XINJE

DS5N1 series servo driver
User manual

Wuxi Xinje Electric Co., Ltd.

Data No. SC5 09 20210818EN 1.0

Basic explanation

- Thank you for purchasing Xinje DS5N1 series servo driver products.
- This manual mainly introduces the product information of DS5N1 series servo driver and MS 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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- Fax: 0510-85111290
- Address: Floor 4, building 7, creative industry park, No. 100, DiCui Road, Wuxi City
- Postcode: 214072

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.

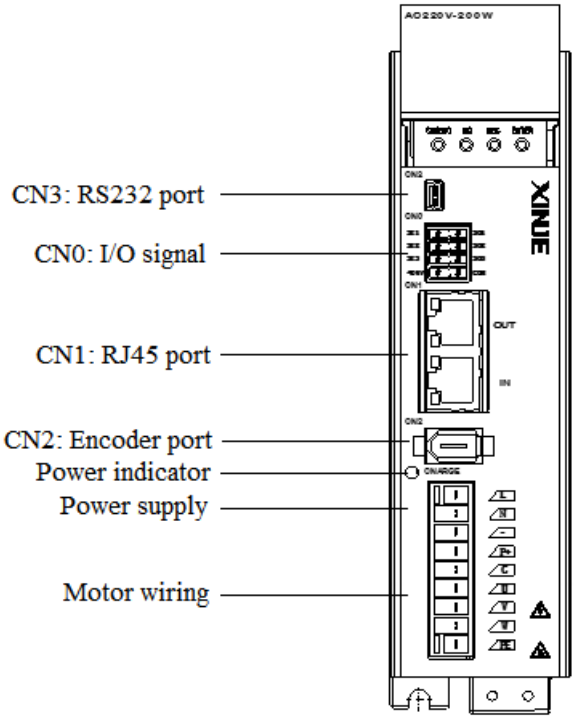
Items	Notes
Does the product on arrival match the specified model?	Please confirm according to the nameplate of servo motor and servo unit.
Does the servomotor shaft rotate smoothly?	The servo motor shaft is normal if it can be turned smoothly by hand. Servo motors with brakes, however, cannot be turned 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 Part description



1.1.2 Naming rule

DS 5□-2 □P□ - PTA

Display	Product name
DS	Servo driver

Display	Product series
5N1	CANopen

Display	Rated input voltage
2	AC220V

Display	Rated output power
0P1	100W
0P2	200W
0P4	400W
0P7	750W

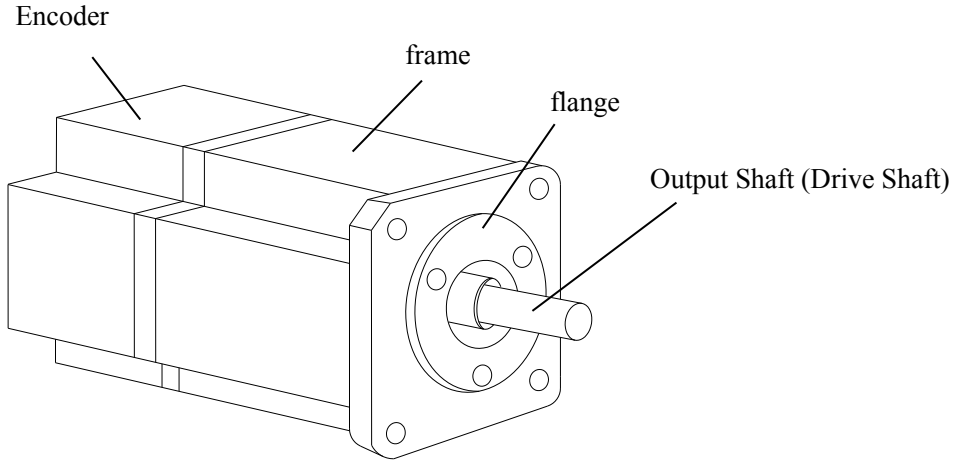
Display	Encoder type
T	Communication type

1.1.3 Performance specification

Servo unit		DS5N1 series servo driver
Applicable encoder		Standard: 17-bit/23-bit communication encoder
Input power supply		DS5N1-2□P□-PTA: single phase AC200-240V, 50/60Hz
Control mode		Three-phase full-wave rectifier IPM PWM control sinusoidal current drive mode
Using condition	Using temperature	0～+50 ℃
	Storage temperature	-20℃～+60℃
	Environment humidity	Below 90% RH (no condensation)
	Vibration resistance	4.9m/s^2
Structure		Pedestal installation

1.2 Selection of servo motor

1.2.1 Part description



1.2.2 Naming rule

■ MS5 series motor

MS5S – 80 ST E – C S 02430 B Z - 2 0P7 – S01

Name	Inertia
MS5S	Low inertia
MS5G	Middle inertia
MS5H	High inertia

Name	Seat number
60	60 seat
80	80 seat

Name	Product name
ST	Sine drive motor

Name	Product name
empty	No oil seal
E	With oil seal

Name	Encoder type
C	Magnetic encoder
T	Photoelectric encoder

Name	Encoder accuracy
S	Single circle 17-bit
M	Multi-circle 17-bit
U	Single circle 23-bit
L	Multi-circle 23-bit

Name	Rated torque (N·m)	Rated speed (rpm)
00630	0.637	3000
01330	1.3	3000
02430	2.39	3000

Name	Design number
S01	standard
S02	Small Aviation Plug Type

Name	Rated power (KW)
0P2	0.2
0P4	0.4
0P7	0.75

Name	Voltage level
2	220V
4	380V

Name	Power-off brake
Empty	without
Z	with

Name	Shaft
A	No key
B	With key

Note: At present, only the combination of CS, CM, TL and T is selected for the type of encoder.

■ MS6 series motor

MS6S–60 C S 30 B Z 1 - 2 0P4

Display	Inertia
MS6S	Low inertia
MS6G	Medium inertia
MS6H	High inertia

Display	Base no.
40	40 flange
60	60 flange
80	80 flange

Symbol	Product name
C	Magnetic Encoder
T	Photoelectric encoder

Symbol	Encoder
S	Single turn 17-bit
M	Multi-turn 17-bit
U	Single turn 23-bit
L	Multi-turn 23-bit

Display	Rated speed (rpm)
15	1500
20	2000
25	2500
30	3000

Symbol	Shaft
A	Key, no oil seal, with threaded hole
B	With key, oil seal and threaded hole
C	No key, no oil seal, with threaded hole
D	No key, with oil seal and threaded hole

Display	Power-loss brake
Z	With brake
Empty	No brake

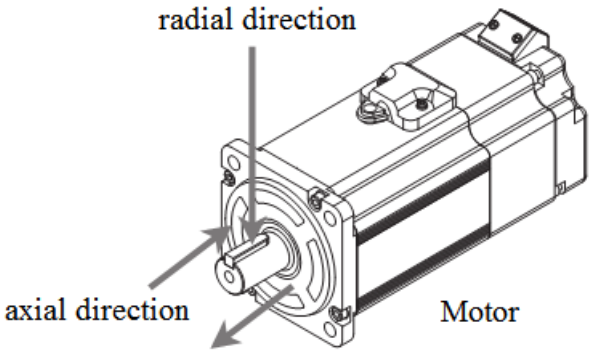
Display	Connector
1	Standard 1
2	Standard 2
D	Customized machine

Display	Power supply
2	220V
4	380V

Display	Rated output
0P1	100W
0P2	200W
0P4	400W
0P7	750W

Note: At present, only the combination of CS, CM, TL and T is selected for the type of encoder.

1.2.3 Axial force and radial force



Base no.	40ST	60ST	80ST	100ST	110ST	130ST	180ST	220ST/265ST
Axial force	54N	74N	147N	≤200N	250N	300N	400N	≤500N
Radial force	78N	245N	392N	500N	500N	600N	800N	1000N

1.3 Cable selection

1.3.1 Naming rule

■ Encoder cable

CP-SP-□□-02

Display	Cable type
CP	Normal
CPT	High flexibility

Display	Plug type
SP	9-core amp plug
SW	7-core aviation plug
SL	15-core aviation plug
SC	10-core small aviation plug
ZDL	Full-sized aviation plug

Display	Plug type
M	No battery box
B	With battery box
BM	With battery box

Display	Length (M)
03	3
05	5
08	8
12	12
16	16
20	20

■ Power cable

CM - P 07 A- M - 03

Display	Cable type
CM	Normal
CMT	High flexibility
CMBT	High flexibility type aviation plug-in power cable with brake

Display	Plug type
P	Small power 4-core amp plug
W	Small power 6-core water proof small aviation plug
L	4-core small aviation plug
XL	4-core medium aviation plug
V	4-core waterproof plastic aviation plug
D	O type terminal

Display	Diameter (mm²)
07	0.75
15	1.5
25	2.5
60	6
100	10

Display	Cold pressed terminal type
A	Pin type

Display	Cable type
M	White amp
Vacant	Black amp

Display	Length (M)
03	3
05	5
08	8

■ Brake cable explanation

- Applicable to flange motors of 80 and below with motor suffix S01, brake cable model shall be selected: CB-P03-length (ordinary material) / CBT-P03-length (high flexible material).
- Applicable to 750W and below motors with motor suffix S02: CMBT-W07-M-length.
- For the MS5G series 130 flange medium inertia brake motor, the cable shall be selected the power cable and brake cable in one.
- The standard wiring length of Xinje is 2m, 3m, 5m, 8m, 10m, 12m, 16m and 20m.
- Non high flexible cables are 25m and 30m.

■ CANopen communication cable

JC — C B — 1

Display	Name
JC	Product supporting cables

Display	Name
C	CAT

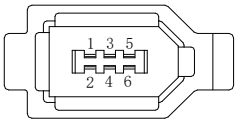
Display	Length (m)
0P1	0.1
0P3	0.3
1	1
3	3

Display	Type
A	Yellow CAT5e cable
B	Green CAT5e cable

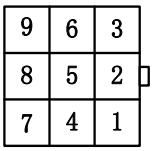
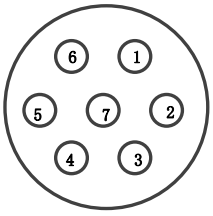
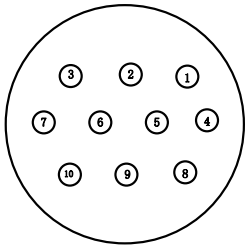
1.3.2 Cable terminal definition

■ Encoder cable

(1) Pin definition of encoder on servo driver side

Connector appearance	Pin definition		
	No.	Definition	Note
	1	5V	Encoder 5V
	2	GND	Encoder GND
	3	/	
	4	/	
	5	485-A	RS485 B
	6	485-B	RS485 A

(2) Cable connection of encoder on motor side

Connector pins	Pin definition		Suitable model
	No.	Definition	
	1	Battery +	MS5-40, 60, 80 flange -S01 motor MS6-40, 60, 80 flange B1 motor
	2	Battery -	
	3	Shielded cable	
	4	485-A	
	5	485-B	
	6	/	
	7	5V	
	8	GND	
	9	/	
	1	Shielded cable	MS5-40, 60, 80 flange -S02 motor MS6-40, 60, 80 flange B2 motor
	2	Battery +	
	3	Battery -	
	4	485-A	
	5	485-B	
	6	5V	
	7	GND	
	1	/	Flange 130 850W medium inertia motor
	2	5V	
	3	GND	
	4	485-A	
	5	485-B	
	6	Battery +	
	7	Battery -	
	8	/	
	9	/	
	10	Shielded cable	

Battery box description:

(1) The encoder including the cable definition of battery +, battery- is for the absolute motor, and the non-

absolute motor cable has no such pin.

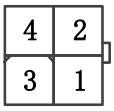
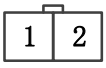
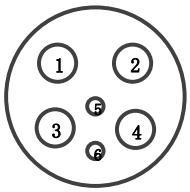
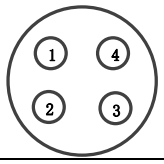
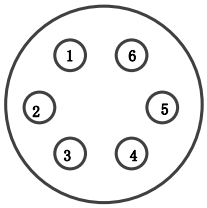
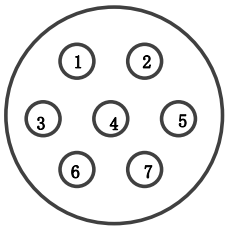
(2) Only the cable of absolute value motor has external battery box, which contains a 3.6V/2.7Ah large capacity battery, and has the function of replacing batteries when power cut. The using life is more than two years.

■ 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	Applicable to 40, 60, 80 flange S01 / B1 motors
	2	W	
	3	V	
	4	PE	
	No.	Definition	Applicable to 40, 60 and 80 flange S01 / B1 brake motors
	1	BK	
	2	BK	
	No.	Definition	Applicable to 40, 60 and 80 flange S02 motors
	1	PE	
	2	U	
	3	V	
	4	W	
	5	BK	
	6	BK	
	No.	Definition	Applicable to 40, 60 and 80 flange B2 motors
	1	U	
	2	W	
	3	V	
	4	PE	
	No.	Definition	Applicable to 40, 60 and 80 flange B2 brake motors
	1	U	
	2	W	
	3	V	
	4	PE	
	5	BK+	
	6	BK-	
	No.	Definition	Applicable to flange 130 850W medium inertia brake motors
	1	PE	
	2	U	
	3	V	
	4	W	
	5	BK+	
	6	BK-	
	7	/	

Brake pins:
The cable including pin BK+, BK- is used for the brake motor. The cable of the non-brake motor has no BK pins.

1.4 Selection of regenerative resistor

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
DS5N1-20P□-PTA	(1) Use external regenerative resistor below 750W: connect the regenerative resistor to terminals P + and C. (2) 750W use external regenerative resistor: connect the regenerative resistor to terminals P + and C, and remove the short wiring of P + and D.

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

Servo driver model	Built-in brake unit	Rmin (Not less than this value)	External regenerative resistance (Recommended resistance value)	External regenerative resistance (Recommended power values)
DS5N1-20P1-PTA	Built-in	≥50Ω	50Ω—100Ω	>200W
DS5N1-20P2-PTA				
DS5N1-20P4-PTA		≥40Ω	40Ω—100Ω	>500W
DS5N1-20P7-PTA		≥40Ω	40Ω—100Ω	>500W

Note:

(1) When selecting external resistance, "resistance" try to choose close to the "minimum resistance" in "recommended resistance". The smaller the resistance, the faster the discharge. The selection of "power" shall be based on the actual use on site, and the specific shall depend on the heating value. Generally, the external regeneration resistor with higher power shall be selected as far as possible.

(2) The surface temperature will be very high when the regenerative resistance is discharged frequently. Please use high-temperature and flame-retardant wires when wiring, and pay attention that the surface of the regenerative resistance does not contact with the wires.

2 Installation of servo system

2.1 Servo driver installation

2.1.1 Installation site

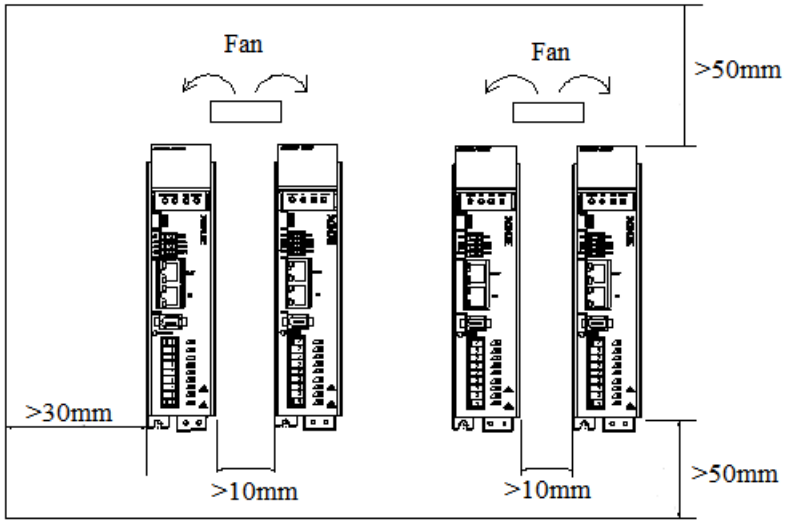
- Please install it in the installation cabinet without sunshine or rain.
- Do not use this product near corrosive and flammable gas environments such as hydrogen sulfide, chlorine, ammonia, sulfur, chlorinated gas, acid, alkali, salt, etc.
- Do not install in high temperature, humidity, dust, metal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

2.1.2 Environment condition

Item	Description
Use ambient temperature	-10~40℃ (no freezing)
Use ambient humidity	-20~90%RH (no condensation)
Storage temperature	-20~60℃
Storage humidity	-20~90%RH (no condensation)
Vibration resistance	≤4.9m/s^2
Altitude	≤1000m, when higher than 1000m, please reduce the amount for use (1% for every 100m)

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 ℃

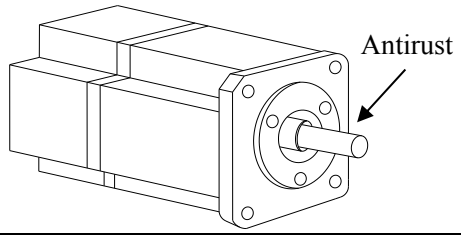
- Humidity: 90%RH or less
- Vibration: 4.9m/s^2
- Condensation and Freezing: None
- Ambient Temperature for Long-term Reliability: 50°C maximum

2.2 Servo motor installation

MS 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.

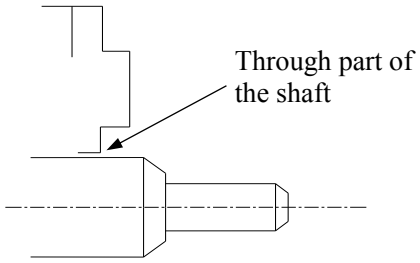


2.2.1 Installation environment

- 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.

2.2.2 Environment condition

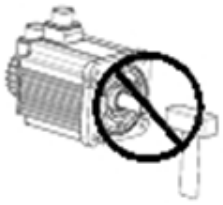
When used in places with water droplets or oil droplets, the protection effect can be achieved through the treatment of motors. However, in order to seal the through part of the shaft, please specify the motor with oil seal. Connectors should be installed downward.



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

Item	Description
Use ambient temperature	-10℃~40℃ (no freeze)
Use ambient humidity	20%~90%RH (no condensation)
Storage temperature	-20℃~60℃
Storage humidity	-20%~90%RH (no condensation)
Protection level	IP65(MS5)/IP66(MS6)

2.2.3 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. 
	◆ 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.

2.3 Servo cable installation

DS5 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 adapter cable connector for motors with 80 flange or more is aviation 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.

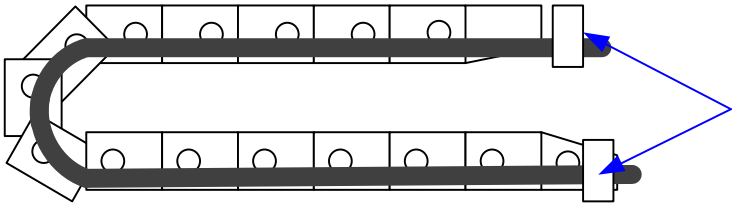
1. In normal situations, the following points should be noted:

- 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)

- The motor is properly grounded.
- High current equipment shall be grounded separately.
- Reasonable wiring. Such as separation of strong and weak current cables.
- Use metal shielding layer to shield, add magnetic ring to the encoder cable to resist interference.

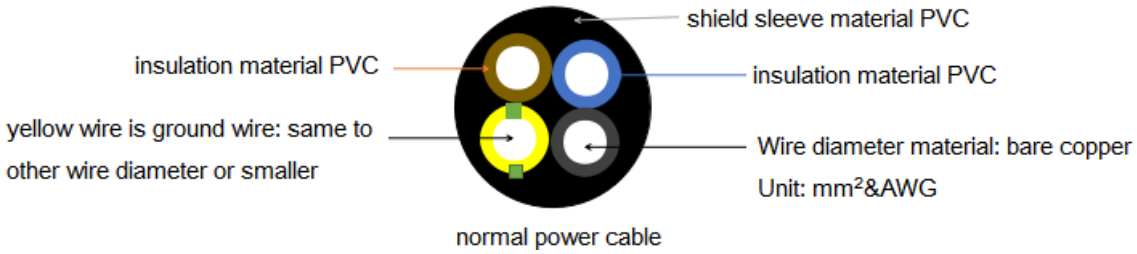
(4) Low / high temperature

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

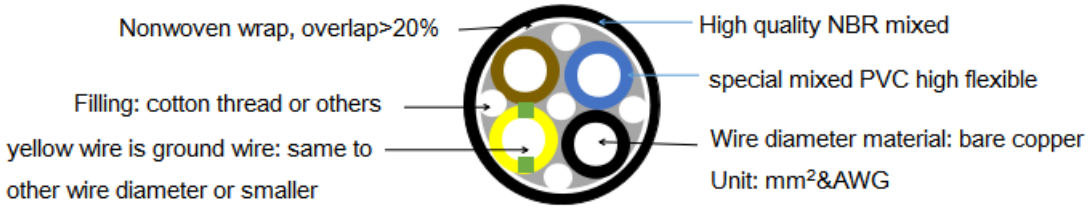
2.3.2 Xinje cable specification

1. Material composition of Xinje cable

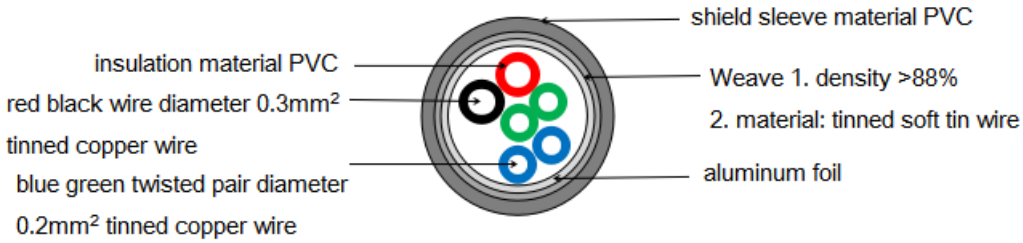
Cross section of cable (encoder, power cable), corresponding introduction of wire skin material, wire diameter, wire core material shielding material, etc.



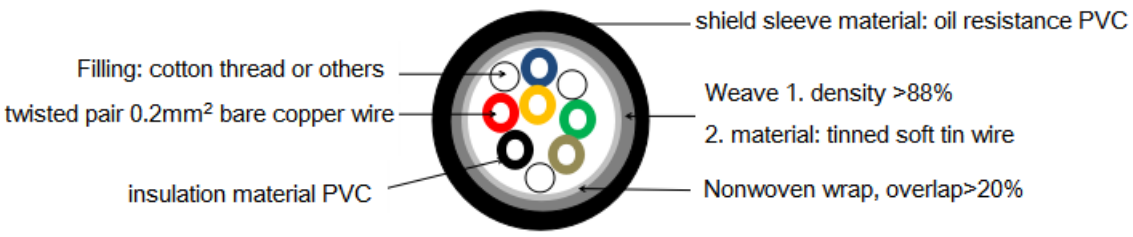
normal power cable



high flexible power cable



normal encoder cable



high flexible encoder cable

2. Cable diameter specification

Type / Power	Encoder cable	Power cable
100W	6*0.2mm²	4*0.75mm²
200W	6*0.2mm²	4*0.75mm²
400W	6*0.2mm²	4*0.75mm²
750W	6*0.2mm²	4*0.75mm² 4*1.5mm²（MS5G-130STE）
1.5kW	6*0.2mm²	4*1.5mm²
3.0kW	6*0.2mm²	4*2.5mm²
5.5kW	6*0.2mm²	3*6.0mm²+1*2.5mm²
7.5kW	6*0.2mm²	3*6.0mm²+1*2.5mm²
11kW	6*0.2mm²	3*6.0mm²+1*2.5mm²
15kW	6*0.2mm²	3*6.0mm²+1*2.5mm²
22kW	6*0.2mm²	3*8mm²+1*4mm²
32kW	6*0.2mm²	3*12mm²+1*4mm²

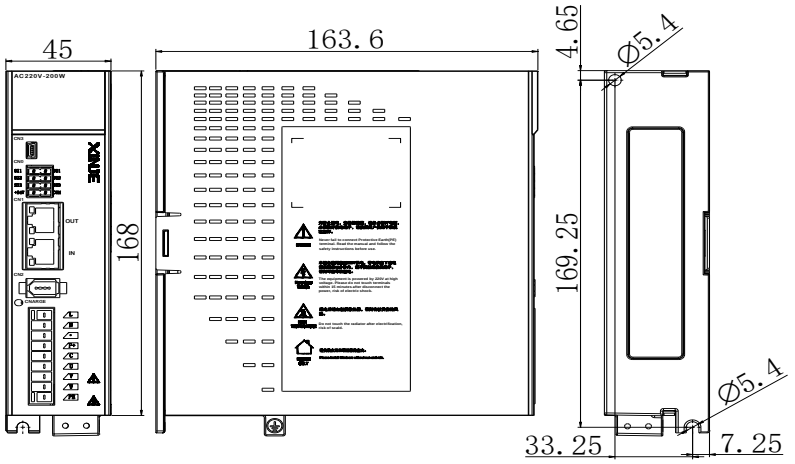
3. Cable performance specification

Performance		Normal cable	High flexible cable
Ordinary temperature resistance		-20℃~80℃	-20℃~80℃
Encoder cable withstand voltage		1000V/min	1000V/min
Power cable withstand voltage		3000V/min	3000V/min
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

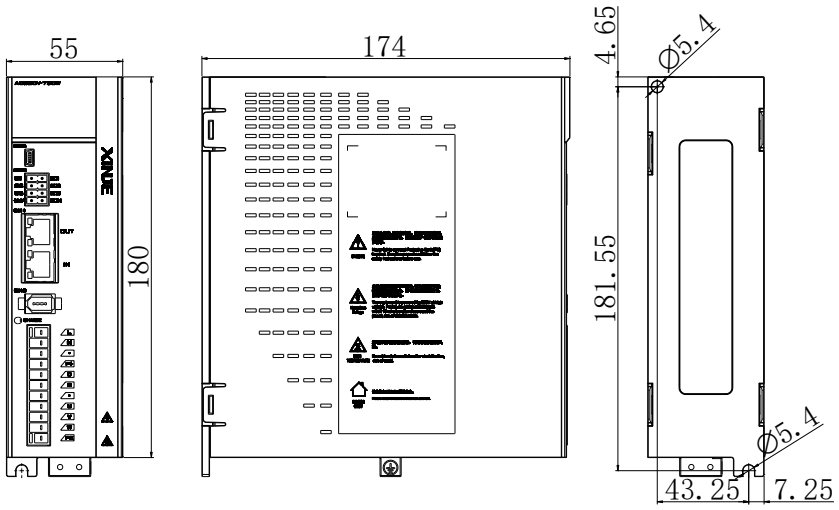
Note: D represents the finished product cable diameter.

2.4 Servo driver dimension

■ DS5N1-20P1/20P2/20P4-PTA Unit: mm

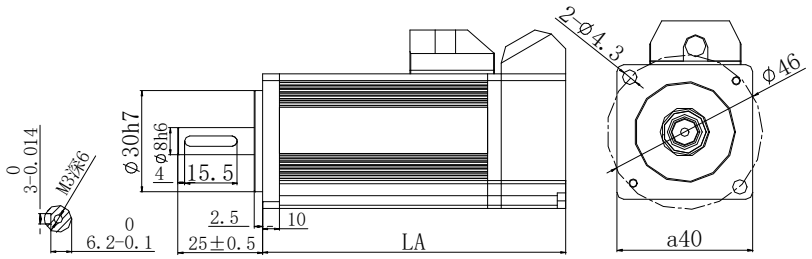


■ DS5N1-20P7-PTA Unit: mm



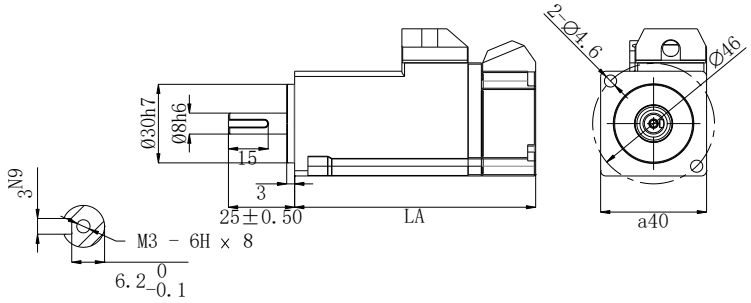
2.5 Servo motor dimension

- 40 series motor installation dimensions Unit: mm
- MS5 motor



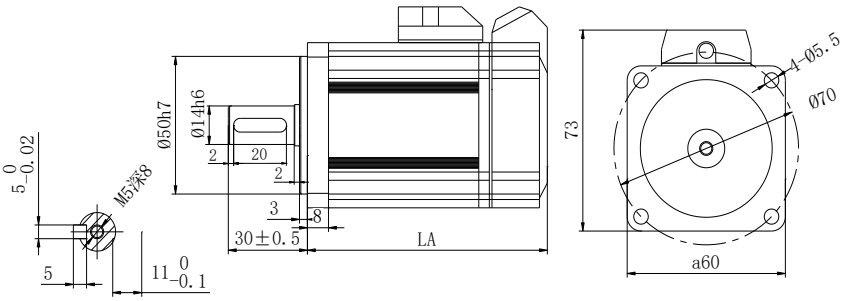
Motor model	LA±1		Inertia level
	Normal	With brake	
MS5S-40STE-C□0030□□-20P1-S01/S02	89.5	Low inertia	Low inertia

- MS6 motor



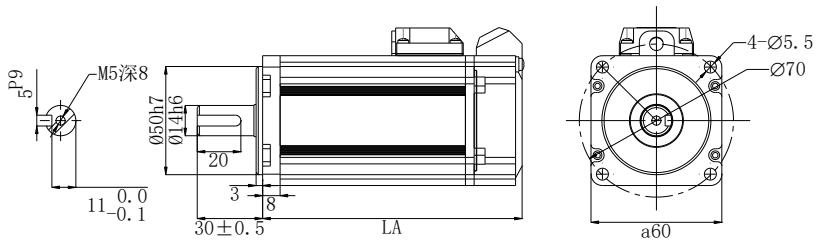
Motor model	LA±1		Inertia level
	Normal	With brake	
MS6H-40C□30B□1-20P1	91	122.9	High inertia

- 60 series motor installation dimensions Unit: mm
- MS5 motor



Motor model	LA±1		Inertia level
	Normal	With brake	
MS5S-60STE-C□00630□□-20P2-S01/S02	79	114	Low inertia
MS5S-60STE-C□01330□□-20P4-S01/S02	99	134	
MS5H-60STE-C□00630□□-20P2-S01/S02	91	126	High inertia
MS5H-60STE-C□01330□□-20P4-S01/S02	111	146	

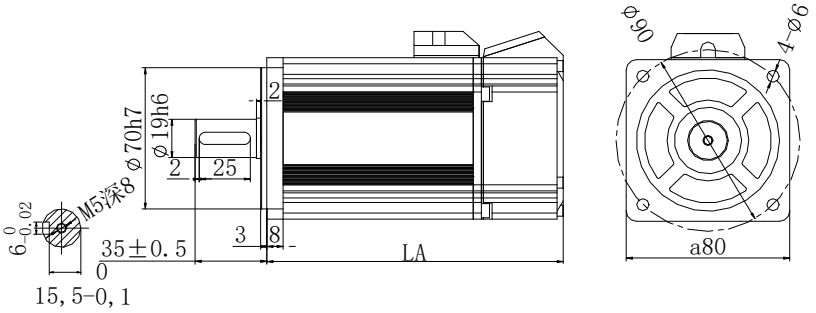
◆ MS6 motor



Motor model	LA±1		Inertia level
	Normal	With brake	
MS6H-60C□301B□□-20P2	90	121	High inertia
MS6S-60C□301B□□-20P4	107	139	Low inertia
MS6H-60C□301B□□-20P4	119	151	High inertia

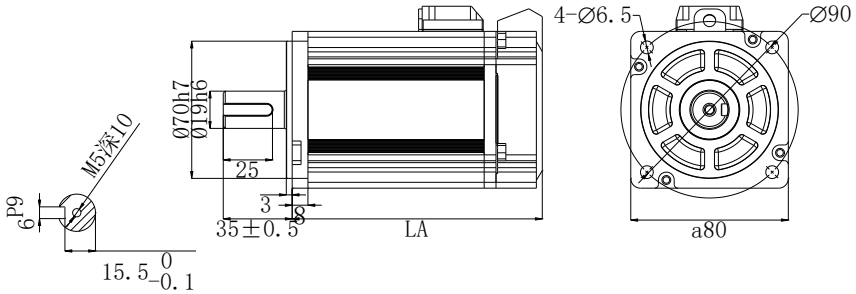
■ 80 series motor installation dimensions Unit: mm

◆ MS5 motor



Motor model	LA±1		Inertia level
	Normal	With brake	
MS5S-80STE-C□02430□□-20P7-S01/S02	107	144	Low inertia
MS5S-80STE-C□03230□□-21P0-S01/S02	128	165	
MS5H-80STE-C□02430□□-20P7-S01/S02	119	156	High inertia
MS5H-80STE-C□03230□□-21P0-S01/S02	140	177	

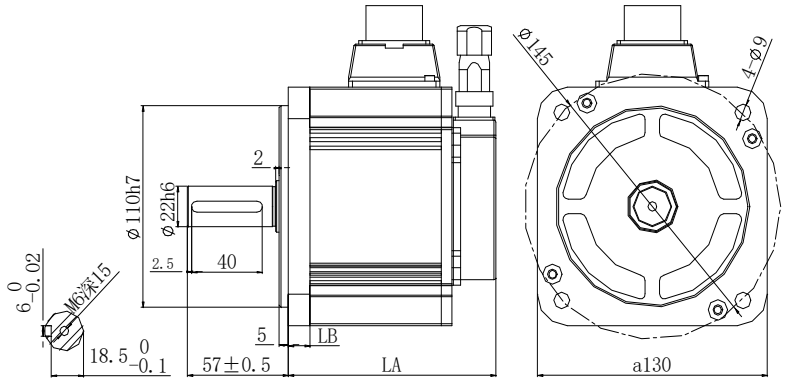
◆ MS6 motor



Motor model	LA±1		Inertia level
	Normal	With brake	
MS6S-80C□30B□□-20P7	117	150	Low inertia
MS6S-80C□20B□□-20P7	127	160	
MS6H-80C□30B□□-20P7	124	157	High inertia
MS6H-80C□20B□□-20P7	149	182	

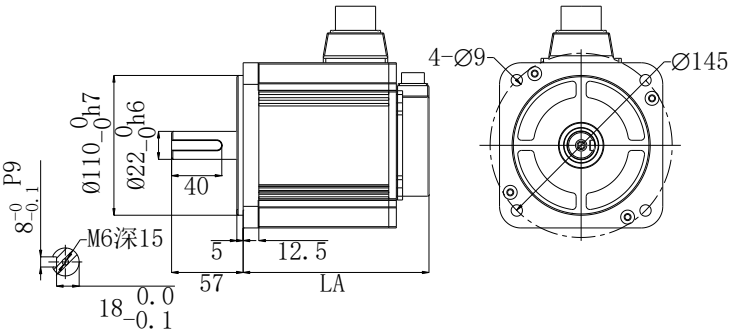
■ 130 series motor installation dimensions Unit: mm

◆ MS5 motor



Motor model	LA±1		LB	Inertia level
	Normal	With brake		
MS5G-130STE-C□05415□□-20P8-S01	117.5	147	12.5	Medium inertia
MS5G-130STE-TL05415□□-20P8-S01	134.5	164.5		

◆ MS6 motor

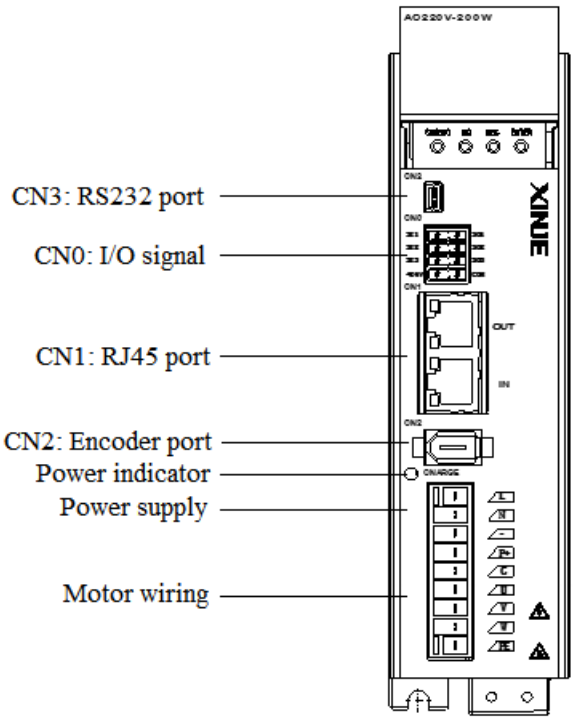


Motor model	LA±1		Inertia level
	Normal	With brake	
MS6H-130C□15B□2-20P8	126	156	High inertia
MS6H-130TL15B□2-20P8	142	172	

3 Servo system wiring

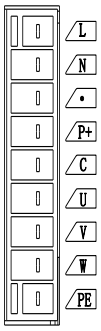
3.1 Main circuit wiring

3.1.1 Servo driver terminal arrangement



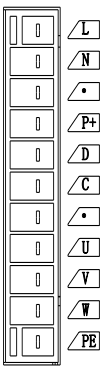
3.1.2 Main circuit terminal

■ DS5N1-20P1/20P2/20P4-PTA



Terminal	Function	Note
L/N	Power supply input of main circuit	Single phase AC 200~240V, 50/60Hz
●	Vacant terminal	-
P+, C	External regenerative resistor	Connect regenerative resistor between P+ and C, P0-25= power value, P0-26= resistor value
U, V, W, PE	Motor terminals	Connect the motor

■ DS5N1-20P7-PTA



Terminal	Function	Note
L/N	Power supply input of main circuit	Single phase AC 200~240V, 50/60Hz
●	Vacant terminal	-
P+, D, C	Internal regenerative resistor	Short P+ and D, disconnect P+ and C
	External regenerative resistor	Connect regenerative resistor between P+ and C, disconnect P+ and D, P0-25= power value, P0-26= resistor value
U, V, W, PE	Motor terminals	Connect the motor

■ Servo motor wiring terminals

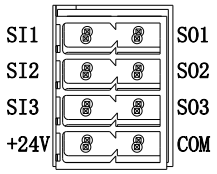
Signal	40, 60, 80 series motor	130 series motor
PE	4-yellow green	1-yellow green
U	1-brown	2-brown
V	3-black	3-black
W	2-blue	4-blue

3.2 CN0, CN1, CN2 terminals

3.2.1 CN0 terminals

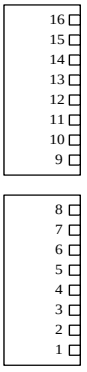
The numbers of the following connectors are in the order when looking at the solder patch.

■ DS5N1-20P1/20P2/20P4/20P7-PTA



Name	Note
SI1	Input terminal 1
SI2	Input terminal 2
SI3	Input terminal 3
+24V	Input terminal +24V
SO1	Output terminal 1
SO2	Output terminal 2
SO3	Output terminal 3
COM	Output terminal ground

3.2.2 CN1terminals

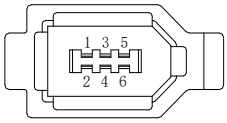


No.	Name	No.	Name
1	CAN_H	9	CAN_H
2	CAN_L	10	CAN_L
3	CAN_GND	11	CAN_GND
4	-	12	-
5	-	13	-
6	-	14	-
7	-	15	-
8	-	16	-

Note: the servo motion bus function requires optional bus module, which is inserted into the driver CN1 port to realize the extended bus function. Note that the module cannot be hot swapped in use. It is recommended to use PROFIBUS standard connecting wire in order to achieve the best communication reliability.

3.2.3 CN2 terminals

The terminals of the CN2 connector are arranged as follows (faced solder plates):



No.	Definition
1	5V
2	GND
5	A
6	B

3.3 CANopen connection

It is recommended to use linear connection method for CANopen bus wiring. The communication between DS5N1 series servo driver and Xinje PLC needs to be connected through left expansion module XD-COBOX-ED. The two communication network ports of the servo driver follow the principle of "bottom in and top out", that is, the XD-COBOX-ED communication port must be connected with the network port below the LIN1 port of the first servo, and then the top network port of the first servo is connected with the bottom network port of the second servo, and so on (the maximum number of supported axes is 16 axes).

The communication transmission process will inevitably be affected by the surrounding electromagnetic environment. It is recommended that users use CAT5e network cable, which can also be purchased from our company.

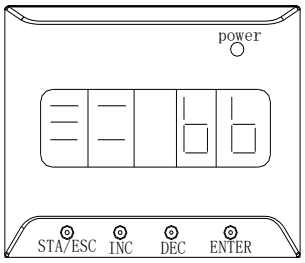
Physical connection diagram of bus communication connection

CANopen communication follows the rules of bottom in and top out.

For the definition of network cable interface pin, see the terminal description of CN1 in chapter 3.2.

4 Operate panel

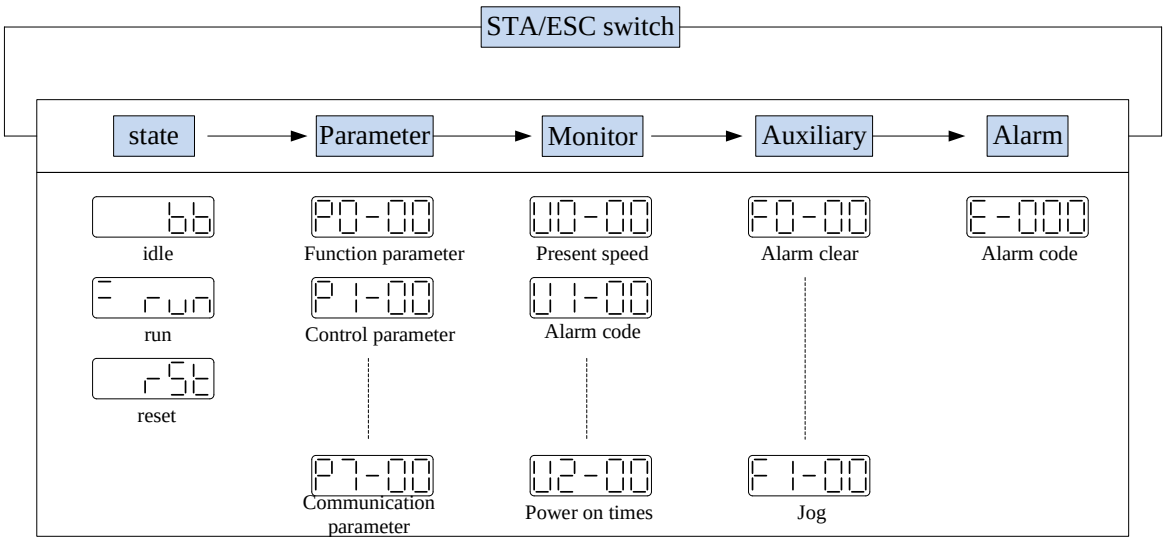
4.1 Panel display



Button	Operation
STA/ESC	Short press: state switch, state return
INC	Short Press: The display data increases Long press: The display data increases continuously
DEC	Short Press: The display data decreases Long press: The display data decreases continuously
ENTER	Short press: shift Long press: Set and view parameters.

By switching the basic state of the panel operator, the operation state display, parameter setting, auxiliary function operation, alarm state and other operations can be carried out. After pressing the STA / ESC key, the States will be switched in the order shown in the figure below.

Status: BB indicates that the servo system is idle. Run indicates that the servo system is running and RST indicates that the servo needs to be powered on again.



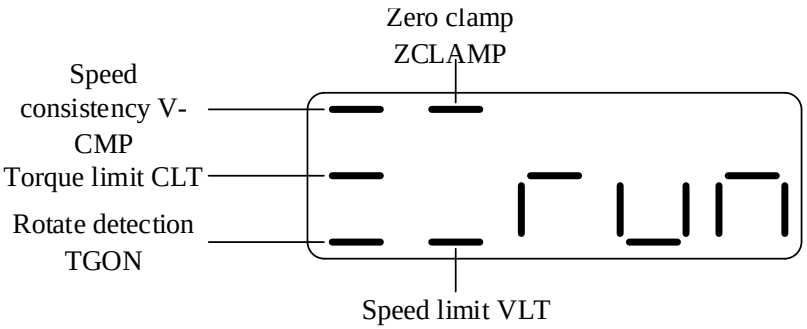
- Parametric setting Px-xx: The first X represents the group number, and the last two X represents the parameter serial number under the group.
- Monitor status Ux-xx: The first X represents the group number, and the last two X represents the parameter number under the group.
- Auxiliary function Fx-xx: The first X denotes the group number, and the last two X denotes the parameter number under the group.
- Alarm state E-xxx: The first two X denote the alarm category, and the last x denotes the small category under the category.

4.2 Operation state display

When powered on, the panel displays, which is set according to P8-25 parameters

Parameter	Signal name	Default	Suitable mode	Meaning	Modify	Effective
P8-25	Operate panel display setting	0	All	0: normal display, power on display 'bb' or 'run' 1: Power on the panel to display the value of U0-00, speed feedback, unit: rpm 2: Power on the panel to display the value of U0-07, torque feedback, unit%	At once	Repower on

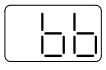
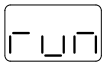
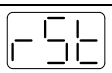
■ Speed, torque control mode

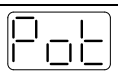
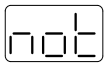


1. Digit display content

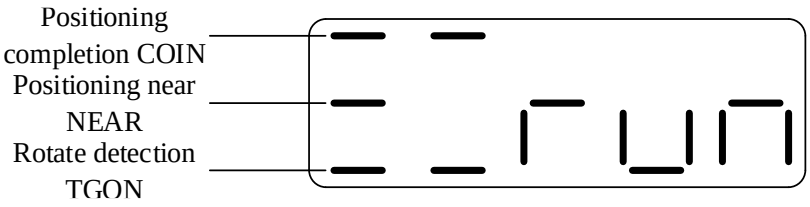
Bit data	Display contents
P5-39 Same speed detection （/V-CMP）	When the actual speed of the motor is the same as the command speed, turn on the light. Detection Width of Same Speed Signal: P5-04 (Unit: rpm)
P5-42 Torque limit（/CLT）	When the speed is controlled, when the torque exceeds the set value, turn on the light. Internal Forward Torque Limitation: P3-28 Internal Reverse Torque Limitation of: P3-29
P5-40 Rotate detection （/TGON）	P5-03 (Unit: rpm) When the motor speed is higher than the rotating speed, turn on the lamp. Rotation detection speed: P5-03 (unit: rpm)
P5-31 Zero clamp （/ZCLAMP）	When the zero clamp signal starts to operate, turn on the light.
P5-43 Speed limit（/VLT）	When the speed exceeds the set value in torque control mode, turn on the light. Forward speed limit in torque control: P3-16; reverse speed limit: P3-17.

2. Short code display content

Short code	Display contents
	Standby status Servo OFF status. (The motor is in a non-electrified state)
	In operation Servo enabling state. (The motor is on-line)
	Need reset status Servo needs to be re-energized

	Forbidden forward drive state P-OT ON status.
	Forbidden reversal drive state N-OT ON status.
	Control mode 2 is vacant.

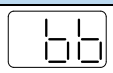
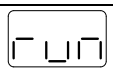
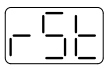
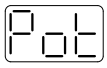
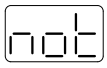
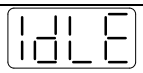
■ Position control mode



1. Digit display contents

Digit data	Display contents
P5-38 Positioning completion （/COIN）	In position control, when the given position is the same as the actual position, turn on the light. Location Completion Width: P5-00 (Unit: Instruction Pulse)
P5-36 Near （/NEAR）	In position control, when the given position is the same as the actual position, turn on the light. Near signal width: P5-06
P5-40 Rotate detection （/TGON）	When the motor speed is higher than the rotating speed, turn on the lamp. Rotation detection speed: P5-03 (unit: rpm)

2. Short code display contents

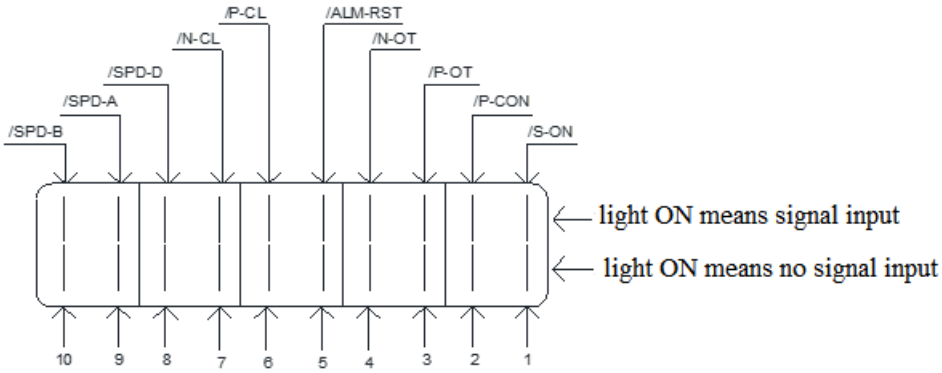
Short code	Display contents
	Standby status Servo OFF status. (The motor is in a non-electrified state)
	In operation Servo enabling state. (The motor is on-line)
	Need reset status Servo needs to be re-energized
	Forbidden forward drive state P-OT ON status.
	Forbidden reversal drive state N-OT ON status.
	Control mode 2 is vacant.

4.3 PX-XX control parameters

See Appendix 1.1 for details.

4.4 UX-XX monitor parameters

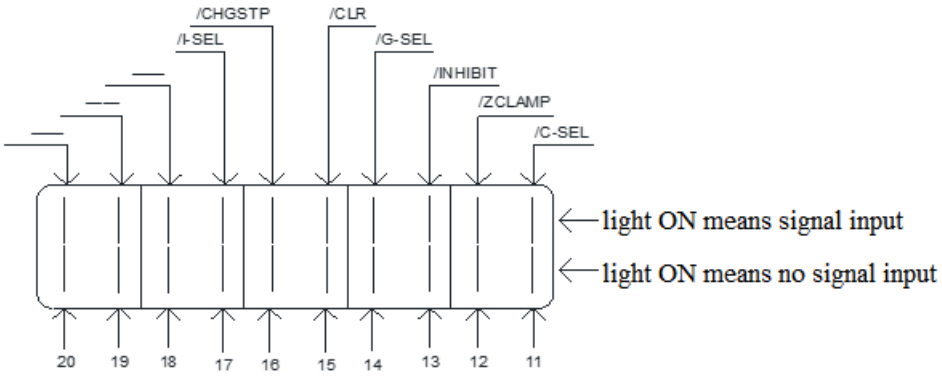
■ U0-21 input signal status



■ U0-21 input signal 1 distribution

Segment code	Description	Segment code	Description
1	/S-ON servo enable	2	/P-CON proportion action instruction
3	/P-OT prohibition of forward drive	4	/N-OT prohibition of reverse drive
5	/ALM-RST alarm reset	6	/P-CL forward side external torque limit
7	/N-CL reverse side external torque limit	8	/SPD-D internal speed selection
9	/SPD-A internal speed selection	10	/SPD-B internal speed selection
Note: When reading through communication, the binary numbers read from right to left correspond to the position of / S-ON, / P-CON, 0 means that the position signal is not input, 1 means that the position signal has input. Example: 0x0001 means / S-ON has input, 0x0201 means / S-ON and / SPD-B has input.			

■ U0-22 input signal status

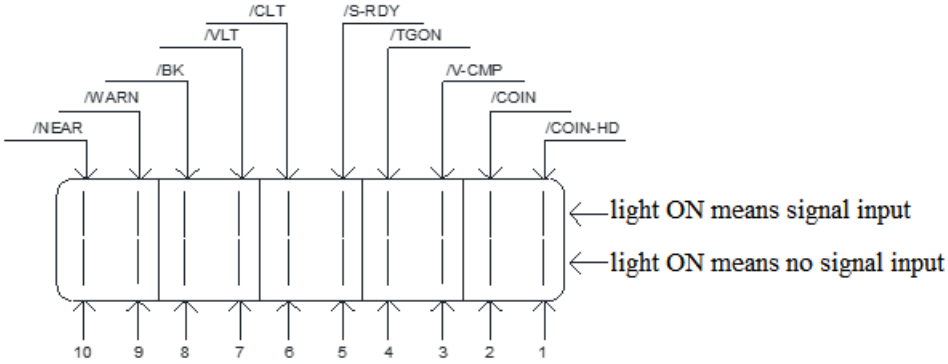


■ U0-22 input signal status

Code	Description	Code	Description
11	/C-SEL control mode selection	12	/ZCLAMP zero clamp
13	/INHIBIT instruction pulse prohibition	14	/G-SEL gain switch
15	/CLR pulse clear	16	/CHGSTP change step
17	/I-SEL inertia switching	18	—
19	—	20	—
Note: When reading through communication, the binary numbers read from right to left correspond to the position of / C-SEL, / ZCLAMP, 0 means that the position signal is not input, 1 means that the position signal has input. Example: 0x0001 means / C-SEL has input, 0x0041 means / C-SEL and / G-SEL have input.			

Note: "-" is for reserved display and does not represent any signal. The status bit is always 0.

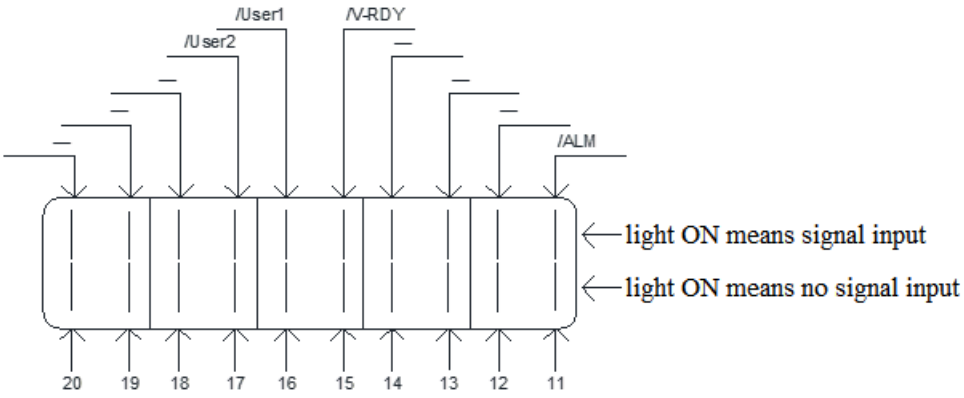
■ U0-23 output signal status



■ U0-23 output signal distribution

Code	Description	Code	Description
1	Positioning completion hold（/COIN_HD）	2	Positioning completion（/COIN）
3	Same speed detection（/V-CMP）	4	Rotate detection（/TGON）
5	Ready （/S-RDY）	6	Torque limit（/CLT）
7	Speed limit detection（/VLT）	8	Break lock（/BK）
9	Warn （/WARN）	10	Output near（/NEAR）
Note: When reading through communication, the binary numbers read from right to left correspond to the position of / COIN_HD, / COIN, 0 means that the position signal is not output, 1 means that the position signal has output. Example: 0x0001 means / COIN_HD has output, 0x0201 means / COIN_HD and / NEAR has output.			

■ U0-24 output signal status



■ U0-24 output signal distribution

Code	Description	Code	Description
11	Alarm (/ALM)	12	—
13	—	14	—
15	Speed reach（/V-RDY）	16	Customized output 1
17	Customized output 2	18	—
19	—	20	—
Note: When reading the state through communication, the binary numbers correspond to /ALM “-“ position in turn from right to left. 0 means that the position signal has no input, and 1 means that the position signal has input. For example, 0x0001 means /ALM has signal output, 0x0041 means /ALM and /customized output 2 have signal output.			

Note: "-" is for reserved display and does not represent any signal. The status bit is always 0.

4.5 FX-XX auxiliary function

■ F0-XX

Function code	Description
F0-00	Alarm clear
F0-01	Resume to default settings
F0-02	Clear the position offset

1. Alarm clear（F0-00）

In case of failure, it will automatically jump out of the alarm state of E-XXX and display the alarm number. In case of no failure, the alarm state will not be visible.
In the alarm state, write 1 to F0-00 through panel operation to reset the fault.
When an alarm occurs, first eliminate the cause of the alarm, and then clear the alarm. In case of servo alarm due to servo power off, it is not necessary to clear the alarm.

2. Resume to default setting（F0-01）

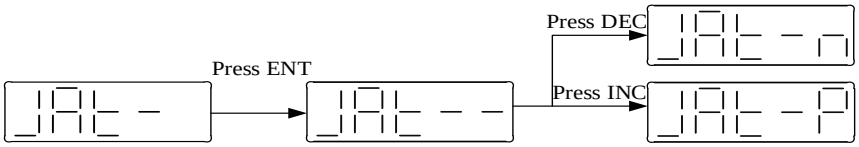
First turn the servo off, and then restore the factory operation. The operation is as follows:
Set F0-01=1 when enabler is shut down, press ENTER to resume to default settings, no need to cut power.

3. Clear the position offset（F0-02）

Set F0-02=1 to clear the offset.

4. Panel inertia identification（F0-07）

Before inertia identification, please use F1-00 jog function to confirm the servo rotation direction. At the beginning of inertia identification, Inc or Dec determines the initial direction of servo operation!
If the servo jitters under the adaptive default parameters, please switch to the adaptive large inertia mode (P2-03.3 = 1) to ensure the stable operation of the servo before inertia identification!
When the servo is in bb state, enter the parameter F0-07 display:



Refer to chapter 8-2-4 for details.

5. Panel external instruction auto-tuning（F0-08）

Refer to chapter 8-4-5 for details.

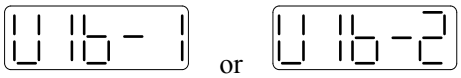
6. Panel internal instruction auto-tuning（F0-09）

Refer to chapter 8-4-4 for details.

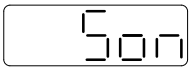
7. Panel vibration suppression（F0-10, F0-11）

Vibration suppression mode	Display	Parameter
Mode 1	vib-1	Only the parameters related to vibration suppression will be changed
Mode 2	Vib-2	The parameters related to vibration suppression and the gain of speed loop will be changed

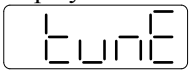
The operation steps are described below:
(1) In the self-tuning mode, enter the parameter F0-10 and the panel displays vib-1 or enter F0-11 and the panel displays vib-2



(2) Press ENTER, the panel displays Son and flashes. At this time, it needs to be enabled manually



(3) After the servo enable is turned on, the panel displays tune and flashes to enter the tuning state



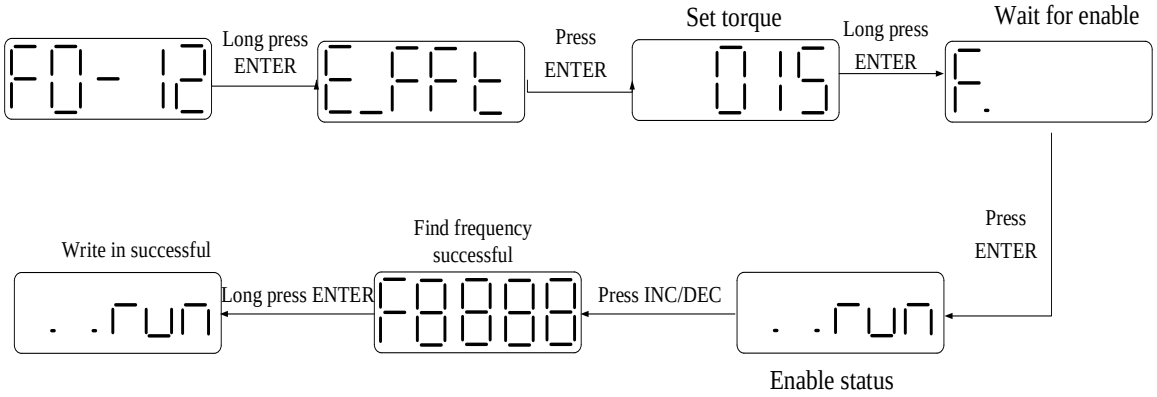
(4) The upper device starts to send pulse command until done is displayed and flashes to complete vibration suppression

(5) Press STA/ESC to exit

The vibration suppression parameters will be automatically written into the second and first notch filters (when there is only one vibration point, the second notch will be opened first). Refer to chapter 8-7-7 notch filter for relevant parameters.

8. Panel vibration suppression（fast FFT）（F0-12）

This function can analyze the mechanical characteristics through F0-12 parameters on the servo operation panel to find out the mechanical resonance frequency, so as to realize vibration suppression.

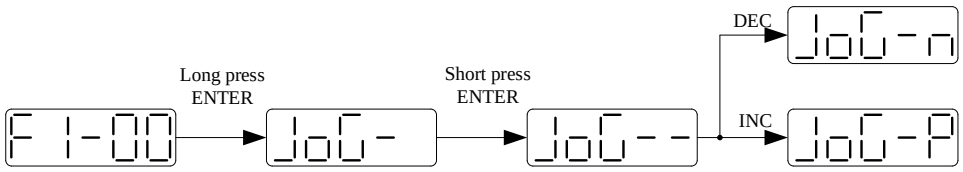


■ F1-XX

Code	Note
F1-00	Jog run
F1-01	Test run
F1-02	Current Sampling Zero-correction
F1-05	Panel enable
F1-06	Reset turns of absolute encoder

1. Jog run（F1-00）

Before entering jog mode, please confirm that the motor shaft is not connected to the machine and the driver is in bb idle status!



During jog operation, parameters such as gain will participate in the control, and whether the parameter setting is appropriate can be judged according to the operation condition.

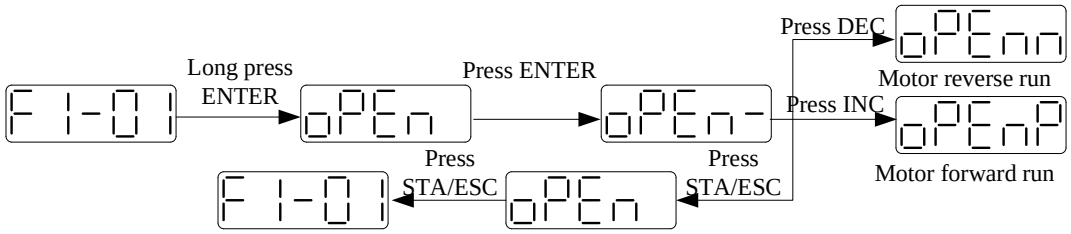
P3-18	JOG speed					
	Unit	Default	Range	Suitable mode	Modify	Effective
	1rpm	100	0~1000	JOG	Servo OFF	At once

2. Test run（F1-01）

Before entering the test run mode, please confirm that the motor shaft is not connected to the machine!

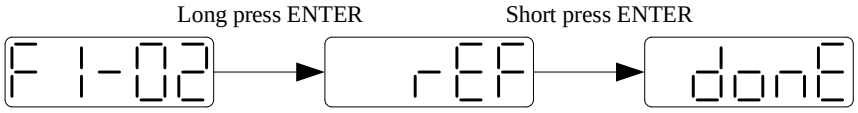
When the servo driver is connected to the non-original encoder or power cable, it should first enter the test run mode to verify that the encoder terminal or power terminal is connected correctly.

Test run mainly checks the power cable and the encoder feedback cable to determine whether the connection is normal. According to the following operation, the motor can normally achieve forward and reverse rotation. If the motor shaft shakes or driver alarms, please immediately disconnect the power supply, and re-check the wiring situation.



3. Current sampling zero-correction（F1-02）

When the servo driver is updated or the motor runs unsteadily after a long time, it is recommended that the user automatically adjust the current detection offset, and carry out the following operations when the driver is bb idle.



Press STATUS/ESC to exit. It needs to repower on the driver.

4. Panel enable（F1-05）

Parameter	Signal name	Setting	Meaning	Change	Effective
P0-03	Enable mode	0	Not enable	Servo OFF	At once
		1 (default)	I/O enable /S-ON		
		2	Software enable (F1-05 or communication)		
		3	Fieldbus enable (the model which supports motion bus)		
Set P0-03=2 F1-05 = 0: cancel enable, enter bb status. F1-05 = 1: forced enable, servo is in RUN status.					

Note:

(1) After power on again, the forced enable set by F1-05 will fail.

(2) If it needs to enable when power on and still enable after re-power on, P0-03 should be set to 1 and P5-20 to n.0010.

5. Reset turns of absolute encoder（F1-06）

First turn the servo off, and then clear the number of turns of the absolute encoder. The operation is as follows:

Write 1 to F1-06 through panel operation to clear the number of turns of absolute encoder.

Write 1 to 0x2106 hexadecimal address through Modbus RTU to clear the number of turns (servo bb status takes effect, and write 0x2106 to 0 after clearing)

4.6 Parameter setting example

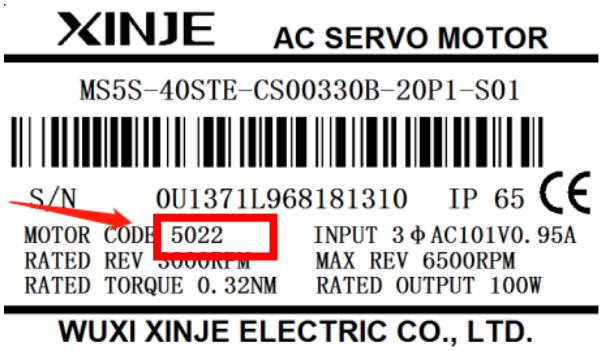
Take P3-09 as an example:

Step	Panel display	Used buttons	Operations
1	bb	STA/ESC INC DEC ENTER	No operation
2	P0-00	STA/ESC	Press STA/ESC
3	P3-00	INC	Press INC for three times to show P3-00
4	P3-00	ENTER	Press ENTER, the last 0 will flash
5	P3-09	INC	Press INC for 9 times

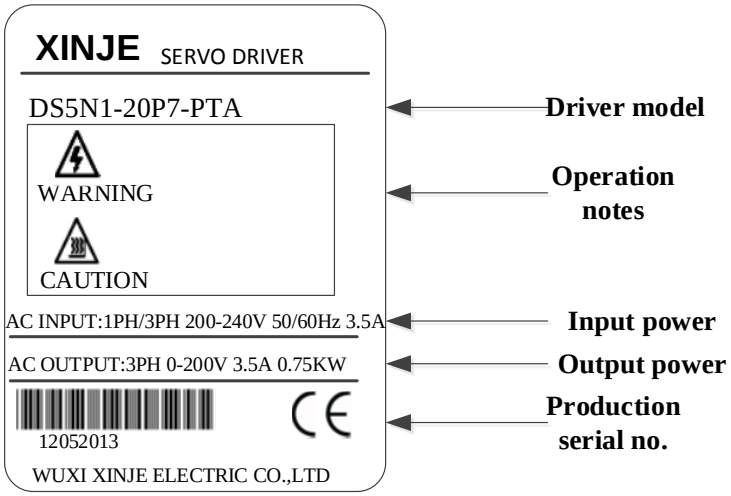
6	P3-09	STA/ESC INC DEC ENTER	Long press ENTER to show the value of P3-09
7	30000	STA/ESC INC DEC ENTER	Press INC, DEC, ENTER to increase decrease or shift, after changing, long press ENTER to confirm
8	END		

4.7 Check motor code

A servo driver can be equipped with a variety of motors with similar power levels. Different types of motors are distinguished by the motor code on the motor nameplate. Before commissioning the servo system, please confirm whether the driver parameter U3-70 is consistent with the motor nameplate label. In case of inconsistency, please contact the agent or technical support.



Driver nameplate



5 Object dictionary area allocation

CANopen object dictionary partition description:

Object dictionary index	Note
0x1000~0x1FFF	DS301 CANopen communication area (CANopen bus area)
0x2000~0x2FFF	Corresponding general function code P group area (manufacturer defined area)
0x3000~0x3FFF	Corresponding monitoring function code U group area (manufacturer defined area)
0x4000~0x4FFF	Corresponding auxiliary function code group F area (manufacturer defined area)
0x6000~0x6FFF	CiA402 object dictionary area (motion control equipment sub protocol area)

The object dictionary of CANopen bus is all in the device description file, namely EDS file, and the file format is eds。 The tool for viewing and editing EDS files can be EDS editor.

5.1 CANopen object dictionary in bus communication area (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
	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

Index	Sub index	Object type	Name	Data type	Read write	PDO mapping
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
	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

Index	Sub index	Object type	Name	Data type	Read write	PDO mapping
	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
	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

Index	Sub index	Object type	Name	Data type	Read write	PDO mapping
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 relevant attributes in the object dictionary.						

5.2 List of object dictionaries in the manufacturer's user defined area

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

Object dictionary index	Corresponding panel parameters	
2000	P0 group parameters	P0-00
2001		P0-01
……		……
205F		P0-95
2100	P1 group parameters	P1-00
2101		P1-01
……		……
214B		P1-75
2200	P2 group parameters	P2-00
2201		P2-01
……		……
2263		P2-99
2300	P3 group parameters	P3-00
2301		P3-01
……		……
232D		P3-45
2400	P4 group parameters	P4-00
2401		P4-01
……		……
24FE		P4-254
2500	P5 group parameters	P5-00
2501		P5-01
……		……
2547		P5-71
2605	P6 group parameters	P6-05
2607		P6-06
2608		P6-08
260C		P6-12
2700	P7 group parameters	P7-00
2701		P7-01
……		……
271F		P7-31
2800	P8 group parameters	P8-00

Object dictionary index	Corresponding panel parameters	
2801		P8-01
……		……
2817		P8-23
2E00	PE group parameters	PE-00
2E02		PE-02
……		……
2E62		PE-62
3000	U0 group parameters	U0-00
3001		U0-01
……		……
3063		U0-99
3100	U1 group parameters	U1-00
3101		U1-01
……		……
3159		U1-59
3200	U2 group parameters	U2-00
3201		U2-01
……		……
3230		U2-30
3300	U3 group parameters	U3-00
3301		U3-01
……		……
3370		U3-70
3400	U4 group parameters	U4-00
3401		U4-01
……		……
340A		U4-10
4000	F0 group parameters	F0-00
4105	F1 group parameters	F1-05
4106		F1-06

5.3 List of object dictionary in sub protocol area of motion control equipment

Index	Sub-Index	Type	Name/Description	Date Type	Access	PDO	Op-mode
6040h	00h	VAR	Controlword	U16	rw	YES	All
			Control word				
6041h	00h	VAR	Statusword	U16	ro	YES	All
			Status word				
605Ah	00h	VAR	Quickstop Option Code	I16	rw	NO	All
			Used to select the action when the servo drive system responds to the emergency stop command. The default value is 2.				
605Bh	00h	VAR	Shutdown option code	I16	rw	NO	All
			Set the motor deceleration stop method when PDS commands "shutdown" and "disable voltage" are received. The default value is 0.				
605Ch	00h	VAR	Disable operation option code	I16	rw	NO	All
			Set the motor deceleration stop method when receiving PDS command "disable operation". The default value is 1.				
605Dh	00h	VAR	Halt option code	I16	rw	NO	All
			Set the motor deceleration stop method when receiving the command "halt". The default value is 1.				
605Eh	00h	VAR	Fault reaction option code	I16	rw	NO	All
			Set the motor stop method when the alarm occurs. The default value is 2.				
6060h	00h	VAR	Modes of Operation	I8	rw	YES	All
			Used to set the control mode of the servo driver.				
6061h	00h	VAR	Modes of Operation Display	I8	ro	YES	All
			Used to indicate the current control mode of servo driver.				
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
			The internal actual position fed back by the servo motor, it is the feedback of the position loop.				
6064h	00h	VAR	Position Actual Value	I32	ro	YES	All
			Actual position fed back by servo motor.				
606Bh	00h	VAR	Velocity Demand Value	I32	ro	YES	PV
			The output value of the velocity trajectory generator, which is the input of the velocity loop.				
606Ch	00h	VAR	Velocity Actual Value	I32	ro	YES	All
			The actual speed fed back by the servo motor which is the feedback of the speed loop.				
6071h	00h	VAR	Target Torque	I16	rw	YES	TQ
			The user target torque input when the servo driver is in TQ mode, 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, and the default value is 3000, that is, 300% of the rated torque.				
6073h	00h	VAR	Max Current	U16	rw	YES	All
			The maximum current that the servo motor can withstand, the unit is 0.1% of the rated current, and the default value is 3000, that is, 300% of the rated current.				
6074h	00h	VAR	Torque Demand Value	I16	rw	YES	All
			Torque command, input of torque loop, unit: 0.1% of rated torque.				
6075h	00h	VAR	Motor Rated Current	U32	ro	YES	All
			The rated current of the servo motor is automatically set 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 the servo motor is automatically set by the system according				

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Type</th><th>Name/Description</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td></td><td></td><td></td><td colspan="5">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 torque.</td></tr>
<tr><td>6077h</td><td>00h</td><td>VAR</td><td>Torque Actual Value</td><td>I16</td><td>ro</td><td>YES</td><td>All</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">The actual torque of the servo motor, i.e. the feedback of the torque loop, the unit is 0.1% of the rated torque.</td></tr>
<tr><td>6078h</td><td>00h</td><td>VAR</td><td>Current Actual Value</td><td>I16</td><td>ro</td><td>YES</td><td>All</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">Actual quadrature axis current of servo motor, unit: 0.1% of rated current.</td></tr>
<tr><td>6079h</td><td>00h</td><td>VAR</td><td>DC Link Circuit Voltage</td><td>U32</td><td>ro</td><td>YES</td><td>All</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">DC bus voltage of servo driver, unit: 0.001V.</td></tr>
<tr><td>607Ah</td><td>00h</td><td>VAR</td><td>Target Position</td><td>I32</td><td>rw</td><td>YES</td><td>PP</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">The user 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>607Eh</td><td>00h</td><td>VAR</td><td>Polarity</td><td>U8</td><td>rw</td><td>YES</td><td>All</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">User instruction polarity, which has 8 bits, as 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, indicates that the user instruction is a forward instruction.
When BitX (X = 5, 6, 7) is 1, indicates that the user instruction is a reverse instruction.</td></tr>
<tr><td>607Fh</td><td>00h</td><td>VAR</td><td>Max Profile Velocity</td><td>U32</td><td>rw</td><td>YES</td><td>PP,PV,HM</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">The maximum speed of servo motor during operation, the unit is command unit/s, is effective in control modes other than TQ. The default value is 1000000 (0xF4240).</td></tr>
<tr><td>6080h</td><td>00h</td><td>VAR</td><td>Max Motor Speed</td><td>U32</td><td>rw</td><td>YES</td><td>ALL</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">The maximum speed of servo motor during operation, the unit is R/min. The default value is 6000 (0x1770).</td></tr>
<tr><td>6081h</td><td>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></td><td></td><td colspan="5">During position trajectory planning, the speed reached when the motor acceleration process is completed, the unit is the command unit/s, which is only valid in PP mode.</td></tr>
<tr><td>6083h</td><td>00h</td><td>VAR</td><td>Profile Acceleration</td><td>U32</td><td>rw</td><td>YES</td><td>PP,PV</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">During position trajectory planning or speed trajectory planning, the acceleration during motor acceleration, the unit is command unit/s^2, which is only effective in PP mode and PV mode. The default value is 5000000.</td></tr>
<tr><td>6084h</td><td>00h</td><td>VAR</td><td>Profile Deceleration</td><td>U32</td><td>rw</td><td>YES</td><td>PP,PV</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">During position trajectory planning or speed trajectory planning, the deceleration speed during motor deceleration, the unit is the command unit/s^2, which is only effective in PP mode and PV mode. The default value is 5000000.</td></tr>
<tr><td>6085h</td><td>00h</td><td>VAR</td><td>Quick Stop Declaration</td><td>U32</td><td>rw</td><td>YES</td><td>PP,PV,HM</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">When the servo drive system responds to the emergency stop command, emergency stop deceleration that can be taken, the unit is the command unit/s^2, which is effective in the control mode other than TQ. The default value is 10000000.</td></tr>
<tr><td>6087h</td><td>00h</td><td>VAR</td><td>Torque Slope</td><td>U32</td><td>rw</td><td>YES</td><td>TQ</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">The torque change rate adopted when the torque command of the servo drive system changes, the unit is 0.1%/s of the rated torque, which is only valid in TQ mode.</td></tr>
<tr><td>6098h</td><td>00h</td><td>VAR</td><td>Homing Method</td><td>I8</td><td>rw</td><td>YES</td><td>HM</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">It is used to set the homing mode of servo drive system, which is only effective in HM mode.</td></tr>
<tr><td>6099h</td><td>00h</td><td>RECORD</td><td>Homing Speeds</td><td>-</td><td>-</td><td>-</td><td>HM</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">It has two sub indexes, which are only valid in HM mode.</td></tr>
<tr><td></td><td>01h</td><td>VAR</td><td>Speed during Search Switch</td><td>U32</td><td>rw</td><td>YES</td><td>HM</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">The speed of the servo motor when looking for the switch signal. The unit is the command unit/s. The default value is 10000.</td></tr>
</table>

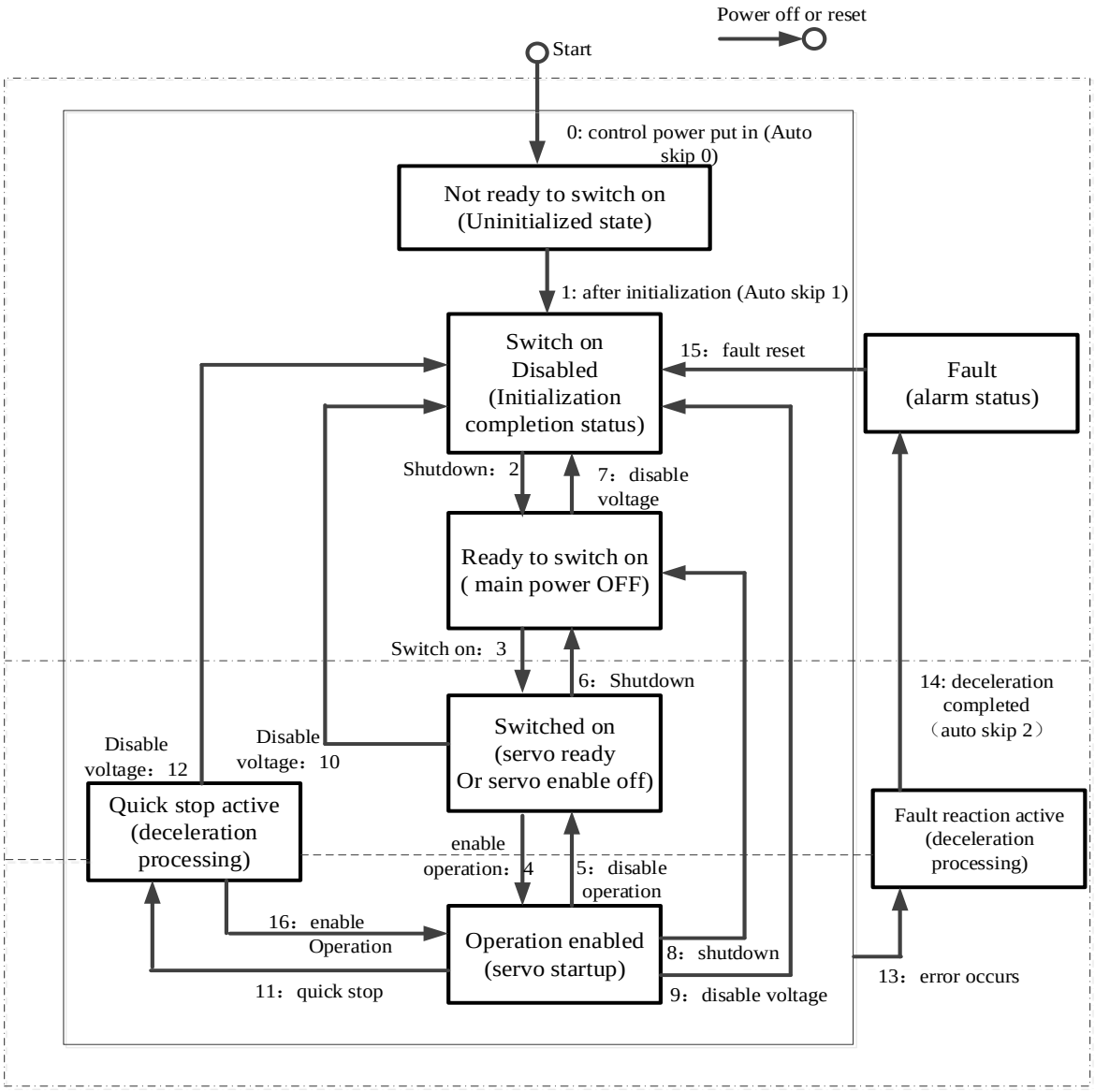
<table>
<tr><th>Index</th><th>Sub-Index</th><th>Type</th><th>Name/Description</th><th>Date Type</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td></td><td>02h</td><td>VAR</td><td>Speed during Search Zero</td><td>U32</td><td>rw</td><td>YES</td><td>HM</td></tr>
<tr><td colspan="8">The speed of servo motor when looking for zero signal. The unit is command unit/s. The default value is 5000.</td></tr>
<tr><td>609Ah</td><td>00h</td><td>VAR</td><td>Homing Acceleration</td><td>U32</td><td>rw</td><td>YES</td><td>HM</td></tr>
<tr><td colspan="8">The acceleration and deceleration adopted by the servo motor during homing movement, the unit is command unit/s^2, which is only valid in HM mode. The default value is 20000.</td></tr>
<tr><td>60C5h</td><td>00h</td><td>VAR</td><td>Max Acceleration</td><td>U32</td><td>rw</td><td>YES</td><td>PP,PV,HM</td></tr>
<tr><td colspan="8">The maximum allowable acceleration of servo motor during acceleration, unit is command unit/s^2, which is effective in PP, PV and HM modes. The default value is 4294967295.</td></tr>
<tr><td>60C6h</td><td>00h</td><td>VAR</td><td>Max Deceleration</td><td>U32</td><td>rw</td><td>YES</td><td>PP,PV,HM</td></tr>
<tr><td colspan="8">The maximum deceleration allowed by the servo motor during deceleration, the unit is the command unit/s^2, which is effective in PP, PV and HM modes. The default value is 4294967295.</td></tr>
<tr><td>60F4h</td><td>00h</td><td>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="8">The position deviation of servo drive system during position control, i.e. 0x60F4 = 0x6062 – 0x6064, is effective in PP and HM modes.</td></tr>
<tr><td>60FCh</td><td>00h</td><td>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="8">The object dictionary 0x6062 is the result of motion polarity processing by the object dictionary 0x607E (polarity), which is the input of the position loop.</td></tr>
<tr><td>60FDh</td><td>00h</td><td>VAR</td><td>Digital Inputs</td><td>U32</td><td>ro</td><td>YES</td><td>All</td></tr>
<tr><td colspan="8">The input states of POT, NOT and SPD-D are indicated by the function signals allocated by panel parameters P5-22 (POT), P5-23 (NOT) and P5-27 (SPD-D). It has 32 bits, as shown in the following table:
<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>60FFh</td><td>00h</td><td>VAR</td><td>Target Velocity</td><td>I32</td><td>rw</td><td>YES</td><td>PV</td></tr>
<tr><td colspan="8">The user target speed when the servo driver is in PV mode. The unit is command unit/s, which is only valid in PV mode.</td></tr>
</table>

6 CIA402 motion control

CANopen bus is divided into two parts: DS301 bus communication function and CiA402 motion control function. DS5N1 series servo turns on the CiA402 bus control function by default. If the common servo function is required, the value of P0-00 (object dictionary 0x2000) must be set to 0 to turn off the CiA402 mode. P0-00 (object dictionary 0x2000) is maintained after power failure.

6.1 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 (controlword). The detailed transformation relationship between these eight states is shown in the figure below:



After migrating to operation enabled(after servo enable turned on), lift it to more than 100ms and input the action command.

The following table shows PDS state migration events (migration conditions) and actions during migration. For PDS migration, confirm that the status has changed through 6041h: statusword, and then send the next migration instruction.

PDS conversion		Event	Action
0	Auto skip 0	After the power is turned on, or after the application layer is reset, it will migrate automatically.	After the power is turned on, or after the application layer is reset, it will migrate automatically.

PDS conversion		Event	Action
1	Auto skip 1	Automatic conversion after initialization.	Communication is established.
2	Shut down	Receive the Shutdown command.	Nothing special.
3	Switch on	When the power supply is on, the Switch on command is received.	Nothing special.
4	Enable operation	Receiving the Enable operation command.	The driving function is effective. In addition, all previous set point data are cleared.
5	Disable operation	Receiving the Disable operation command.	The drive function is invalid.
6	Shutdown	When the power supply is on, the Shutdown command is received. Check out the condition that the power supply is off.	Nothing special.
7	Disable voltage	Receiving the Disable voltage command. Receiving the Quick stop command.	Nothing special.
8	Shutdown	When the power supply is on, the Shutdown command is received.	The drive function is invalid.
9	Disable voltage	Receiving the Disable voltage command.	The drive function is invalid.
10	Disable voltage	Receiving the Disable voltage command. Receiving the Quick stop command.	Nothing special.
11	Quick stop	Receiving the Quick stop command.	Execute Quick stop function.
12	Disable voltage	When the Quick stop selection code is the set value of 1, 2 and 3, and the quick stop action is completed. When the Quick stop selection code is the set value of 5, 6 and 7, and the disable voltage command is received after the quick stop action is completed. Check out the condition that the power supply is off.	The drive function is invalid.
13	Error occurs	Abnormal detection.	Execute Fault reaction function.
14	Auto skip 2	After the abnormality detection and deceleration processing is completed, it will migrate automatically.	The drive function is invalid.
15	Fault reset	After the fault factor is removed, the fault reset instruction is received.	If the fault factor does not exist, reset the fault status.
16	Enable operation	When the quick stop selection code is the set value of 5, 6 and 7, the Enable operation command is received.	The driving function is effective.

6.2 Control status

6.2.1 Controlword(6040h)

The commands of PDS state migration and control slave station (servo driver) are 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 conversion.
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 (Not correspond)
oms = operation mode specific (control mode based on bit)
h = halt
fr = fault reset
eo = enable operation
qs = quick stop
ev = enable voltage
so = switch on

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

The bit logic of the Quick stop instruction is valid under 0.
Please note that other bit logic and opposite actions are executed.
When bit8 (HALT): 1, the motor deceleration pause is executed through 605Dh (halt selection code). After pause, return to 0 and start the action. However, if the action is interrupted by 1 in HM control mode, it cannot be opened again even if it returns 0.
Bit6-4 (operation mode specific): the following represents the inherent change of OMS bit in the control mode (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

6.2.2 Statusword(6041h)

Indicates the status of the servo drive:

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 drive:
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 (Not correspond)
oms = operation mode specific (control mode based on bit)
ila = internal limit active
tr= target reached
rm = remote
sod = switch on disabled
qs = quick stop
ve = voltage enabled
f = fault
oe = operation enabled
so = switched on
rtso = ready to switch on

bit6,5,3-0 (switch on disabled/quick stop/fault/operation enabled/switched on/ready to switch on): The status of PDS can be confirmed according to this bit. The following indicates the status and the corresponding bit.

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 completion status
xxxx xxxx x01x 0001 b	Ready to switch on	Initialization completion status
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 immediately
xxxx xxxx x0xx 1111 b	Fault reaction active	Abnormal (alarm) judgment
xxxx xxxx x0xx 1000 b	Fault	Abnormal (alarm) status

In addition, the current state of PDS state machine of DS5N1 series servo can be monitored through U0-99. Refer to the following table for specific meaning:

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

bit4 (voltage enabled): 1 indicates that the power supply voltage is applied to the PDS.
bit5 (quick stop): 0 indicates that the PDS receives the quick stop request. The bit logic of quick stop is valid under 0. Please note that other bit logic and opposite actions are executed.
bit11 (internal limit active): subject to internal restrictions.
bit13,12 (operation mode specific): the inherent change of OMS bit in the control mode is shown below. (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

6.3 Control mode

6.3.1 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 the servo driver.
Non corresponding control mode setting is prohibited.

bit	Mode of operation	Abb.	Correspond
-128~ -1	Reserved	-	-
0	No mode changed/No mode assigned	-	-
1	Profile position mode	pp	YES
3	Profile velocity mode	pv	YES
4	Torque profile mode	tq	YES
6	Homing mode	hm	YES
7~127	Reserved	-	-

Because 6060h (modes of operation) is default = (no mode change / no mode assigned), please be sure to set the control mode value after the power is put into operation. When the set value of 6060h is 0 and the set value of 6061h is 0, if the PDS state is transferred to operation enabled, E-881 (control mode setting fault protection) occurs.
After the initial state 6060h = 0 (no mode assigned) is converted to the supportable control mode (PP, PV, TQ, HM), the condition of 6060h = 0 is set again as "no mode changed", and the switching of control mode cannot be performed. (maintain the previous control mode).

6.3.2 Modes of operation display (6061h)

The confirmation of the control mode inside the servo driver is performed according to 6061h (modes of operation display). After 6060h (modes of operation) is set, confirm whether the action is feasible by detecting and setting this object.

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

Indicates the current control mode.

bit	Mode of operation	Abb.	Correspond
-128~ -1	Reserved	-	-
0	No mode changed/No mode assigned	-	-
1	Profile position mode	pp	YES
3	Profile velocity mode	pv	YES
4	Torque profile mode	tq	YES
6	Homing mode	hm	YES
7~127	Reserved	-	-

6.4 Selection of the code (Deceleration stop time setting)

PDS is a motor deceleration stop method for setting the interruption of main power supply or the occurrence of alarm in the operation enabled state (servo enable turned on).
The deceleration mode (dynamic brake stop, free running stop, instant stop) of the deceleration function (selection code) defined by COE (CiA402) is used in combination.
PDS selection code list:

Index	Sub-Index	Name/Description	Range	DateType	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 object list:

Index	Sub-Index	Name/Description	Range	DateType	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

6.4.1 Quick stop option code(605Ah)

Set the motor deceleration stop method when PDS command "quick stop" is received.

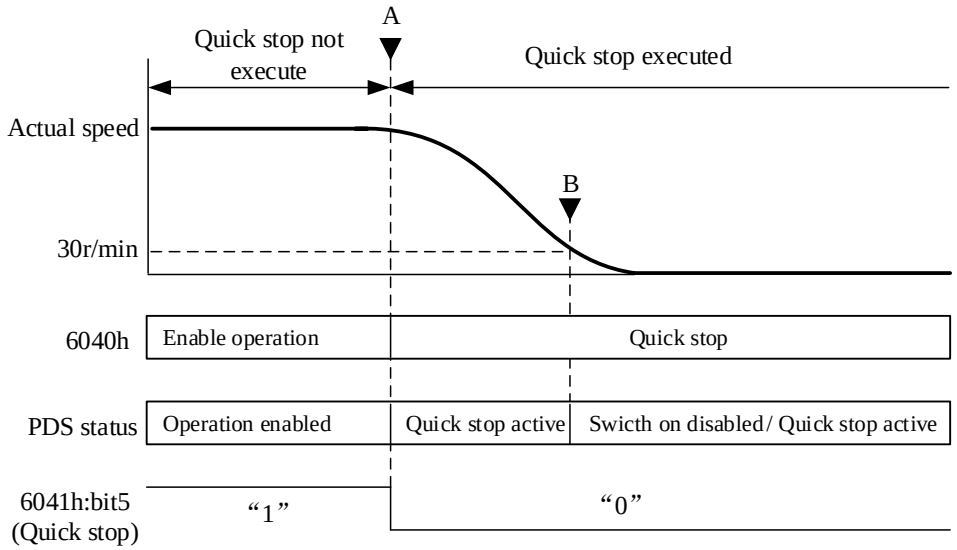
Index	Sub-Index	Name/Description	Range	DateType	Access	PDO	Op-mode
605Ah	00h	Quick stop option code	0-7	I16	rw	NO	All

Set the timing of quick stop. The definition varies according to the control mode.
It is forbidden to set other than the following values.

Value	Definition
0	Stop immediately and the PDS state will be transferred to Switch on disabled
1	The control mode is PP, PV: after the motor is stopped through 0x6084 (profile decision), the PDS state shifts to Switch on disabled
	The control mode is HM: after the motor is stopped through 0x609A (Homing acceleration), the PDS state shifts to Switch on disabled
	The control mode is TQ: after the motor is stopped through 0x6087 (torque slope), the PDS state shifts to Switch on disabled
2	The control modes are PP, PV and HM: after the motor is stopped through 0x6085 (quick stop declaration), the PDS state is transferred to Switch on disabled
	The control mode is TQ: after the motor is stopped through 0x6087 (torque slope), the PDS state shifts to Switch on disabled
3	The control modes are PP, PV and HM: after the motor is stopped through 0x60C6 (max deceleration), the PDS state is transferred to Switch on disabled
	The control mode is TQ: after the motor stops through torque 0, the PDS state shifts to Switch on disabled
5	The control mode is PP, PV: after the motor is stopped through 0x6084 (profile deceleration), the PDS state is transferred to Quick stop active
	The control mode is HM: after the motor is stopped through 0x609A (Homing acceleration), the PDS state will be transferred to Quick stop active
	The control mode is TQ: after the motor is stopped through 0x6087 (torque slope), the PDS state is transferred to Quick stop active
6	The control modes are PP, PV and HM: after the motor is stopped

			through 0x6085 (quick stop declaration), the PDS state will be transferred to Quick stop active		
			The control mode is TQ: after the motor is stopped through 0x6087 (torque slope), the PDS state is transferred to Quick stop active		
		7	The control modes are PP, PV and HM: after the motor is stopped through 0x60C6 (max deceleration), the PDS state will be transferred to Quick stop active		
			The control mode is TQ: after the motor stops through torque 0, the PDS state will be transferred to Quick stop active		

Example of deceleration stop action according to quick stop command: if 6040h: bit2 (controlword: quick stop) changes from 1 to 0, deceleration stop starts. The PDS status in deceleration changes to quick stop active. The PDS status after stopping is switch on disabled, or it changes to quick stop active.



6.4.2 Shutdown on code(605Bh)

Set the motor deceleration stop method when PDS commands "shutdown" and "disable voltage" are received.

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

Set the timing of "shutdown" and "disable voltage". The definition varies according to the control mode.
It is forbidden to set other than the following values.

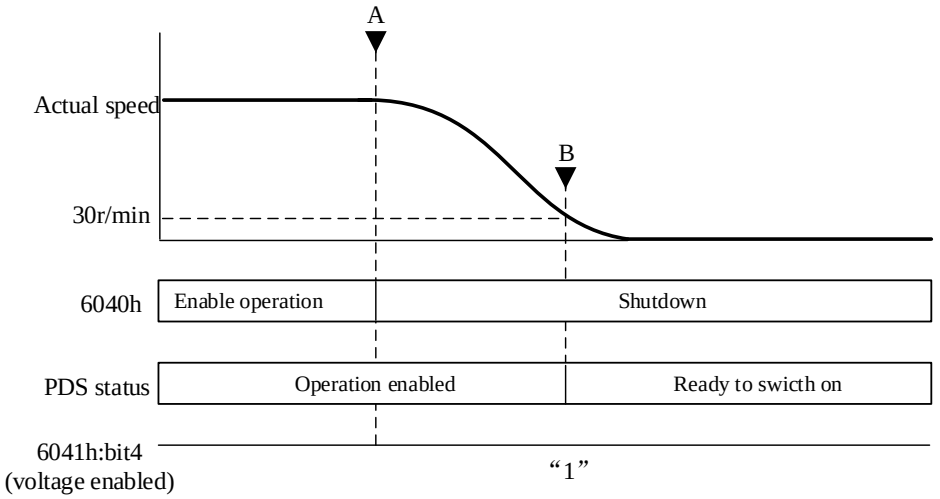
(1) PDS command「Shutdown」receiving

Value	Definition
0	Stop immediately and the PDS status will be transferred to Ready to switch on.
1	The control mode is PP, PV: after the motor is stopped through 0x6084 (profile deceleration), the PDS state is transferred to Ready to switch on.
	The control mode is HM: after the motor is stopped through 0x609Ah (homing acceleration), the PDS state is transferred to Ready to switch on.
	The control mode is TQ: after the motor is stopped through 0x6087 (torque slope), the PDS state is transferred to Ready to switch on.

(2) PDS command「Disable voltage」receiving

Value	Definition
0	Stop immediately and the PDS state will be transferred to Switch on disabled.
1	The control mode is PP, PV: after the motor is stopped through 0x6084 (profile deceleration), the PDS state is transferred to Switch on disabled.
	The control mode is HM: after the motor is stopped through 0x609Ah (homing acceleration), the PDS state is transferred to Switch on disabled.
	The control mode is TQ: after the motor is stopped through 0x6087 (torque slope), the PDS state is transferred to Switch on disabled.

Example of deceleration stop action according to the shutdown command: if received the PDS command "shutdown", starts deceleration stop. PDS status in deceleration remains Operation enabled. The PDS status after stop is Ready to switch on.



Note: 6041h: bit4 (statusword: voltage enabled) is still 1 and does not change.

6.4.3 Disable operation option code(605Ch)

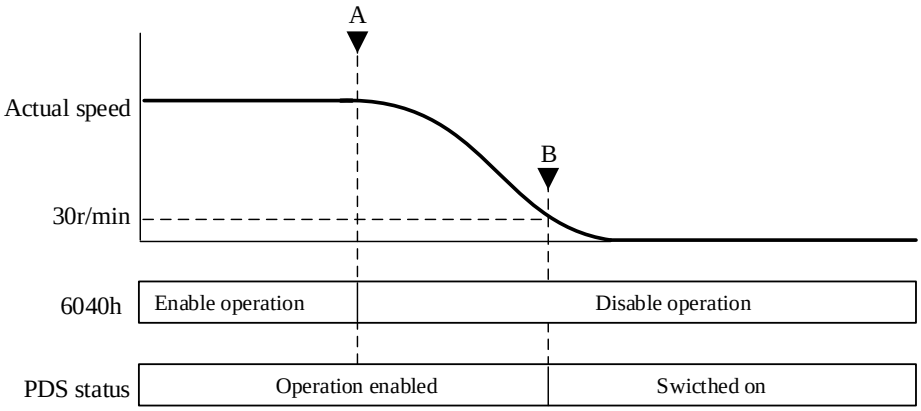
Set the motor deceleration stop method when receiving PDS command "disable operation".

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

Set the timing of "disable operation". The definition varies according to the control mode. It is forbidden to set other than the following values.

Value	Definition
0	Stop immediately and the PDS state will be transferred to Switch on.
1	The control mode is PP, PV: after the motor is stopped through 0x6084 (profile deceleration), the PDS state is transferred to Switch on.
	The control mode is HM: after the motor is stopped through 0x609Ah (homing acceleration), the PDS state is transferred to Switch on.
	The control mode is TQ: after the motor is stopped through 0x6087 (torque slope), the PDS state is transferred to Switch on.

Example of deceleration stop according to the Disable operation command. If the PDS command "disable operation" is received, the deceleration stop starts. PDS status in deceleration remains operation enabled. PDS status is switched on after stop.



6.4.4 Halt option code(605Dh)

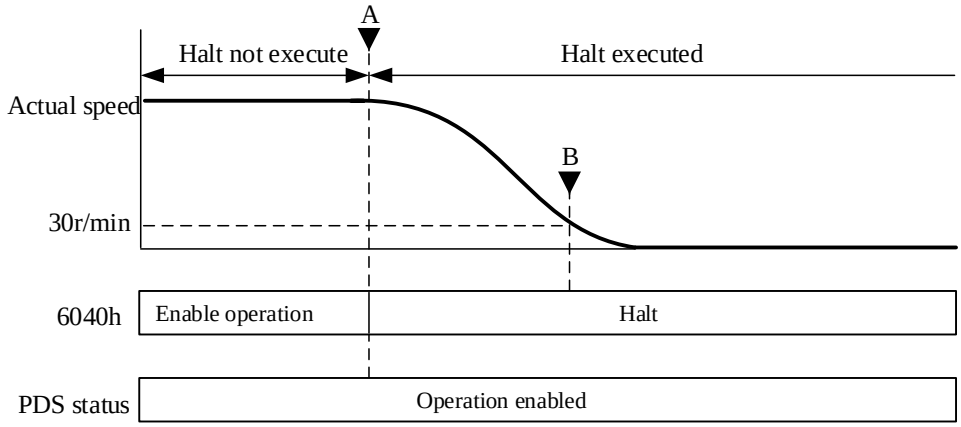
When bit8 (HALT) of 6040h (controlword) is 1, set the motor deceleration stop method.

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

Set the timing of Halt action. The definition varies according to the control mode.
It is forbidden to set other than the following values.

Value	Definition
1	The control mode is PP, PV: after the motor is stopped through 0x6084 (profile deceleration), the PDS state is transferred to Operation enabled
	The control mode is HM: after the motor is stopped through 0x609A (homing acceleration), the PDS state is transferred to Operation enabled
	The control mode is TQ: after the motor is stopped through 0x6087 (torque slope), the PDS state is transferred to Operation enabled
2	The control modes are PP, PV and HM: after the motor is stopped through 0x6085 (quick stop declaration), the PDS state is transferred to Operation enabled
	The control mode is CST, TQ: after the motor is stopped through 0x6087 (torque slope), the PDS state is transferred to Operation enabled
3	The control modes are PP, PV and HM: after the motor is stopped through 0x60C6 (max deceleration), the PDS state will be transferred to Operation enabled
	The control mode is TQ: after the motor stops through torque 0, the PDS state will be transferred to Operation enabled

The example of the deceleration stop action according to the halt function, if 6040h: bit8 (controlword: halt) changes from 0 to 1, the deceleration stop starts. PDS status in deceleration remains Operation enabled. The PDS status after stop remains Operation enabled.

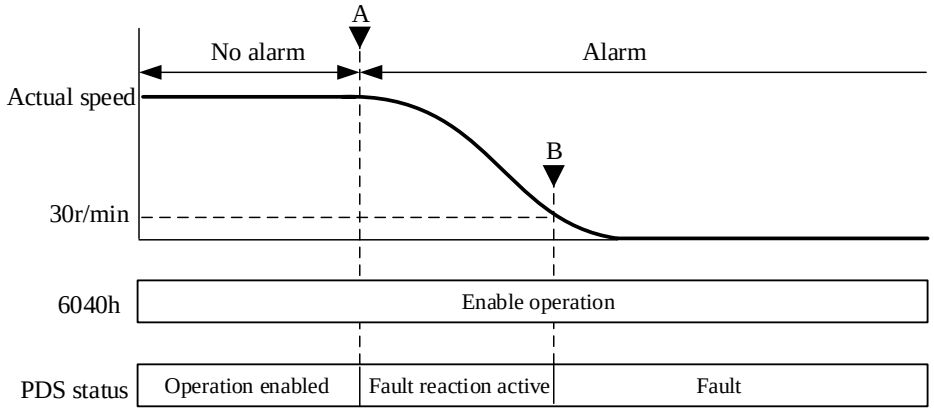


6.4.5 Fault reaction option code(605Eh)

Set the motor stop method when the alarm occurs.

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>DateType</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td>605Eh</td><td>00h</td><td>Fault reaction option code</td><td>0-2</td><td>I16</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="8">Set the timing when the alarm occurs. The definition varies according to the control mode. It is forbidden to set the value other than below list.
<table>
<tr><th>Value</th><th>Definition</th></tr>
<tr><td>0</td><td>Stop immediately and the PDS status will be transferred to Fault.</td></tr>
<tr><td rowspan="3">1</td><td>The control mode is PP, PV: after the motor is stopped through 0x6084 (profile deceleration), the PDS state is transferred to Fault.</td></tr>
<tr><td>The control mode is HM: after the motor is stopped through 0x609Ah (homing acceleration), the PDS state is transferred to Fault.</td></tr>
<tr><td>The control mode is TQ: after the motor is stopped through 0x6087 (torque slope), the PDS state is transferred to Fault.</td></tr>
<tr><td rowspan="2">2</td><td>The control modes are PP, PV and HM: after the motor stops through 6085h (Quick stop cancellation), it will be transferred to Fault.</td></tr>
<tr><td>The control mode is TQ: after the motor is stopped through 0x6087 (torque slope), the PDS state is transferred to Fault</td></tr>
</table></td></tr>
</table>

Example of deceleration stop when the alarm occurs, if the alarm occurs, starts deceleration stop. PDS status in deceleration is Fault reaction active. The PDS status after stopping is Fault.



7 DS5N1 motion control mode

DS5N1 supports four bus motion control modes based on CANopen bus, including contour position mode (PP), contour speed mode (PV), contour torque mode (TQ) and homing mode (HM), and does not support external control modes (CSP, CSV, CST).

7.1 PP mode

PP (profile position control mode) is a position control mode that specifies the target position, target speed, acceleration and deceleration, and acts after generating position commands in the servo driver.

7.1.1 Related parameters

PP control mode related object (command · setting):

Register	Note	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	Command unit /s²
RXPDO[0x6084]	Internal deceleration	Command unit /s²
RXPDO[0x60C5]	Max acceleration	Command unit /s²
RXPDO[0x60C6]	Max deceleration	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) in the action is not reflected in the action.

PP control mode related object (command · monitor):

Register	Note	Unit
TXPDO[0x6041]	Status word	-
TXPDO[0x6061]	Mode queries	
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 follow error	Command unit

7.1.2 Control word (6040h) < pp control mode function >

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>DateType</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="4">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 correspond)
oms = operation mode specific (control mode based on bit)
h = halt
fr = fault reset
eo = enable operation
qs = quick stop
ev = enable voltage</td></tr>
</table>

		so = switch on

Bit4-6 (operation mode specific):

Bit	Name	Value	Definition
4	new set-point	0 -> 1	The start of positioning action, the trigger for setting value update Get new location decision task (607Ah (Target position), 6081h (Profile velocity) etc.)
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) Treat as absolute position.
		1	607Ah (Target position) Treat as relative position.

Please do not change the acceleration and deceleration (*) during motor operation.

If the acceleration and deceleration are changed, please change bit4 (new set point) from 0 to 1 after the motor stops.

6083h（Profile acceleration）

6084h（Profile deceleration）

60C5h（Max acceleration）

60C6h（Max deceleration）

7.1.3 Status word (6041h) < pp control mode function >

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

Indicates the status of the servo drive.

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 correspond)

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

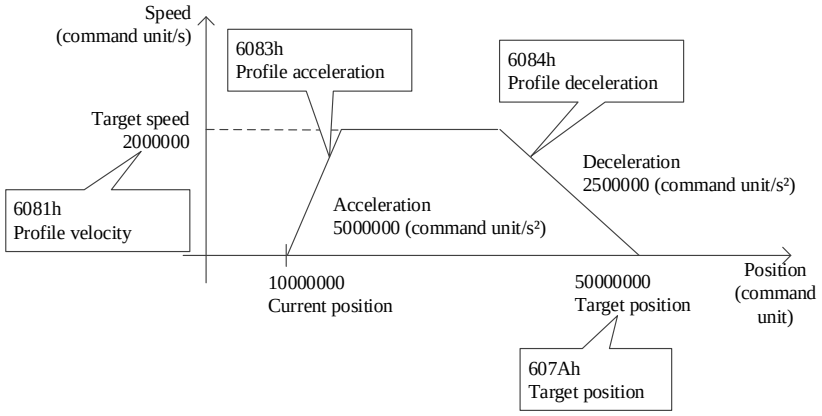
rtso = ready to switch on

bit12,10 (operation mode specific):

Bit	Name	Value	Definition
10	target reached	0	halt=0 (usually): positioning is not completed halt=1(when stopped according to halt): the shaft is decelerating
		1	halt=0 (usually): positioning is completed halt=1 (when stopped according to halt): shaft stop (shaft speed is 0)
12	set-point acknowledge	0	new-setpoint is 0 and the buffer is empty after the action of the current target location is executed
		1	The new positioning task puts the data into the buffer. The buffer is not empty

7.1.4 Action description of PP control mode

The working principle diagram of object dictionary 0x607A, 0x6081, 0x6083 and 0x6084 is as follows:



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

Action 1: basic set-point

① Master station

After setting the value of 607Ah (target position), change the bit4 (new set-point) of 6040h (controlword) from 0 to 1. At this time, please also set 6081h (profile velocity). When 6081h (Profile velocity), the motor does not operate.

② Slave station

Confirm the rising edge (0 → 1) of bit4 (new set-point) of 6040h (controlword) and 607Ah (target position) as the target position to start the positioning action. At this time, the bit12 (set-point acknowledge) of 6041h (status word) changes from 0 to 1.

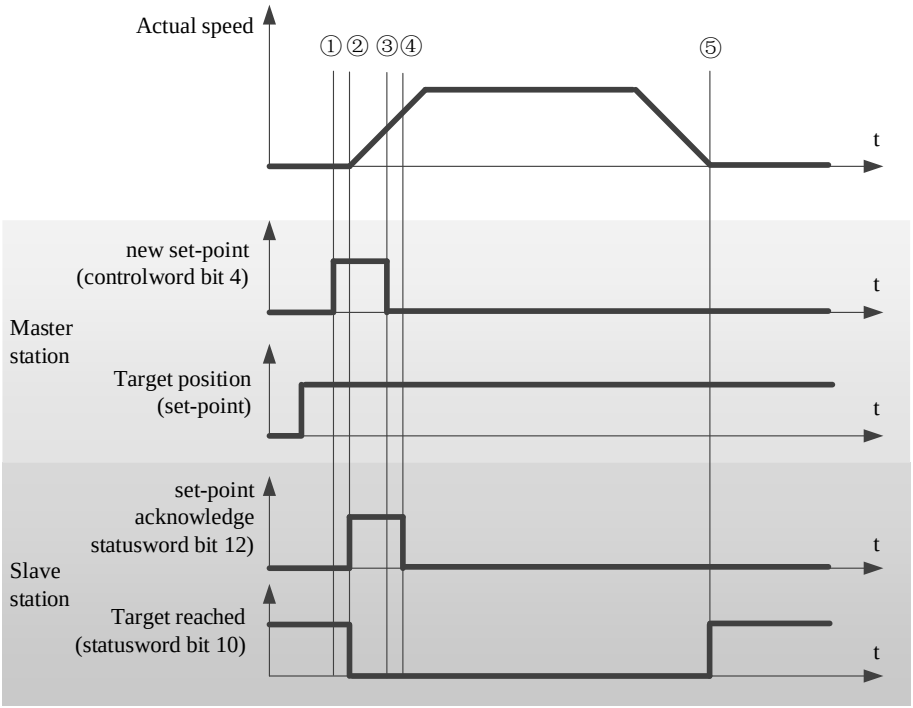
③ Master station

Confirm that bit12 (set-point acknowledge) of 6041h (statusword) has changed from 0 to 1, bit4 (new set-point) of 6040h (controlword) returns 0.

④ Slave station

Confirm that bit4 (new set-point) of 6040h (control word) is 0, bit12 (set-point acknowledge) of 6041h (status word) has changed to 0.

⑤ When reached target position, bit10 (target reached) of 6041h (Controlword) changes from 0 to 1.



< Set-point example >

Action 2: Action data change without buffer: single set-point
When bit5 (change set immediately) of 6040h (controlword) is 1, if the data used for positioning action in the action has been changed, interrupt the current positioning action and start the next positioning action immediately.

① Master station

Confirm that bit12 (set-point acknowledge) of 6041h (statusword) is 0. After changing the value of 607Ah (target position), change bit4 (new set-point) of 6040h (controlword) from 0 to 1.
Note: please do not change the acceleration and deceleration at this time.

② Slave station

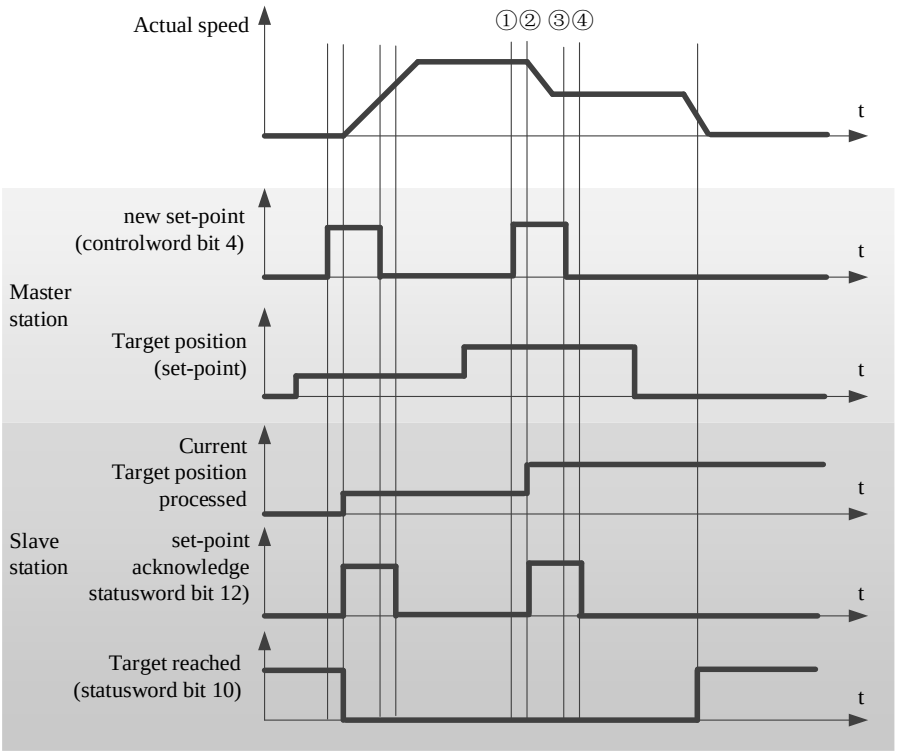
Confirm that the rising edge of 6040h (Controlword) bit4 (new set-point) changes from 0 to 1, 607Ah (target position) and 6081h (profile velocity) are updated immediately as the new target position and the new internal execution speed. At this time, bit12 (set-point acknowledge) of 6041h (statusword) is changed from 0 to 1.

③ Master station

Confirm that bit12 (set-point acknowledge) of 6041h (statusword) has changed from 0 to 1. Bit4 (new set-point) of 6040h (controlword) returns 0.

④ Slave station

Confirm that bit4 (new set-point) of 6040h (Controlword) is 0, bit12 (set-point acknowledge) of 6041h (Statusword) is 0.



< handshaking procedure for the single set-point method >

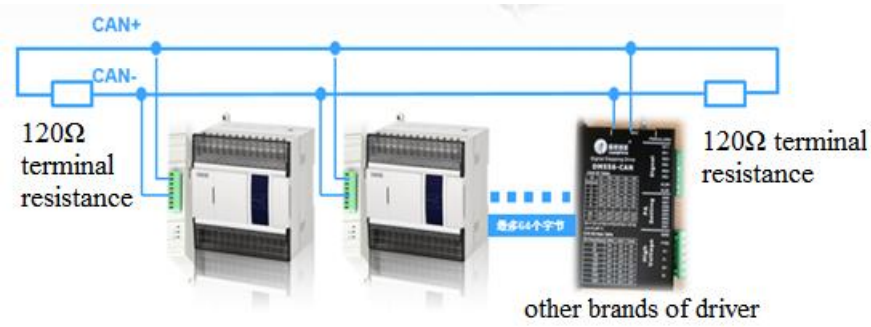
7.1.5 Operation instance of pp mode

To realize the CANopen function of Xinje DS5N1 servo, Xinje XD-COBOX-ED module can be used as the master station of CANopen network (this module can also be used as a slave station of other master stations). When composing CANopen network, XD-COBOX-ED module needs to cooperate with XD5 / XDM / XD5E / XDME series PLC and connect with XD-COBOX-ED through the left expansion communication port (COM3) of PLC.

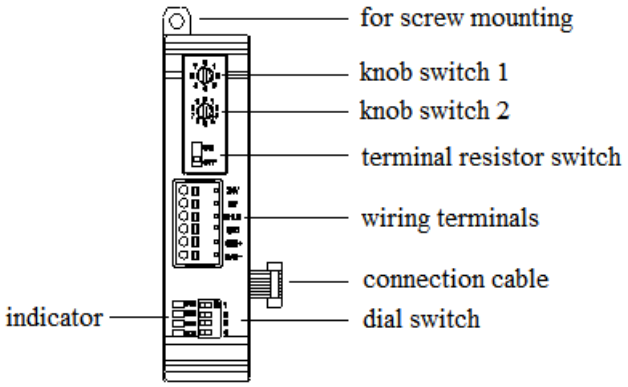
1. Wiring

When XD-COBOX-ED is connected to the CAN bus network, it adopts the linear topology structure. It only needs to connect CAN+ (CAN_H) to CAN+ (CAN_H) and CAN- (CAN_L) to CAN- (CAN_L) to establish communication, that is, the orange and white wire at one end of the network cable is connected to the CAN+ of XD-COBOX-ED module, the orange wire is connected to the CAN- of XD-COBOX-ED module, and the other end of the network cable is directly inserted into the IN port of servo. If the field has high requirements for the anti-interference ability of the bus, it needs to be connected to GND. The physical connection is shown in the figure.

In order to enhance the reliability of CAN communication and eliminate the reflection interference of CAN bus terminal signal, the two farthest endpoints of CAN bus network usually need to add terminal resistance. The value of the terminal resistance is determined by the characteristic impedance of the transmission cable. For example, if the characteristic impedance of the twisted pair is 120Ω, the farthest two terminals on the bus need to be installed with 120Ω terminal resistance. If the number of nodes is greater than 2, the intermediate node does not need to install terminal resistance. XD-COBOX-ED is equipped with a 120Ω terminal resistance dial switch (up is on and down is off). If other CANopen devices do not have their own terminal resistance, they need to be installed by the user. The CAN bus network supports up to 64 nodes, and the fastest communication speed can reach 1M. When 1M communication speed is adopted, the longest distance is 25m.



2. Station no. and baud rate settings



Knob switches 1 and 2 are used to set the node address (i.e. station number) of XD-COBOX-ED module in CANopen network.

- Setting range: 1 ~ 64 (0, 65 ~ 79 are not available).
- Knob switch 1: range 0 ~ 7, representing the high position of station number (decimal).
- Knob switch 2: range 0 ~ 9, representing the low position of station number (decimal).

Set parameter P7-30 through the servo software or panel to change the station number of servo in CANopen network. Setting range: 1 ~ 64.

For example: when the user wants to set the communication station number of XD-COBOX-ED module to 37, just turn knob switch 1 to 3, and then turn knob switch 2 to 7. To modify the servo slave station number to 15, modify the P7-30 parameter to 15 through the servo software or servo panel. (the station numbers of the two stations cannot be the same)

Note: after setting, the servo needs to be powered on again.

The dial switch is used to set the baud rate and the master/slave station, and the baud rate of the master/slave station shall be consistent.

- Dial switch 4 is set as master/slave station. On is the master station and off is the slave station.
- Dial switches 1 ~ 3 are used to set baud rate. See the following table for details:

DIP1	DIP2	DIP3	Communication speed/bps	Max communication distance
ON	ON	ON	10K	5000m
OFF	ON	ON	20K	2500m
ON	OFF	ON	50K	1000m
OFF	OFF	ON	100K	500m
ON	ON	OFF	125K	500m
OFF	ON	OFF	250K	250m
ON	OFF	OFF	500K	100m
OFF	OFF	OFF	1000K	25m

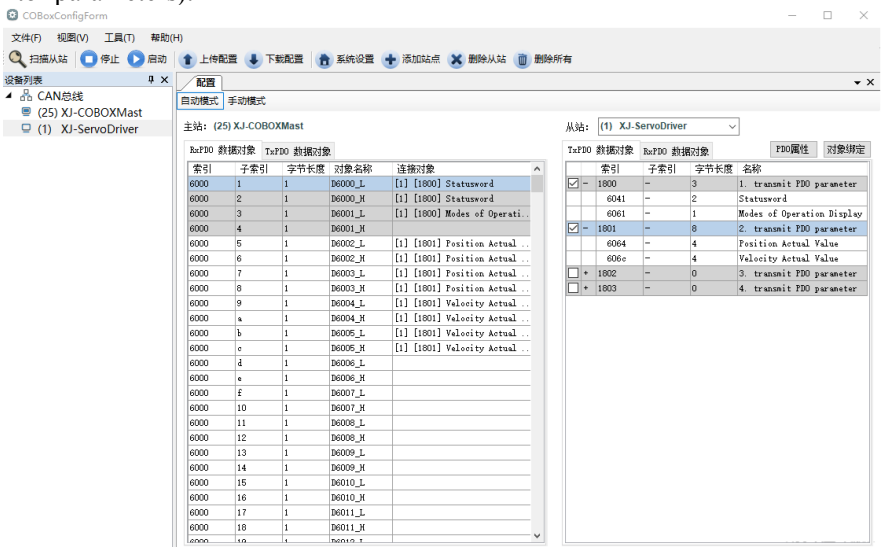
Note: the dial switch is only effective when the module is powered off. After setting, power on the module.

For example: realize the CANopen function of the DS5N1 servo of Xinje, use the XD-COBOX-ED module of Xinje as the master station of the CANopen network, cooperate with the XDM series PLC of Xinje, and set the dial switch 4 to on. Set the P7-31 parameter through the upper computer or panel (or modify 271Fh through SDO read-write instruction) and set the DS5N1 servo baud rate to 500kbps, then the baud rate of the corresponding XD-COBOX-ED module should also be set to 500kpbs (the baud rate of the master and slave station should be consistent), that is, set the dial switch 1 to on, 2 and 3 to off.
Under normal communication conditions, the COBOX indicator light should be PWR and RUN always on, ERR light is not on, and COM light is flashing. For specific instructions on the indicator light and dial switch, please refer to the user manual of XD series PLC left expansion module and CANopen communication user manual.

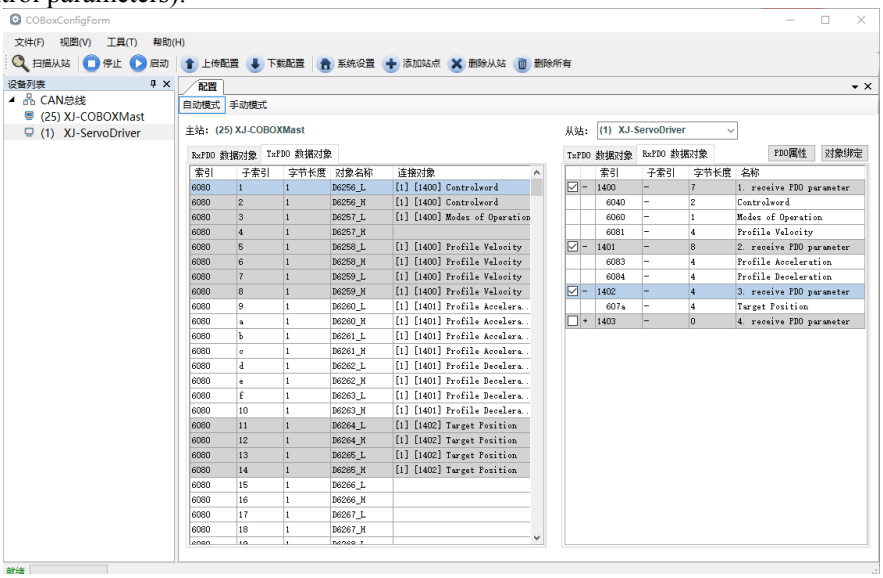
3. PP mode setting and control process

① click scan/add to add EDS file in CANopen configuration interface. Set the object binding of TxPDO and RxPDO. Here, some common objects in PP mode can be bound. If there are other requirements, you can add them yourself. After binding, you need to enable the configured PDO. The specific configuration is shown in the figure below.

TxPDO (monitor parameters):



RxPDO (control parameters):



② Download and activate the configurations. The slave station state machine automatically switches from PreOP to OP state. At this time, SDO and PDO can receive and send signals. XDPpro allows you to monitor or modify the mapping of the object dictionary. The specific correspondence is shown in the figure below.

PLC1-自由监控3

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
D6256	0	单字	10进制	control word
D6257	1	单字	10进制	control mode
D6258	0	双字	10进制	internal speed setting 6081
D6260	0	双字	10进制	acceleration 6083
D6262	0	双字	10进制	deceleration 6084
D6264	0	双字	10进制	target position
D6000	624	单字	10进制	6041 status word
D6001	1	单字	10进制	6061 mode inquire
D6002	0	双字	10进制	6064 position feedback
D6004	-2	双字	10进制	606C speed feedback

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

7.2 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.

7.2.1 Related parameters

PV control mode related objects (command · setting)

Register	Note	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	Command unit /s²
RXPDO[0x6084]	Internal deceleration	Command unit /s²
RXPDO[0x60C5]	Max acceleration	Command unit /s²
RXPDO[0x60C6]	Max deceleration	Command unit /s²

PV control mode related objects (command · monitor)

Register	Note	Unit
TXPDO[0x6041]	Status word	-
TXPDO[0x6061]	Mode inquires	-
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%

7.2.2 Control word (6040h) < pv control mode function >

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 conversion.

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 (not correspond)
oms = operation mode specific (control mode based on bit)
h = halt
fr = fault reset
eo = enable operation
qs = quick stop
ev = enable voltage
so = switch on

PV mode, not use oms bit.

7.2.3 Control word (6041h) < pv control mode function >

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>DateType</th><th>Access</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6041h</td><td rowspan="2">00h</td><td>Statusword</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the status of the servo drive.
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>Target reached</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>w</td><td>sod</td><td>qs</td><td>ve</td><td>f</td><td>oe</td><td>so</td><td>rsto</td></tr>
</table>
r = reserved (not correspond)
oms = operation mode specific (control mode based on bit)
ila = internal limit active
rm = remote so = switched on
rtso = ready to switch on
w = warning
sod = switch on disabled
qs = quick stop
ve = voltage enabled
f = faultoe = operation enabled</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, the bit10 of 6041h (status word) becomes 1.

Bit	Name	Value	Definition
10	Target reached	0	halt=0 (general): Speed control not completed halt=1 (when stop according to halt): the shaft is decelerating
		1	halt=0 (general): speed control completed halt=1(when stop according to halt): shaft stop (shaft speed is 0)

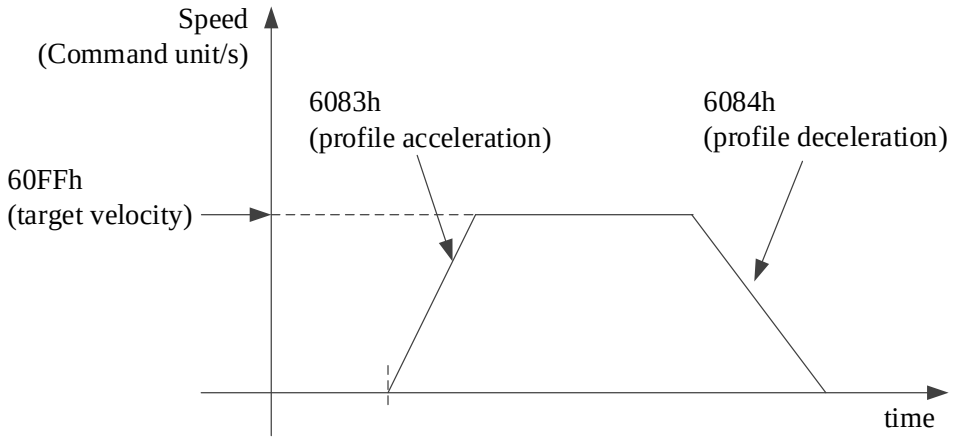
7.2.4 pv control mode action description

The PV control mode generates speed commands based on the following parameters:

Target Velocity (60FFh) Profile acceleration (6083h)

Profile deceleration (6084h)

Turn off the motor enable, set the target word 6060h to 3, set the 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). When the motor is enabled, the motor shall start to act according to the set value.

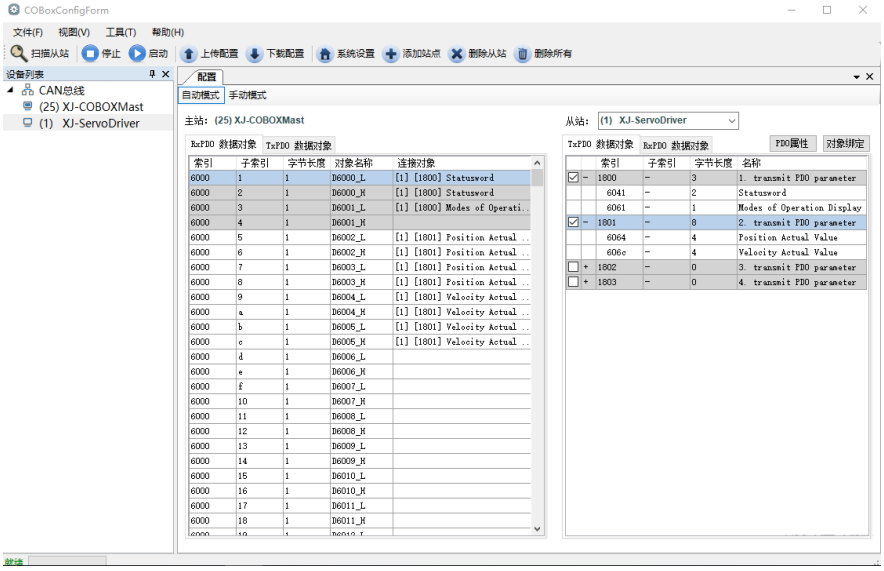


7.2.5 PV mode operation instance

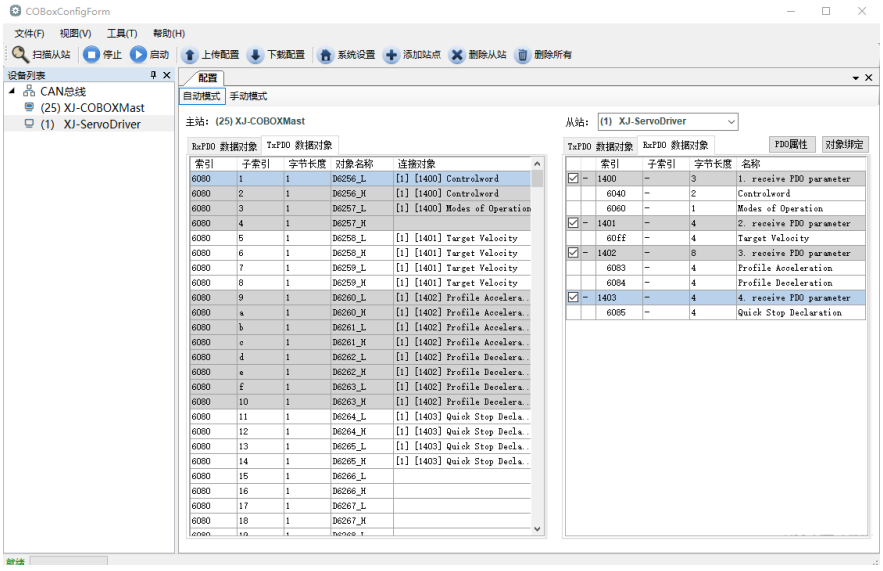
1. The wiring please refer to chapter 3-1-5.
2. Station no. and baud rate please refer to chapter 3-1-5.
3. PV mode configuration and control process

① click scan/add to add EDS file in the CANopen configuration interface. Configure the object binding of TxPDO and RxPDO. Here, some common objects of PV mode can be bound. If there are other requirements, you can add them yourself. After binding, you need to enable the configured PDO. The specific configuration is shown in the figure below.

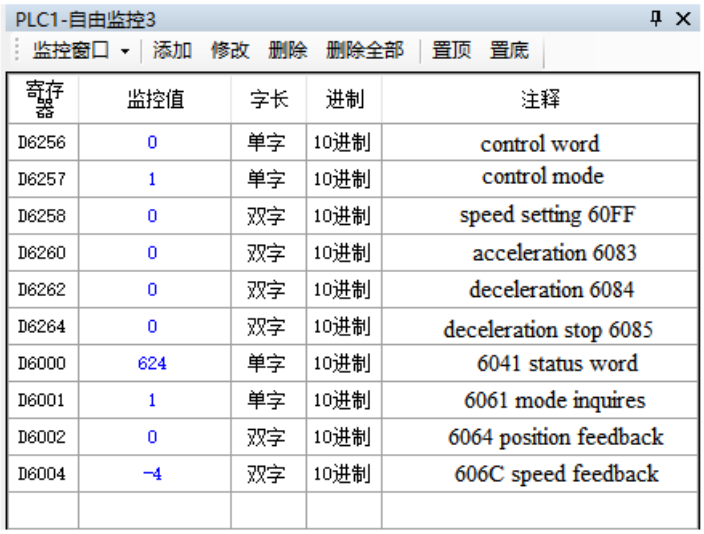
TxPDO (monitor parameters):



RxPDO (control parameters)



② Download and activate the configurations. The slave station state machine automatically switches from PreOP to OP state. At this time, SDO and PDO can receive and send signals. The mapping of object dictionary can be monitored or modified through XDPpro. The specific correspondence is shown in the figure below.



寄存器	监控值	字长	进制	注释
D6256	0	单字	10进制	control word
D6257	1	单字	10进制	control mode
D6258	0	双字	10进制	speed setting 60FF
D6260	0	双字	10进制	acceleration 6083
D6262	0	双字	10进制	deceleration 6084
D6264	0	双字	10进制	deceleration stop 6085
D6000	624	单字	10进制	6041 status word
D6001	1	单字	10进制	6061 mode inquires
D6002	0	双字	10进制	6064 position feedback
D6004	-4	双字	10进制	606C speed feedback

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

7.3 TQ mode

TQ (profile torque control mode) is a torque control mode that specifies the target torque, acceleration and deceleration, and acts after generating position commands in the servo driver.

7.3.1 Related parameters

TQ control mode related object (command・setting)

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	Datatype	Access	PDO	OP-mode
6087h	00h	Torque slope	0.1 %	0~4294967295	U32	rw	RxPDO	tq cst
		Set the parameter value to give the tendency torque command. If set to 0, the internal processing operates with 1.						

TQ control mode related object (command・monitor)

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

7.3.2 Control word (6040h) < tq control mode function >

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 conversion.
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 (not correspond)
oms = operation mode specific (control mode based on bit)
h = halt
fr = fault reset
eo = enable operation
qs = quick stop
ev = enable voltage
so = switch on

TQ mode, not use oms bit.

7.3.3 Status word (6041h) < tq control mode function >

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/Description</th><th>Range</th><th>DateType</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 status of the servo drive.
<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>Target reached</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>w</td><td>sod</td><td>qs</td><td>ve</td><td>f</td><td>oe</td><td>so</td><td>rsto</td></tr>
</table>
Bit information
r = reserved (not correspond)
oms = operation mode specific
(control mode based on bit)
ila = internal limit active
rm = remote
w = warning
sod = switch on disabled
qs = quick stop
ve = voltage enabled
f = fault
oe = operation enabled
so = switched on
rtso = ready to switch on</td></tr>
</table>

bit13,12,10 (operation mode specific):

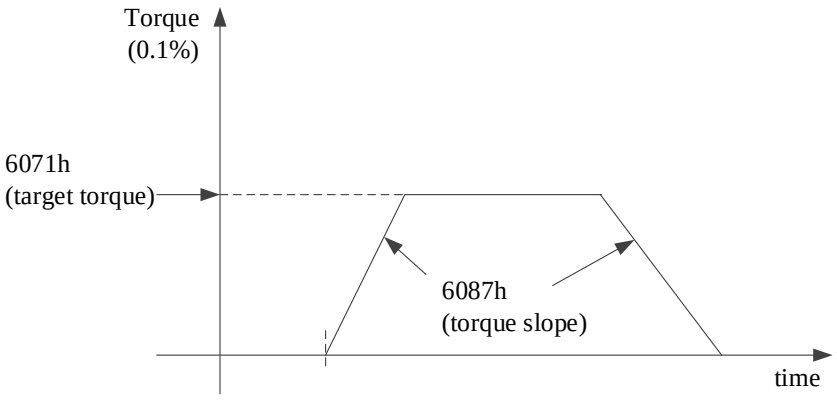
Bit	Name	Value	Definition
10	target reached	0	halt=0 (general): 6074h (Torque demand) not reach target torque halt=1 (stop as halt): shaft is decelerating
		1	halt=0 (general): 6074h (Torque demand) reached target torque halt=1 (stop as halt): shaft stop (shaft speed is 0)
12	reserved	-	not used
13	reserved	-	not used

7.3.4 TQ control action description

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

Operation steps:

(1) turn off the motor enable, set the object word 6060 to 4, set 6071h (Target torque), 6080h (Max motor speed) and 6072h (Max torque).
(2) Turn on the motor enable, the motor shall increase the output torque according to the set torque slope until the set value and the speed does not exceed the set maximum speed.



7.3.5 TQ mode operation instance

1. Wiring

Refer to chapter 3-1-5.

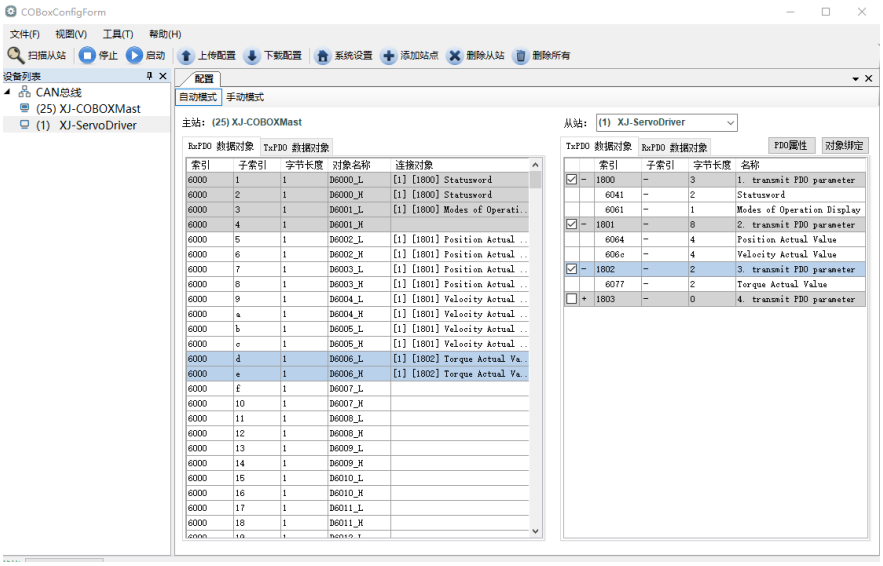
2. Baud rate and station no.

Refer to chapter 3-1-5.

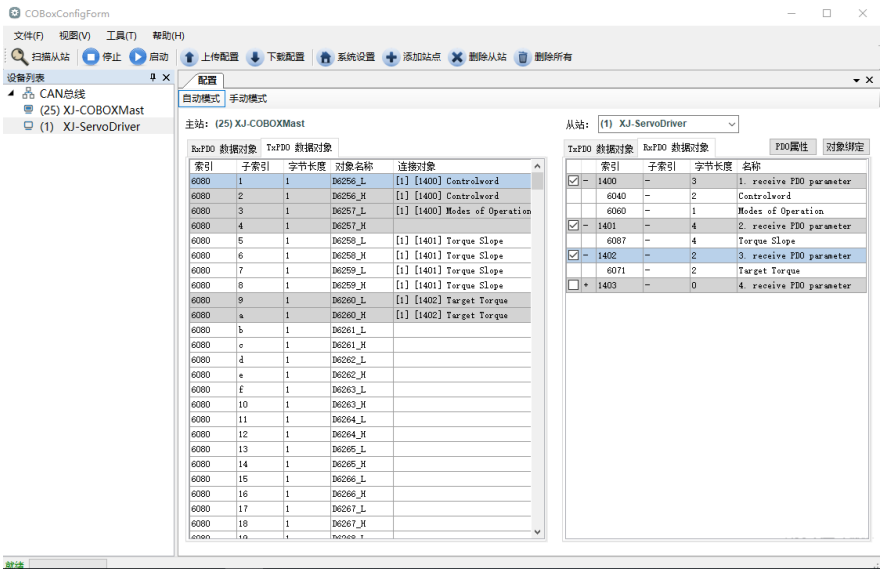
3. TQ mode configuration and control process.

① Click [scan] or [add slave] in CANopen configuration interface to add corresponding EDS files, and configure the object binding of TxPDO and RxPDO. Here, some common objects in TQ mode can be bound. If there are other requirements, you can add them yourself. After binding, you need to enable the configured PDO. Some SDO data can be read or written through SDO configuration tool or SDO read-write instruction. The specific configuration is shown in the figure below.

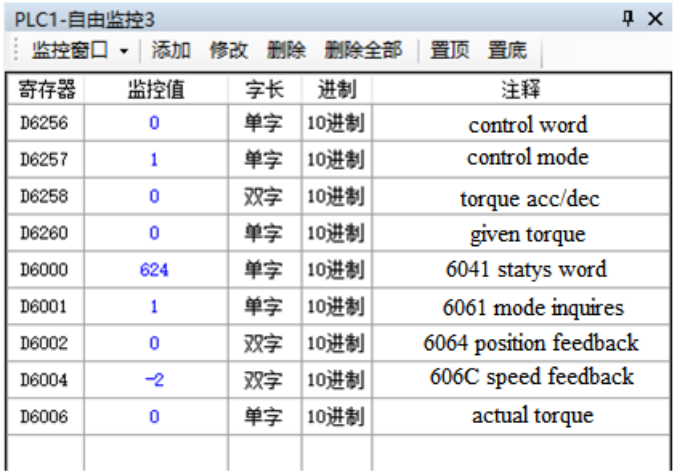
TxPDO (monitor parameters):



RxPDO (control parameters):



② Download the activation configuration, and the slave state machine will automatically switch from PreOP to OP state. At this time, SDO and PDO can receive and send signals. The mapping of object dictionary can be monitored or modified through XDPpro software. The specific correspondence is shown in the figure below.



寄存器	监控值	字长	进制	注释
D6256	0	单字	10进制	control word
D6257	1	单字	10进制	control mode
D6258	0	双字	10进制	torque acc/dec
D6260	0	单字	10进制	given torque
D6000	624	单字	10进制	6041 statys word
D6001	1	单字	10进制	6061 mode inquires
D6002	0	双字	10进制	6064 position feedback
D6004	-2	双字	10进制	606C speed feedback
D6006	0	单字	10进制	actual torque

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

7.4 HM mode

HM mode (i.e. homing mode) is a position control mode that specifies various action speeds, generates position instructions inside the servo driver and performs homing action. In this mode, external signals (POT, NOT, SPD-D) must be used together. If the external signal is not configured correctly, it may lead to partial homing mode failure of normal operation.

7.4.1 Related parameters

HM control mode related object (command · setting)

Register	Note
RXPDO[0x6040]	Control word, turn on the homing function by modifying the control word
RXPDO[0x6060]	Set to 6 when the motor is not enabled
RXPDO[0x607F]	Maximum internal speed
RXPDO[0x6080]	Maximum motor speed
RXPDO[0x60C5]	Maximum acceleration
RXPDO[0x60C6]	Maximum deceleration
RXPDO[0x6098]	Homing mode
RXPDO[0x6099]	Homing speed
RXPDO[0x609A]	Homing acceleration

PV control mode related object (command · monitor)

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

7.4.2 Control word (6040h) < hm control mode function >

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 conversion.
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 (not correspond)
oms = operation mode specific (control mode based on bit)
h = halt
sh = start homing
fr = fault reset
eo = enable operation
qs = quick stop
ev = enable voltage
so = switch on

bit6-4 (operation mode specific):

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

7.4.3 Status word (6041h) < hm control mode function >

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

Indicates the status of the servo drive.
Bit information

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

r = reserved (not correspond)
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

bit10, 12-13 (operation mode specific):

Bit	Name	Value	Definition
10	target reached	0	Homing action in progress
		1	Homing action has been completed
12	homing attained	0	Homing action not completed
		1	Homing action is completed normally
13	homing error	0	Homing action is not abnormal
		1	Homing action is abnormal

The homing action has the following states:

Bit13	Bit12	Bit10	Definition
0	0	0	Homing action in progress
0	0	1	The homing action has not started, or the homing action is interrupted
0	1	0	The homing action has been completed, but the target position has

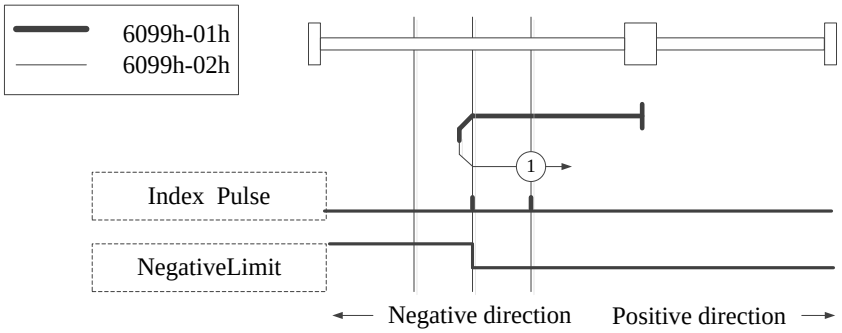
			not been reached
0	1	1	The homing action has been completed and successfully reached the target position
1	0	0	Abnormal homing action is detected and it is still operating
1	0	1	It is detected that the homing action is abnormal and has stopped

7.4.4 Homing mode (6098h)

1-14，17~30，33，34，35，37。At present, DS5N1 series servo supports the homing mode of 1-14, 17 ~ 30, 33, 34, 35 and 37.

- Mode 1:

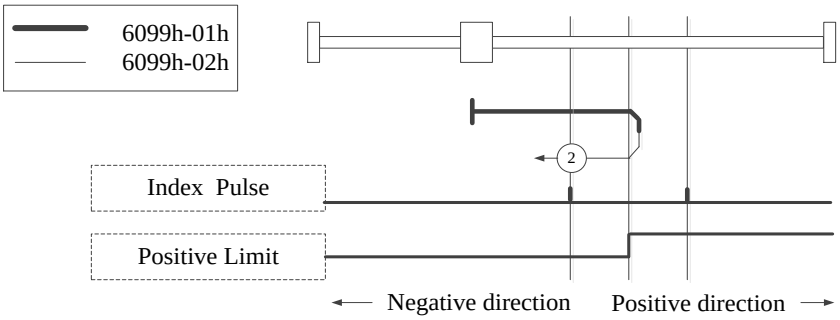
When using homing mode 1, if the reverse limit switch is in the non triggered state, the initial moving direction is left. The origin position is at the first z-phase pulse on the right of the position where the negative limit switch becomes invalid.



Homing on negative limit switch and index pulse

- Mode 2:

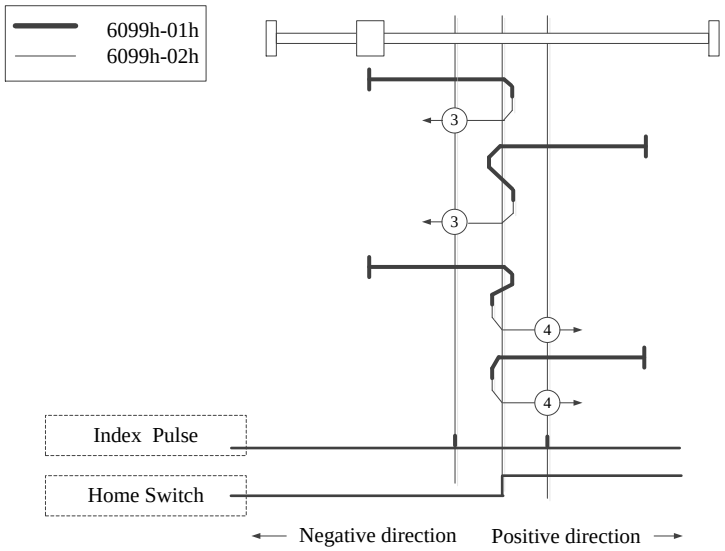
When using homing mode 2, if the forward limit switch is not triggered, the initial moving direction is right. The origin position is at the first z-phase pulse on the left of the position where the positive limit switch becomes invalid.



Homing on positive limit switch and index pulse

- Mode 3, 4:

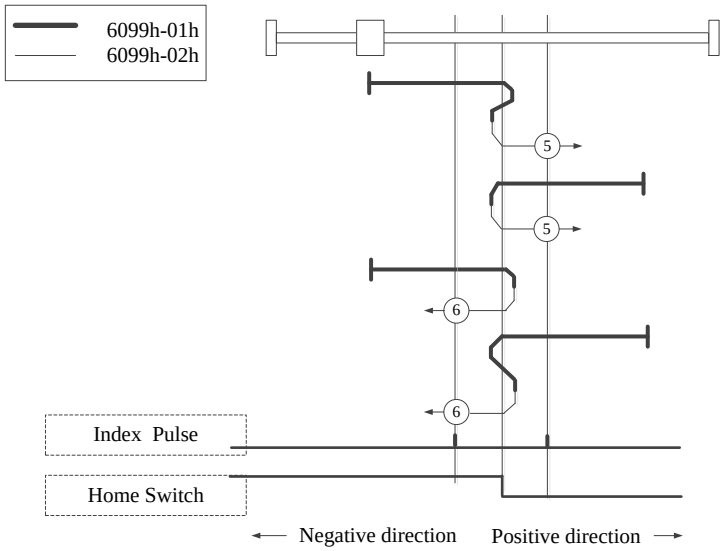
When using homing mode 3 or 4, the initial direction of movement depends on the status of the origin switch. The origin position is on the reverse side of the origin switch or on the initially detected z-phase position in the forward direction.



Homing on positive home switch and index pulse

- Mode 5, 6:

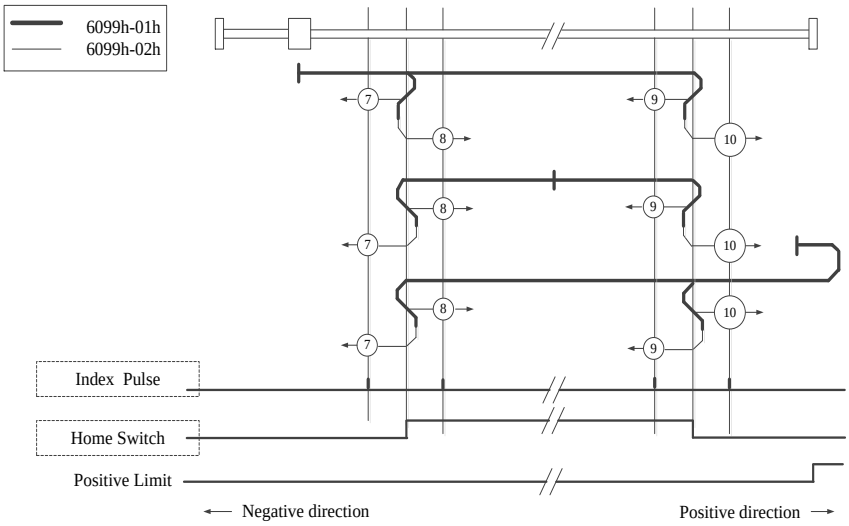
When using homing mode 5 or 6, the initial direction of movement depends on the status of the origin switch. The origin position is on the reverse side of the origin switch or on the initially detected z-phase position in the forward direction.



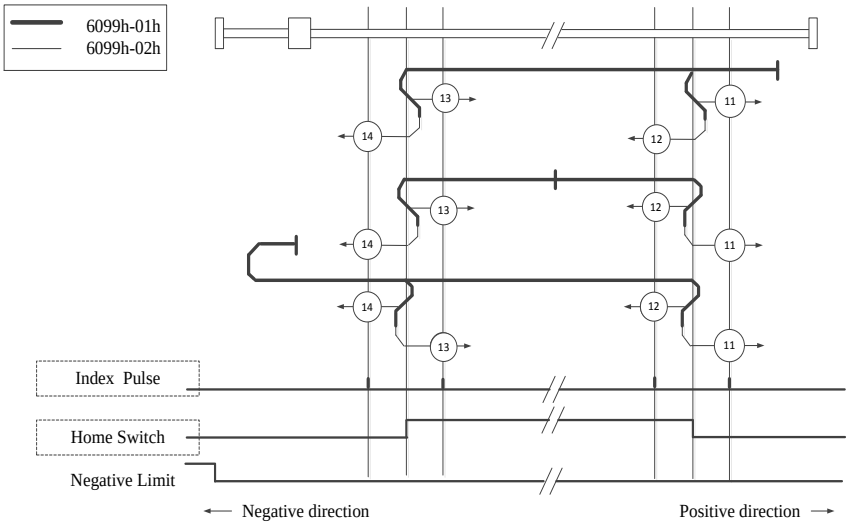
Homing on negative home switch and index pulse

- Mode 7~14:

Mode 7~14 all use origin switch and z-phase signal.
Mode 7, 8 initial direction: if origin switch has been activated when action starts, it is negative direction.
Mode 9, 10 initial direction: if origin switch has been activated when action starts, it is positive direction.
Mode 11, 12 initial direction: if origin switch has been activated when action starts, it is positive direction.
Mode 13, 14 initial direction: if origin switch has been activated when action starts, it is negative direction.
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



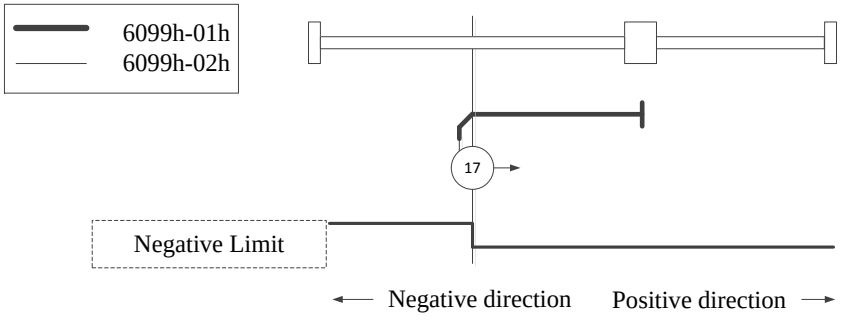
Homing on home switch and index pulse – Negative initial motion

■ Mode 17

Mode 7 is similar to Mode 1.

The difference is that the origin detection position is not the Index pulse, but the position where the Limit switch changes. (please refer to the figure below)

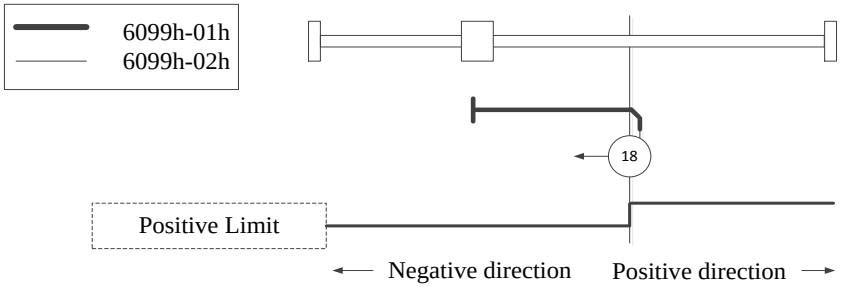
When NOT is not distributed, Homing error = 1.



Homing on negative limit switch

■ Mode 18

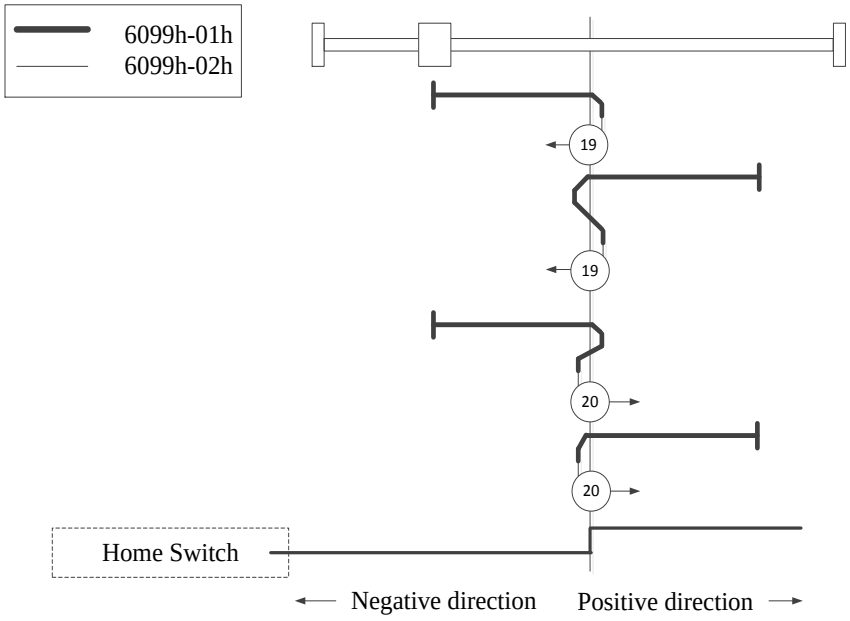
Mode 8 is similar to Mode 2.
The difference is that the origin detection position is not the Index pulse, but the position where the Limit switch changes. (please refer to the figure below)
When POT is not distributed, Homing error = 1.



Homing on positive limit switch

■ Mode 19, 20

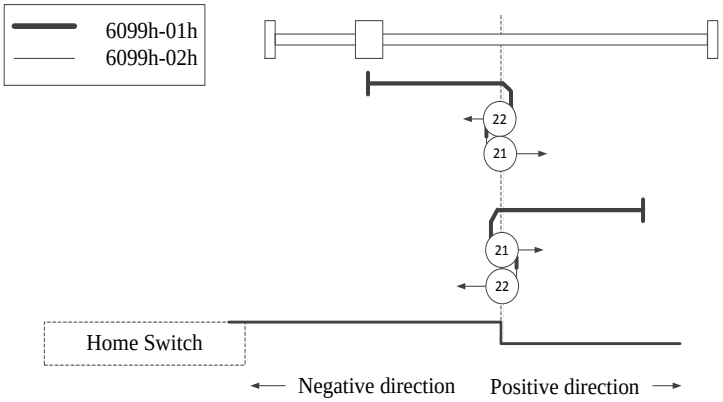
Mode 19, 20 are similar to Mode 3, 4.
The difference is that the origin detection position is not the Index pulse, but the position where the Home switch changes. (please refer to the figure below)
When HOME is not distributed, Homing error = 1.



Homing on positive home switch

■ Mode 21, 22

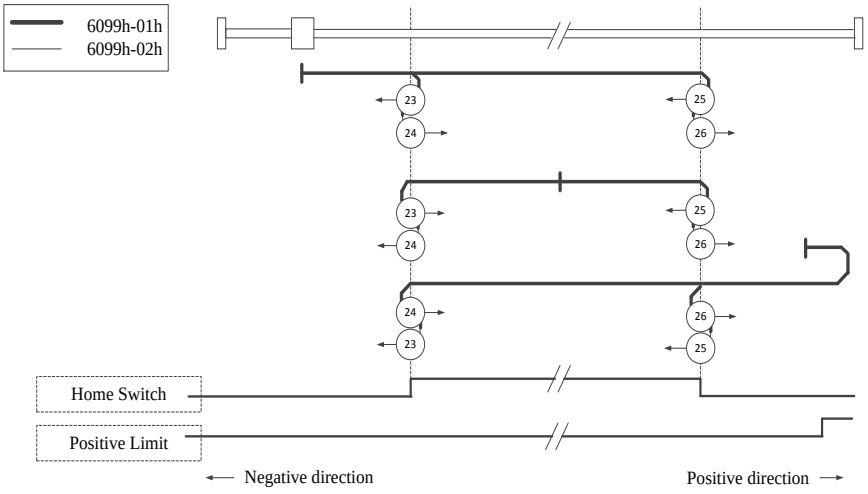
Mode 21, 22 are similar to Mode 5, 6.
The difference is that the origin detection position is not the Index pulse, but the position where the Home switch changes. (please refer to the figure below)
When HOME is not distributed, Homing error = 1.



Homing on positive home switch and index pulse

■ Mode 23, 24, 25, 26

Mode 23, 24, 25, 26 are similar to Mode 7, 8, 9, 10.
The difference is that the origin detection position is not the Index pulse, but the position where the Home switch changes. (please refer to the figure below)
When HOME, POT are not distributed, Homing error = 1.



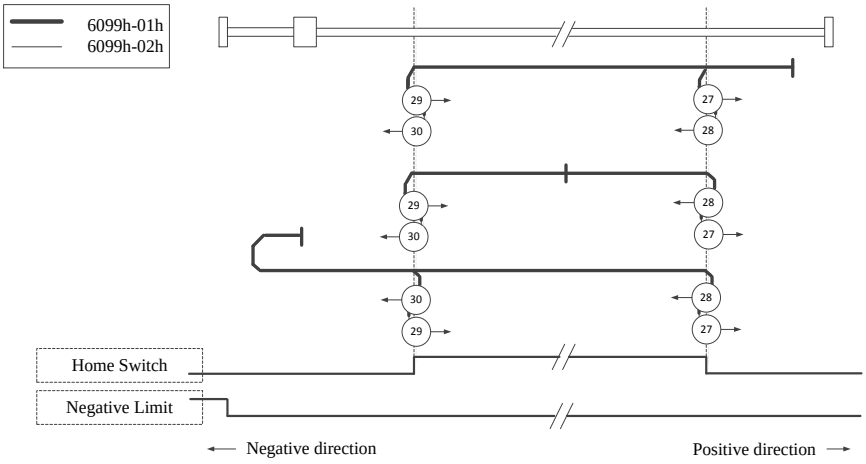
Homing on home switch and index pulse – positive initial motion

■ Mode 27, 28, 29, 30

Mode 27, 28, 29, 30 are similar to Mode 11, 12, 13, 14.

The difference is that the origin detection position is not the Index pulse, but the position where the Home switch changes. (please refer to the figure below)

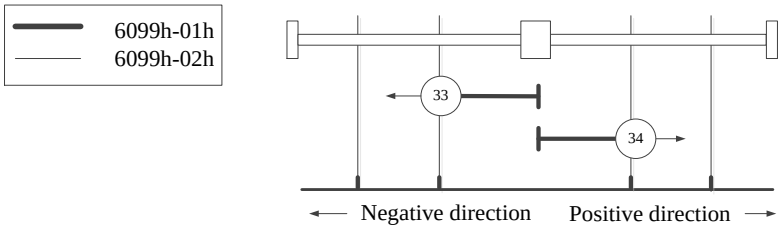
When HOME, NOT are not distributed, Homing error = 1.



Homing on home switch and index pulse – Negative initial motion

■ Mode 33, 34:

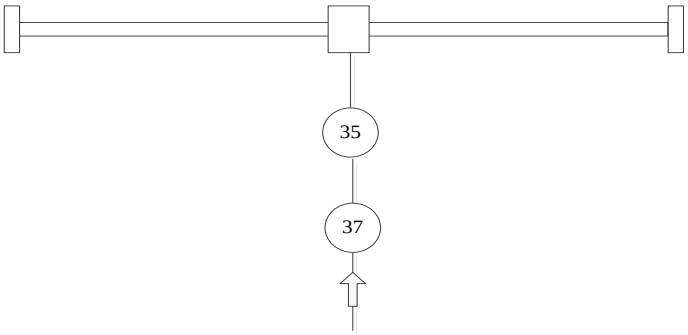
When using mode 33 or 34, the return to origin direction is negative or positive, respectively. The original position is located at the Z phase near the selected direction.



Homing on index pulse

■ Mode 35, 37

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



7.4.5 HM mode operation instance

1. Wiring

Refer to chapter 3-1-5.

2. Station no. and baud rate

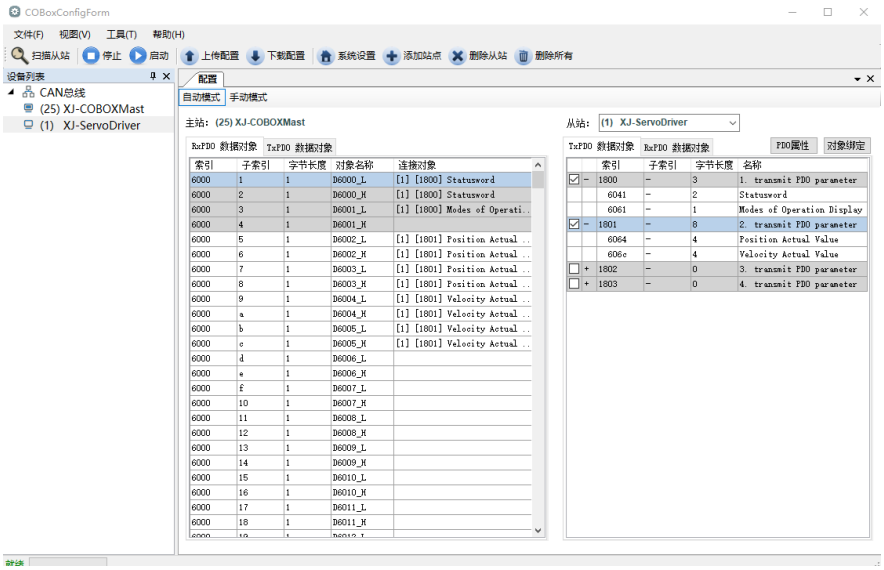
Refer to chapter 3-1-5.

3. HM configuration and control process.

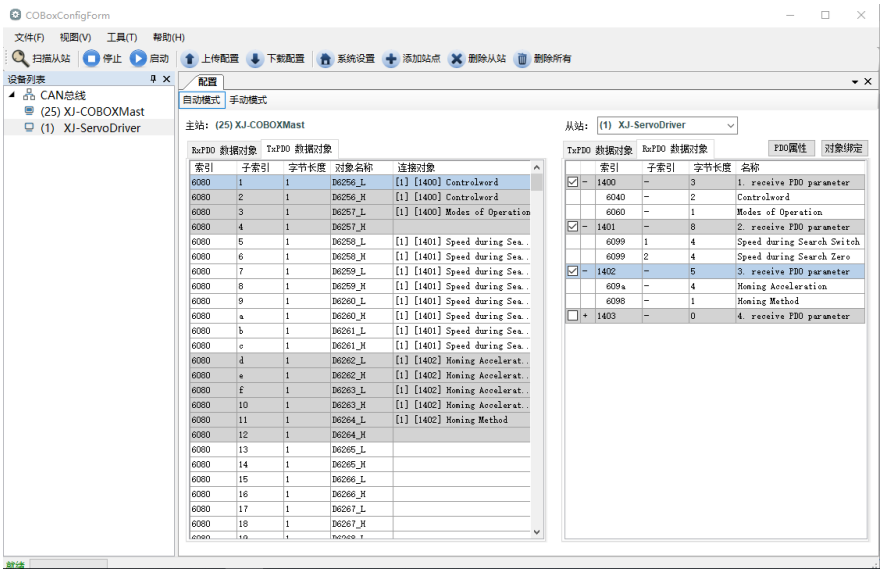
① Carry out terminal assignment. Modify P5-22, P5-23, P5-27 through upper computer or configure the P-OT, N-OT, SPD-D signal for the index 2516, 2517, 251B through SDO read write command. If not assigned correctly, then homing error = 1.

② Click [scan] or [add slave] in CANopen configuration interface to add corresponding EDS files, and configure the object binding of TxPDO and RxPDO. Here, some common objects in HM mode can be bound. If there are other requirements, you can add them yourself. After binding, you need to enable the configured PDO. The specific configuration is shown in the figure below.

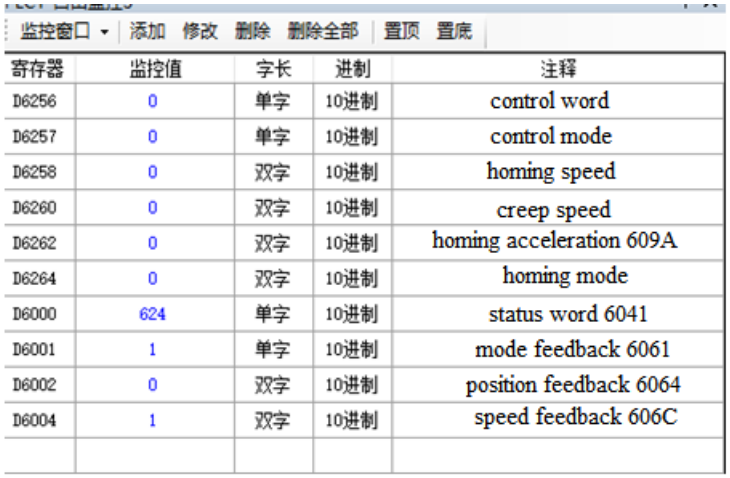
TxPDO (monitor type parameters):



RxPDO (control type parameters):



③ Download and activate the configuration, and the slave state machine will automatically switch from PreOP to OP state. At this time, SDO and PDO can receive and send data. The mapping of the object dictionary can be monitored or modified through XDPpro software. The specific correspondence is shown in the figure below.



寄存器	监控值	字长	进制	注释
D6256	0	单字	10进制	control word
D6257	0	单字	10进制	control mode
D6258	0	双字	10进制	homing speed
D6260	0	双字	10进制	creep speed
D6262	0	双字	10进制	homing acceleration 609A
D6264	0	双字	10进制	homing mode
D6000	624	单字	10进制	status word 6041
D6001	1	单字	10进制	mode feedback 6061
D6002	0	双字	10进制	position feedback 6064
D6004	1	双字	10进制	speed feedback 606C

④ First set P0-00 to 1 to start the motion control function of CiA402, then set D6257 to HM mode (set 6060h to 6), set the homing mode through D6258 (6098h), and set the homing 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 homing mode. Other monitoring parameters are monitored by D6000-D6011. In the homing process, if the origin signal is triggered, it will slow down and stop according to the corresponding homing mode. If you need to homing again, first change 6040h to 0x06h, and then repeat the above operation.

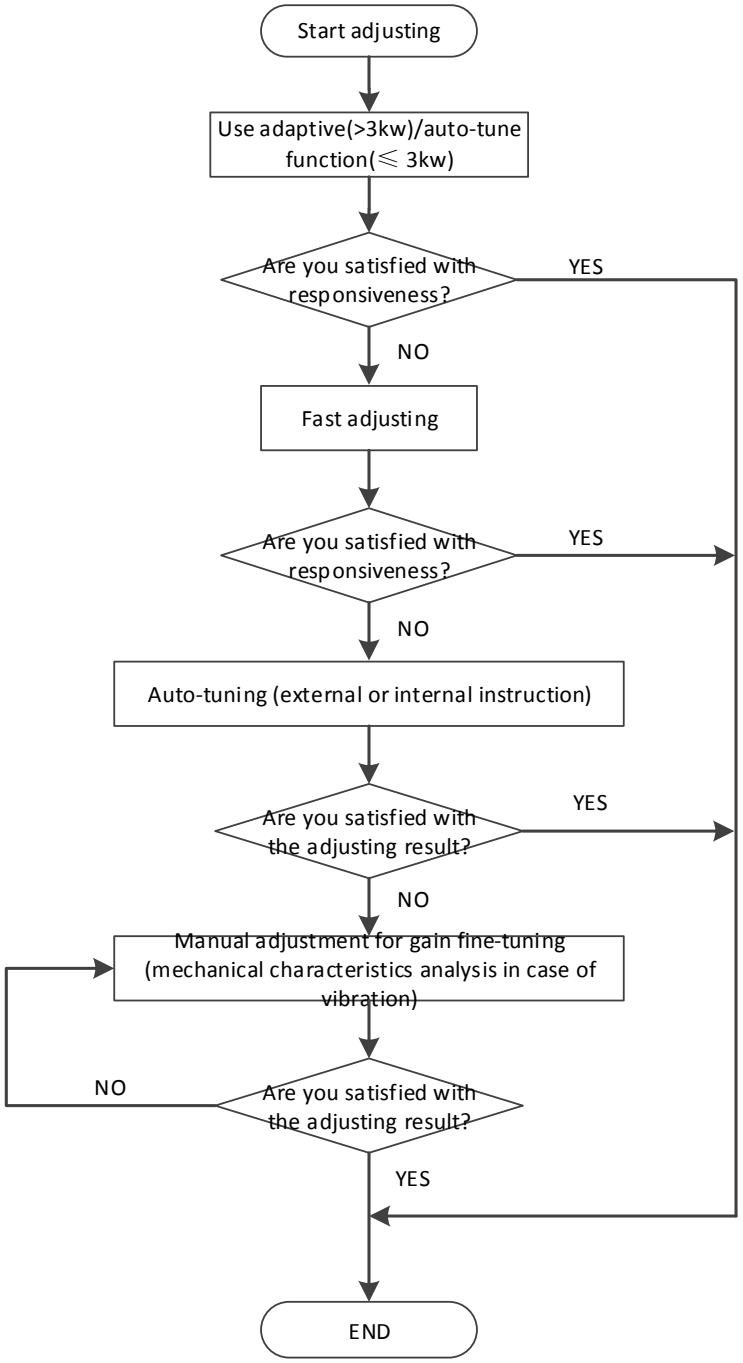
8 Servo gain adjustment

8.1 Overview of servo gain adjustment

8.1.1 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.



8.1.2 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	

8.2 Rotary inertia presumption

8.2.1 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	500	%	0~50000	Anytime	At once

8.2.2 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 500 times (parameter upper limit is 50000). If the estimated inertia ratio is exactly 50000, it means that the inertia ratio has reached the upper limit and can not be used, please replace the motor with larger rotor inertia.

8.2.3 Operation tool

The tools that can estimate the moment of inertia of the load include the driver panel and xinjeservo software.

8.2.4 Operation steps

Estimate the inertia through the driver panel

1. Parameter setting

Parameter	Meaning	Default setting	Unit	Range	Modification	Effective
P2-15	Inertia configured trip	100	0.01 circle	1~3000	Anytime	At once
P2-17	Inertia identification and internal instruction auto-tuning max speed	-	rpm	0~65535	Anytime	At once
P2-18	Inertia identification initial inertia ratio	500	%	1~20000	Anytime	At once

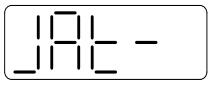
The recommended parameters of P2-17 are 500 rpm or more. Low instruction speed will lead to inaccurate identification of inertia ratio.

2. Execute the inertia identification

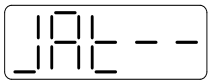
Before inertia identification, please confirm the direction of servo rotation by using F1-00 jog motion function. Initial direction of servo operation is determined by INC or DEC at the beginning of inertia identification.

If the servo jitter is under the adaptive default parameters, please switch to the adaptive large inertia mode (P2-03.3=1) to ensure the basic smooth operation of the servo and then identify the inertia!

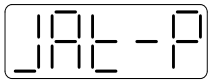
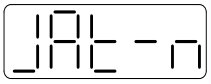
Servo entering parameter F0-07 in BB state:



Press ENTER, servo is enabled:



Press INC or DEC to run forward or reverse (select one of them):

 or 

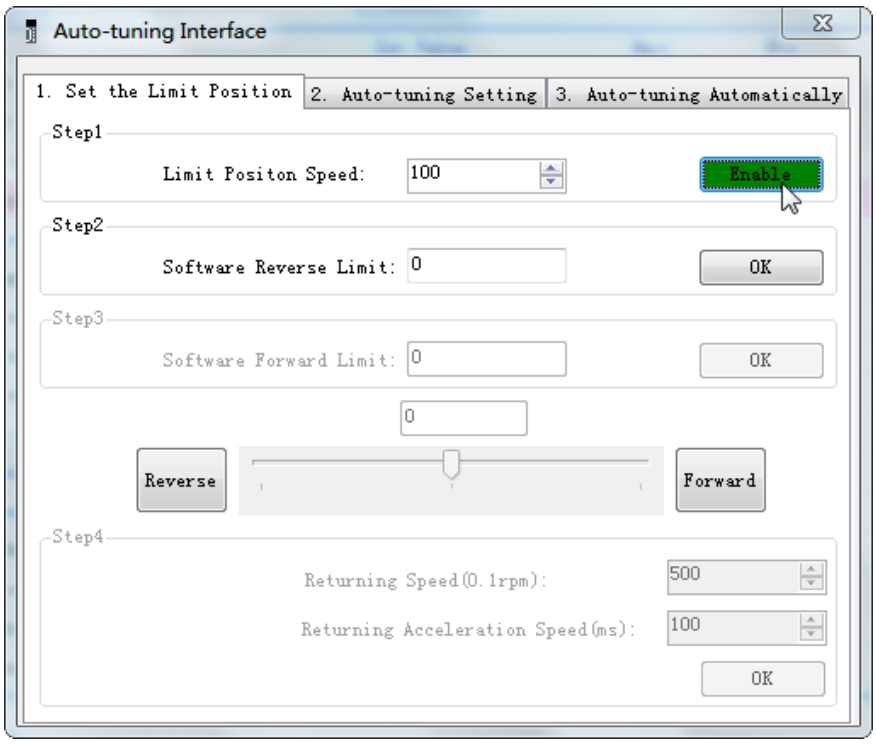
At this point, start action, under the condition of P-05 = 0 (initial positive direction), if press INC, then turn forward and then reverse; if press DEC, turn reverse and then forward. If the inertia identification is successful, the load inertia ratio is prompted and written to P0-07 automatically after several forward and reverse operations. If the inertia identification error occurs, the error code will be displayed. Press STA/ESC key to exit the panel inertia identification operation.

■ Alarm for inertia identification of panel

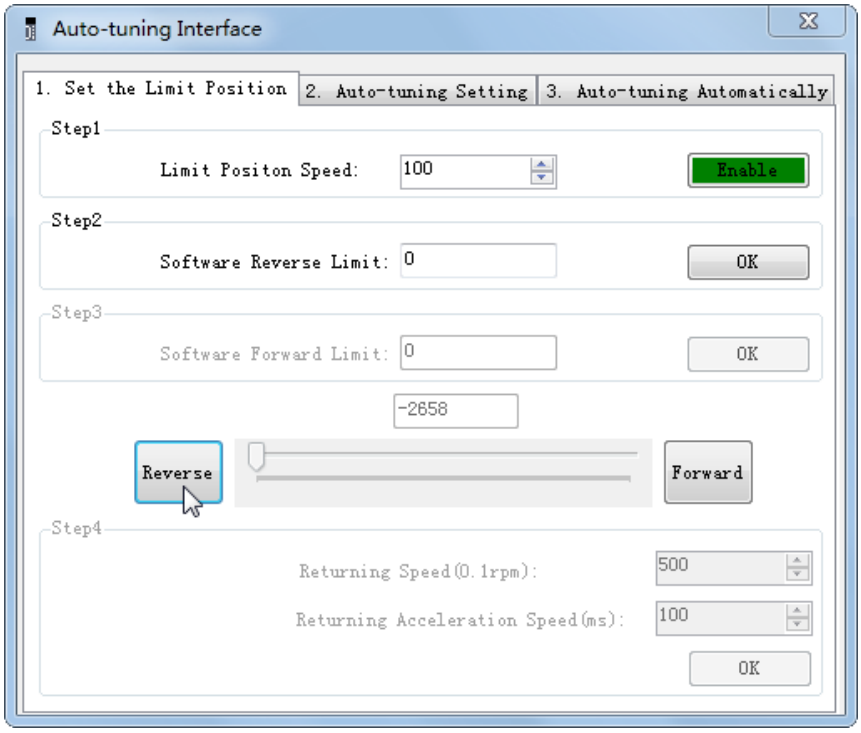
Error code	Meaning	Reasons and solutions	Reasons
Err-1	Motor Torque Saturation	① Initial inertia is too small; in adaptive mode, switch to large inertia mode P2-03.3=1 or the initial inertia of inertia identification P2-18 set to 2 times of the present value. ② The maximum speed is too high (P2-17), but it is recommended not to be less than 500 rpm. Low instruction speed will lead to inaccurate identification of inertia ratio. ③ torque limit too small（P3-28/29）	Initial inertia too small; Maximum speed too large; Torque limit too small
Err-2	value error is too large when calculating the inertia	① The maximum speed limit is too small (P2-17), but it is recommended not to be less than 500 rpm. Low instruction speed will lead to inaccurate identification of inertia ratio. ② The presumed inertia trip is too small. It is suggested that the minimum for P2-15 should no be less than 50 (0.5 cycles). If the trip is too small, the identification of inertia ratio will be inaccurate. ③ mechanism friction too large ④ overshoot	The maximum speed limit is too small; the travel is too small; the friction of the mechanism is too large; the overrun occurs
Err-3	Driver internal trip calculation error	① The presumed inertia trip is too small. It is suggested that the minimum for P2-15 should no be less than 50 (0.5 cycles). If the trip is too small, the identification of inertia ratio will be inaccurate.	Contact us
Err-5	Unrestrained Vibration in the Process of Inertia Identification	Unhandled vibration occurs	Unhandled vibration occurs
Err-6	Driver is not currently in BB state	① Enable have been opened. P5-20 can be set to 0 first ② When the driver alarms, it will appear. Press ESC key to exit the auto-tuning interface to see if there is an alarm.	Will occur when enable is turned on or driver has alarm
Err-7	The driver alarms in the process of inertia identification	Driver has alarm, press ESC key to exit the auto-tuning interface, check the alarm code, first solve the alarm and then make inertia estimation.	Driver has alarm

Estimate the inertia through XinJeServo software

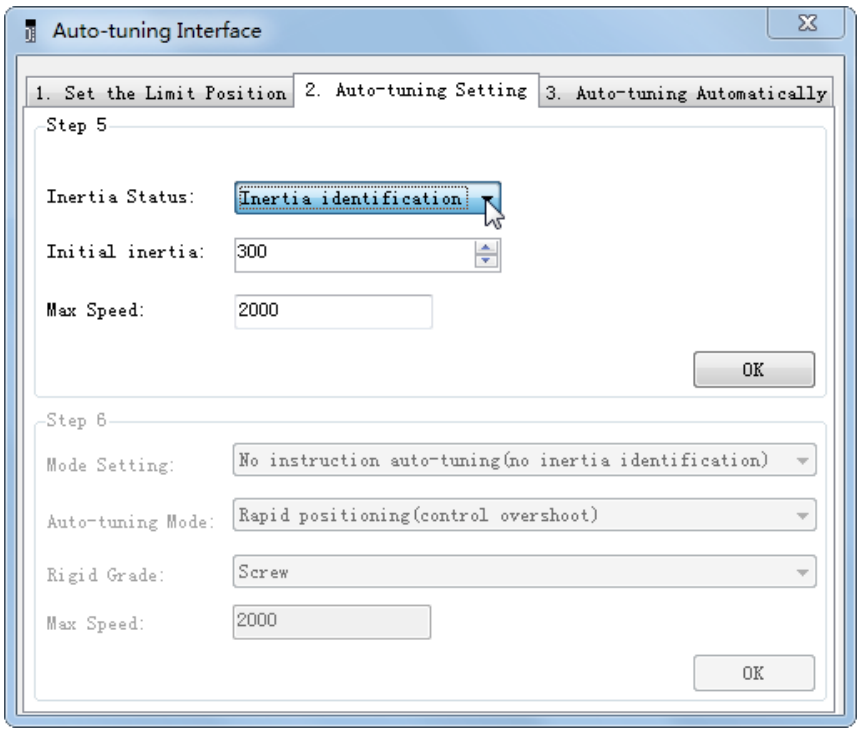
1. Click auto-tuning on the main interface of XinJeServo



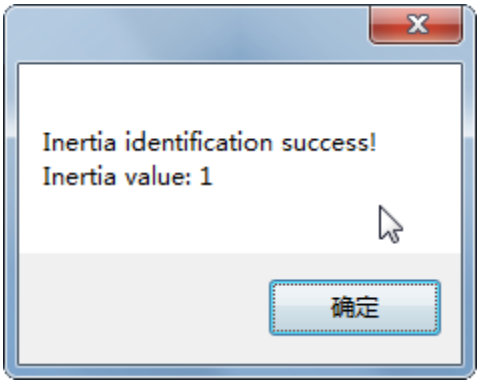
2. select jog setting or manual setting to configure the inertia estimation trip



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.

8.3 Fast adjustment

8.3.1 Overview

Fast adjustment needs to set the moment of inertia of load first, then turn off the adaptive function. If the inertia does not match, it will cause oscillation alarm. Servo firmware version 3640 and later versions support this function, and the version is viewed through U2-07. Fast adjustment of gain parameters belongs to auto-tuning mode.

8.3.2 Fast adjustment steps

1. estimate the load inertia through servo driver panel or XinJeServo software, refer to chapter 8.2
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

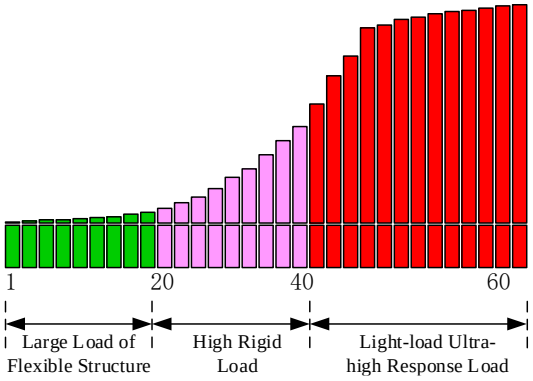
8.3.3 Rigidity level corresponding gain parameters

■ 3770 and later firmware

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 (3700~3720) Model loop gain	P2-49 (3730 and later) Model loop gain
1	20	31831	20	100	50	50
2	50	12732	50	100	80	80
3	70	9094	70	100	90	90
4	80	7957	80	100	100	100
5	100	6366	100	100	100	120
6	120	5305	120	100	150	150
7	140	4547	140	100	150	200
8	160	3978	160	100	200	250
9	180	3536	180	100	250	310
10	200	3183	200	100	300	350
11	220	2893	220	100	300	380
12	240	2652	240	100	350	410
13	260	2448	260	100	350	440
14	280	2273	280	100	350	470
15	300	2122	300	100	400	500
16	320	1989	320	100	400	540
17	340	1872	340	100	400	580
18	360	1768	360	100	450	620
19	380	1675	380	100	450	660
20	400	1591	400	100	500	700
21	450	1414	400	90	600	800
22	500	1273	450	80	700	950
23	550	1157	450	70	800	1100
24	600	1061	500	60	900	1300
25	650	979	550	50	1000	1500
26	700	909	600	40	1100	1800
27	750	848	650	30	1200	2100
28	800	795	700	20	1300	2400
29	850	748	750	10	1400	2700
30	900	707	800	10	1500	3000
31	950	670	900	10	1500	3100
32	1000	636	900	10	1600	3200
33	1050	606	950	10	1800	3300

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 (3700~3720) Model loop gain	P2-49 (3730 and later) Model loop gain
34	1100	578	1000	10	2000	3400
35	1150	553	1050	10	2200	3500
36	1200	530	1100	10	2400	3600
37	1250	509	1100	10	2500	3700
38	1300	489	1100	10	2600	3800
39	1350	471	1200	10	2700	3900
40	1400	454	1200	10	2800	4000
41	1450	439	1250	10	2900	4100
42	1500	424	1300	10	3000	4200
43	1550	410	1350	10	3200	4300
44	1600	397	1400	10	3500	4400
45	1650	385	1450	10	3800	4500
46	1700	374	1500	10	4000	4600
47	1750	363	1750	10	4500	4800
48	1800	353	1800	10	5000	5000
49	1850	344	1850	10	5000	5000
50	1900	335	1900	10	5000	5000
51	1950	326	1950	10	5000	5000
52	2000	318	2000	10	5000	5000
53	2050	310	2050	10	6000	6000
54	2100	303	2100	10	6000	6000
55	2150	296	2150	10	6000	6000
56	2200	289	2200	10	6000	6000
57	2250	282	2250	10	6000	6000
58	2300	276	2300	10	6000	6000
59	2350	270	2350	10	6000	6000
60	2400	265	2400	10	6000	6000
61	2450	259	2450	10	6000	6000
62	2500	254	2500	10	6000	6000
63	2600	244	2600	10	6000	6000

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.
Ultra-high response load under light load: refers to equipment with very small inertia, strong mechanical stiffness and high response.

Driver power	Default parameters	Firmware 3770 and up corresponding rigidity level
1.5kw and up	P1-00=200 P1-01=3300 P1-02=200 P2-35=100 P2-49=300	10
200w~750w	P1-00=300 P1-01=2200 P1-02=300 P2-35=100 P2-49=400	15
100w	P1-00=400 P1-01=1650 P1-02=400 P2-35=100 P2-49=500	20

8.3.4 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 8.7 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.

8.4 Auto-tuning

8.4.1 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)

8.4.2 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.

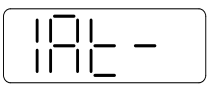
8.4.3 Operation tools

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

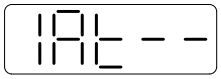
8.4.4 Internal instruction auto-tuning steps

Driver panel auto-tuning steps

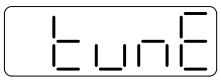
1. The inertia identification is carried out, and the inertia estimation steps please refer to chapter 8.2.4 operation steps.
2. Enter F0-09, panel display is iat-；



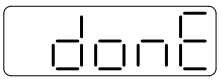
3. Press ENTER, panel display is iat--, servo is in enabled status right now;



4. Press INC or DEC, panel display is tune and flashing, enter auto-tuning status;



5. Driver will automatically send pulse instructions, if the auto-tuning is successful, the panel shows done and flashing.



6. Press STA/ESC to exit internal instruction auto-tuning.

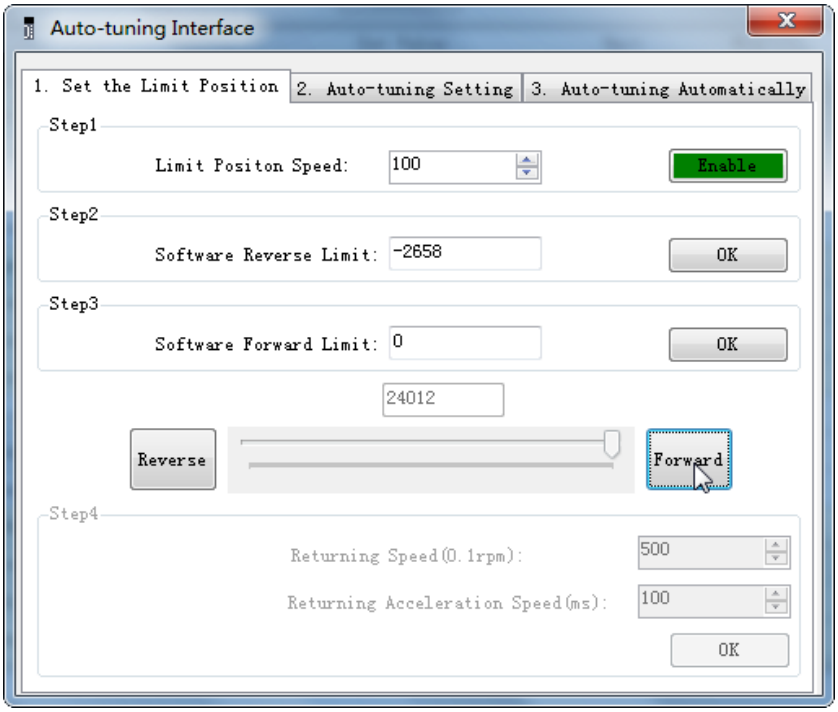
Note: In the process of auto-tuning, press STA/ESC will exit the auto-tuning operation and use the gain parameters at the exit time. If auto-tuning fails, it is necessary to initialize the driver before auto-tuning again.

■ Panel alarm in auto-tuning process

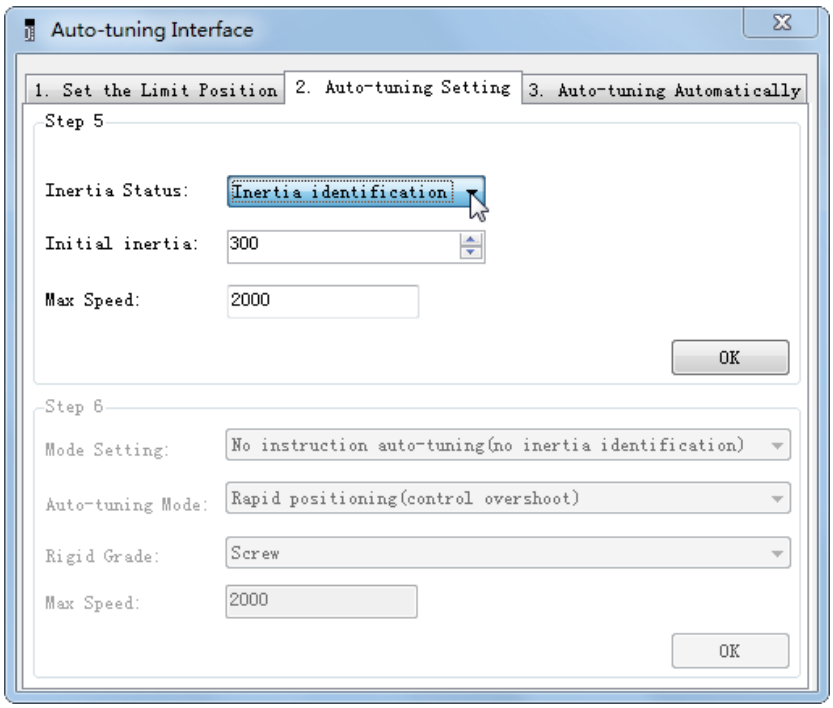
Error code	Meaning	Reasons
Err-1	Failure to search for optimal gain	Too large inertia ratio; too weak rigidity of mechanism
Err-2	Overtrip alarm in auto-tuning process	Please make sure that there is no overrun and alarm before auto-tuning.
Err-6	Driver is not in "bb" state at the time of operation	Please make sure the present status of driver
Err-7	Driver alarmed in auto-tuning process	The driver alarm occurs

XinJeServo software auto-tuning steps

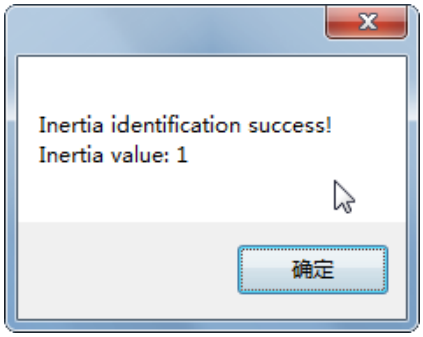
1. click auto-tuning on the XinJeServo software main interface
2. set the auto-tuning trip in jog mode or manually



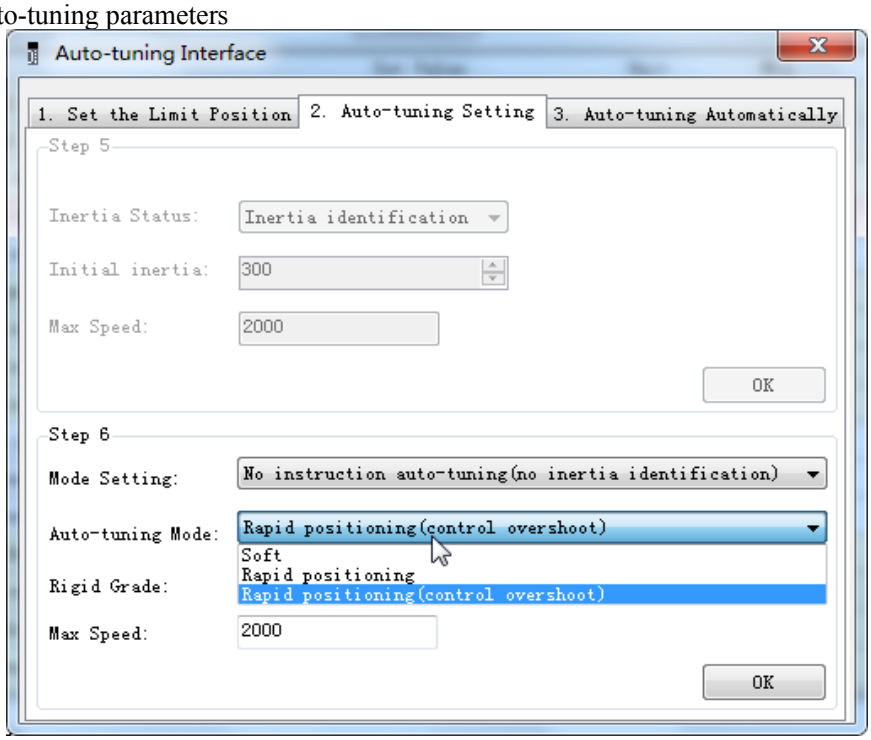
3. set the auto-tuning interface



4. click ok to estimate the inertia.



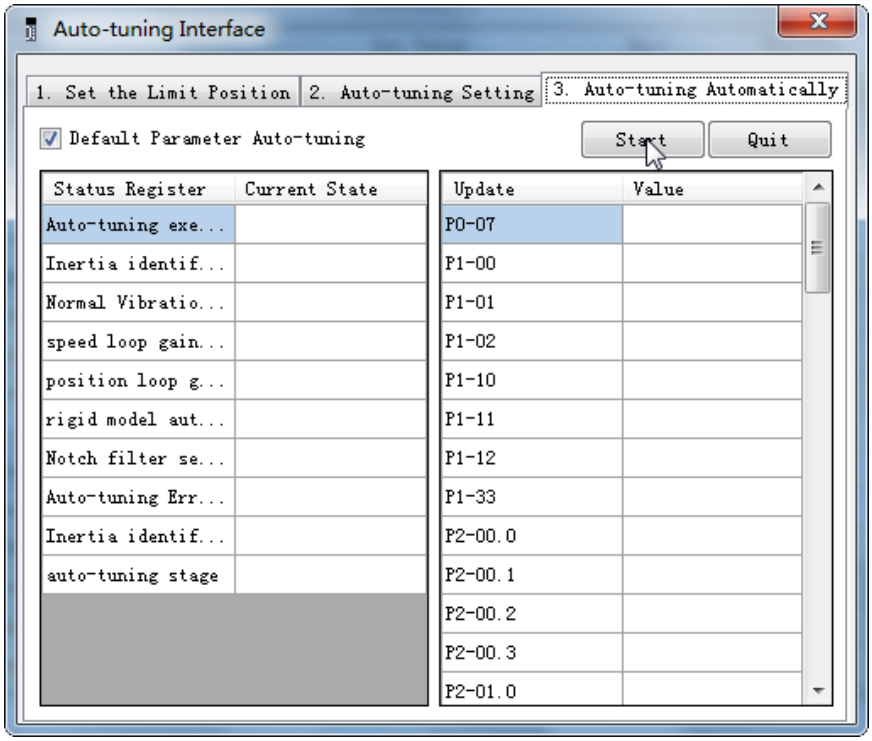
5. set the auto-tuning parameters



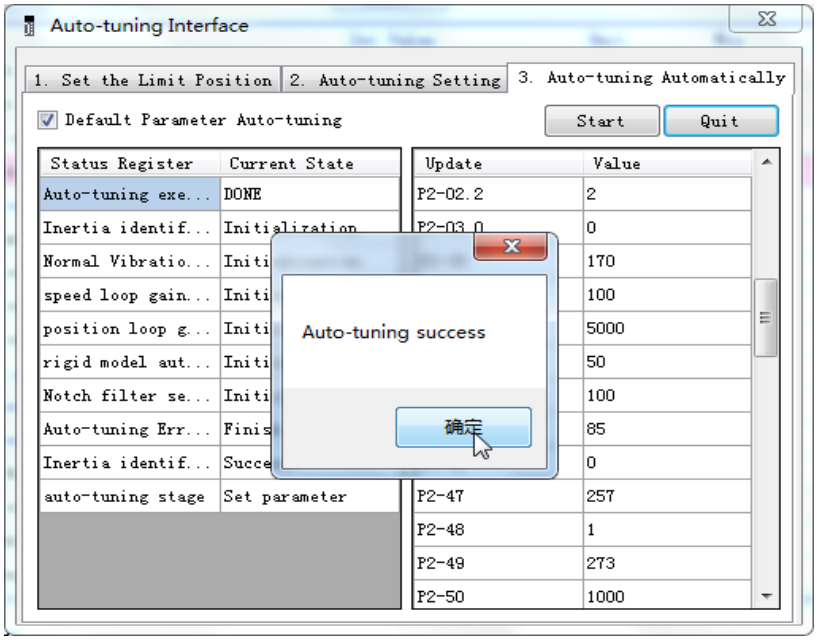
Load type	Description
Synchronous belt	Fit for the adjustment of lower rigidity mechanism such as synchronous belt mechanism.
Screw rod	It is suitable for adjustment of higher rigidity mechanism such as ball screw mechanism. If there is no corresponding mechanism, please choose this type.
Rigid connection	It is suitable for the adjustment of rigid body system and other mechanisms with higher rigidity.

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.

6. Start auto-tuning



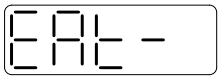
7. Wait for the end of the auto-tuning



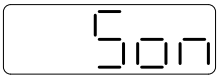
8.4.5 External instruction auto-tuning steps

Driver panel auto-tuning steps

1. The inertia identification is carried out and the step of inertia estimation please refers to the driver panel inertia estimation (8.2.4 operation step)
2. Shut down adaptive function (P2-01.0 sets to 0), power on again
3. Enter parameter F0-08, it will show Eat-（Exteral Refrence Auto-tuning）

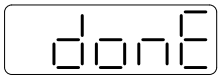


4. Press ENTER, if the enabler is not open, the panel displays Son and flickers, waiting for the enabler to open, if the enabler has been opened, skip this step;



5. Turn on the servo enabler, the panel displays tune and flickers, enter auto-tuning status.

6. The upper device starts to send pulse, if the auto-tuning is successful, it displays done and flickers.



7. Press STA/ESC to exit the external instruction auto-tuning.

Note: in the auto-tuning process, press STA/ESC will exit the auto-tuning, and use the gain parameters at the exit moment.

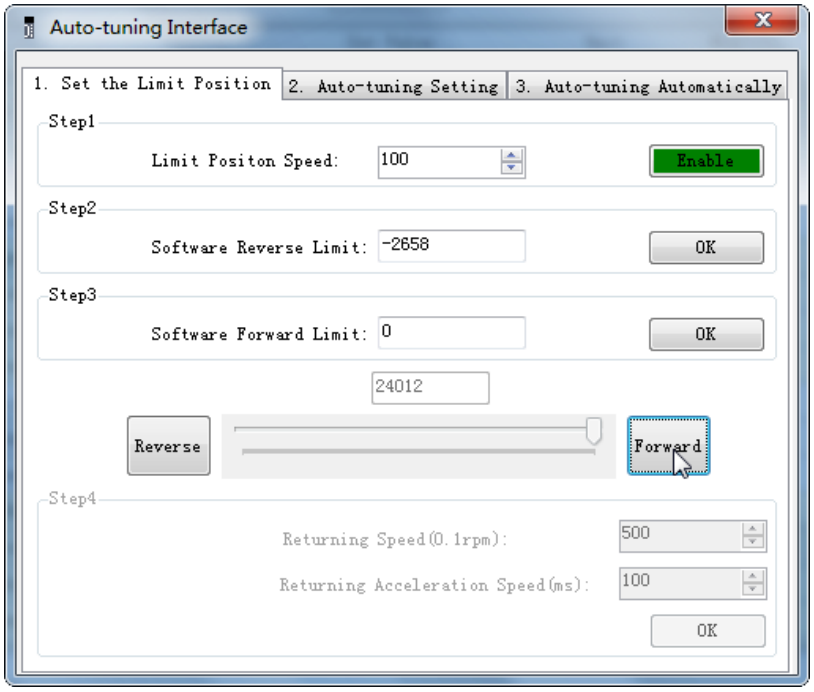
■ Panel error alarm in auto-tuning process

Error code	Meaning	Reasons
Err-1	Failure to search for optimal gain	Too large inertia ratio; too weak rigidity of mechanism
Err-2	①Overrun/alarm occurs during auto-tuning ②External instruction auto-tuning/Vibration suppression mode: servo shut down the enabler during auto-tuning	Please make sure that there is no overrun and alarm before auto-tuning. Make sure that the enable is not closed during auto-tuning
Err-3	Current non-position control mode	Please auto-tune in position mode

Err-4	Unclosed adaptive function	Set P2-01.0 to 0 before auto-tuning
Err-7	Driver alarm during auto-tuning	Driver alarmed
Err-8	Positioning completion signal instability	Short instruction interval

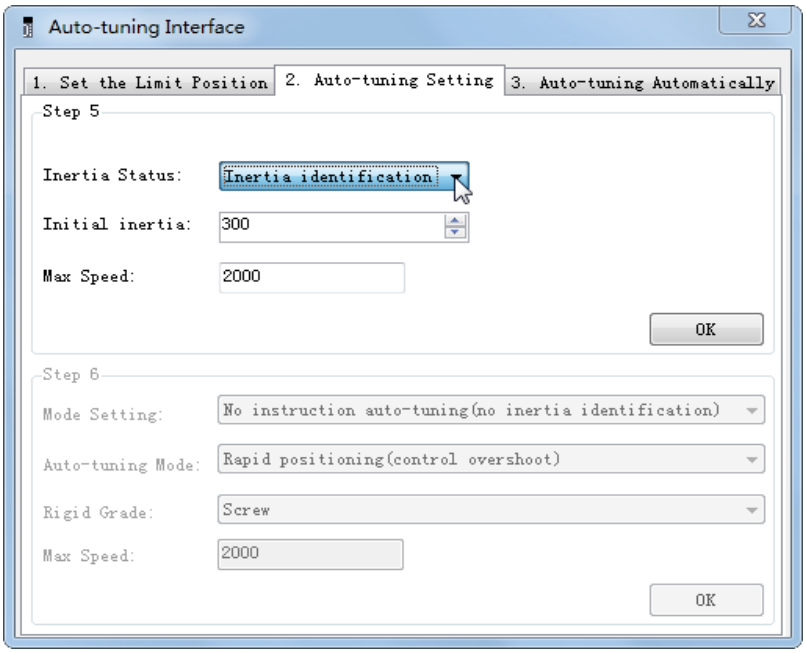
XinJeServo software auto-tuning steps

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

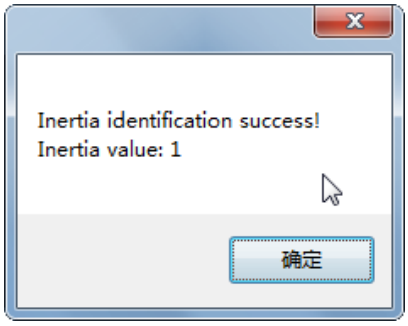


2. Select jog or manual setting to configure the trip of inertia identification.

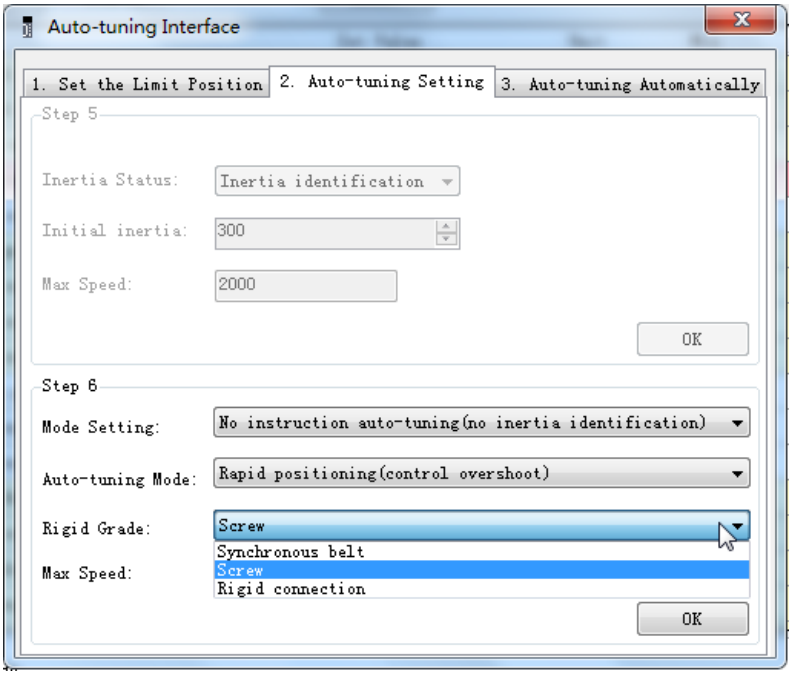
3. Set the auto-tuning interface



4. Click ok to start the inertia identification.



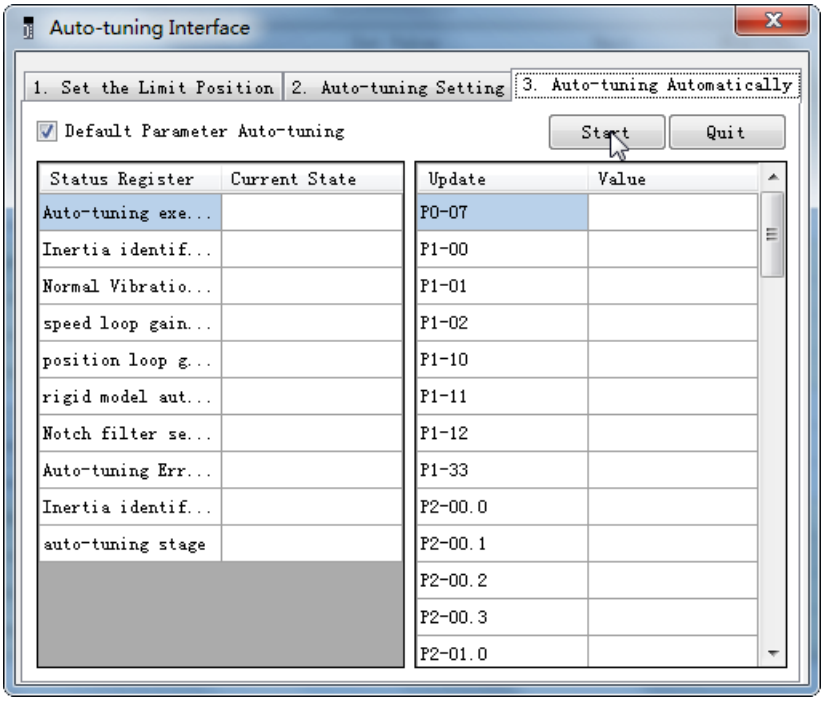
5. Configure the auto-tuning parameters



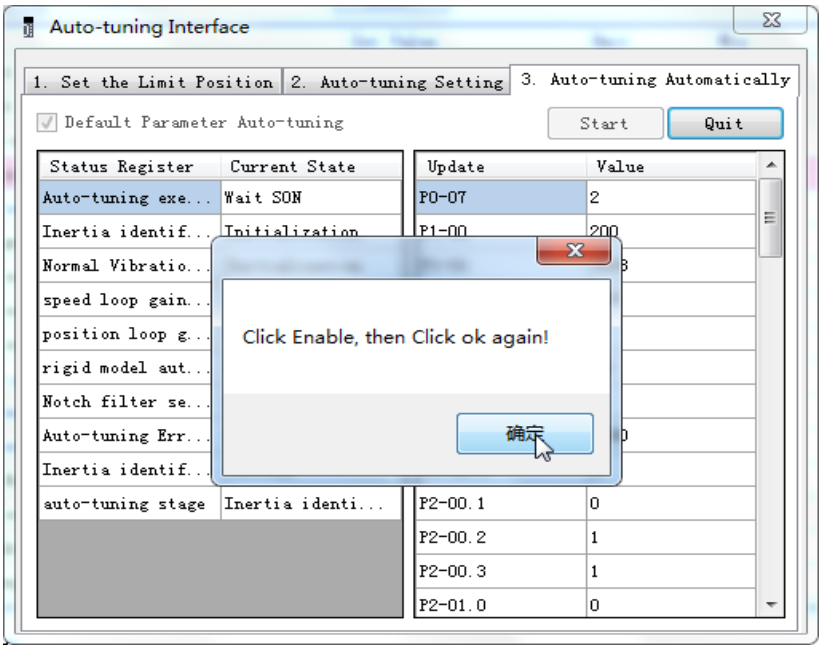
Auto-tuning mode	Description
Soft	Make a soft gain adjustment. Besides gain adjustment, notch filter is automatically adjusted.
Rapid positioning	Make special adjustment for positioning purpose. Besides gain adjustment, the model loop gain and notch filter are automatically adjusted.
Rapid positioning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

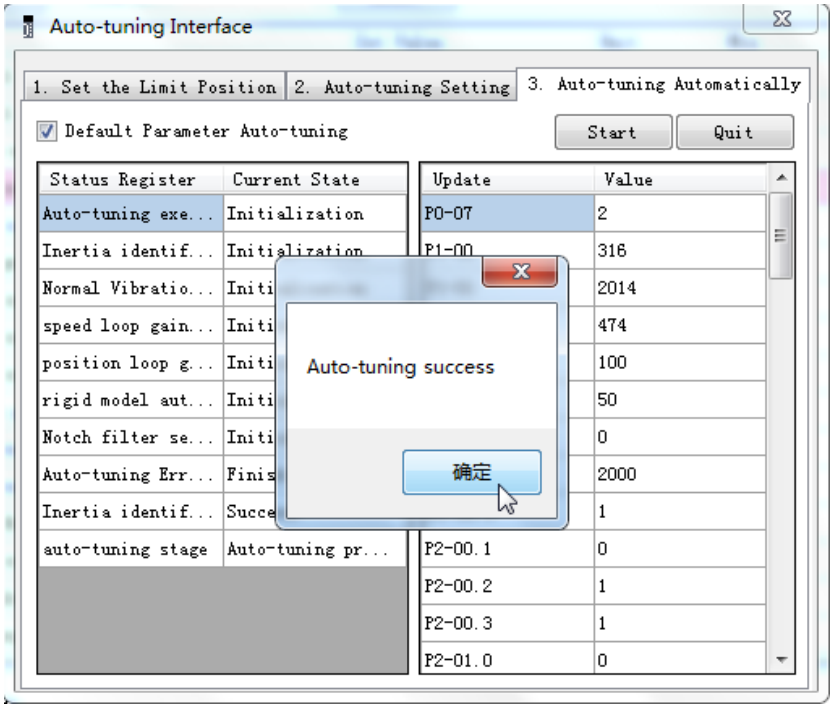


7. Open the servo enable, then click ok.



8. The upper device starts to send pulses, wait the completion of auto-tuning.

9. Auto-tuning is finished, click ok.



8.4.6 Related parameters

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

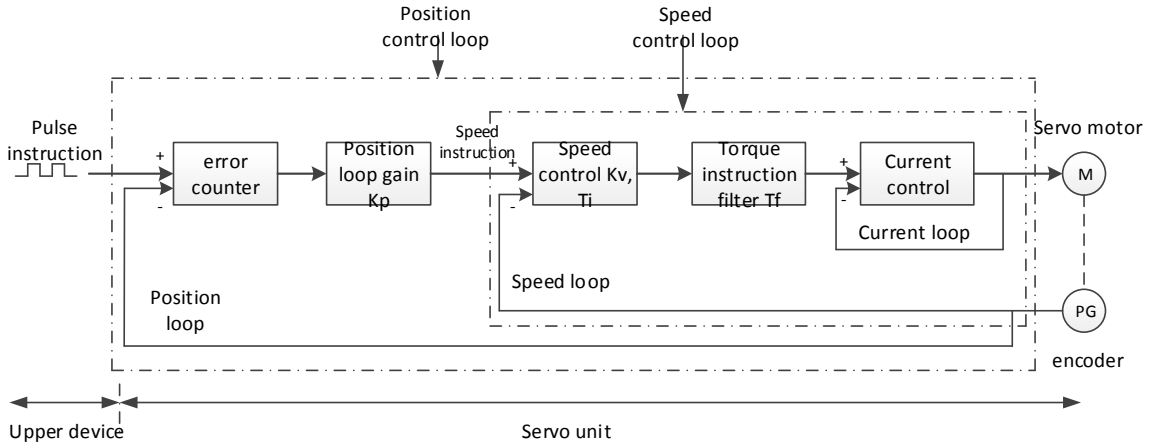
Parameter	Name	Property	The influence of numerical value on gain after auto-tuning
P0-07	First inertia ratio	Gain performance parameters	Yes
P1-00	First speed loop gain		
P1-01	Integral time constant of the first speed loop		
P1-02	First position loop gain		
P2-00.0	Disturbance observer switch		
P2-01.0	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	The second group of active vibration damping		
P2-67	Second group 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		

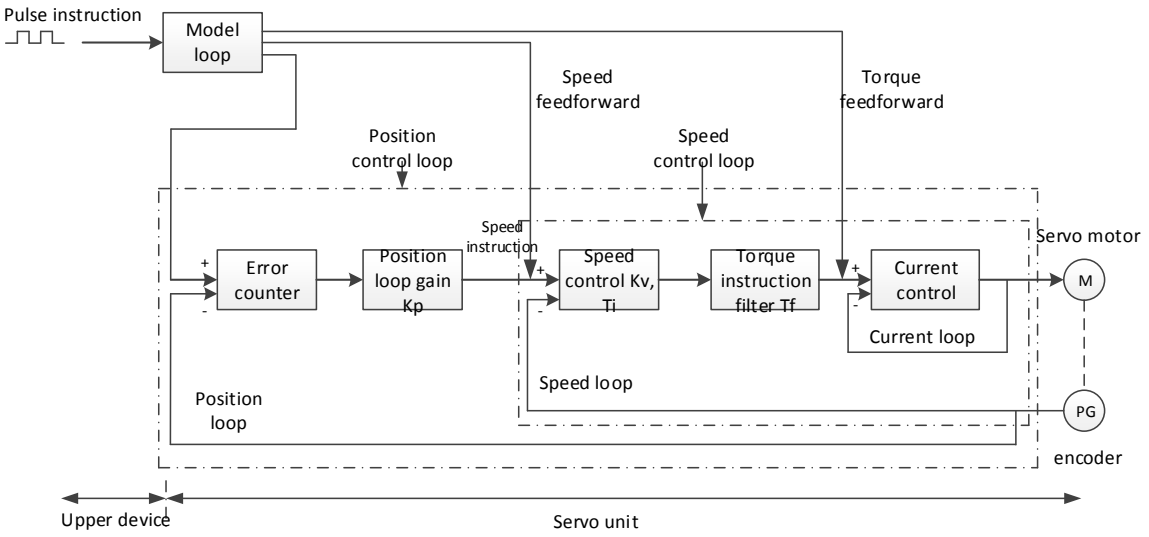
Note: P2-60~P2-67 are automatically modified in auto-tuning process. Users are not allowed to modify them manually. Manual modification may lead to the risk of system runaway.

8.5 Manual adjustment

8.5.1 Overview



Position control loop diagram (turn off 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

8.5.2 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)

8.5.3 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	200	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	3300	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	200	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	500	0.1Hz	10～20000	Anytime	At once

8.6 Adaptive

8.6.1 Overview

Adaptive function means that no matter what kind of machine and load fluctuation, it can obtain stable response through automatic adjustment. It starts to automatically adjust when servo is ON.

8.6.2 Notes

- When the servo unit is installed on the machine, it may produce instantaneous sound when the servo is ON. This is the sound when the automatic notch filter is set, not the fault. For the next time the servo is ON, no sound will be emitted.
- When the inertia of the motor exceeds the allowable load, the motor may produce vibration. At this time, please modify the adaptive parameters to match the present load inertia.
- In adaptive operation, in order to ensure safety, the adaptive function should be executed at any time when the servo enablement can be stopped or turned off urgently.

8.6.3 Operation steps

The factory settings are self-adaptive effective without modifying other parameters. The effectiveness of self-adaptation is controlled by the following parameters.

Parameter		Meaning	Default setting	Modification	Effective
P2-01	n.□□□0	Adaptive turn off	n.□□□1	Servo bb	Re-power on
	n.□□□1	Adaptive turn on			

8.6.4 Inertia mode and related parameters

The adaptive default parameter is defined as small inertia mode. If the load inertia far exceeds the allowable load inertia of the motor (such as 60 times inertia of the 60 motor), the adaptive large inertia mode can be turned on.

Parameter		Meaning	Default setting	Modification	Effective
P2-03	n.0□□□	Adaptive small inertia mode	n.0□□□	Servo bb	Re-power on
	n.1□□□	Adaptive large inertia mode			

Parameter	Meaning	Default setting	Modification	Effective
P2-05	Adaptive speed loop gain	400[Note1]	Servo bb	Repower on
P2-10	Adaptive speed loop integral	500	Servo bb	Repower on
P2-11	Adaptive position loop gain	100	Servo bb	Repower on
P2-07	Adaptive inertia ratio	0	Servo bb	Repower on
P2-08	Adaptive speed observer gain	60	Servo bb	Repower on
P2-12	Adaptive stable max inertia ratio	30	Servo bb	Repower on
P2-16	Adaptive motor rotor inertia coefficient	100	Servo bb	Repower on
P2-19	Adaptive bandwidth	50[Note2]	Anytime	At once
P6-05	Adaptive large inertia mode speed loop gain	200	Servo bb	Repower on
P6-07	Adaptive large inertia mode inertia ratio	50	Servo bb	Repower on
P6-08	Adaptive large inertia mode speed observer gain	40	Servo bb	Repower on
P6-12	Adaptive large inertia mode max inertia ratio	50	Servo bb	Repower on

Note 1: DS5 series servo 750W and below driver default value is 400; other power section default value is 200.
Note 2: DS5 series servo 400W and below driver default value is 70; other power section default value is 50.

8.6.5 Recommended inertia ratio parameters

Under the adaptive default parameters, the load can only run steadily under a certain moment of inertia. If the load inertia is large, some parameters need to be adjusted. The recommended parameters are as follows (the parameters are modified under the default parameters).

Motor flange	Inertia	Parameters
40~90	Within 20 times inertia	Adaptive small inertia mode (default parameters)
	20-30 times inertia	Set P2-08=50, P2-12=40
	30-40 times inertia	Set P2-08=50, P2-12=40, P2-07=10
	40-50 times inertia	Set P2-08=50, P2-12=40, P2-07=30
	50-80 times inertia	Switch to adaptive large inertia mode or set P2-08=40, P2-12=50, P2-07=50
130	Within 10 times inertia	Adaptive small inertia mode (default parameters)
	10~15 times inertia	Set P2-08=50, P2-12=40
	15~20 times inertia	Switch to adaptive large inertia mode or set P2-08=40, P2-12=50, P2-07=50

Note: The large inertia parameters can still drive a smaller inertia load. For example, when the parameters of 50 times inertia are used in the mechanism of 20 times inertia, only the response will become worse.

8.6.6 Adaptive parameters effect

Parameter Small inertia/large inertia	Name	Default value	Range	Effect
P2-05/P6-05	Adaptive speed loop gain	400/200	200-400	Reduction can improve the inertia capability, but it will reduce the responsiveness, which has a greater impact on the responsiveness.
P2-07/P6-07	Adaptive load inertia ratio	0/50	0-200	Increase can greatly improve the inertia capacity without affecting the responsiveness. Too large will produce vibration.
P2-08/P6-08	Speed observer gain	60/40	30-60	Reducing P2-08 and increasing P2-12 can greatly improve the inertia capability, but it will reduce the responsiveness, which has a great impact on responsiveness.
P2-12/P6-12	Adaptive stable max inertia ratio	30/50	30-60	
P2-10	Adaptive speed loop integral time coefficient	500	200-larger	Adjust according to need, generally increase
P2-11	Adaptive position loop gain coefficient	100	50-200	Adjust according to the need, increasing will make the response fast, reducing will make the response slow
P2-16	Adaptive motor rotor inertia coefficient	100	100-200	Increasing will improve the servo rigidity and enhance anti-disturbance ability, can solve operation jitter.
P2-19	Adaptive bandwidth	50~70	40-80	Increasing will improve the inertia capacity slightly, and has little effect on the responsiveness, to be an auxiliary parameter.

8.6.7 Invalid parameters when adaptive effective

When the adaptive function is effective (P2-01.0=1), the invalid parameters are shown as below:

Item	Parameters	Descriptions
Gain	P1-00 P1-05	First speed loop gain Second speed loop gain
	P1-01 P1-06	First speed loop integral time constant Second speed loop integral time constant
	P1-02 P1-07	First position loop gain Second position loop gain
	P2-49	Model loop gain
	P0-07 P0-08	First inertia ratio Second inertia ratio
	P5-36	/I-SEL inertia ratio switch

8.7 Vibration suppression

8.7.1 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.

8.7.2 Operation tools

Adjustment mode	Operation tools	Control mode	Operation steps	Version
Adaptive mode	XinJeServo Mechanical Characteristic Analysis	Position mode	8.7.4 Vibration Suppression (PC Software)	All versions of upper computer software support
Auto-tuning mode	Panel vibration suppression		8.7.3 Vibration Suppression (Panel)	All versions of firmware support
	XinJeServo Mechanical Characteristic Analysis		8.7.4 Vibration Suppression (PC Software)	All versions of upper computer software support
Auto-tuning/adaptive mode	Panel vibration suppression		8.7.6 vibration suppression (easyFFT)	All versions of firmware support

8.7.3 Vibration suppression (panel)

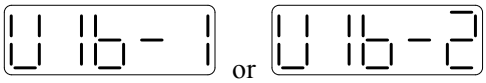
There are two modes of panel vibration suppression, mode 1(vib-1) and mode 2(vib-2).

■ Difference between Two Kinds of Vibration Suppression

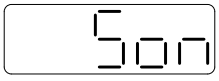
Mode	Display	Changed parameters
Mode 1	vib-1	Only the parameters related to vibration suppression will be changed.
Mode 2	Vib-2	It will change the parameters of vibration suppression and the gain of speed loop.

The operation steps:

1. Enter F0-10 in auto-tuning mode, the panel shows vib-1 or enter F0-11, the panel shows vib-2;



2. Press ENTER, panel shows Son and flashes, turn on the enabler by manual;



3. After turn on the enabler, panel shows tune and flickers, enter auto-tuning process;

4. The upper device starts to send pulses, then it will show done and flicker

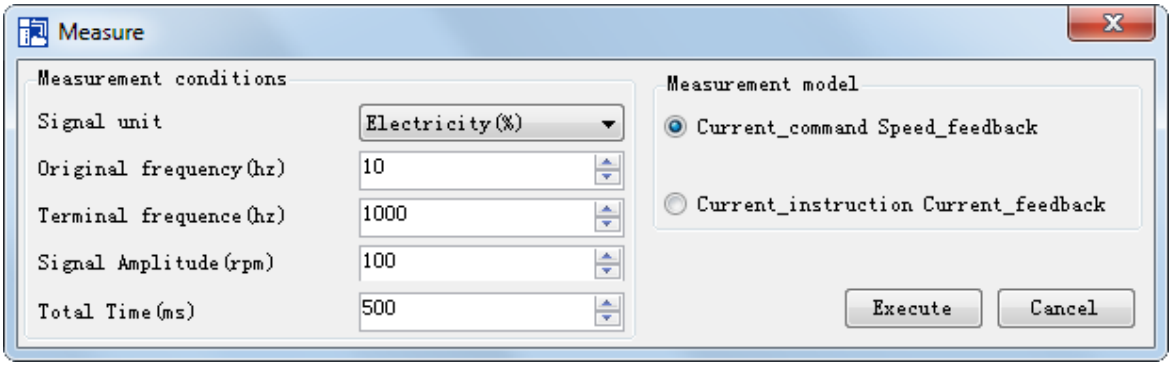
5. Press STA/ESC to exit
6. Vibration suppression parameters are automatically written into the second and first notches (the second notches are preferred when there is only one vibration point). The related parameters are detailed in 8.7.7 notch filter.

■ Fault alarm of panel in vibration suppression process

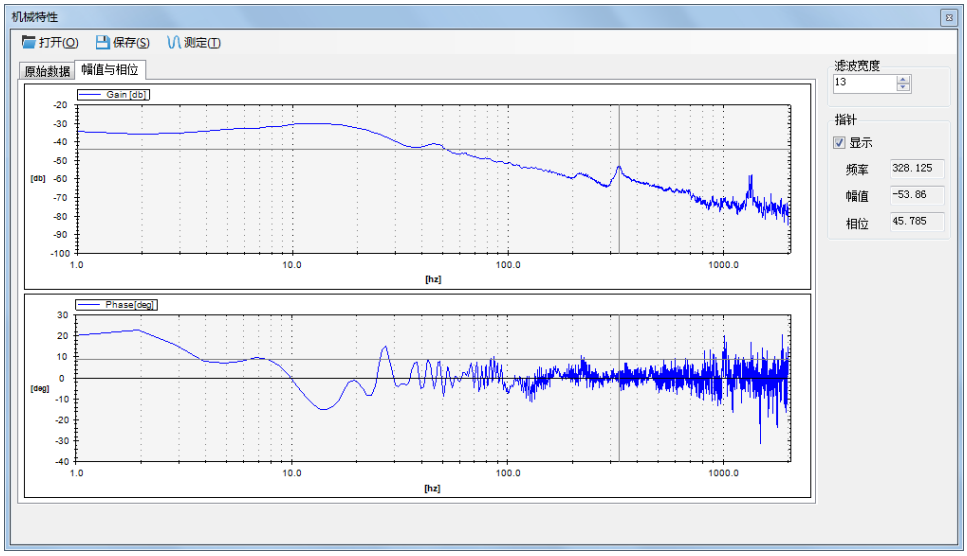
Error code	Meaning	Reasons
Err-1	Failure to search for optimal gain	Too large inertia ratio; too weak rigidity of mechanism
Err-2	(1) Overrun/alarm occurs during auto-tuning (2) External instruction auto-tuning/Vibration Suppression Mode: Servo turns off the Enabler in auto-tuning process	Please make sure that there is no overrun and alarm before auto-tuning. Make sure that the enabler is not turned off when auto-tuning
Err-3	Non-position control mode	please auto-tune in position mode
Err-4	Not turn off the adaptive function	please set P2-01.0 to 0, then auto-tune
Err-7	Driver alarm in auto-tuning process	driver alarmed
Err-8	Positioning Completion Signal Instability	Short instruction interval

8.7.4 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 8.7.7 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.

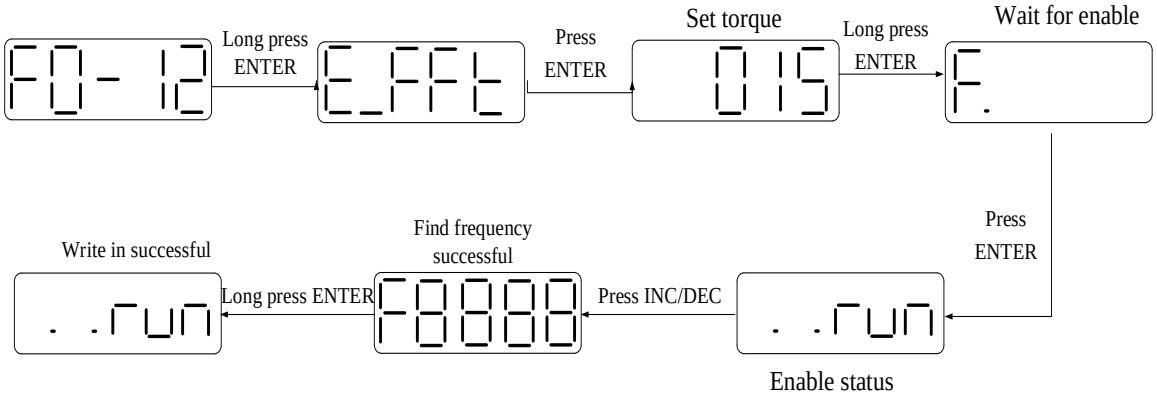
8.7.5 Vibration suppression (manual setting)

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 8.7.7 notch filter.

8.7.6 Vibration suppression (quick FFT)

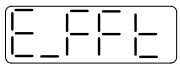
This function can analyze the mechanical characteristics through the parameter F0-12 on the servo operate panel, find out the mechanical resonance frequency and realize the vibration suppression.

The complete operation process is shown in the figure below:

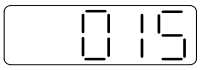


The operation steps are described as follows:

1. F0-12, long press【ENTER】to enter quick FFT function, it will show “E_FFt”.

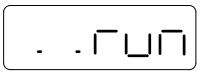


2. Press 【ENTER】 to enter torque setting interface, it will show the current setting torque, which is the value of P6-89. Press【INC】,【DEC】to increase or decrease torque command. When increasing the torque command, it is recommended to increase it a little bit to avoid severe vibration of the equipment.



3. After setting the torque command, long press【ENTER】, enter “read to enable” status, it will show ‘F”.

4. Press【ENTER】, enable, it will show “..run”.



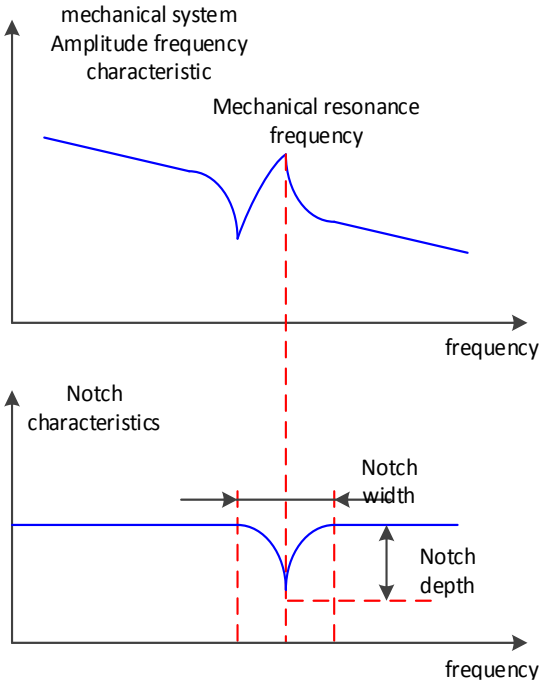
5. Press【INC】,【DEC】 to run forward or reverse and find the resonance frequency. “E_FFt” will shining on the panel when operation. If the resonance frequency is found, it will show “Fxxxx”, “xxxx” is the resonance frequency. If failed, it will show “F----”.

6. Whatever it shown “Fxxxx” or “F----”, press【INC】,【DEC】 can find the resonance frequency again. If the resonance frequency is found, long press【ENTER】to set the resonance frequency in the notch filter of servo driver.

Note: for above each step, press STA/ESC can return to the last step or exit.

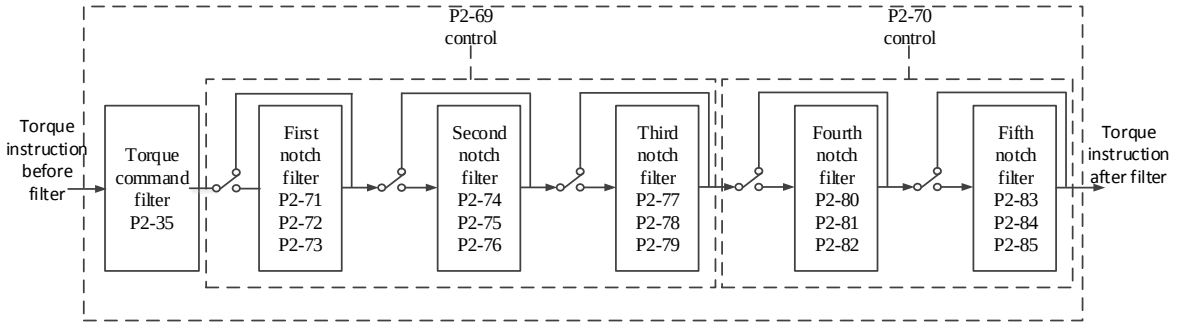
8.7.7 Notch filter

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.

8.8 Gain adjustment

8.8.1 Model loop control

In the self-tuning mode, in addition to the gain of speed loop and position loop, there is also the gain of model loop, which has a great influence on the servo response. When the model loop is not open, the servo responsiveness is determined by the position loop gain. When the model ring is open, the servo responsiveness is determined by the model loop gain. The model loop is equivalent to the feedforward function in the driver control loop. Refer to 8.5 manual adjustment for its specific function.

When the self-tuning mode is soft, the model loop function will be automatically off. When the self-tuning mode selects fast positioning or fast positioning (control overshoot), the model loop function will be automatically turned on.

Self-tuning mode:

Parameter		Meaning	Default setting	Modify	Effective
P2-02	n.□□□1	Soft	n.□□□3	Any time	At once
	n.□□□2	Fast positioning			
	n.□□□3	Quick positioning (control overshoot)			

Selection of self-tuning mode:

(1) Soft (P2-02.0 = 1):

This mode does not turn on the gain of the model loop, and the operation is soft. It is suitable for occasions with insufficient mechanical rigidity and low response requirements.

(2) Quick positioning (P2-02.0 = 2):

This method has the fastest response to setting parameters, but has no special suppression on overshoot.

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

In this way, the setting parameter response is fast, which will inhibit the overshoot.

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.

Self-tuning 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

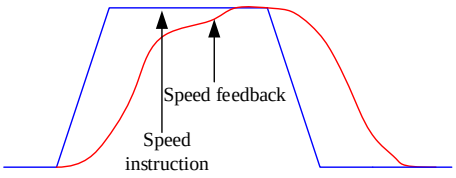
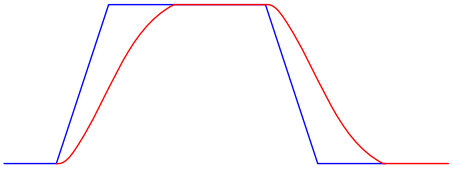
Parameter		Meaning	Default setting	Modification	Effective
P2-02	n.□□□1	Soft	n.□□□3	At anytime	at once
	n.□□□2	Fast positioning			
	n.□□□3	fast positioning (control overshoot)			

Model loop function

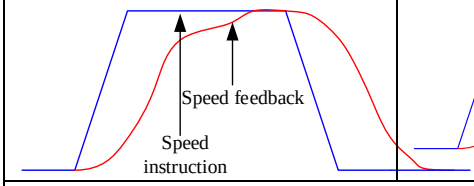
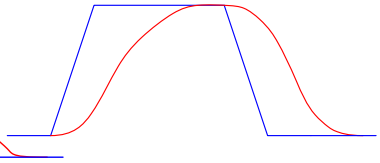
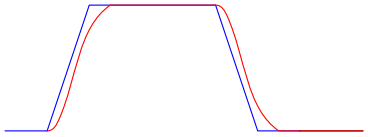
Parameter		Meaning	Default setting	Modification	Effective
P2-47	n.□□□0	Model loop turn off	n.□□□0	At anytime	At once
	n.□□□1	Model loop turn on			

Taking DS5 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.

8.8.2 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	85	%	0~100	Anytime	At once

	observer gain					

8.8.3 Gain adjustment parameters

Parameter	Meaning	Default setting	Unit	Range	Modify	Effective
P1-00	First speed loop gain	20P1：400 Others：200	0.1Hz	10~20000	Servo bb	At once
P1-01	Integral time constant of the first velocity loop	20P1：1650 Others：3300	0.01ms	15~51200	Servo bb	At once
P1-02	First position loop gain	20P1：400 Others：200	0.1/s	10~20000	Servo bb	At once
P1-05	Second speed loop gain	20P1：400 Others：200	0.1Hz	10~20000	Servo bb	At once
P1-06	Second velocity loop integral constant	20P1：1650 Others：3300	0.01ms	15~51200	Servo bb	At once
P1-07	Second position loop gain	20P1：400 Others：200	0.1/s	10~20000	Servo bb	At once

Note: Version 3770 and later added a second set of gain adjustments.

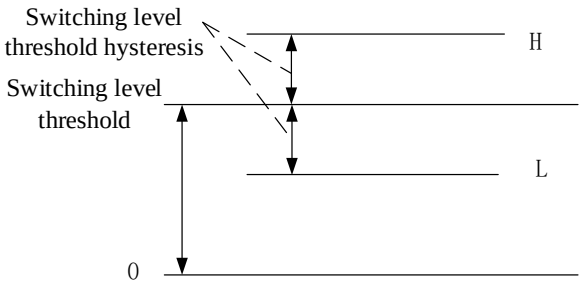
8.8.4 Gain switch

Parameter		Meaning	Default setting	Modify	Effective
P1-14	n.□□□0	0-SI terminal switching gain is valid (the gain switching condition parameter is not valid) 1 - perform gain switching according to gain switching conditions 2 - reserved	0	Servo bb	At once
	n.□□□1	n.□□X□: Gain switching condition selection 0 - first gain fixed 1 - switching by external SI terminals 2 - large torque command 3 - large speed command 4 - speed command changes greatly 5 - [reserved] - fixed as the first gain 6 - large position deviation 7 - position command 8 - positioning completed 9 - large actual speed A - position command + actual speed			
P1-15		Gain switching waiting time	5	Servo bb	At once
P1-16		Gain switching level threshold	50	Servo bb	At once
P1-17		Hysteresis of gain switching level threshold	30	Servo bb	At once
P1-18		Position loop gain switching time	2	Servo bb	At once

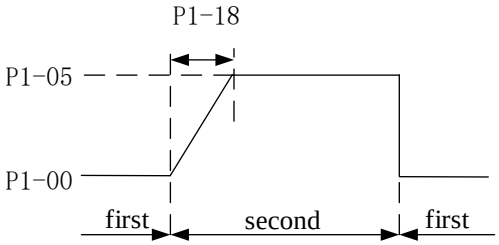
Note:

(1) The gain switching waiting time is effective only when the second gain is switched back to the first gain

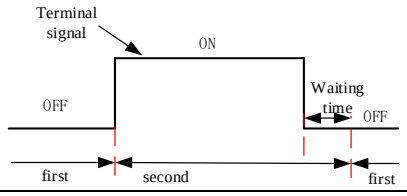
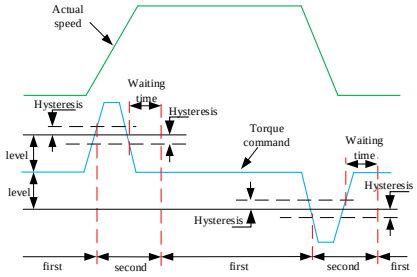
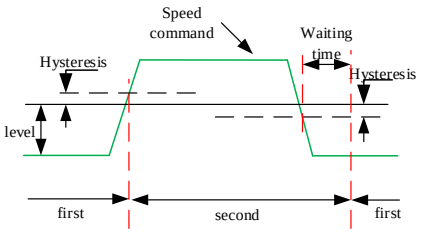
(2) The definition of gain switching level threshold hysteresis:

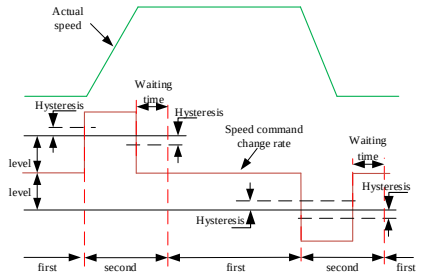
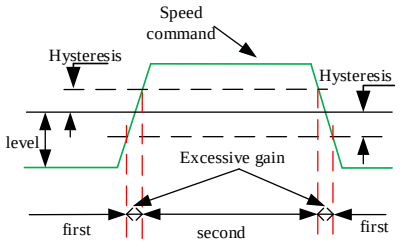
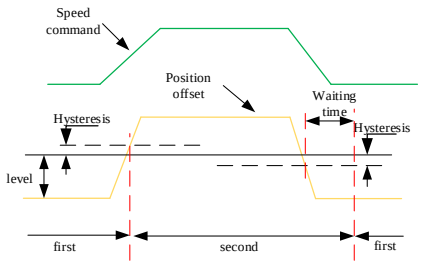
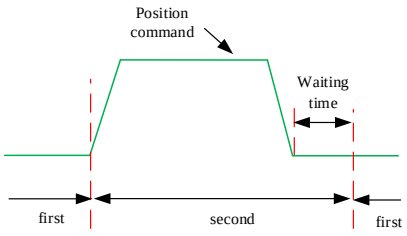


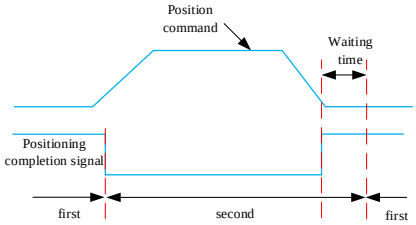
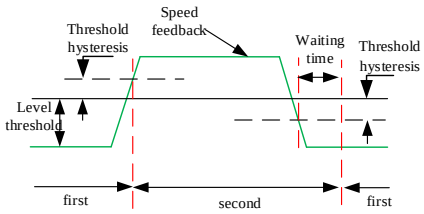
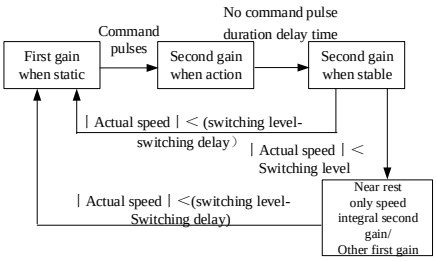
(3) The definition of position gain switching time:



(4) Gain switching conditions:

Gain switching condition				Parameter		
P1-14.1	Condition	Diagram	Notes	P1-15	P1-16	P1-17
0	The first gain fixed	-	-	invalid	invalid	invalid
1	Terminal switching		Switch the gain through G-SEL signal: G-SEL invalid, first group of gain, G-SEL valid, second group of gain	Valid	invalid	invalid
2	Torque command		When the absolute value of torque command exceeds (level + hysteresis) [%] at the last first gain, switch to the second gain. At the last second gain, the absolute value of the torque command is less than (level - hysteresis) [%], and then wait until P1-15 remain in this state, return to the first gain.	Valid	Valid (%)	Valid (%)
3	Speed command		When the absolute value of the speed command exceeds (level + hysteresis) [RPM] at the last first gain, switch to the second gain. At the last second gain, when the absolute value of the speed command is less than (level - hysteresis) [RPM], wait until P1-15 remain in this state, and return to the first gain.	Valid	Valid	Valid

Gain switching condition				Parameter		
4	Speed command change rate		At the last first gain, when the absolute value of the speed command change rate exceeds (level + hysteresis) [10rpm/s], switch to the second gain. At the last second gain, when the absolute value of the speed command change rate is less than (level- hysteresis) [10rpm/s], wait until P1-15 remain in this state, and return to the first gain.	valid	valid (10rpm/s)	valid (10rpm/s)
5	Speed command high and low speed threshold [not supported temporarily]		At the last first gain, when the absolute value of the speed command exceeds (level-hysteresis) [RPM], switch to the second gain, and the gain gradually changes. When the absolute value of the speed command reaches (level + hysteresis) [RPM], the gain completely changes to the second gain. At the last second gain, when the absolute value of the speed command is lower than (level + hysteresis) [RPM], it starts to return to the first gain, and the gain changes gradually. When the absolute value of the speed command reaches (level-hysteresis) [RPM], the gain completely returns to the first gain.	invalid	valid (rpm)	valid (rpm)
6	Position offset		Valid only in position mode (other modes are fixed as the first gain) When the absolute value of position deviation exceeds (level + hysteresis) [encoder unit] at the last first gain, switch to the second gain. When the absolute value of the position deviation is less than (level-hysteresis) [encoder unit] at the last second gain, wait until P1-15 remain in this state, and return to the first gain.	valid	valid (encoder unit)	valid (encoder unit)
7	Position command		Valid only in position mode (other modes are fixed as the first gain) At the last first gain, if the position command is not 0, switch to the second gain. At the last second gain, if the position command is in the state of 0 which remains in the waiting time P1-15, it returns to the first gain.	valid	invalid	invalid

Gain switching condition				Parameter		
8	Positioning completion		Valid only in position mode (other modes are fixed as the first gain) At the last first gain, if the positioning is not completed, switch to the second gain. At the last second gain, if the state of positioning completion remains in this state for the waiting time P1-15, the first gain is returned. Note: it is necessary to set the positioning completion detection mode according to P5-01.	valid	invalid	invalid
9	Actual speed		Valid only in position mode (other modes are fixed as the first gain): At the last first gain, the absolute value of the actual speed exceeds (level + hysteresis) [RPM], switching to the second gain. At the last second gain, when the absolute value of the inter speed is less than (level-hysteresis) [RPM], wait until P1-15 remain in this state, and return to the first gain.	valid	valid (rpm)	valid (rpm)
A	Position command+ actual speed		Valid only in position mode (other modes are fixed as the first gain): At the last first gain, if the position command is not 0, switch to the second gain. At the last second gain, the state in which the position command is 0 within the waiting time P1-15, maintains the second gain. When the position command is 0 and the waiting time P1-15 reached, if the absolute value of the actual speed is less than (level) [RPM], the speed integral time constant is fixed at the second speed loop integral time constant (P1-07), and the others return to the first gain. If the absolute value of the actual speed is less than (level-hysteresis) [RPM], the speed integral also returns to the integral time constant of the first speed loop (P1-02).	valid	valid (rpm)	valid (rpm)

8.9 Gain adjustment

8.9.1 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.

8.9.2 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

8.9.3 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 8.8.2 vibration.

9 Alarm

9.1 CANopen communication association abnormal alarm

Alarm	Error reason		Solution
E-852	Communication disconnection	Interruption of data interaction with CANopen master station	1. Check whether the wiring of CAN network is dropped or damaged 2. Check whether CANopen master station is powered off 3. After ensuring that there is no problem with the wiring, first power off and restart the CANopen slave station, and then power off and restart the CANopen master station

9.2 CANopen communication non associated abnormal alarm

Type		Code	Description	Reasons	Solutions
EEEE	1	EEEE1	Communication error between panel and CPU	(1) Voltage fluctuation of power supply is large, and low voltage leads to failure of panel refresh; (2) Damage of panel program	(1) Stable power supply to ensure the stability of power supply voltage. (2) after repower on the driver, if the alarm cannot be removed, please contact the agent or the manufacturer.
	2	EEEE2			
	3	EEEE3			
	4	EEEE4			
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
	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) If it is single-phase 220V power supply, please connect L1 and L3. (2) show E-024 immediately after power failure (3) Resetting parameters
	5	E-025	Erase FLASH error	Abnormal parameter preservation during	please contact the agent or the manufacturer

Type		Code	Description	Reasons	Solutions
				power failure	
	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, 220V Power Supply Machine (U0-05≥402V) 380V Power Supply Machine (U0-05≥780V)	High voltage of power grid	Check the fluctuation of power grid, 220V driver normal voltage range 200V ~ 240V, 380V driver normal voltage range 360V ~ 420V. 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, (220V: bus voltage U0-05 = 392 discharge starts, U-05 = 377 discharge ends; 380V: U-05 = 750 discharge starts, U-05 = 720 discharge ends;) (2) Increasing Acceleration and Deceleration Time (3) Reducing load inertia (4) Reduce start-stop frequency (5) Replacement of larger power drivers and motors
				Brake resistance damage or excessive resistance value	Check the regenerative resistor and replace the external resistor with the appropriate resistance value. See chapter 1.4.1 for the selection of the external resistor.
				Acceleration and deceleration time is too short	Extending Acceleration and Deceleration Time
				Hardware Fault of Driver Internal Sampling Circuit	The AC gear of the multimeter measures the input value of the servo LN (R/S/T), which is 220V ± 10% of the normal value. If the power supply voltage is more than 220V+10% (380V+10%), check the power supply voltage; if the power supply voltage is normal, then the servo BB state, monitor U0-05, the voltage measured by the multimeter * 1.414 < U0-05 (within 10V error), then the servo driver is faulty and needs to be sent back for repair.
04	0	E-040	Bus voltage U0-05 is lower than the actual preset threshold. 220V power supply machine (U0-05 ≤ 150V) 380V power supply machine (U0-05 ≤ 300V)	low voltage of power grid when normal power on	(1) Check the fluctuation of power grid. The normal voltage range of 220V driver is 200V~240V. If the voltage fluctuation is large, the voltage regulator is recommended. (2) Replacement of larger capacity transformers
				Instantaneous power failure	Re-energize after voltage stabilization
				Hardware Fault of Driver Internal Sampling Circuit	The AC gear of the multimeter measures the input value of the servo LN (R/S/T), which is 220V ± 10% of the normal value. If < 220V + 10%

Type		Code	Description	Reasons	Solutions
					(380V + 10%), then check the supply voltage; if the supply voltage is normal, then servo BB state, monitoring U0-05, multimeter measurement voltage * 1.414 > U0-05 (error within 10V), then the servo driver is faulty and needs to be sent back for repair
	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	① The motor thermocouple of 11kw and above power is disconnected ② False opening detection and disconnection alarm of motor below 11kw	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 P0-33 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.
				Encoder fault	(1) Check the encoder cable or change a new one

Type		Code	Description	Reasons	Solutions
					(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).
				Parameter setting	When the actual speed > P3-21/P3-22, it will alarm
09	2	E-092	Analog Tref Zero-Calibration Over limit	Analog Zero Calibration Operation Error	Please correct zero without analog voltage
	3	E-093	Analog Vref Zero-Calibration Over limit	Analog Zero Calibration Operation Error	Please correct zero without analog voltage
10	0	E-100	Position offset too large	In position control, the difference between the given position and the actual position exceeds the limit value.	(1) Observe whether the motor is blocked or not. (2) Reducing the given speed of position; (3) Increase the deviation pulse limit P0-23.
	1	E-101	Position command mutation	The position difference of every 6K cycle exceeds the command difference alarm value set by P0-70	(1) Check and modify program (2) Set the appropriate p0-70 value
11	0	E-110	External UVW Short Circuit Discovered in Self-Inspection	Not match the motor code	Check if the driver P0-33 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).

Type		Code	Description	Reasons	Solutions
13	0	E-150	Power cable disconnection	Any phase in UVW of driver, cable or motor broken	Disconnect the power supply of the driver and check the connection of the power cable. It is suggested that the multimeter be used to test the condition. After eliminating the errors, the driver should be re-energized.
16	1	E-161	Driver thermal power overload	Not match the motor code	Check if the driver U3-00 is identical with the motor code of the motor label (the number after MOTOR CODE), if not, please change to the same one, then power on again.
				Overload, the actual operating torque exceeds the rated torque, and continuous operation for a long time. (Monitor U0-02 to check the actual operating torque. If the motor is in normal operation, it will not jam or jitter. If the U0-02 is longer than 100, it will be considered improper selection of the motor.)	Increase the capacity of drivers and motors. Extend the acceleration and deceleration time and reduce the load. Monitor the U-00, whether it is running over speed.
				Mechanisms are impacted, suddenly weighted and distorted.	Eliminate mechanical distortion. Reduce load
				Motor action when motor brake is not opened	Measure the voltage of the brake terminal and decide to open the brake. It is suggested to use servo BK signal to control the brake lock. If it is not servo control, attention must be paid to the timing of brake opening and motor action.
				Wrong wiring of encoder cable, power cable or broken wire or loose pin of connector plug	Check the UVW connection of power cable to see if there is any phase sequence error. The multimeter is used to measure whether all the encoder cable are on. Check whether the plug is loose, for machine vibration, whether the plug has shrinkage pin, virtual welding, damage.
				In multiple mechanical wirings, incorrect connection of motor cable to other shafts leads to incorrect wiring.	Detection of servo wiring, the motor cable, encoder cable are correctly connected to the corresponding shaft.
16	1	E-161	Driver thermal power overload	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

Type		Code	Description	Reasons	Solutions
					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 AC gear of the multimeter measures the input value of the servo LN (R/S/T), which is 220V ± 10% of the normal value. If the power supply voltage is more than 220V+10% (380V+10%), check the power supply voltage; if the power supply voltage is normal, then in servo BB state, monitor U0-05, the voltage measured by the multimeter * 1.414 < U0-05 (within 10V error), then the servo driver is faulty and needs to be sent back for repair.
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.
				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

Type		Code	Description	Reasons	Solutions
					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
22	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 F0-79. 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	① The number of	① Restart driver

Type		Code	Description	Reasons	Solutions
			fetching encoder position data	consecutive errors in encoder data update sequence is greater than the value in P0-68 ② CPU timer fluctuates	② Check the arrangement of transmission cables to ensure that the strong and weak current are wired separately. ③ High current equipment is supplied separately. ④ The grounding is good.
	1	E-241	Encoder responding data scrambling	The received encoder data is wrong and the number of errors exceeds the value in encoder error retry number register P0-56	① Check the arrangement of transmission cables to ensure that the strong and weak current are wired separately. ② High current equipment is supplied separately. ③ The grounding is good.
26	0	E-260	Over range alarm	Overrun signal was detected and the overrun processing mode was configured to alarm	If you do not want to alarm immediately when the overrun occurs, you can change the overrun signal processing mode.
	1	E-261	Overrun signal connection error	(1) When the motor is in forward rotation, it encounters reverse overrun signal. (2) When the motor is in reverse rotation, it encounters forward overrun signal.	Check over-run signal connection and over-run terminal allocation.
	2	E-262	Control stop timeout	(1) Excessive inertia (2) Stop timeouts too short (3) The setting of braking torque is too small.	(1) Reduce inertia or use brake motor; (2) Increase the stop timeout time P0-30; (3) Increase braking torque P3-32.

Type		Code	Explanation	Reason	Solution
26	4	E-264	Excessive vibration	(1) Oscillation caused by external forces (2) Load inertia is large and the setting of load inertia ratio is wrong or the gain is too small, which leads to the oscillation of positioning.	(1) Check the source of external force to see if there are any problems in mechanical installation; (2) Increase the servo gain to improve the anti-disturbance ability; (3) Acquisition speed curve analysis; When the first three peaks are convergenced after pulse instruction completed (0.8* | first peak | > | second peak | and 0.8* | second peak | > | third peak |), the driver should not alarm, which can adjust the relevant threshold. When the first three peaks speed are not less than 300 rpm for three consecutive times after the completion of the pulse instruction, the driver will alarm. (4) Contact manufacturers for technical support
	5	E-265	Excessive motor vibration	Mechanical vibration	Check the motor installation
28	0	E-280	Failed to read	Request to read	On the premise that the driver and motor

			motor parameters	EEPROM failed	are matched and can be used together, read the alarm shielding position of motor parameters through P0-53, and set the motor code of P0-33 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 of P0-33 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 P0-33 motor code correctly
	1	E-311	When the motor code is read automatically, the motor parameter is 0, and the driver P0-33 = 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 of P0-33 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 of P0-33 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 of P0-33 correctly. At this time, the motor parameters are in the driver, which can work normally, but may affect some performance
	4	E-314	Motor code does not match software version	Encoder hardware version is higher than driver firmware version	Contact the manufacturer's technical support to update the driver firmware
	5	E-315	When the motor code is read automatically, the motor parameter is 0, and the driver P0-33 ≠ 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 of P0-33 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

Appendix

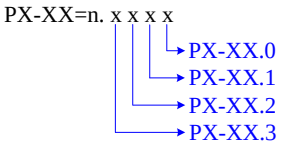
Appendix 1. Parameter list

Appendix 1.1 Group P parameter list

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.
“Δ” means modifying anytime and take effect when the motor doesn’t rotate.
“▲” means modifying anytime and take effect when power on again.

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 parameters

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode
P0-00	Drive type 0 - General Type 1- Canopen type	-	1	0～1	○	All
P0-01	P0-00=0: general type 1-Internal Torque Mode 2-External Analog Torque Mode 3-Internal speed Model 4-External Analog speed Mode 5-Internal Location Mode 6-External Pulse Position Mode 7-External Pulse speed Mode	-	1	1～7	○	All
P0-02	Control mode 2 (the description is the same as above) When the /C-SEL signal is valid, the servo system will switch to the mode selected by P0-02 for operation	-	0	1～7	○	All
P0-03	Enable mode: 0 - not enabled, 1- IO/Son input signal, 2 - software enable (panel / MODBUS) panel F1-05 write 1; Modbus writes 1 to 0x2105 register. Write 0 cancel enable 3- bus enable	-	1	0~3	○	All
P0-04	Rigidity grade	-	20P1: 0 20P2/20P4 /20P7: 15 >=21P5: 10	0~63	△	All
P0-05	Rotation direction selection	-	0	0~1	●	All

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode
P0-07	First inertia ratio	1%	500	0~50000	√	All
P0-09.0	Forward Direction of Input Pulse Instruction 0-Forward Pulse Counting 1-Reverse Pulse Counting	-	0	0~1	●	6, 7
P0-09.2	Input pulse command filter time	-	F	0~F	●	6, 7
P0-09.3	Predistribution of input pulse command filter	-	0	0~7	●	6, 7
P-10.0 xxx□	0-CW/CCW 1-AB 2-P+D	-	2	0~2	○	6, 7
P0-11	Pulse per rotation low bit ×1	-	0	0~9999	○	5, 6
P0-12	Pulse per rotation high bit ×10000	-	1	0~65535	○	5, 6
P0-13	Electronic Gear Numerator	-	1	1~65535	○(before 3770) √(3770 and later)	5, 6
P0-14	Denominator of Electronic Gear	-	1	1~65535	○	5, 6
P0-15	Pulse frequency corresponding to rated speed in speed mode	100Hz	1000	0~10000	○	7
P0-16	Speed command pulse filter time	0.01ms	100	0~10000	○	7
P0-23	pulse offset limit	0.01 turn	2000	0~65535	√	5, 6
P0-24	0 - cumulative discharge time 1 - average power mode 1 2-average power mode 2	-	0	0~1	○	All
P0-25	Power Value of Discharge Resistance	W	Related to the driver power	0~65535	○	All
P0-26	Discharge resistance value	Ω		1~500	○	All
P0-27	Servo shutdown the enable stop mode 0-Inertial Operation Stop 2-deceleration stop	-	0	0, 2	○	All
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	-	0	0~3	○	All
P0-29	Servo Alarm Stop Mode 0-Inertial Operation Stop 2-deceleration stop	-	0	0、2	○	All
P0-30	stop timeout time	1ms	20000	0~65535	○	All
P0-31	Deceleration stop time	1ms	25	0~5000	○	All
P0-33	Set the motor code	-		0~65535	●	All
P0-53	Read motor parameter alarm shield bit 0-not shield alarm shield alarm 1- Shield the alarm of not read valid motor parameter	-	0	0/1	●	All
P0-55	Open loop rotation speed	-	0	-6000~6000		All

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode
P0-56	Number of encoder communication attempts	-	10	1~65535		All
P0-68.0~ P0-68.1 xx□□	Number of continuous error alarms in the update sequence of coded data		0x05	0x01~0xFF		All
P0-68.2~ P0-68.3 □□xx	E-241 alarm filter times	-	0	0~0xFF		All
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-not shield thermocouple disconnection alarm 1-shield thermocouple disconnection alarm	-	1	0/1	√	All
P0-74	Blocking alarm time	1ms	0	0-65535	√	All
P0-75	Blocking alarm speed	1rpm	50	5~9999	√	All
P0-79	Absolute Encoder Battery Undervoltage Alarm Switch 0-used as absolute value encoder 1-used as incremental encoder used as absolute value encoder, ignoring multi turn overflow alarm	-	1	0~2	●	All
P0-80	Thermal Power Protection of Motor 0-current protection 1-Average Thermal Power Protection 2-Analog Thermal Power Protection	-	2	0~2	●	All
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	1~9999 1~65535	○	5, 6
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	1~9999 1~65535	○	5, 6

P1 parameters

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode
P1-00	First speed loop gain	0.1Hz	20P1: 400 Others: 200	10~20000	√	All
P1-01	Integral Time Constant of the First Speed Loop	0.01ms	20P1: 1650 Others: 3300	15~51200	√	All
P1-02	First position loop gain	0.1/s	20P1: 400 Others: 200	10~20000	√	All
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
P1-14	Gain switching mode setting	-	0	0~0x00A2	√	All
P1-15	Gain switching waiting time	-	5	0~1000	√	All

Parameter	Function	Unit	Default value	Range	Effective	Suitable mode
P1-16	Gain switching level threshold	-	50	0~20000	√	All
P1-17	Gain switching level hysteresis	-	30	0~20000	√	All
P1-18	Position loop gain switching time	-	3	0~1000	√	All
P1-22	Speed Instruction Filter Selection 0-first order low pass filter 1-Smooth Average Filter	-	0	0~1	○	3|4|7
P1-23	speed instruction filter time	0.1ms	0	0~65535	○	3|4|7
P1-24	Position command acceleration and deceleration filtering time	0.1ms	0	0~65535	△	5|6
P1-25	position instruction smooth filter time	0.1ms	0	0~65535	△	5|6
P1-74	Encoder zero offset detection cycle	-	1000	0~65535	√	All
P1-75	Encoder zero offset detection threshold	-	10	0~500	√	All

P2 parameters

P2-XX	Function	Unit	Default value	Range	Effective	Suitable mode
P2-00.0	Disturbance observer switch 0- OFF 1- ON	-	0	0~1	○	All
P2-01.0	Adaptive mode switch 0-OFF 1-ON	-	0	0~1	●	All
P2-01.1	Adaptive level 0-high response 1-low noise	-	According to the model	0~1	●	All
P2-02.0	Auto-tuning mode 1-soft 2-fast positioning 3-fast positioning, control the overshoot	-	3	1~3	√	All
P2-02.2	Load type (valid only during auto-tuning) 1- synchronous belt 2- screw rod 3-Rigid Connection	-	2	1~3	√	All
P2-03.3	Adaptive load type 0-Small Inertia Mode 1-Large Inertia Mode	-	0	0~1	●	All
P2-05	Adaptive mode speed loop gain (standard)	0.1Hz	20P1/20P2/ 20P4/20P7: 400 >=21P5: 200	1~65535	○	All
P2-07	Adaptive mode inertia ratio (standard)	%	0	0~10000	○	All
P2-08	Gain of adaptive mode speed observer (standard)	Hz	20P1/20P2/ 20P4/20P7: 60 >=21P5: 40	10~1000	○	All
P2-12	Maximum Inertia Ratio of Adaptive Mode (Standard)	-	30	1~10000	○	All
P2-15	Inertia Identification and Internal Instruction Auto-tuning Maximum Travel	0.01r	100	1~3000	√	All
P2-17	Maximum Speed of Inertia Identification and Internal Instruction Auto-tuning	-	0	0~65535	√	All

P2-XX	Function	Unit	Default value	Range	Effective	Suitable mode
P2-18	Initial inertia ratio of inertia identification	%	500	1~20000	√	All
P2-19	Adaptive mode bandwidth	%	20P1: 100 20P2/20P4: 70 >=20P7: 50	1~100	○	All
P2-35	Torque Instruction Filtering Time Constant 1	0.01ms	100	0~65535	√	All
P2-36	Torque Instruction Filtering Time Constant 2	0.01ms	100	0~65535	√	All
P2-41	Disturbance Torque Compensation Coefficient (Non-adaptive Mode Effective)	%	85	0~100	√	All
P2-47.0	Model Loop Switch 0-OFF 1-ON	-	1	0~f	√	All
P2-49	Model loop gain	0.1Hz	500	10~20000	√	3|4|5|6|7
P2-60.0	Active Vibration Suppression Switch 0-OFF 1-ON	-	0	0~1	√	3|4|5|6|7
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|4|5|6|7
P2-61	Active Vibration Suppression frequency	0.1Hz	10000	10~20000	√	All
P2-62	Active Vibration Suppression gain	%	100	1~1000	√	All
P2-63	Active Vibration Suppression damping	%	100	0~300	√	All
P2-64	Active vibration suppression frequency 1	-	0	-10000~10000	√	All
P2-65	Active vibration suppression frequency 2	-	0	-10000~10000	√	All
P2-69.0	Notch filter 1 switch	-	0	0~1	√	All
P2-69.1	Notch filter 2 switch	-	0	0~1	√	All
P2-69.3	Notch filter 3 switch	-	0	0~1	√	All
P2-70.0	Notch filter 4 switch	-	0	0~1	√	All
P2-70.1	Notch filter 5 switch	-	0	0~1	√	All
P2-71	First notch frequency	Hz	5000	50~5000	√	All
P2-72	First notch attenuation	0.1dB	70	50~1000	√	All
P2-73	First notch band width	Hz	0	0~1000	√	All
P2-74	Second notch frequency	Hz	5000	50~5000	√	All
P2-75	Second notch attenuation	0.1dB	70	50~1000	√	All
P2-76	Second notch band width	Hz	0	0~1000	√	All
P2-77	Third notch frequency	Hz	5000	50~5000	√	All
P2-78	Third notch attenuation	0.1dB	70	50~1000	√	All
P2-79	Third notch band width	Hz	0	0~1000	√	All
P2-80	Fourth notch frequency	Hz	5000	50~5000	√	All
P2-81	Fourth notch attenuation	0.1dB	70	50~1000	√	All
P2-82	Fourth notch band width	Hz	0	0~1000	√	All
P2-83	Fifth notch frequency	Hz	5000	50~5000	√	All
P2-84	Fifth notch attenuation	0.1dB	70	50~1000	√	All
P2-85	Fifth notch band width	Hz	0	0~1000	√	All

P3 parameters

P3-XX	Function	Unit	Default value	Range	Effective	Suitable mode
P3-05	Preset speed 1	rpm	0	-9999~9999	√	3
P3-06	Preset speed 2	rpm	0	-9999~9999	√	3
P3-07	Preset speed 3	rpm	0	-9999~9999	√	3
P3-09	Acceleration time	ms	0	0~65535	○	3|4|7
P3-10	Deceleration time	ms	0	0~65535	○	3|4|7
P3-12	Zero-speed clamping mode	-	0	0~3	○	3|4|7
P3-13	Zero-speed clamping speed	rpm	10	0~300	○	3|4|7
P3-14	Forward Maximum Speed Instruction Limit	rpm	4000	0~10000	○	All
P3-15	Reverse Maximum Speed Instruction Limit	rpm	4000	0~10000	○	All
P3-16	Internal Forward Speed Limitation in Torque Control	rpm	2000	5~10000	√	1|2
P3-17	Internal Reverse Speed Limitation in Torque Control	rpm	2000	5~10000	√	1|2
P3-18	Jogging speed	rpm	100	0~1000	○	All
P3-19	forward warning speed	rpm	3000	0~10000	○	All
P3-20	reverse warning speed	rpm	3000	0~10000	○	All
P3-21	forward alarming speed	rpm	4000	0~10000	○	All
P3-22	reverse alarming speed	rpm	4000	0~10000	○	All
P3-28	Internal forward torque limit	%	300	0~1000	√	All
P3-29	Internal reverse torque limit	%	300	0~1000	√	All
P3-30	external forward torque limit	%	300	0~1000	√	All
P3-31	external reverse torque limit	%	300	0~1000	√	All
P3-32	Brake torque	1%	300	0~1000	√	All
P3-33	Preset torque	%	0	-1000~1000	√	1
P3-45	Torque mode switching delay	ms	40	0~9999	√	1|2

P4 parameters

P4-XX	Function	Unit	Default value	Range	Effective	Suitable mode
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)	个	2	0~f	○	5|6
P4-00.1	Search the origin function 0-OFF 1-ON	-	0	0~1	○	5|6
P4-00.2	homing overrun prohibition 0-not prohibit 1-prohibit	-	0	0~1	○	5|6
P4-01	Speed of hitting the proximity switch	rpm	600	0~65535	○	5|6
P4-02	Speed of leaving proximity switch	rpm	100	0~65535	○	5|6
P4-03.0	Internal Location Given Mode Sets Location Mode 0-relative positioning 1-Absolute positioning	-	0	0~1	○	5
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	-	0	0~5	○	5

P4-XX	Function	Unit	Default value	Range	Effective	Suitable mode
	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					
P4-03.2	Internal position mode sets waiting mode 0-wait positioning completion 1-not wait positioning completion	-	0	0~1	○	5
P4-04	Valid segment number	-	0	0~35	○	5
P4-10～P4-11	Internal position mode start segment No	1pul	0	-327689999~327679999	√	5
P4-12	First segment pulse	0.1rpm	0	0~65535	√	5
P4-13	First segment speed	1ms	0	0~65535	√	5
P4-14	First segment acceleration time	1ms	0	0~65535	√	5
P4-16	First segment deceleration time	1ms	0	0~65535	√	5
P4-10+（n-1）*7 ~ P4-16+（n-1）*7	Adjusting time	-	-	-	√	5
Note: (1) setting pulse number=pulse number (high bit)×10000 + pulse number (low bit) (2) 35 sections in total; The parameters of sections 1 ~ 12 can be set through the panel, and the parameters of sections 13 ~ 35 need to be written through communication (RS232 and RS485).						

P5 parameters

P5-XX	Function	Unit	Default value	Range	Effective	Suitable mode
P5-00	Positioning completion width/COIN	Command unit	11	1~65535	√	5|6
P5-01	Location Completion Detection Mode	-	0	0~3	√	5|6
P5-02	Location completion retention time	ms	0	0~65535	√	5|6
P5-03	Rotation Detection Speed	rpm	50	0~10000	√	All
P5-04	Same speed detection speed	rpm	50	0~10000	√	All
P5-05	Reached detection speed	rpm	1000	0~10000	√	All
P5-06	Positioning near output width	Command unit	50	0~65535	√	5|6
P5-07	Servo OFF delay time	ms	500	0~65535	○	All
P5-08	Brake instruction output speed	rpm	30	20~10000	○	All
P5-09	Brake instruction waiting time	ms	500	0~65535	○	All
P5-10	user-defined output 1 trigger condition	-	0	0~ffff	√	All
P5-11	Set a value that compares with the trigger condition of custom output 1	Relating to trigger condition	0	-9999~9999	√	All
P5-12	Select custom output 1 mode	-	0	0~3	√	All
P5-13	Setting custom output 1 hysteresis	Relating to trigger condition	0	0~65535	√	All
P5-14	Custom Output 2 Trigger Condition	-	0	0~ffff	√	All
P5-15	Set a value that compares with the trigger condition of custom output 2	Relating to trigger condition	0	-9999~9999	√	All
P5-16	Select custom output 2 mode	-	0	0~3	√	All
P5-17	Setting custom output 2 hysteresis	Relating to trigger condition	0	0~65535	√	All
P5-18	IO filter time multiple	-	1	0~10000	√	All
P5-19	Z phase output maintain time	ms	2	1~65535	√	All

P5-XX	Function	Unit	Default value	Range	Effective	Suitable mode
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	√	All
P5-20.2	SI terminal filtering time	ms	0	0~f	√	All
P5-21.0~1	/P-CON proportion action instruction	-	00	0~ff	√	All
P5-21.2	SI terminal filtering time	ms	0	0~f	√	All
P5-22.0~1	/P-OT: Forbidden forward driving	-	01	0~ff	√	All
P5-22.2	SI terminal filtering time	ms	0	0~f	√	All
P5-23.0~1	/N-OT: forbidden reverse driving	-	02	0~ff	√	All
P5-23.2	SI terminal filtering time	ms	0	0~f	√	All
P5-24.0~1	/ALM-RST: alarm clear	-	00	0~ff	√	All
P5-24.2	SI terminal filtering time	ms	0	0~f	√	All
P5-25.0~1	/P-CL：External Torque Limitation at Forward Rotation Side	-	00	0~ff	√	All
P5-25.2	SI terminal filtering time	ms	0	0~f	√	All
P5-26.0~1	/N-CL：External Torque Limitation at Reverse Rotation Side	-	00	0~ff	√	All
P5-26.2	SI terminal filtering time	ms	0	0~f	√	All
P5-27.0~1	/SPD-D: Internal Speed Direction Selection	-	03	0~ff	√	1|2|3|4|7
P5-27.2	SI terminal filtering time	ms	0	0~f	√	1|2|3|4|7
P5-28.0~1	/SPD-A: Internal Setting Speed Selection	-	00	0~ff	√	3|5
P5-28.2	SI terminal filtering time	ms	0	0~f	√	3|5
P5-29.0~1	/SPD-B: Internal Setting Speed Selection	-	00	0~ff	√	3|5
P5-29.2	SI terminal filtering time	ms	0	0~f	√	3|5
P5-30.0~1	/C-SEL: control mode selection	-	00	0~ff	√	All
P5-30.2	SI terminal filtering time	ms	0	0~f	√	All
P5-31.0~1	/ZCLAMP: zero position clamping	-	00	0~ff	√	3|4|7
P5-31.2	SI terminal filtering time	ms	0	0~f	√	3|4|7
P5-32.0~1	/INHIBIT: Instruction pulse prohibition	-	00	0~ff	√	5|6|7
P5-32.2	SI terminal filtering time	ms	0	0~f	√	5|6|7
P5-33.0~1	/CLR: pulse offset clear	-	00	0~ff	√	All
P5-33.2	SI terminal filtering time	ms	0	0~f	√	All
P5-34.0~1	/ZCLAMP: zero position clamping	-	00	0~ff	√	5|6

P5-XX	Function	Unit	Default value	Range	Effective	Suitable mode
P5-34.2	SI terminal filtering time	ms	0	0~f	√	5|6
P5-35.0~1	/CHGSTP: internal position mode change step signal	-	00	0~ff	√	5
P5-35.2	SI terminal filtering time	ms	0	0~f	√	5
P5-36.0~1	/I-SEL: inertia ratio switching	-	00	0~ff	√	All
P5-36.2	SI terminal filtering time	ms	0	0~f	√	All
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
P5-38	/COIN: positioning completion	-	0001	0~ffff	√	5|6
P5-39	/V-CMP: same speed detection	-	0000	0~ffff	√	3|4|7
P5-40	/TGON: rotation detection	-	0000	0~ffff	√	All
P5-41	/S-RDY: ready	-	0000	0~ffff	√	All
P5-42	/CLT: torque limit	-	0000	0~ffff	√	All
P5-43	/VLT: speed limit detection	-	0000	0~ffff	√	1|2
P5-44	/BK: brake locking	-	0000	0~ffff	○	All
P5-45	/WARN: warning	-	0000	0~ffff	√	All
P5-46	/NEAR: near	-	0000	0~ffff	√	5|6
P5-47	/ALM: alarm	-	0002	0~ffff	√	All
P5-48	/Z: encoder Z phase signal output	-	0000	0~ffff	√	All
P5-50	/MRUN: internal position mode motion starting signal	-	0000	0~ffff	√	5
P5-51	/V-RDY: speed reached	-	0000	0~ffff	√	3|4|7
P5-52	/USER1: user-defined output 1	-	0000	0~ffff	√	All
P5-53	/USER2: user-defined output 2	-	0000	0~ffff	√	All
P5-57	/PREFA: intenral position selection signal A	-	0	※1	√	5
P5-58	/PREFB: intenral position selection signal B	—	0	※1	√	5
P5-59	/PREFC: internal position selection signal C	—	0	※1	√	5
P5-61.0~1	/TRAJ-START: Motion start trigger signal	-	00	0~ff	√	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	√	All
P5-71	Function Selection of Directional Terminal of Pulse Speed Mode	-	0	0~1	√	7

P6 signal parameters (Some parameters are reserved)

P6-XX	Function	Unit	Default value	Range	Effective	Suitable mode
P6-05	Adaptive Mode Speed Loop Gain (Large Inertia)	0.1Hz	200	1~65535	○	1|2|3|4|5|6|7
P6-07	Adaptive mode inertia ratio (Large inertia)	%	50	0~10000	○	1|2|3|4|5|6|7
P6-08	Gain of adaptive mode speed observer (large inertia)	Hz	40	10~1000	○	1|2|3|4|5|6|7
P6-12	Maximum Inertia Ratio of Adaptive Mode (Large Inertia)	-	50	1~10000	○	1|2|3|4|5|6|7

Communication parameters Group P7

P7-XX	Name	Unit	Default	Range	Effective
P7-10	RS232 station no.	-	1	0~100	○
P7-11.0~1	RS232 baud rate 00：300 01：600 02：1200 03：2400 04：4800 05：9600 06：19200 07：38400 08：57600 09：115200 0A：192000 0B：256000 0C：288000 0D：384000 0E：512000 0F：576000 10：768000 11：1M 12：2M 13：3M 14：4M 15：5M 16：6M	Baud rate	06	0~16	○
P7-11.2	RS232 stop bit 0：2 bits 2：1 bit	Stop bit	2	0~2	○
P7-11.3	RS232 parity bit 0：no parity 1：odd parity 2：even parity	Parity bit	2	0~2	○
P7-30	CAN bus communication station no.	-	1	1~64	●
P7-31	CAN bus baud rate 00：100000 01：125000 02：250000 03：500000 04：750000 05：1000000	bps	5	0~5	●

P8-XX	Name	Unit	Default value	Range	Effective	Suitable mode
P8-25	Panel display selection (3770 and later version support)	-	0	0~2	▲	All

Table 1 input signal distribution

Input terminal parameter	Servo model	Range
P5-20~P5-36 P5-57~P5-59	DS5N1 series	n.0000~n.0003 n.0010~n.0013

Table 2 output signal distribution

Output terminal parameter	Servo model	Range
P5-37~P5-53	DS5N1 series	n.0000~n.0003 n.0010~n.0013

Appendix 1.2 Group F parameters

Function code	Explanation
F0-00	Clear alarm
F0-01	Factory reset
F0-02	Clear position offset
F1-00	Jog run
F1-01	Test run
F1-02	Current sampling zero calibration
F1-05	Panel enable
F1-06	Absolute encoder turns reset

Appendix 1.3 Group U monitor 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	
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		0.001V
U0-20	Analog input T-REF value		0.001V
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

Code	Contents	Unit
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
U0-55	Discharge power of instantaneous regenerative braking	1W
U0-56	Average regenerative brake discharge power	1W
U0-57	Absolute encoder present position feedback low 32-bit	Encoder pulse
U0-58		
U0-59	Absolute encoder present position feedback high 32-bit	Encoder pulse
U0-60		
U0-89	Position command end flag	
U0-91	Multi-turn absolute motor circles	
U0-98	High power motor temperature	0.1℃

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	0.01A
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 2nd warning code	
U1-22	Recent 3rd warning code	
U1-23	Recent 4th warning code	
U1-24	Recent 5th warning code	
U1-25	Recent 6th 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	-
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	Cumulative turns of motor	(0000~9999) *1	Turn
U2-19		(0000~9999) *10000	Turn
U2-20	Device serial no.: low 16-bit		
U2-21	Device serial no.: high 16-bit		
U2-22	Firmware generation date: year		
U2-23	Firmware generation date: month/day		
U2-24	Firmware generation date: hour/minute		

U3-XX:

Code	Contents	Unit
U3-00	Motor code (including thermal power parameters) read automatically by driver	-
U3-01	Motor version	-
U3-02	Encoder version	-
U3-70	Automatically read the motor code of the encoder in the motor parameters (only related to the motor code)	-

U4-XX:

Code	Contents	Unit
U4-10	Resonance frequency detected by fast FFT	Hz
U4-16	Cumulative value of continuous overload operation of thermal power protection	-
U4-17	Cumulative value of instantaneous overload operation of thermal power protection	-

Appendix 2. Term set

Abbreviation	Full name	Description
CANopen	Controller Area Network,CAN	High level communication protocol based on control local area network
pp	Profile position	Internal position control mode
pv	Profile velocity	Internal speed control mode
tq	Torque profile	Internal torque control mode
csp	Cyclic synchronous position mode	Cyclic position control mode
hm	Homing mode	Zero reset position control mode
csv	Cyclic synchronous velocity mode	Cyclic speed control mode
cst	Cyclic synchronous torque mode	Cyclic torque control mode
DC	Distributed Clock	Distributed clock
SDO	Service Data Object	The service data object is used to transmit aperiodic communication data
PDO	Process Data Object	The process data object is used to transmit periodic communication data
TxPDO	-	PDO transmitted from slave station to master station
RxPDO	-	PDO transmitted from master station to slave station
PHY	Physical layer device that converts data from the Ethernet controller to electric or optical signals.	Physical layer device that converts data from the Ethernet controller to electric or optical signals.
PDI	Process Data Interface or Physical Device Interface	Process Data Interface or Physical Device Interface
EEPROM	Electrically Erasable Programmable Read Only Memory	Programmable read only memory, which is used to store the non-volatile memory of ESC configuration and device description. Connect to ESI interface

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