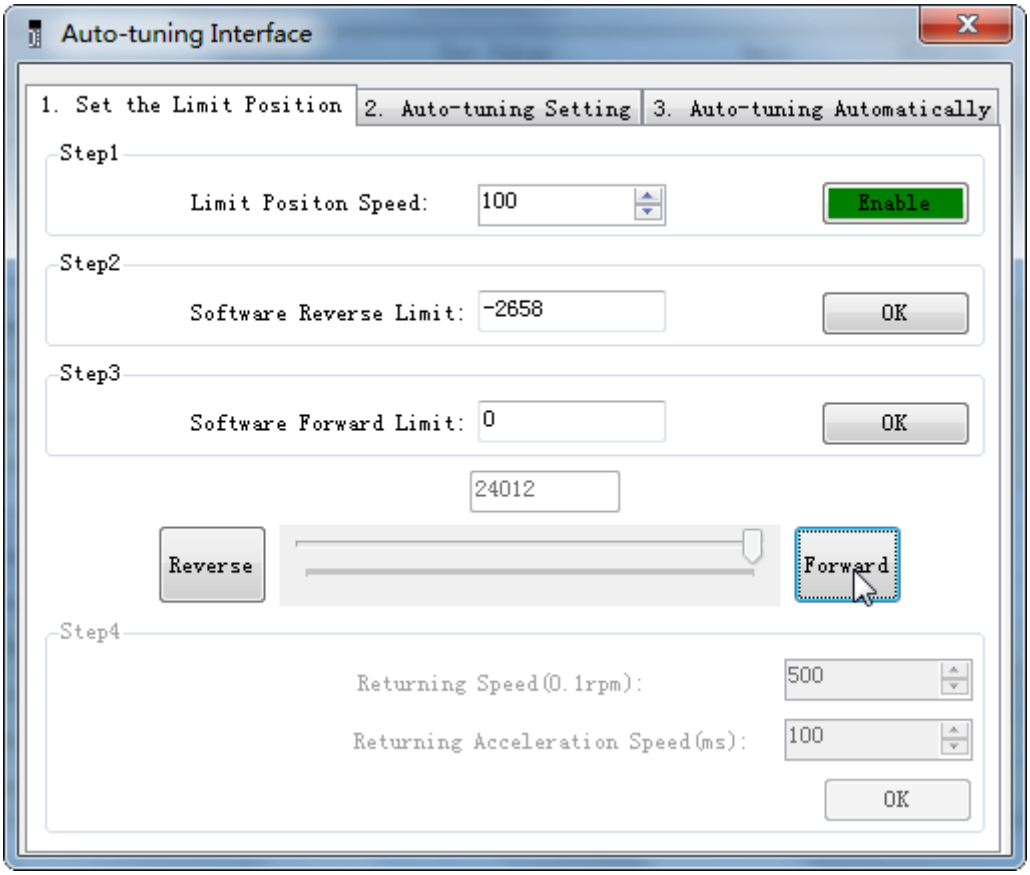
Internal instruction auto-tuning and external instruction auto-tuning can be executed by XinJeServo software.

Auto-tuning mode	Operation tools	Limit item
Internal instruction auto-tuning external instruction auto-tuning	XinJeServo software	All the versions support

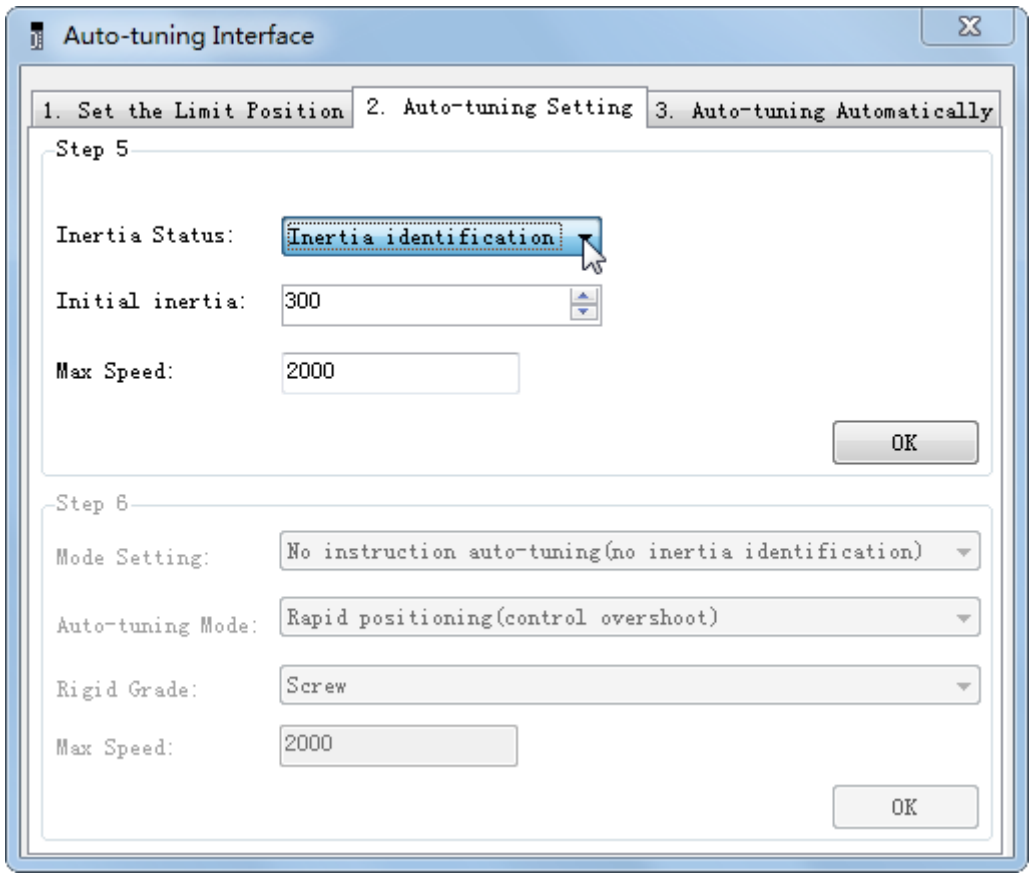
Note: please check the driver firmware version through U2-07.

5.4.4 Internal instruction auto-tuning steps

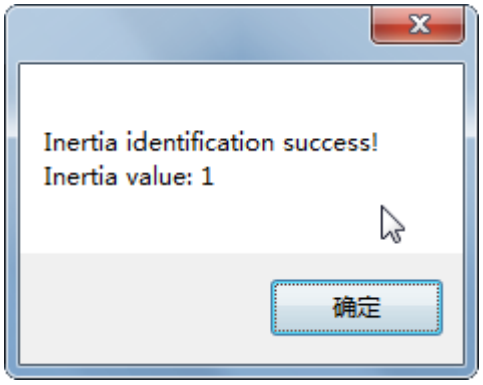
1. click auto-tuning on the XinJeServo software main interface
2. set the auto-tuning trip in jog mode or manually



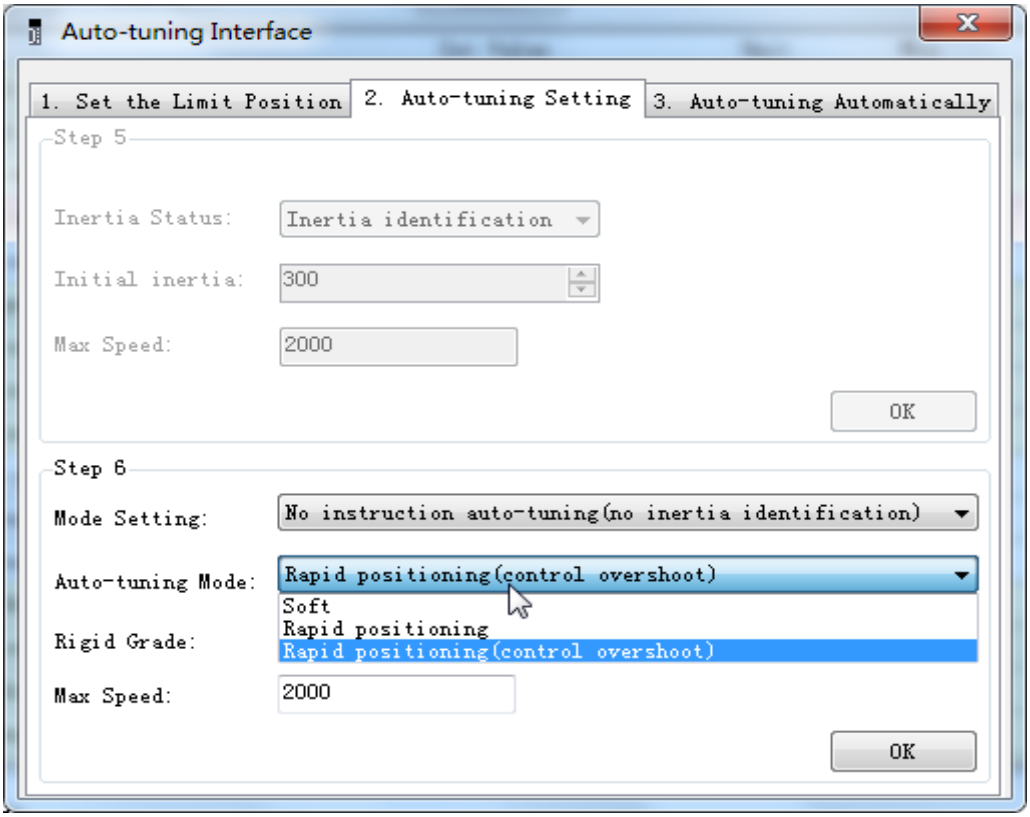
3. set the auto-tuning interface



4. click ok to estimate the inertia.



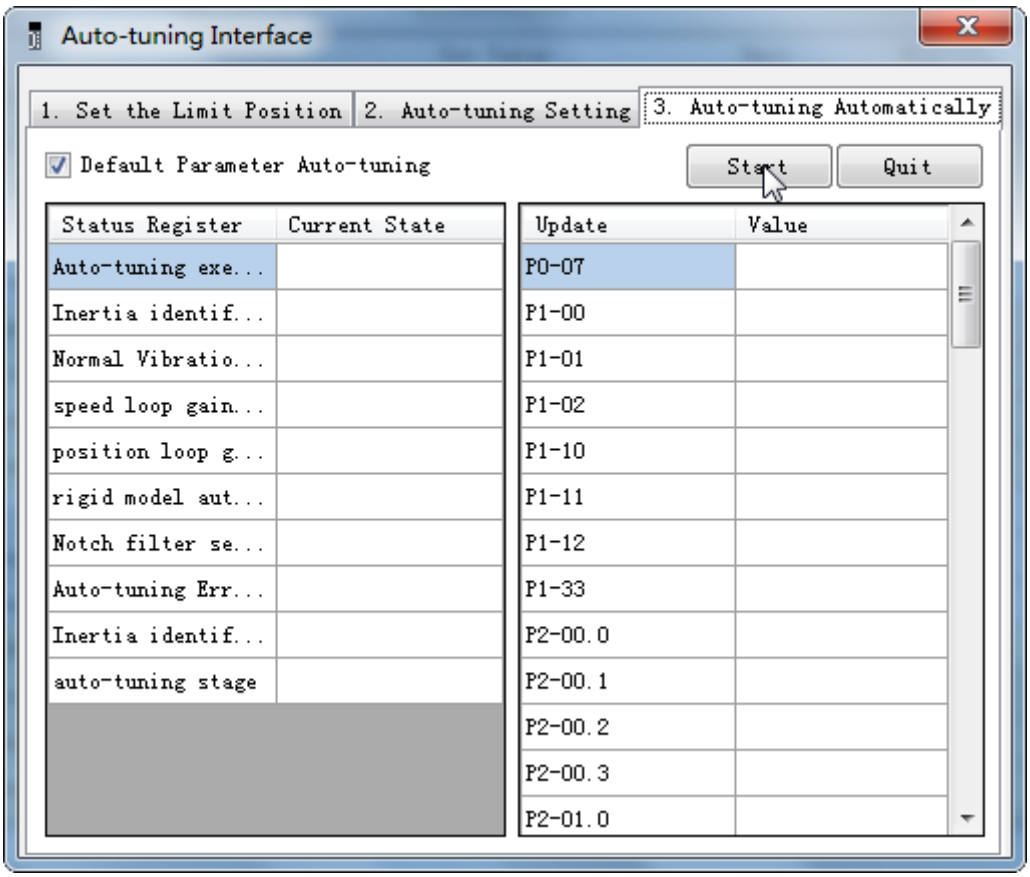
5. set the auto-tuning parameters



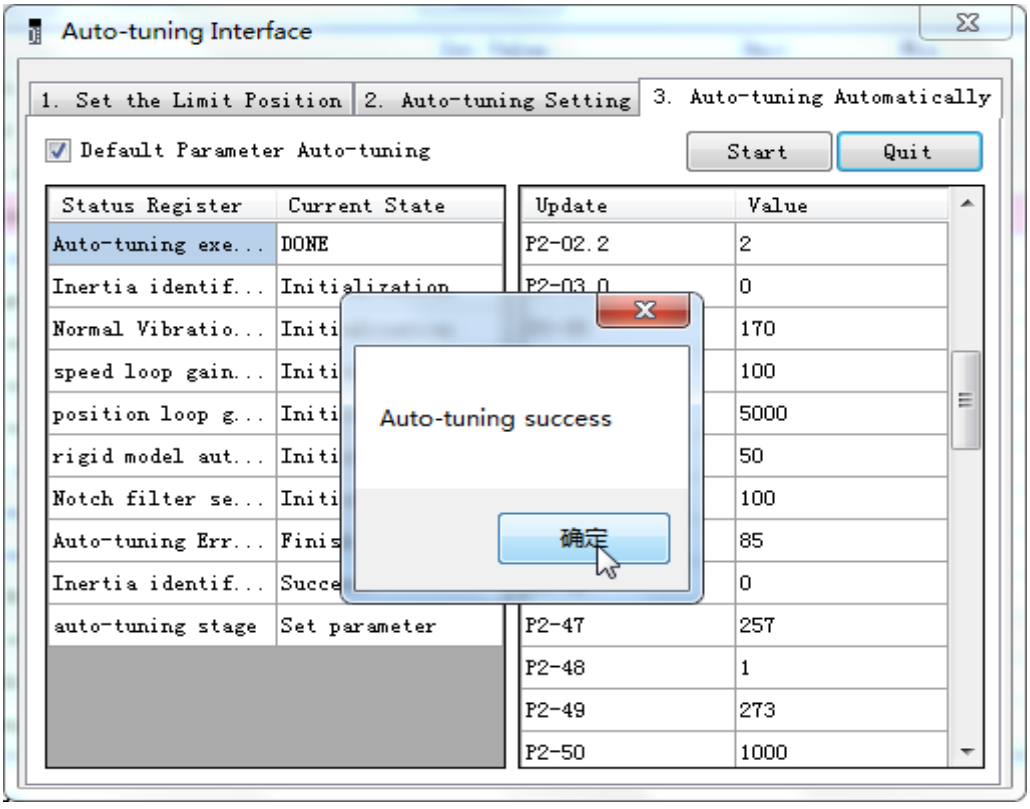
Auto-tuning mode	Description
Soft	Make a soft gain adjustment. Besides gain adjustment, notch filter is automatically adjusted.
Fast positioning	Make special adjustment for positioning purpose. Besides gain adjustment, the model loop gain and notch filter are automatically adjusted.
Fast positioning（control 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

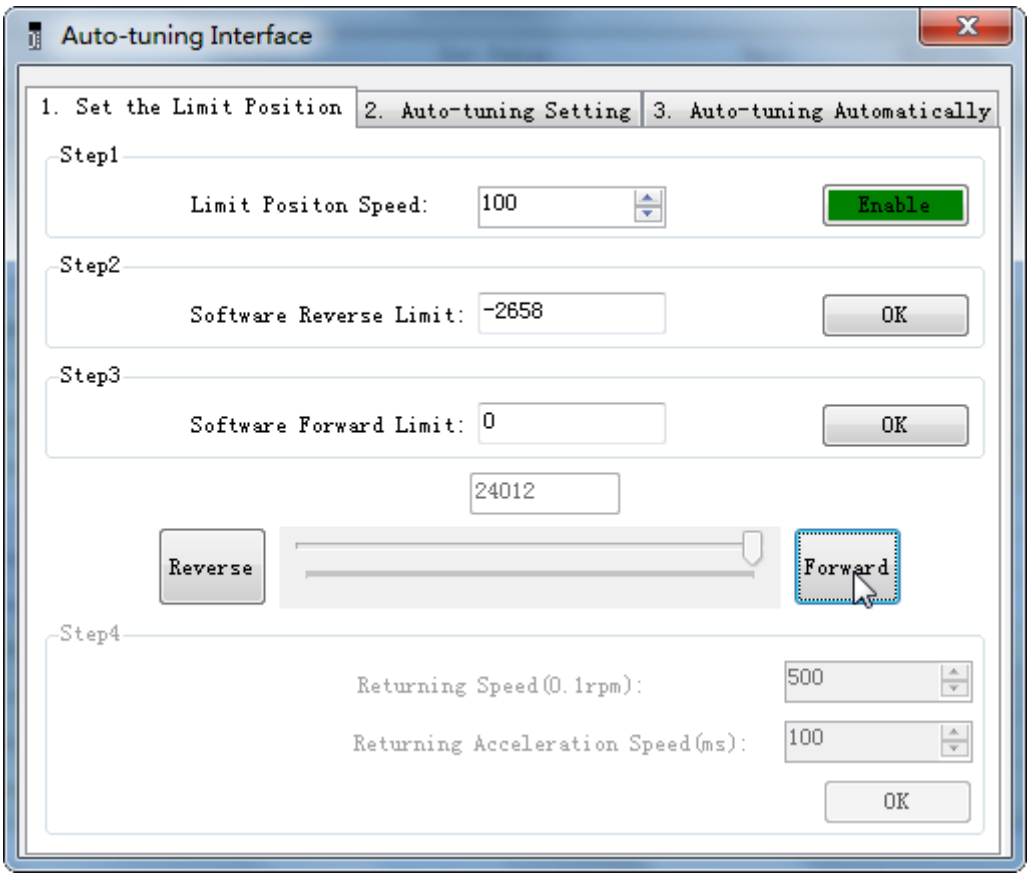


7. Wait for the end of the auto-tuning



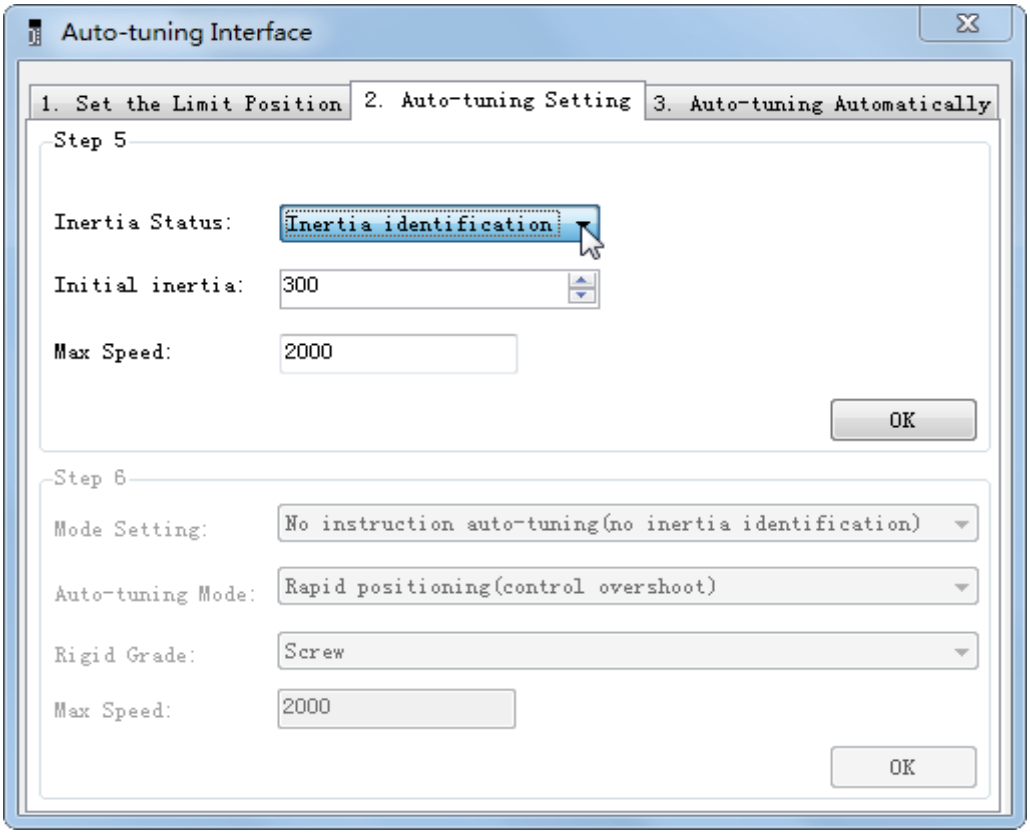
5.4.5 External instruction auto-tuning steps

1. Click auto-tuning on the main interface of XinJeServo software

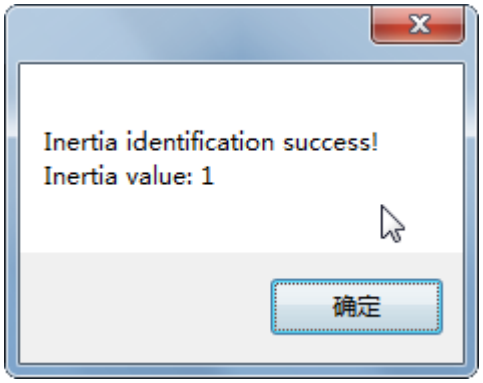


2. Select jog or manual setting to configure the trip of inertia identification.

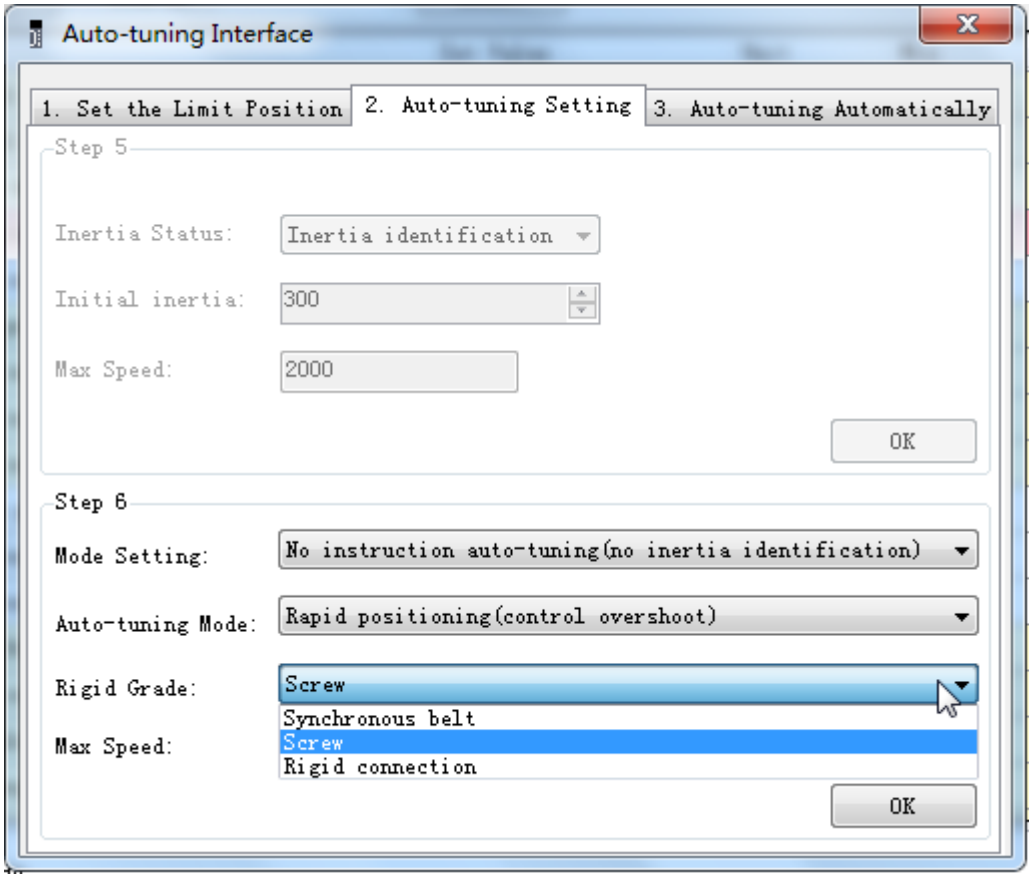
3. Set the auto-tuning interface



4. Click ok to start the inertia identification.



5. Configure the auto-tuning parameters

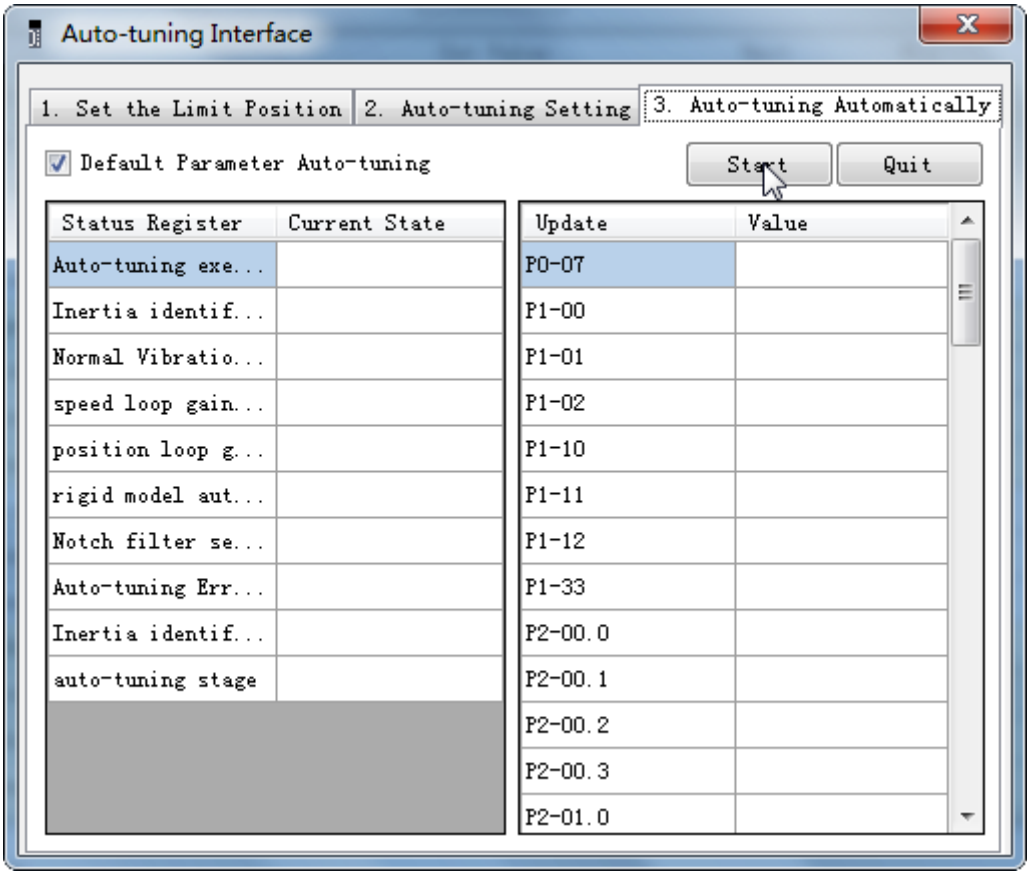


Auto-tuning mode	Description
Soft	Make a soft gain adjustment. Besides gain adjustment, notch filter is automatically adjusted.
Rapid positioning	Make special adjustment for positioning purpose. Besides gain adjustment, the model loop gain and notch filter are automatically adjusted.
Rapid positioning (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.

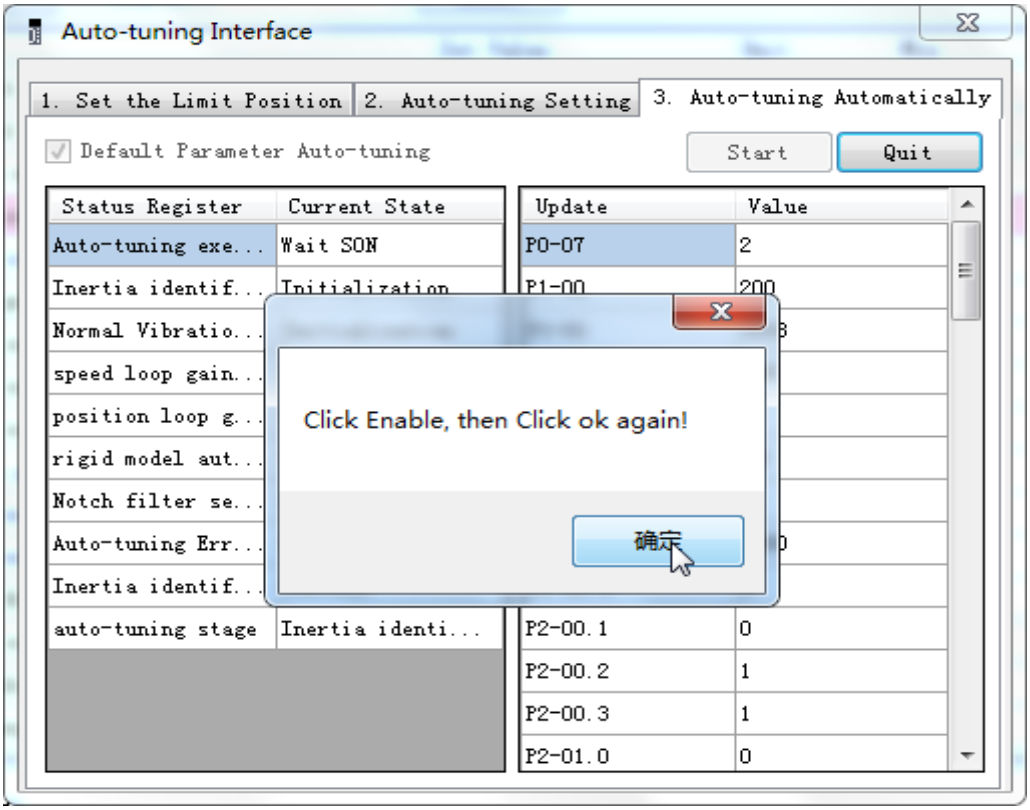
Load type	Description
Synchronous belt	Adjustment of lower rigidity mechanism such as synchronous belt
Screw	It is suitable for adjusting higher rigidity mechanism such as ball screw mechanism. If there is no corresponding mechanism, please choose this type.

Rigid connection	It is suitable for the adjustment of rigid body system and other mechanisms with higher rigidity.

6. Start auto-tune

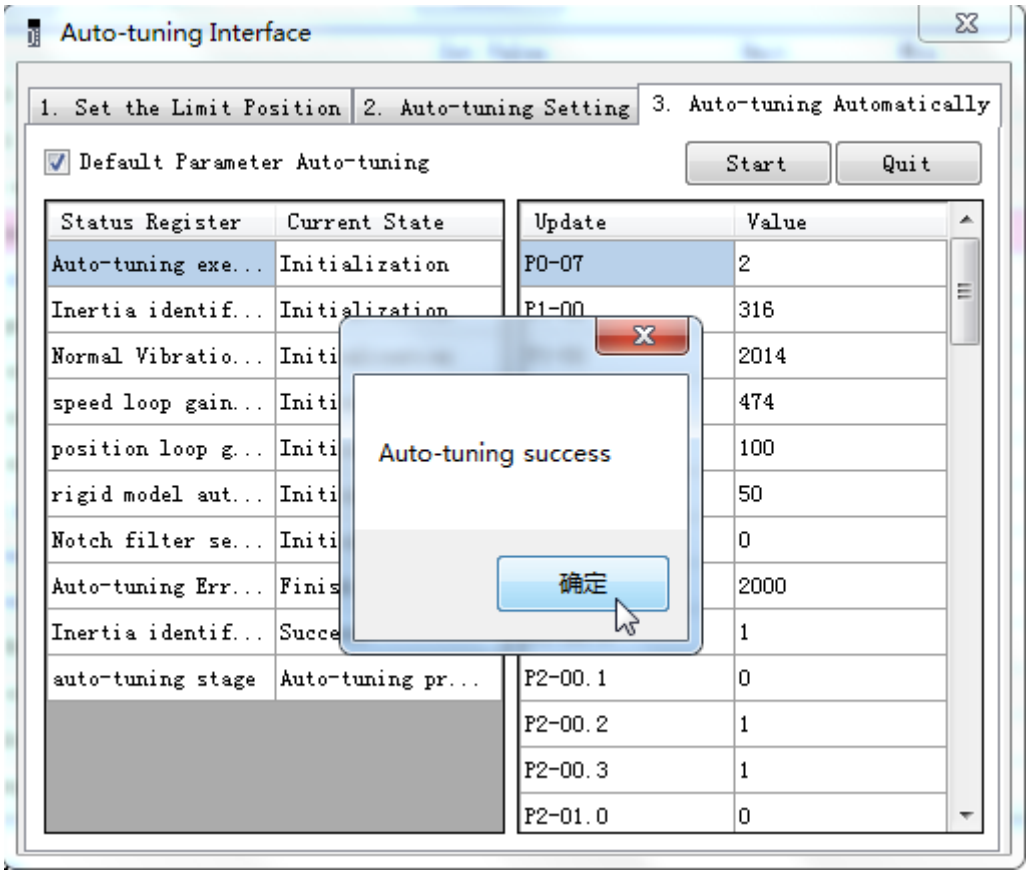


7. Open the servo enable, then click ok.



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

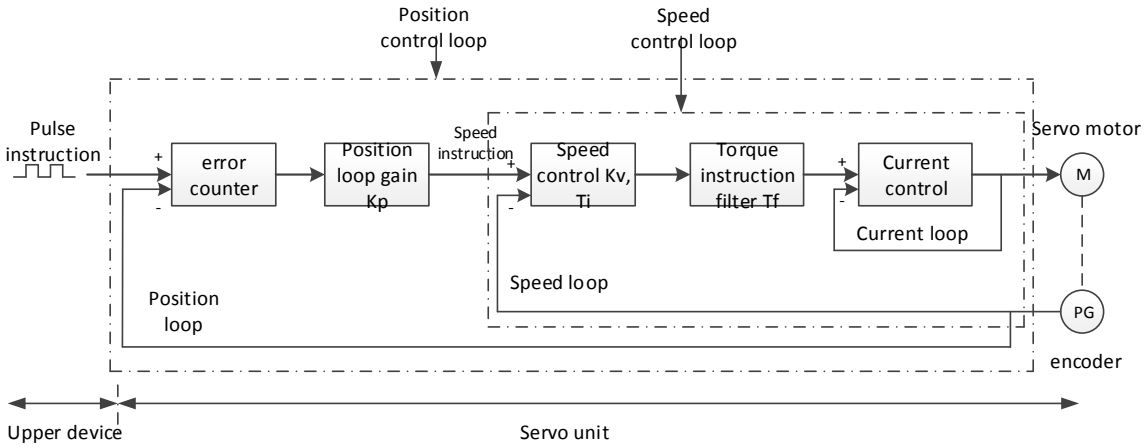
The following parameters may be modified during auto-tuning. Do not change them manually during auto-tuning.

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		
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		

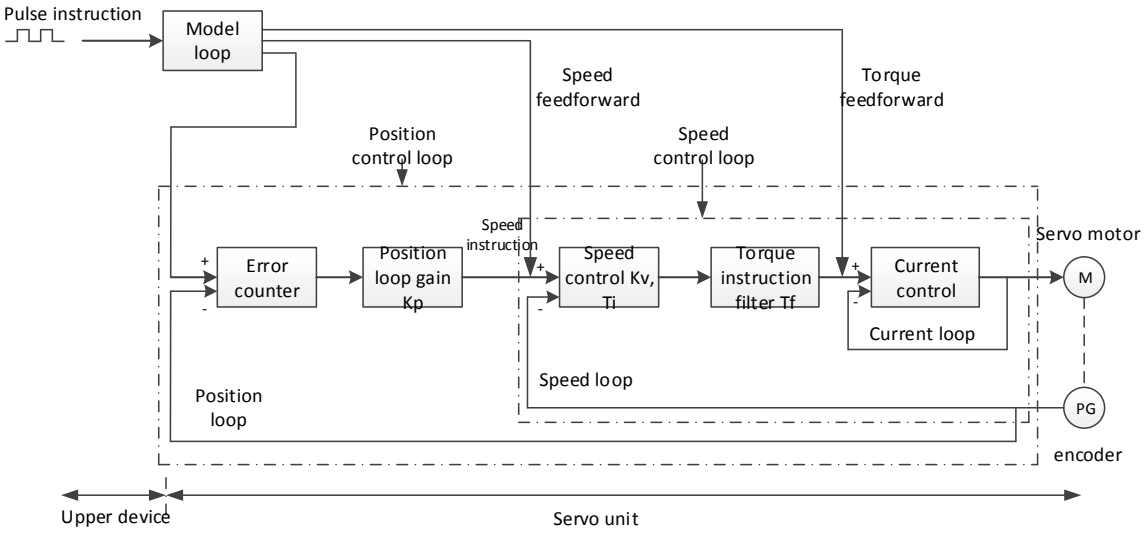
Note: P2-60~P2-67 are automatically modified in auto-tuning process. Users are not allowed to modify them manually. Manual modification may lead to the risk of system runaway.

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.

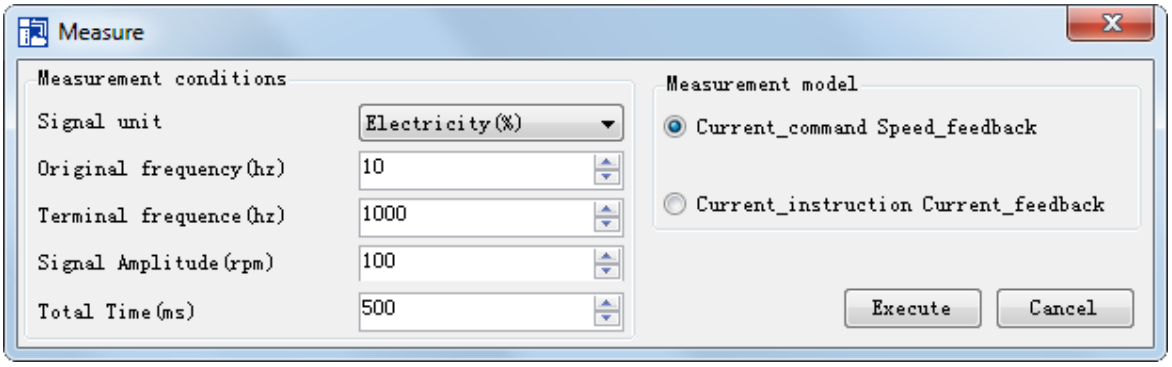
5.6.2 Operation tools

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

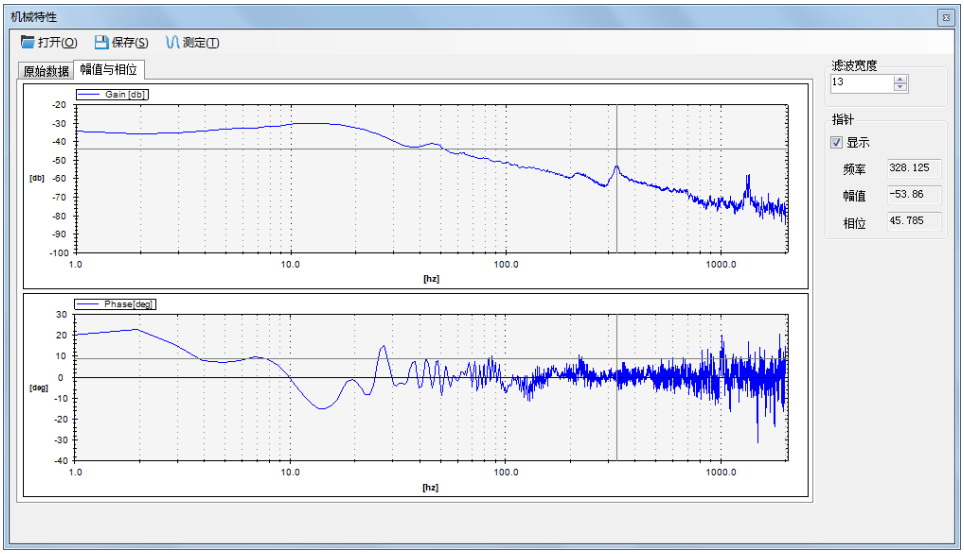
Note: The firmware version of the drive is viewed through U2-07.

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

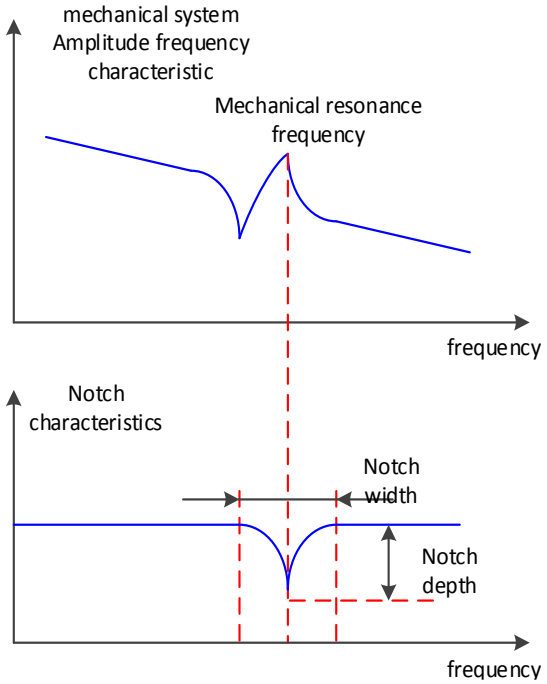
Note: In both adaptive and auto-tuning modes, if mechanical characteristic analysis is used, the notch can be set manually. If there are multiple resonance points, the third to fifth notch can be configured in turn.

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

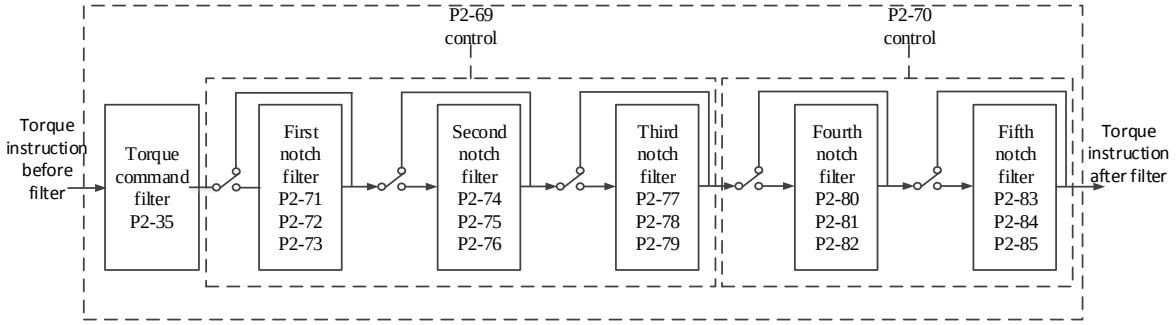
Notch filter can suppress mechanical resonance by reducing the gain at a specific frequency. After the notch filter is set correctly, the vibration can be effectively suppressed and the servo gain can be continuously increased.
The principle diagram of notch filter is as follows:



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
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.

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
	4	E-044	Three phase voltage input phase loss	√	√	No	Servo off
06	0	E-060	Module temperature too high	√	√	No	Servo enable

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	
	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 EEPROM	√	○	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	
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	Conflict of TREF or VREF Function Settings	P0-01=4, P3-00 set to 1 will alarm
	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

Main type	Sub type	Code	Description	Reasons	Solutions
03	0	E-030	Bus voltage U0-05 is higher than the actual preset threshold, 48V Power Supply Machine (U0-05≥83V)	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 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 maximum reverse speed is	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 changes normally, increasing in one direction and decreasing in one direction (0-9999 cycle display).

			P3-22.	Parameter setting	When the actual speed is larger than P3-21/P3-22, it will alarm.

Main type	Sub type	Code	Description	Reasons	Solutions
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 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.

Main type	Sub type	Code	Description	Reasons	Solutions
16	1	E-161	Driver thermal power overload	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.
				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 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.

Main type	Sub type	Code	Description	Reasons	Solutions
22	0	E-220	Communication error of absolute servo encoder	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 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.

Main type	Sub type	Code	Description	Reasons	Solutions
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.
	4	E-264	Excessive vibration	(1) Oscillation caused by external	(1) Check the source of external force to see if there are any problems in

				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.	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 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

Main type	Sub type	Code	Description	Reasons	Solutions
31	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.

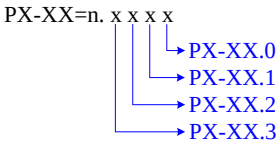
"√" means modifying anytime and take effect at once.

"●" 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 Counting 1-Reverse Pulse Counting	-	0	0~1	●	6|7	4.3.2
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	0~2	○	6|7	4.3.2

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	2-P+D						
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) 0-not shield the alarm 1-shield the alarm	-	2 0	0~3 0~1	○	1|3|5|6|7	4.2.4
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

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
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 + P0-93 *10000	-	1	1~9999 1~65535	○	5|6	4.3.1.1
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 during auto-tuning) 1- synchronous belt 2- screw rod 3-Rigid Connection	-	2	1~3	√	1|3|5|6|7	5.1.3
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	-

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
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 Suppression gain	%	100	1~1000	√	1|3|5|6|7	5.4.6
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

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
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
P3-01	Analog voltage corresponding to rated speed	0.001V	10000	1500~30000	○	1	4.5
P3-02	Analog voltage speed filter	0.01ms	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

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
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 corresponding to rated torque	0.001V	10000	1500~30000	○	3|5|6|7	-
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

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
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 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	-	0	0~6	○	6	4.3.3.1
P4-03.2	Internal position mode sets waiting mode	-	0	0~1	○	5	4.3.3.1

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	0-wait positioning completion 1-not wait positioning completion						
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 time	ms	500	0~65535	○	1|3|5|6|7	4.2.5
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

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
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
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

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
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
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	-	00	0~ff	√	5	4.3.3.1

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	selection signal C						
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	baud rate	06	0~16	○	1|3|5|6|7	7.2

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	13：3M 14：4M 15：5M 16：6M						
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
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	Baud rate	6	0~16	○	1|3|5|6|7	7.2

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode	Reference chapter
	0F：576000 10：768000 11：1M 12：2M 13：3M 14：4M 15：5M 16：6M						
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

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		-
U0-66	Xnet communication CRC parity error		-
U0-67	Xnet communication UART error		-
U0-68	Xnet communication timeout counting		-

Code	Contents		Unit
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		℃

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	

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	

Code	Contents		Unit
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

Appendix 3. 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

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
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

Parameter	Modbus address		Parameter	Modbus address	
	Hex	Decimal		Hex	Decimal
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
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			

■ 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

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
Parameter	Modbus address		Parameter	Modbus address	

	Hex	Decimal		Hex	Decimal
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 4. Q&A

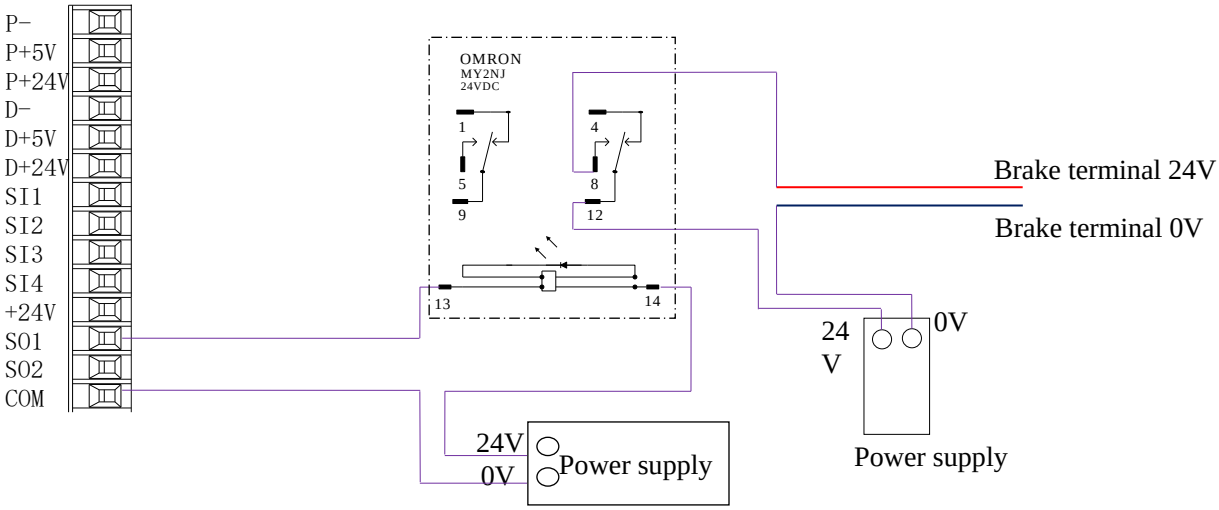
Q1: What is BB and run?
1. BB standby state, without enabling, the motor is in the state of power failure.
2. Run running state, with enabling, the motor is in the power on state.

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?

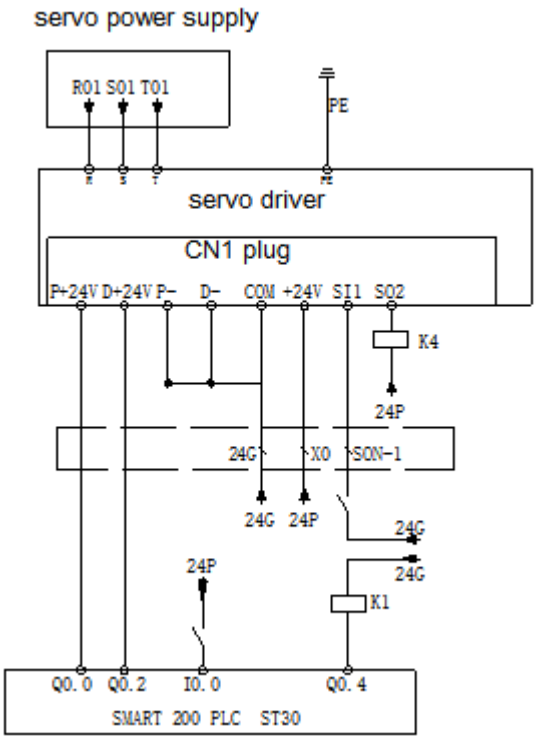


1. P5-44 defines the terminal of the brake output signal. As shown in the figure above, the SO1 controls brake, that is, P5-44 = 0001.
2. Extend the delay time of servo OFF P5-07 (default 500ms), and the waiting time of braking instruction P5-09 is set to 0, which can be responded.

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.

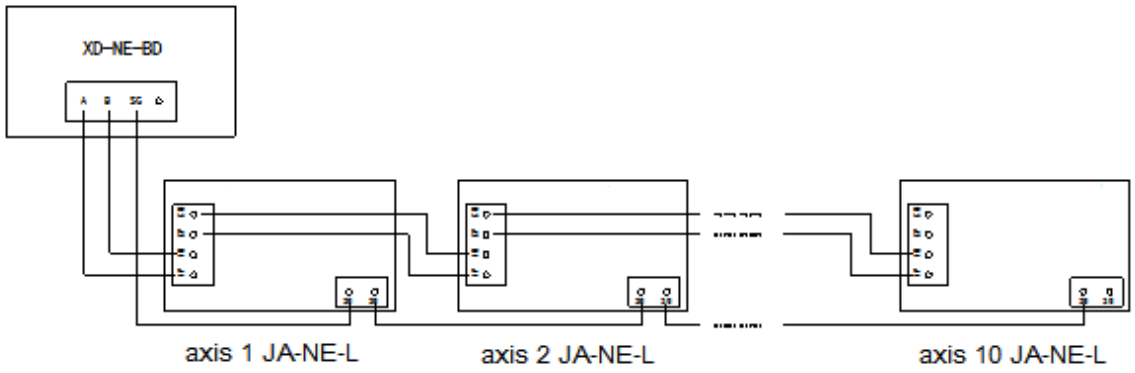
Q7: How do the two modes switch to each other?
Both P0-01 main mode and P0-02 sub-mode set the required mode. P5-30=0002 and SI2 are defined as mode switching terminals. When the SI2 terminal has no signal, it runs according to the set mode in the main mode P0-01. When the SI2 terminal has signal input, it runs according to the set mode in the sub-mode P0-02.
Note: SI2 terminal signal can be switched only if it is a constant ON signal.

Q8: What is the connection mode between PLC and servo?
1. 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.

Q10: How to connect bus control BD board and JA-NE-L?
A-A1, B-B1, SG-SG when one axis running; the PLC BD board and the terminal resistor of the last JA-NE-L board of electrical connection should be ON when multi-axis running; and the terminal resistance of JA-NE-L board in the middle should be OFF.

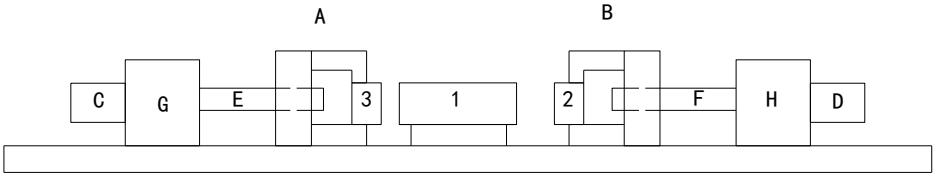


Appendix 5. General debugging steps

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.

Appendix 6. 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

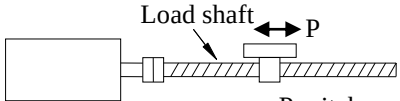
/COIN positioning finished signal: SO1

/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
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
Running mode: P0-01=6
Pulse command state: P0-10=2
Electronic gear ratio: P0-11=0 P0-12=0 P0-13=16384 P0-14=625
Forward torque limit: P3-28=150
Reverse torque limit: P3-29=150
Positioning finished width: P5-00=7
/S-ON: P5-20=0010
/CLR: P5-34=0001
/COIN: P5-38=0001
/CLT: P5-42=0002

Appendix 7. Servo general mode parameters

Appendix 7.1 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 7.2 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 7.3 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 7.4 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 7.5 Internal speed control general parameters

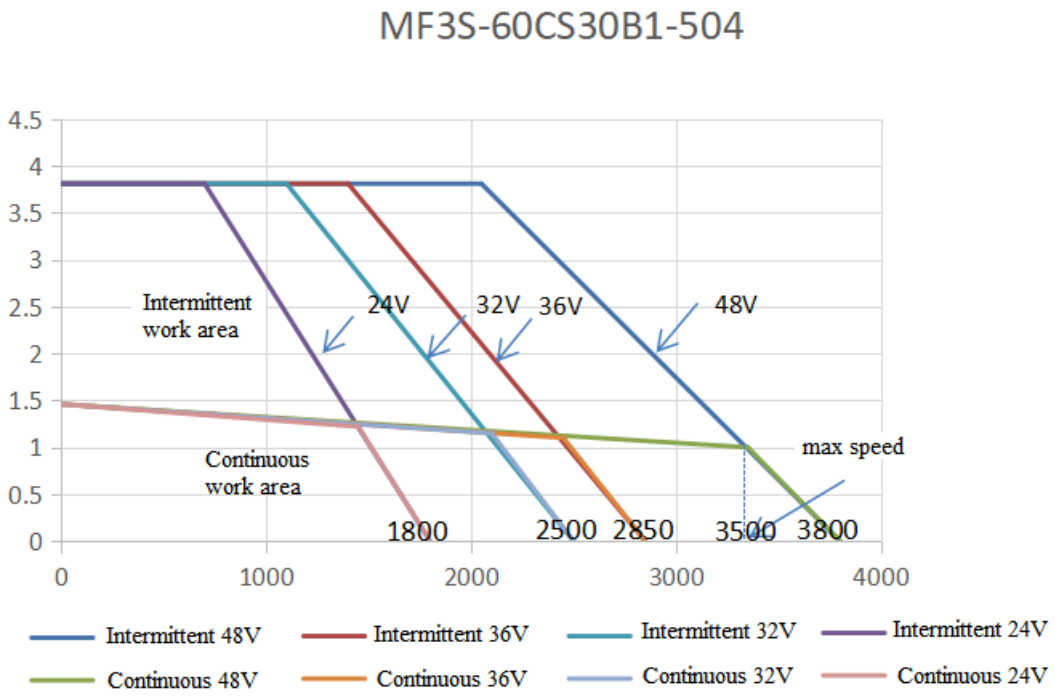
Internal speed control	
Parameter	Overview
P0-01 control mode selection	Set to 3: internal speed control mode
P3-05 internal set speed 1 P3-06 internal set speed 2 P3-07 internal set speed 3	Speed value setting of internal 3-segment speed in rpm
P5-28 internal speed selection /SPD-A P5-29 internal speed 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

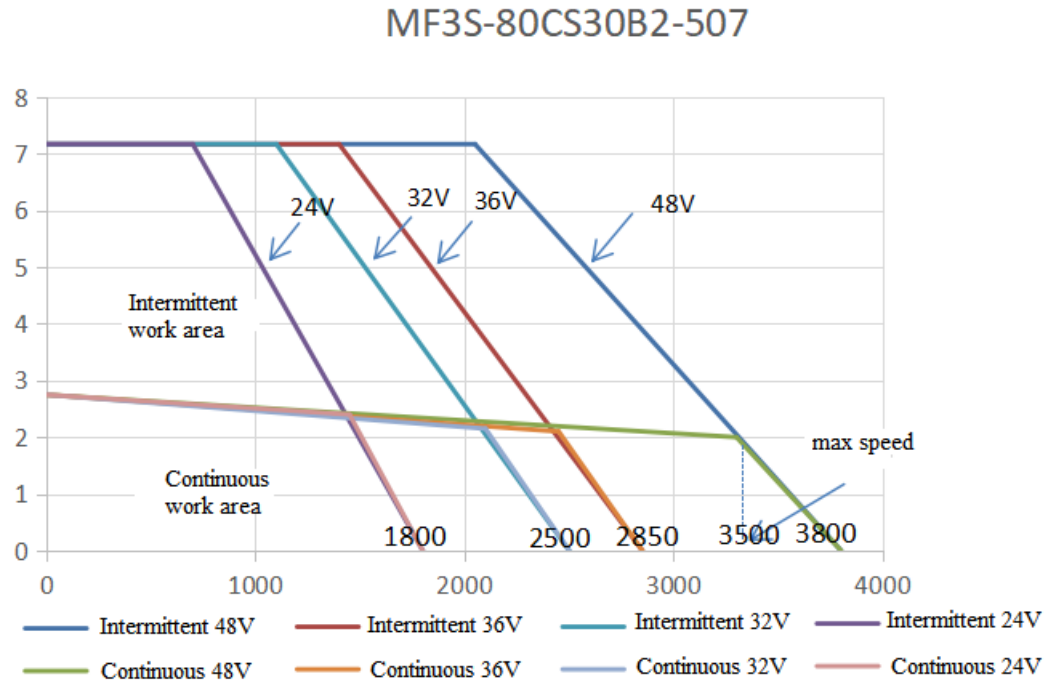
Appendix 7.6 External pulse speed control general parameters

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. Torque-speed characteristic curve





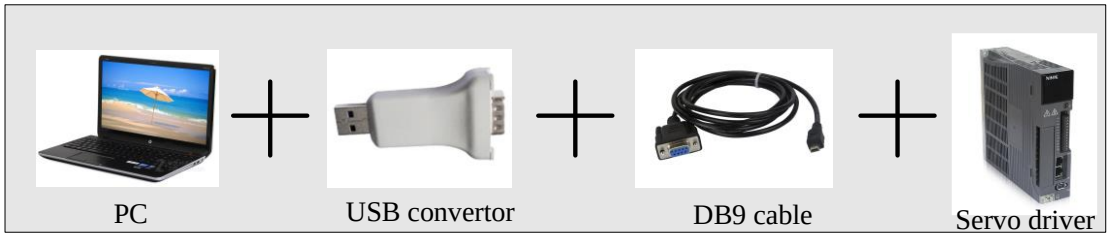
Appendix 9. List of model selection and configuration

Motor model	Matched driver	Encoder cable	Power cable	Brake cable	Cable accessories package
MF3S-60CS/CM30B1-504	DF3E-0410(Z)	CP(T)-SP-M-length	CM(T)-P07-M-Length		JAM-P9-P4
MF3S-60CS/CM30BZ1-504		CP(T)-SP-M-Length	CM(T)-P07-M-Length	CB(T)-P03-Length	JAM-P9-P4-P2
MF3S-80CS/CM30B2-507	DF3E-0720(Z)	CP(T)-SP-M-Length	CM(T)-P07-M-Length		JAM-P9-P4
MF3S-80CS/CM30BZ2-507		CP(T)-SP-M-Length	CM(T)-P07-M-Length	CB(T)-P03-Length	JAM-P9-P4-P2

Appendix 10. Servo software

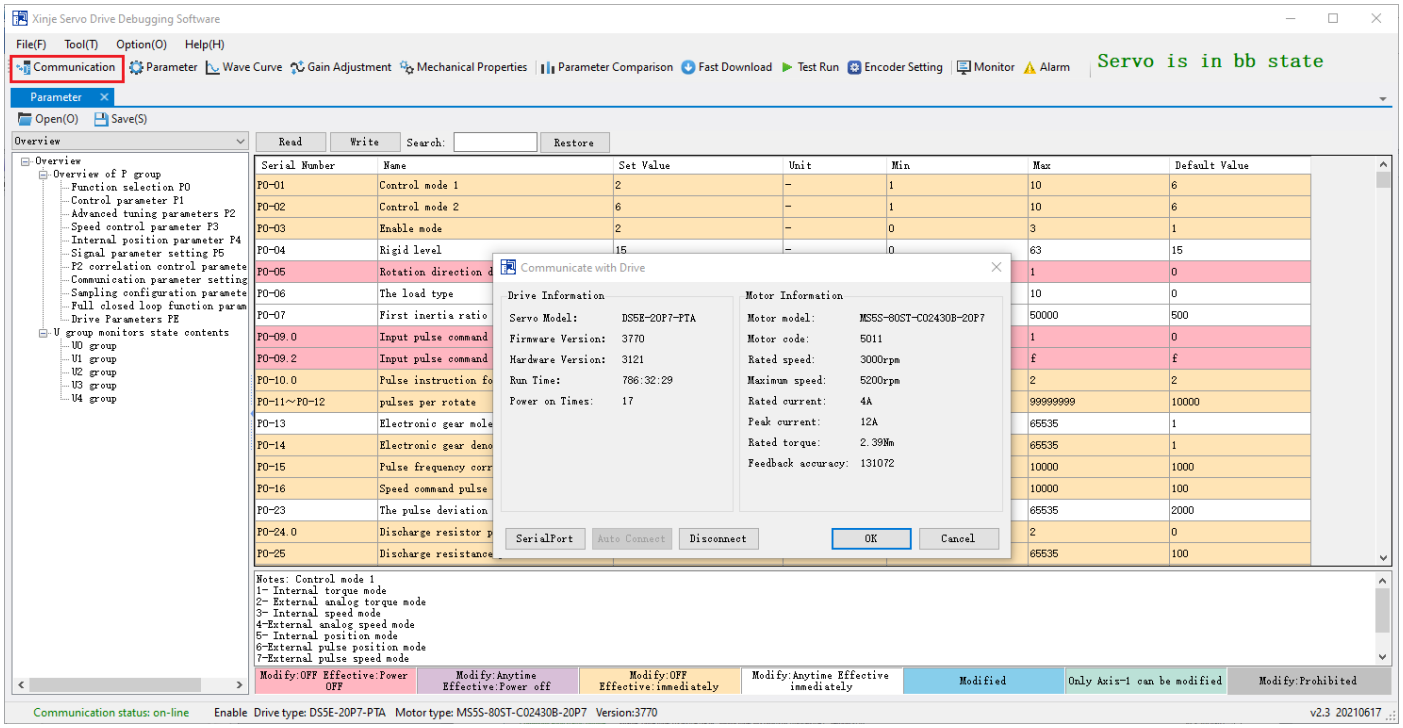
Appendix 10.1 Communication between servo software and servo driver

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 10.2 start [driver communication]

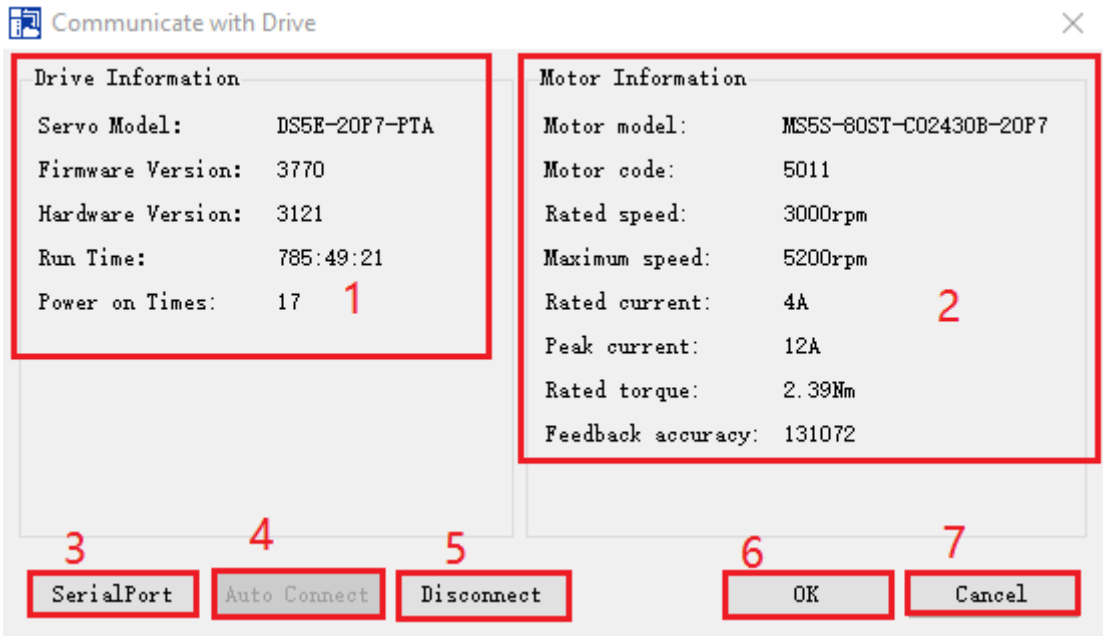
There are two ways to open the communication window.
First, click [communication] on the main interface toolbar to open the communication with driver window.
Second, double click [communication status: offline] in the main interface to open the communication with drive window.
If the [communication status] is online, double-click it to change to offline status.



Appendix 10.3 Close [driver communication]

Click  of【communicate with drive】window to close the window.

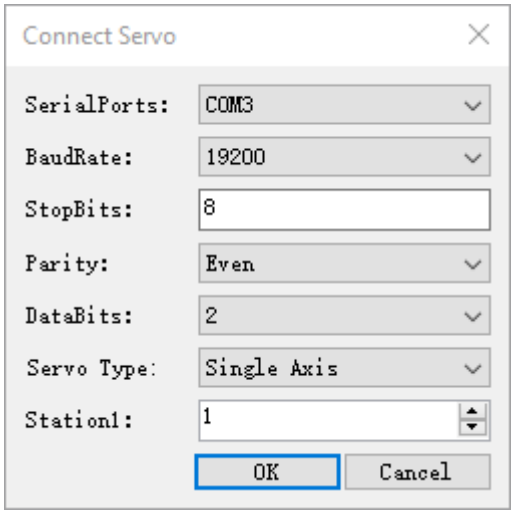
Appendix 10.4 [Driver communication] interface



Area 1: drive information
Area 2: motor information
Note: 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

SerialPort

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.



Note: 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

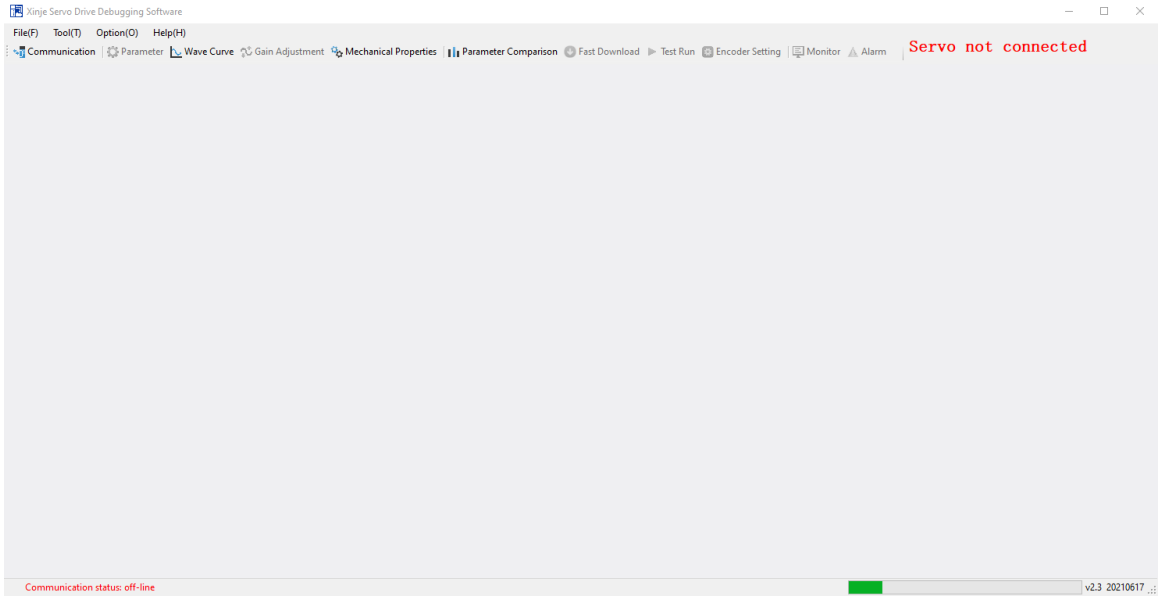
The automatic connection is only valid when the station number is 1. Automatic connection can automatically find the serial port that can communicate with the servo and read the information of the driver and motor.
Area 5: disconnect

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.

XINJE

Wechat ID

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