

— Driving Follow Heart, Winning The Future —

FS Series AC Servo System Usermanual

SPECIAL MOTOR DRIVEN SOLUTION PROVIDER



ZHEJIANG NEW FOLINN ELECTRIC CO.,LTD

Add:No.2 Jinhuan Road,Chengbei Street,Wenling City,Zhejiang,China
Tel:+86-575-86421218
Fax:+86-576-86421168
<http://www.chinafolinn.com>

Preface

Thank you for choosing FS series ac synchronous servo system from our company Taizhou FuLing Electrical Co.,Ltd. Please read and understand all information in this manual before use. Incorrect use will cause abnormal operation, shorten the life time or damage.Please safekeep this manual.

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In this manual, safety considerations are divided into the following two parts:



The risk of wrong operation may lead to serious injury, or death.



The risk of wrong operation may cause to moderate damage or injuries, And equipment damage.

1. 1 Safety considerations

1.Before install:



Don't use the damaged or incomplete drive; Otherwise,there is risk of injury.

2.When installing:



Please install the drive on metal or other nonflammable material, and keep it away from the combustible material. Otherwisethere is danger of fire;



- ★ When more than two drives are installed in the same control cabinet,pleas pay attention to the installing place to guarantee the effectiveheat dissipation.
- ★ No drop of bolt, conducting wire or other thingsinto the inner of drive; Otherwise there is damage to drive.

3.Wiring



- ★ Wire is connected by professional person.Otherwise there is risk of electric shock.
- ★ It must use braker between drive and power supply.Otherwise there is danger of fire.
- ★ Wire is connected only when the main circuit is cut off, otherwise there is a danger of shock.
- ★ Earth must be reliable. Otherwise there is a danger of shock.



- ★ AC power supply should not be connected with output ports U, V, W;Otherwise there is a danger of damage to drive.
- ★ Please make sure all wirings meet EMC requirement and satisfy safety standard in the local area; Please refer to recommendations in this manual or national standards of wire diameter to avoid accidents.

4.Before electrification



- ★ Please make sure that voltage grade of power supply is consistent with drive's voltage and then check whether the wiring is correct and firm, and whether there is short circuit in peripheral equipment's circuit. Otherwise it will damage drive and other equipments.
- ★ Before the frequency inverter is connected to the input power supply,make sure that the cover has been fixed well. Otherwise it will cause electric shock.



- ★ Drive is no need to pressure test, It has been done in factory.Otherwise it may cause an accident!
- ★ Check all periphery fittings are wired properly according to the handbook; Otherwise it will cause accidents.

5.After electrification



- ★ After electrified, it is forbidden to open the cover, make wiring, and check up; Otherwise, it will cause the danger of electric shock.
- ★ Do not operate or touch drive with wet hand. Otherwise there is dangers of damage to frequency inverter and electric shock.
- ★ Do not touch drive terminal.Otherwise, it will cause the danger of electric shock.
- ★ After electrified, it is forbidden to security check external high-voltage electrical circuits . Otherwise it will cause the danger of electric shock.

Chapter 2 Product Introduction

2.1 Check product

The product have undergone a rigorous testing and quality control before leaving the factory. Please confirm whether there is any damage occurred during transportation:

Check whether driver and motor are in accordance with your order.

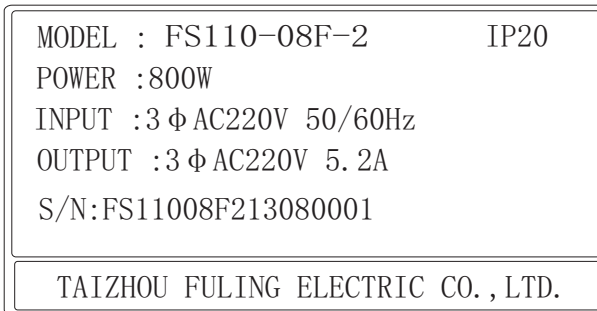
Please check drive to ensure it without any internal damage. If it has obvious damage, please do not operate machine.

Check whether servo drive and motor wiring terminal screws are loose.

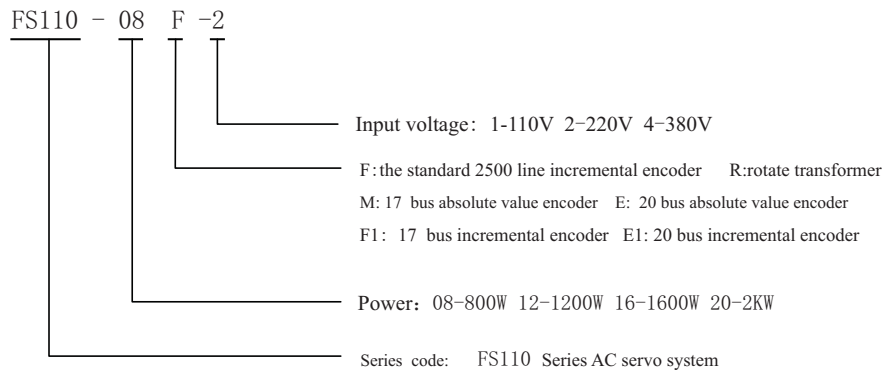
Check whether servo motor rotor shaft and motor with brake can rotate smoothly or not.

If it has damage, please timely contact the manufacturer or distribution company.

2.2 Servo Drive nameplate and models illustration:



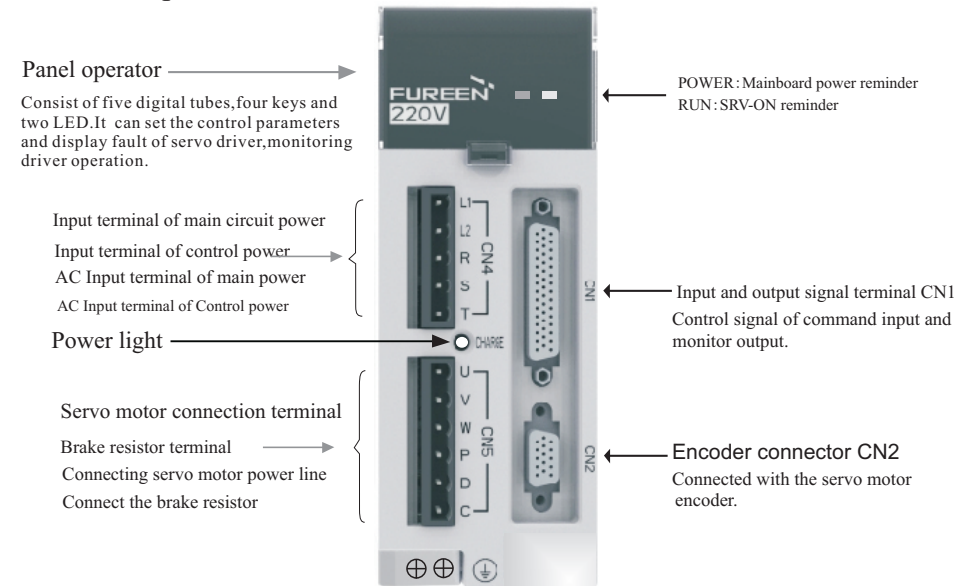
2.3 Models illustration:



2.4 Servo power standard

Input power	Power Control	220V Class: 1 Phase AC200V~230V+10%~15%, 50/60Hz				
	main power	220V Class: 3 Phase AC200V~230V+10%~15%, 50/60Hz				
200V	400W	800W	1.2KW	1.6KW	2KW	
rated current	2.6	5.2	7.8	10.4	13	
Max current	7.8A	15A	23A	31A	39A	

2.5 Each part name



Chapter 3 Installation and Wiring

3.1 Servo motor installation

Installation environmental requirements:

Ambient temperature: 0~40°C; Humidity:40%~80%(No condensation)

Storage temperature: -40~50°C; Storage humidity: Under 93% (No condensation)

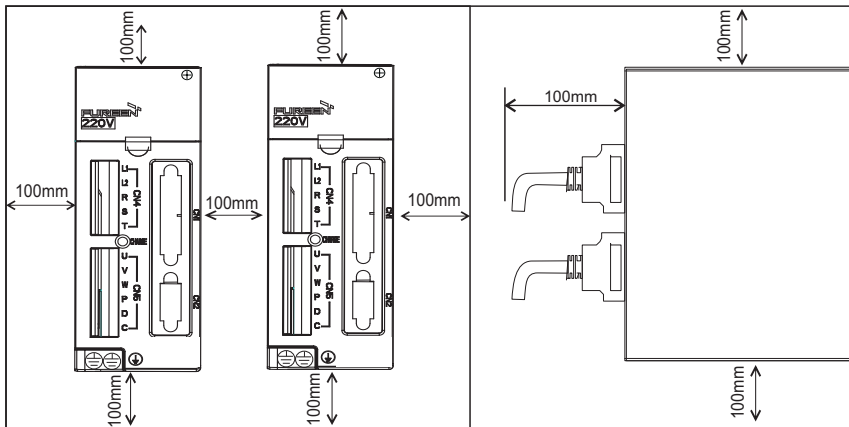
Vibration:Under 0.5G.

Well ventilated, less moisture and dust environment.

Environment without corrosivity, flammable gas, oil gas, cutting fluid, metal dust, water vapour, and direct sunlight.

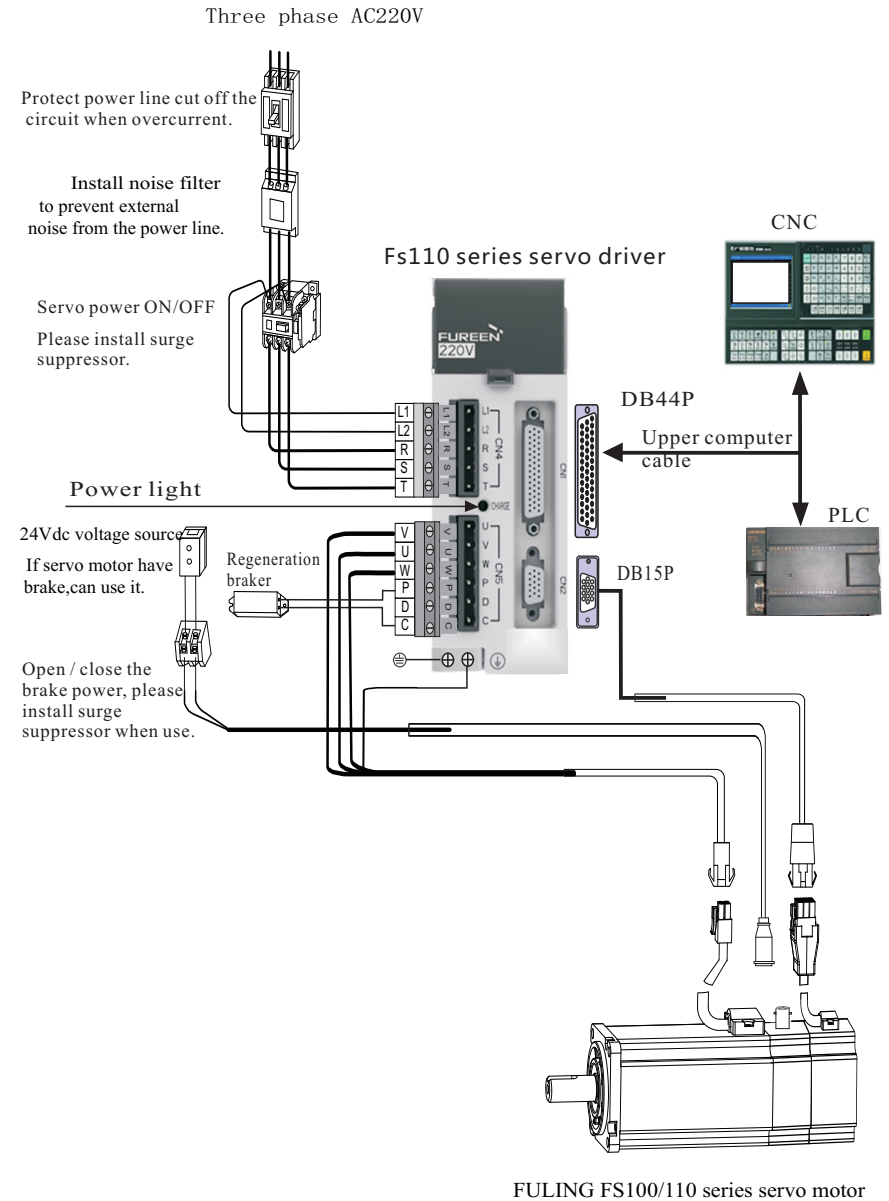
3.2 Method of installation

- 1.Horizontal installation: Please put cable outlet below to avoid water,oil etc liquid drop from wire into inside of motor.
- 2.Vertical installation: When motor shaft install upwards with speed reducer, please pay attention to avoid oil drop from motor shaft into inside of motor.
- 3.The extended length of motor shaft should be enough.if not enough will easy to vibration.
- 4.When install and disassembly motor, don't use hammer to knock motor.Otherwise, it easy to cause motor shaft and encoder damage.
- 5.It should have enough space to heat dissipation when installation.



3.3 System composition and wiring

3.3.1 Wiring diagram of servo system



3.3. 2 Wiring instructions

Wiring notice:

- * Wiring materials using is according to specification.
- * The length of the cable:instruction cable within 3m.The encoder cable within 20m.
- * Check R、S、T and L1、L2 power and wiring, Please confirm controller voltage level before wiring.
- * The motor output U、V、W terminal must match with corresponding terminal .if wrong motor don't run or galloping. Can't exchange three terminal to make motor reversal, it's big different with asynchronous motor
- * Grounding correctly with single point grounding.
- * Relay installed in the output signal , connect of the diode should be correct,Otherwise signal can not output.
- * In order to prevent the noise error action,please install insulating transformer and noise filter,etc.
- * Please keep power line (High voltage circuit of power wire, motor wire) more than 30cm between signal wire. Don't put in the same wiring tube.
- * Please install non fuse breaker to cut off the external power supply in time when drive fault.

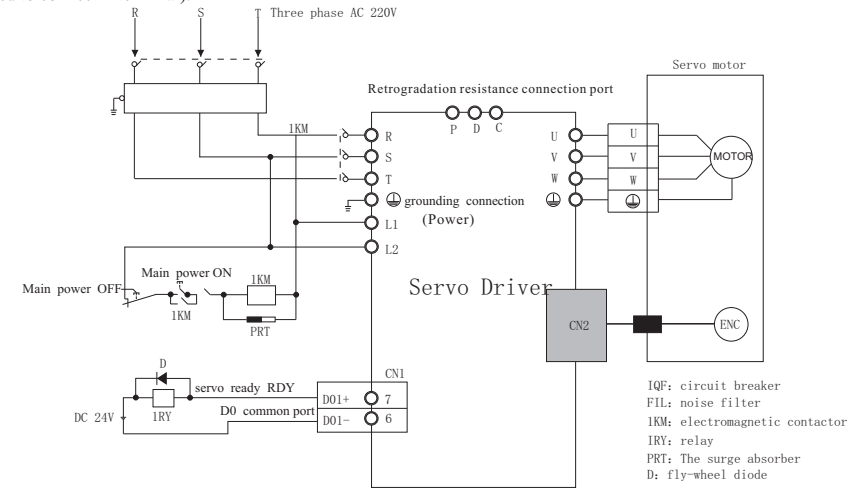
3.3. 3 Wire type

Connector	Symbol	Wire
main circuit power	R、S、T	1.0-2.5mm ²
Control Power	L1、L2	0.75mm ²
Motor connection terminal	U、V、W	1.0-2.0mm ²
Ground terminal	⊕	1.0-1.5mm ²
Control signal terminal	CN1	≥0.1mm ² (AWG26) , with shield line
Encoder signal terminal	CN2	≥0.1mm ² (AWG26) , with shield line

The encoder cable must use shielded twisted-pair cable, If the encoder cable is too long (>20m), it will cause the encoder power shortage. The power and ground wire can use multiple wire connection or coarse wire.

3.3. 4 Wiring diagram of motor and power supply

The servo driver power supply use three-phase AC 220V, gain three-phase AC 380V from transformer. In particular cases, motor less than 750W can use single phase 220V (single phase power supply connect R, S two terminals, no need to connect T terminal).



3.1. 5 Electricity wiring terminal description

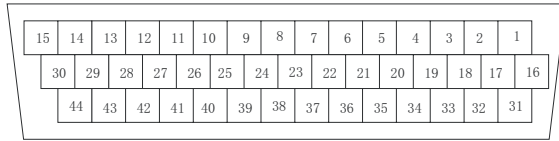
Name	Terminal symbol	Details
Main circuit power	R、S、T	Connect the external AC power Three phase 220VAC -15~+10% 50/60Hz
Control circuit power	L1、L2	Connect the external AC power Single phase 220VAC -15~+10% 50/60Hz
Motor connection terminal	U	Output to U phase power of motor
	V	Output to V phase power of motor
	W	Output to W phase power of motor
Ground terminal	⊕	Motor case ground terminal, driver ground terminal

3.4 Control signal terminal

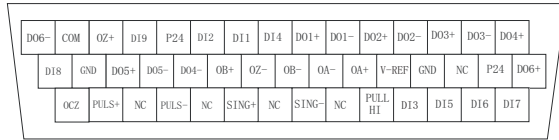
CN1 control signal terminal provide signal connected with upper controller.It use DB44 socket.Signal is include:

- * 8 programmable input;
- * 3 programmable output;
- * 1 group analog quantity instruction input;
- * Encoder signal A/B/Z frequency demultiplication difference output and Z signal push-pull output;
- * 1 group instruction pulse input.

3. 4. 1 CN1 Terminal plug pin function



CN1 DB-44 Plug pin arrangement

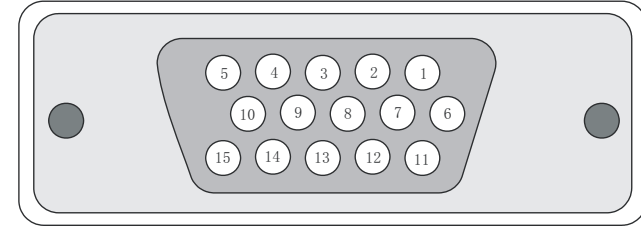


CN1 DB-44 Plug signal arrangement

3. 4. 2 CN1 input / output terminal signal description

Signal name	Stitch	Function
digital input	D11:SON	9
	D12:ARST	10
	D13:CCWL	34
	D14:CWL	8
	D15:CLR	33
	D16:obligate	32
	D17:obligate	31
	D18:obligate	30
digital output	24V	35、36
	GND	19、33
	D01+:RDY	7
Position pulse command	D02+:ALM	5
	D03+:BRK	3
	D01/2/3-	2、4、6
	SIGN+	39
Encoder signal frequency dividing output	SIGN-	37
	OB+	25
	OB-	23
	OZ+	13
Z signal collector output	OZ-	24
	CZ	44
Analog signal input	GND	29
	V-REF	20
I/O input power terminal	GND	19
Internal 500MA power supply	24V	11
	P24	17
NC(Not Connected)	G24	14
	hang in the air	————
Shield wire protection	plug metal shell	————

3. 4. 3 CN2 encoder terminal definition



HDR-15P Plug sequence permutation

3. 4. 4 CN2 Encoder signal connection terminal description

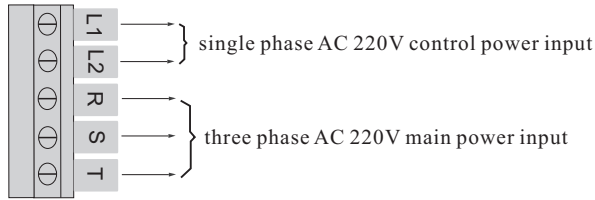
Signal name	Stitch	signal line color		Function
		Standard type	(14 Core)	
encoder power	5V	13	RED	encoder use 5V power (provide by the driver)
	0V	14/15	BLACK	
encoder A input	A+	1	BROWN	connected with the encoder A phase output
	A-	6	BLACK BROWN	
encoder B input	B+	2	YELLOW	connected with the encoder B phase output
	B-	7	BLACK YELLOW	
encoder Z input	Z+	3	GREEN	connected with the encoder Z phase output
	Z-	8	GREEN BLACK	
encoder U input	U+	4	GREY	connected with the encoder U phase output
	U-	9	GREY BLACK	
encoder V input	V+	5	WHITE	connected with the encoder V phase output
	V-	10	WHITE BLACK	
encoder W input	W+	11	ORANGE	connected with the encoder W phase output
	W-	12	ORANGE BALCK	
Shielding wire protection	FG	case	Shielding layer	Connected with the signal cable shielding wire

Note 1: Our company provide 14 core cable length of 3 meters to 10 meters

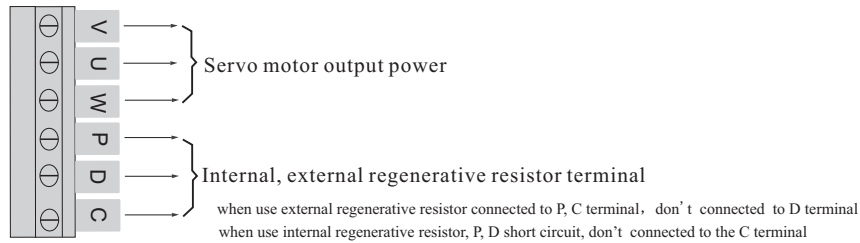
Model FS-AMD2P-3.0~10.0

3.4.5 CN3 Communication terminal (this type have no communication function)

3.4.6 CN4 power input terminal

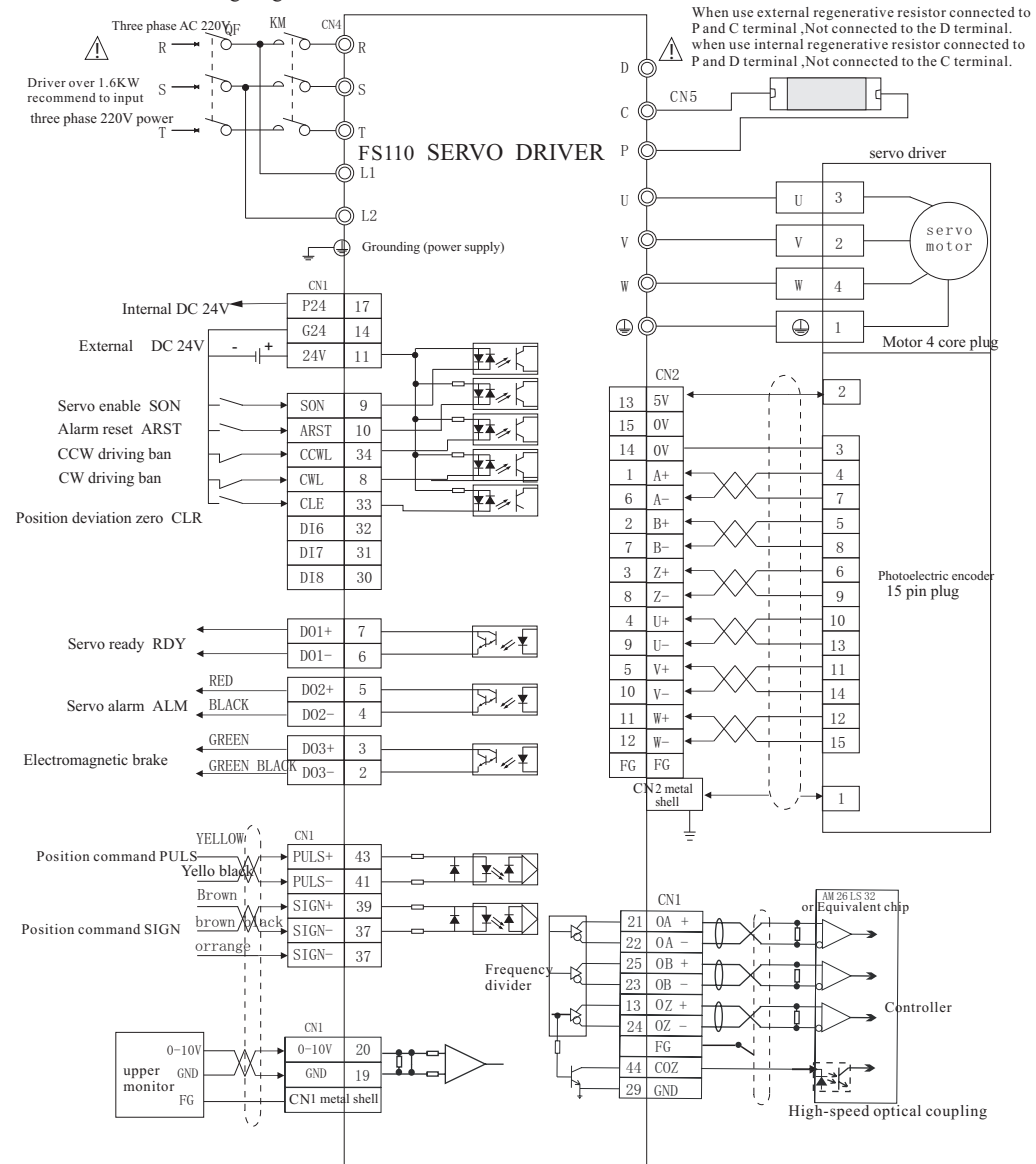


3.4.7 CN5 Retrogradation resistance and motor power output terminal



3.5 FS110 series standard wiring diagram

3.5.1 Standard wiring diagram



Note: DI / DO function of CN1 is definable by software ,this figure is value setting of factory default.It can satisfy general use. User can change by requirement.

3.5.2 CN1 Terminal connection type

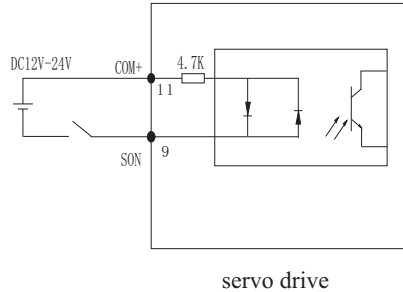
The following introduce CN1 connection circuit and the upper control device connection mode.

1. Digital input connection (C1)

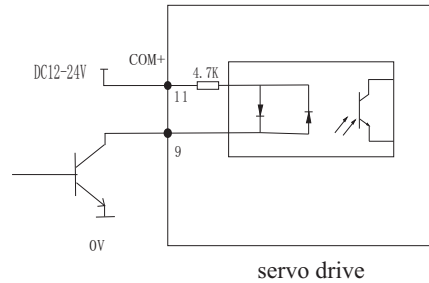
Digital input connection circuit can be controlled by the switch, relay, open collector triode, photoelectric coupler.

Relay selection need low current relay, to avoid the bad contact phenomenon. External voltage range DC12V~24V.

C1-1: Switch input



Transistor open collector input

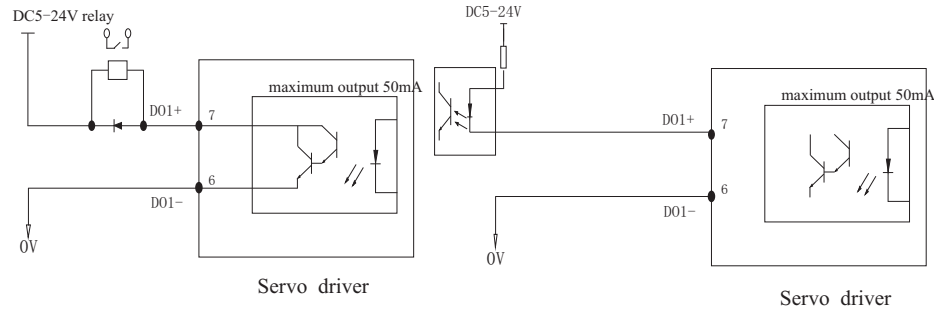


2. Digital output connection (C2)

Output circuit using darlington photoelectric coupler, it can connected with the relay, a photoelectric coupler. Note:

- * Power provided by user, If the power supply is connected contrary, it will damage drive.
- * External power supply maximum 25V, maximum output current is 50mA, 3 way current total does not exceed 100mA.
- * When using the relay or inductive load, it need to use diode and inductive load in parallel. If the polarity of diode is contrary, it will damage drive.
- * When conducting, it have 1V pressure drop, and can't meet the requirement of TTL low level, So that can't directly connected with TTL circuit.

C1-2: The relay and the photoelectric coupler



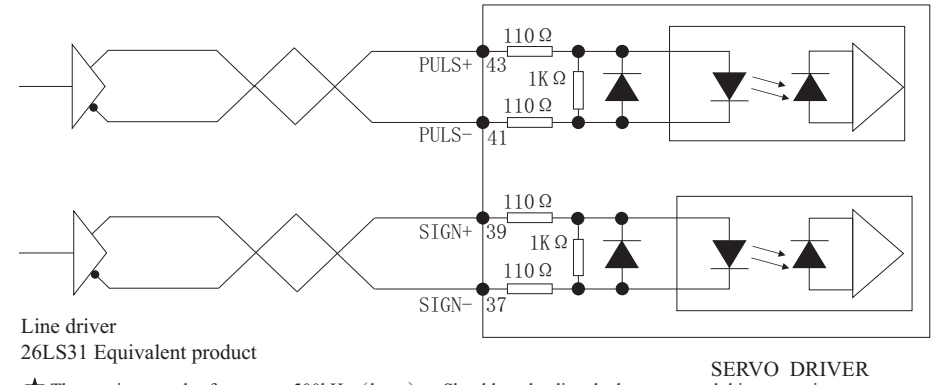
★ Relay coil must use fly-wheel diode

3. Position pulse command connection (C3)

It have differential drive and single-ended drive two connection method. Recommended differential drive connection method.

Wiring should use shielded twisted pair. Driving current 8-15mA. The parameter C035 setting work mode: Pulse + symbols, Forward / reverse pulse, Orthogonal pulse.

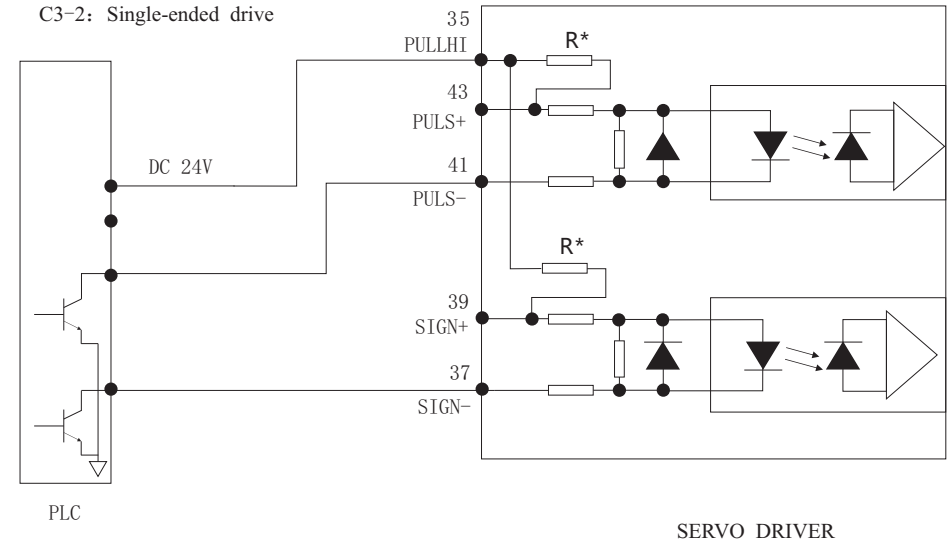
C3-1: Differential drive



Line driver
26LS31 Equivalent product

★ The maximum pulse frequency 500kHz (kpps) ; Should not be disturbed, recommend this connection.

C3-2: Single-ended drive

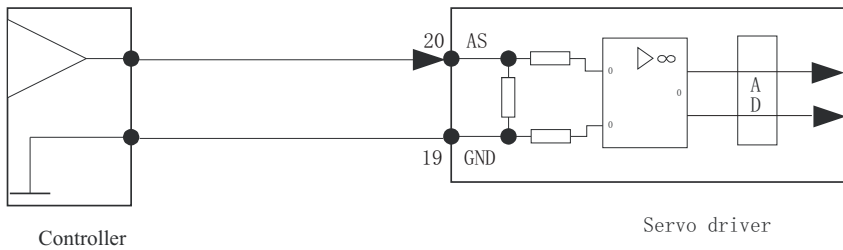


★ The maximum pulse frequency 200kHz (kpps) :

Recommend to use resistor R resistance:

VCC	R
5V	82 Ω ~ 120 Ω
12V	510 Ω ~ 820 Ω
24V	1.5K Ω ~ 2K Ω

C3-3: Analog quantity input ;

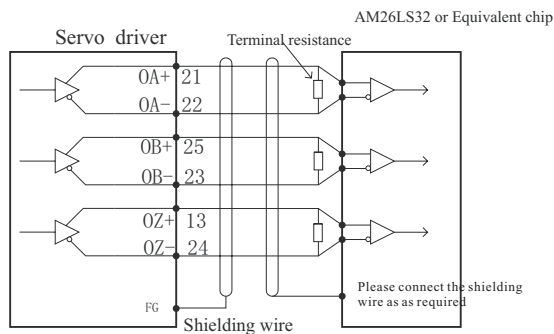


The analog quantity input circuit AI+, AI- input voltage range from -10V to +10V, over 10% will damage drive.

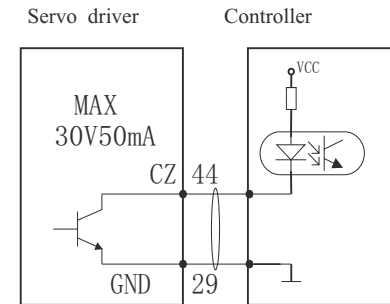
4. Encoder frequency dividing output and Z signal open collector output (C4)

Output encoder Z signal into upper controller by open collector. Because the Z signal pulse width is narrow, please receiving by high speed photoelectric coupler.

C4-1:A/B/Z Encoder signal differential output:



C4-2: Open collector output CZ



3. 5. 3 DI Connection definition of digital input

The DI digital input connection is programmable. It can set different function by corresponding parameter. The factory defined default values are as follows.

Parameter	Name	Range	Default value	Unit	Application
C100	Digital input DI Function1	-21~21	1	—	ALL
C101	Digital input DI Function2	-21~21	2	—	ALL
C102	Digital input DI Function3	-21~21	3	—	ALL
C103	Digital input DI Function4	-21~21	4	—	ALL
C104	Digital input DI Function5	-21~21	20	—	ALL

Parameter absolute value means function, symbol means logic. Positive number means positive logic. Negative numbers means negative logic (ON is effective, OFF is invalid).

Parameter value	DI input signal	DI result
Positive number	open circuit	OFF
	breakover	ON
Negative number	open circuit	ON
	breakover	OFF

DI Function description table:

Number	Symbol	DI function
0	NULL	Nonfunction
1	SON	SRV-ON
2	ARST	Alarm clear
3	CCWL	Forward rotation driving ban
4	CWL	Reversal driving ban
5	TCCW	Forward rotation torque limit
6	TCW	Reversal torque limit
15	EMG	Emergency cut-off
18	GEAR1	Electronic gear selector 1
19	GEAR2	Electronic gear selector 2
20	CLR	Position deviation clear
21	INH	Pulse Output ban

DO Function description table:

Number	Symbol	DO function
0	OFF	Always ineffective
1	ON	Always ineffective
2	RDY	Servo ready
3	ALM	Alarm
5	COIN	Complete location
6	ASP	Quickly reach
8	BRK	Electromagnetic brake
11	TRQL	Torque limiting

3.5.4 DO Digital output connection definition

Each of DO digital output connection are programmable, It can set different function by corresponding parameter.

The factory defined default values are as follows. User can modify as required.

Parameter	Name	Range	Default value	Unit	Application
C130	Digital output DO Function1	-11~11	2	—	ALL
C131	Digital output DO Function2	-11~11	3	—	ALL
C132	Digital output DO Function3	-11~11	8	—	ALL

Parameter absolute value means function, symbol means logic. 0 is force OFF. 1 is force ON. Symbol means output logic, positive number means positive logic, negative number means negative logic.

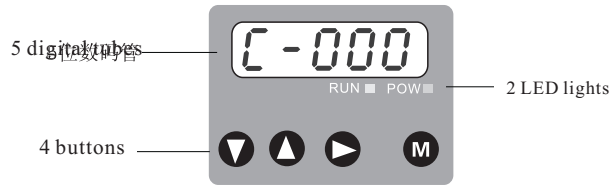
Parameter value	DO input signal	DO result
Positive number	breakover	ON
	open circuit	OFF
Negative number	open circuit	ON
	breakover	OFF

Chapter 4 Operation and Display

4.1 Drive panel description

4.1.1 Consist of panel

Panel is consist of 5 LED digital tube displays and 4 buttons ▲、▼、▶、Ⓜ and 2 LED lights, it's display system state、parameters setting, etc. Operation is stratified operation, carried out from the main menu step by step.

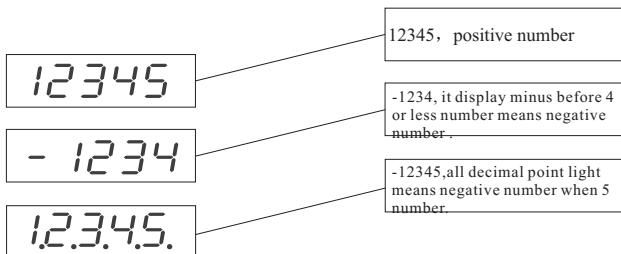


4.1.2 Panel description

Symbol	Name	Function
POW	Main power light	Light: the main power is power on Extinct: the main power supply is power off
RUN	Run light	Light: the motor is power on and running Extinct: motor is power off
▲	Increase key	Increase serial number or value; long press have redundancy effect
▼	Decrease key	Reduce serial number or value; long press have redundancy effect
▶	Back to previous menu key	Menu exit: Cancel operate, back to the previous menu.
Ⓜ	Confirm key	Menu enter :Confirm operate.

4.1.3 Numerical display

Numerical value using 5 digital tube displays ,it means negative number when minus display in front of numerical value. If 5 negative number, all the decimal point light means negative number. If numerical value is too long and occupy location of prefix character ,it will not display prefix character and only display numerical value.

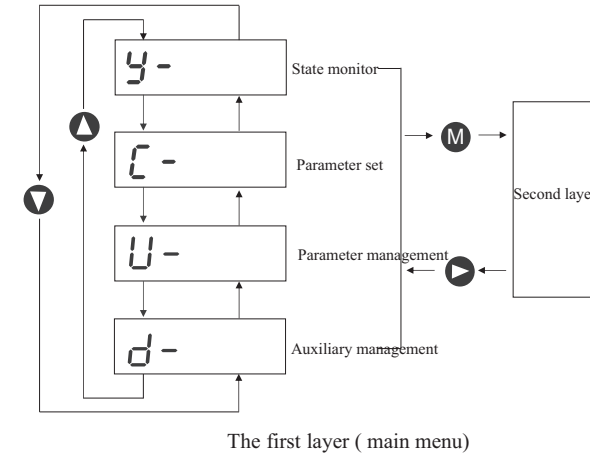


The first layer is the main menu, it has 4 kinds of operation, use and to change, and press enter second layer to details

operation, and press back to main menu.

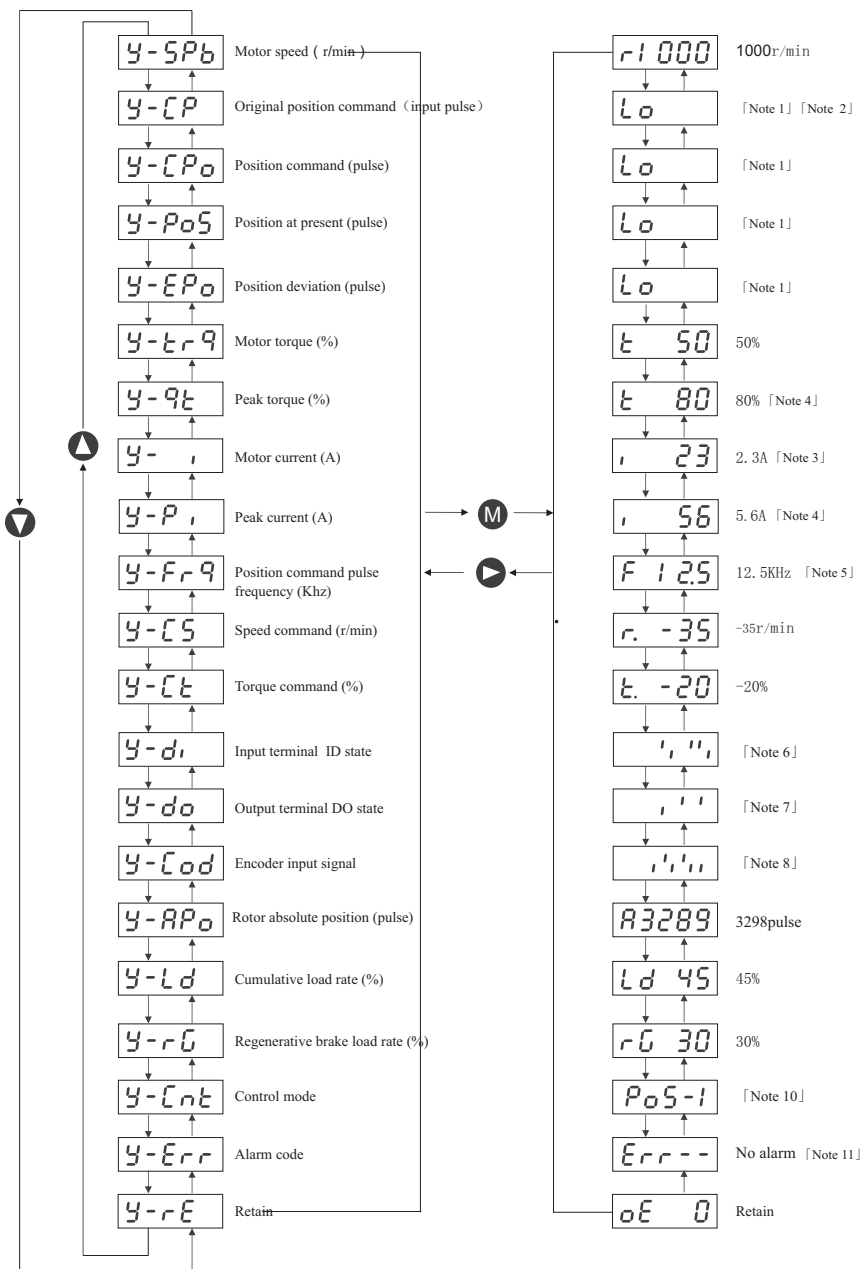
4.2 Main menu

The first layer is main menu, it has 4 operation modes. Use ▲ ▼ change mode, press Ⓜ enter to second layer to details operation, and press ▶ back to main menu.



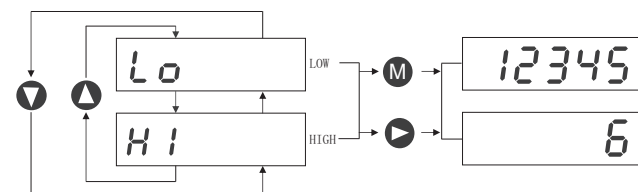
4.3 State monitor

Select state monitor in main menu "y-" and "Ⓜ" into monitor mode. There are a variety of monitor project. ▲ ▼ key to select display project, press "Ⓜ" key enter to detail display state.



1. 32 bit binary value display [Note 1]

The 32 binary system range is -2147483648~2147483647. Represented by the low and high combination, select by menu, and compound complete numerical value as follow formula.



$$32 \text{ numerical value} = \text{high numerical value} * 100000 + \text{low numerical value}$$

2. Pulse unit [Note 2]

The original position command pulse is refer number of pulse input without electronic gear conversion. Other project pulse unit is encoder pulse unit. With a practical 2500 line encoder as an example:

$$\begin{aligned} \text{Encoder pulse unit} &= \text{encoder resolution} \\ &= 4 * \text{Coder line number} \\ &= 4 * 2500 \text{ (pulse/rev)} \\ &= 10000 \text{ (pulse/rev)} \end{aligned}$$

3. Motor current [Note 3]

Motor phase current effective value.

4. Peak torque and peak current [Note 4]

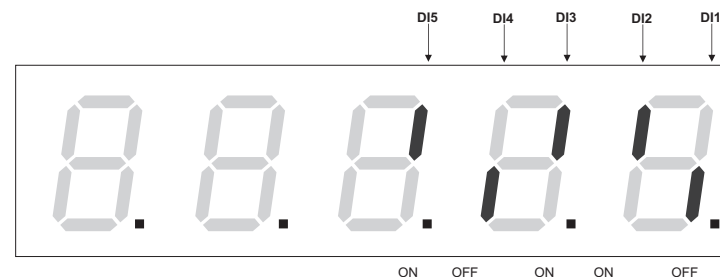
Motor maximum torque and the maximum phase current effective value in the past 10 seconds.

5. Position command pulse frequency [Note 5]

Actual pulse frequency before amplification of input electronic gear, forward rotate direction display positive number, reversal direction display negative number.

6. Input terminal DI [Note 6]

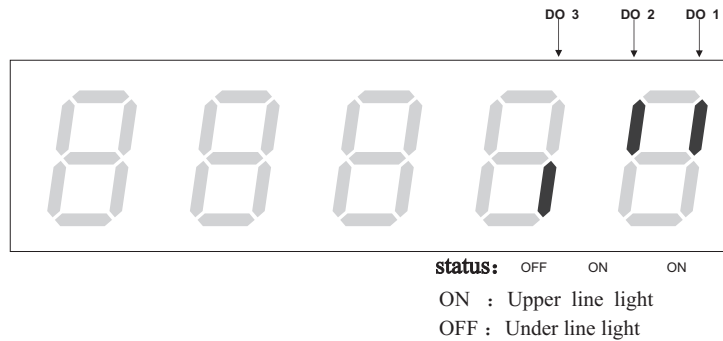
Digital tube vertical line represents a state, vertical upper line light means ON, under line light means OFF.



Status: ON : Upper line light
OFF : Under line light

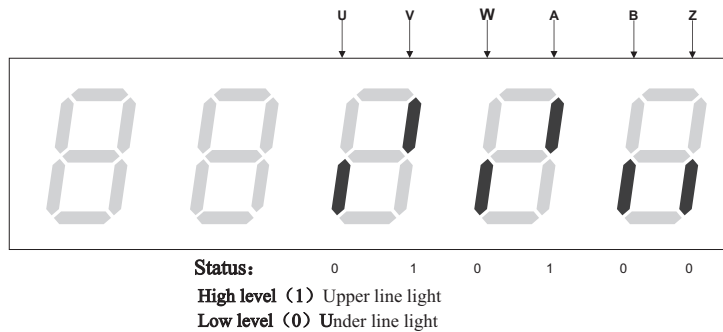
7. Output terminal DO [Note 7]

Digital tube vertical line represents a state. Vertical upper line light means ON, under line light means OFF.



8. Encoder input signal [Note 8]

Digital tube vertical line represents a state. Vertical upper line light mean high level, under line light means low level.

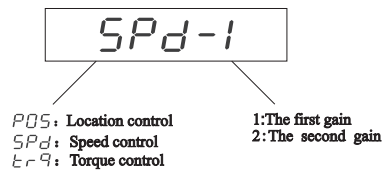


9. Absolute location of rotor [Note 9]

It means rotor relative stator location when rotate one time, rotate one time as a cycle, encoder Z pulse as a center. For example 2500 line encoder, range of 0~9999. The value is 0 when Z pulse appear.

10. Control method [Note 10]

The first 3 characters means control mode, the last character means gain combination.



11. Alarm code [Note 11]

Display two minus when no alarm. Display alarm number, when alarm and flicker. When alarm, displayer will enter state monitor automatically and display alarm number. but it can operate others by keyboard. When it is not in the state monitor, decimal point of digital tube flicker in rightmost it means alarm exists.



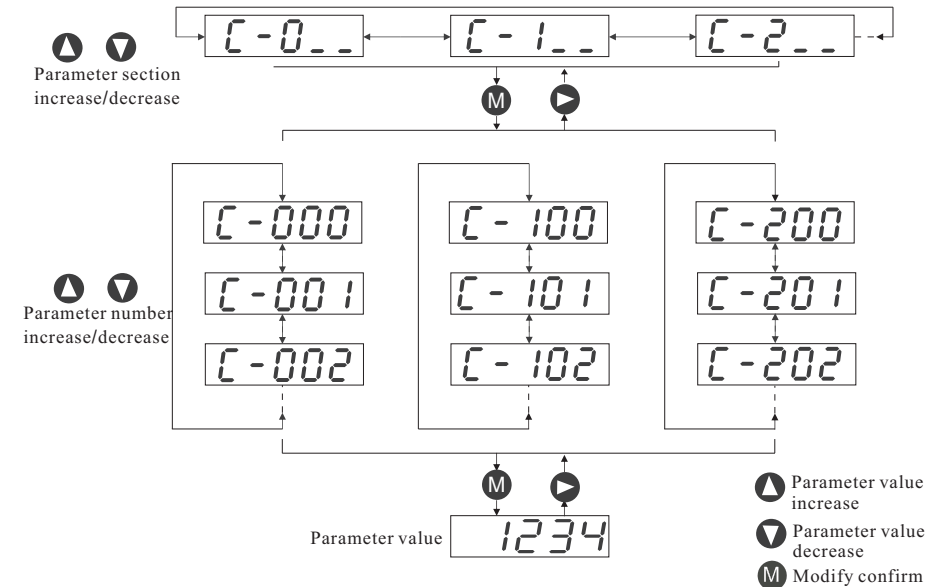
4.1 Parameter setting

Parameter is display parameter section and parameter number. Hundreds' digit is section number, ten digit and single digit are parameter number. For example parameter C102, section is "1", parameter number is "02", displayer will display "C-102".

Select parameter set "C-" in main menu, and press "M" enter parameter setting. First, use ▲, ▼ to select parameter section. Then, press "M" to enter parameter number selection, and use ▲, ▼ to select parameter number. After that, press "M" to display parameter.

Use ▲, ▼ to modify parameter. Press this two key one time, parameter will increase or decrease one. When modify, decimal point of LED in rightmost will light. And press "M" to confirm. Then, LED will extinguish. It will take effect immediately after modify (parts of parameter effect need save and re-up electricity). It can go on modify, and press ⏪ back to parameter setting state after finish modify. If need to cancel, it can press ⏩ to cancel.

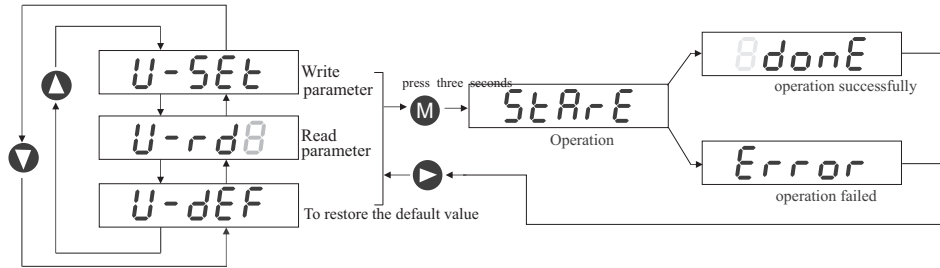
Parameter after modify is not save in EEPROM, if it need save forever, please use parameter write in parameter manage. Parameter section and number are not always continuous. It can't be choose when operate.



4.5 Parameter management

Parameter management is to process operation between parameter list and EEPROM. "U-" to enter Parameter management.

Select the mode of operation, have 3 modes. key to choose, and then press and keep three seconds to activation operation. Press key back to operation state.



◆ Write parameter

It means write parameter into EEPROM. User modify parameter one time will restored to the original value when power on next time. if it need to modify forever, it need write parameter into EEPROM, it will use new parameter after power next time.

◆ Read parameter

It means read EEPROM parameter into parameter table, it will execute one time automatically when power on. When begin, parameter in table is same with EEPROM. Once user modify, it will modify parameter in table. If user is unsatisfy or it is wrong parameter, it can read EEPROM data into parameter table, restore all data.

◆ To restore the default value

It means read all default value into parameter table and write into EEPROM. It will use default value when next time power on. If user mess parameter and can not work normally, This operation can reset all parameters to factory condition. Before resets, it must make sure driver code (parameter C001) and motor code (parameter C002) correctly.

U-SEt

Write parameter: parameter table \rightarrow EEPROM

U-rd8

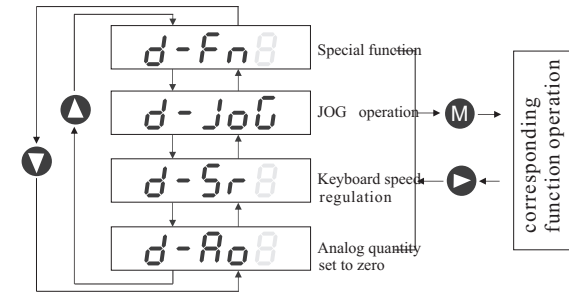
Read parameter: parameter table \leftarrow EEPROM

U-dEF

Restore default value: factory default value \rightarrow Parameter table、EEPROM

4.6 Additional function

Choose additional function "d-" in main menu, and then press this key to enter operator schema. Then press key "M" to enter, After finish, press back to operation mode selection.



4.6.1 Special function

Factory use.

4.6.2 JOG function

Please press "d-JoG" enter to JOG operation mode. And will see JOG prompt "J". Unit is r/min. Speed instruction is provided by key. Press and keeping, motor positive rotation operation according to JOG speed. Release button, motor stop, zero speed. Press this key and keep in seconds, motor reversal operation according to JOG speed. Release button, motor stop, zero speed. JOG speed is set by Parameter C076.

J 100

Press

4.6.3 Keyboard speed regulation

Keyboard speed "d-Sr" . Press this key to enter keyboard speed control. Prompt is "r", unit is r/min, speed instruction provided by key. And press key to change speed instruction. Motor is operation by setting speed. Positive number means forward rotate (CCW), negative number means reversal rotate (CW). Min speed is 0. 1r/min.

r. 50

Command increase or decrease

4.7 Parameter default value recovery

Please restore default values (factory parameter) when the following situation:

- 1) Parameter is mess, the system cannot work normally;
- 2) Change motor, new motor is different with original motor ;

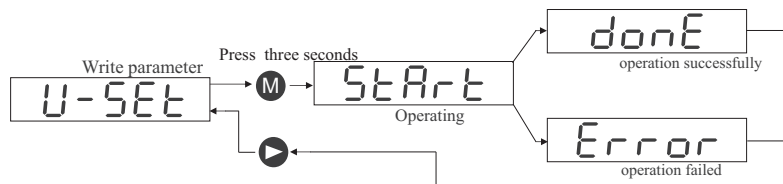
3) Other reason cause driver code(parameter C001) is not match with motor code(parameter C002).

Step of restore default values parameter are as follow:

- 1) Check the drive code (parameter C001) is correct or not.
- 2) Check the motor code (parameter C002) is correct or not. If correct, step 5, if not correct, execute following steps.
- 3) Modify the password (parameter C000) to 333.
- 4) Modify the motor code (parameter C002) as needed, and motor code refer to chapter 8.4 motor adaptation table.
- 5) Enter the parameter management, execute a) or b) as follow:

a) To restore part of parameter default value.

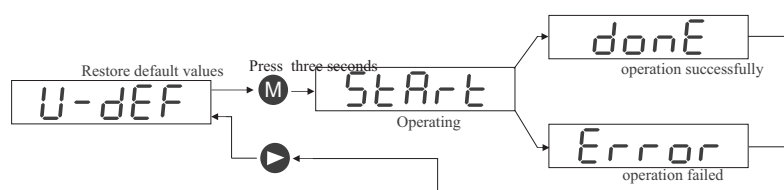
Only restore default parameter related with driver and motor, keep the other user parameters. Password must be 369 and modify the motor code, so that can restore default value function. In other situation, only can write parameter.



Only restore default value related with driver and motor

b) To restore all parameters default value

Restore all parameter to default value. Modified parameter is restore to the factory default value. To restore the default value in parameter management.



Restore the default value of all parameters

6) Power off and electricity again, it can working.

5.1 No-load test run

The purpose of test run is to confirm following items:

- * Wiring of drive power supply;
- * Wiring of Servo motor;
- * Wiring of encoder;
- * Running direction and speed of servo motor

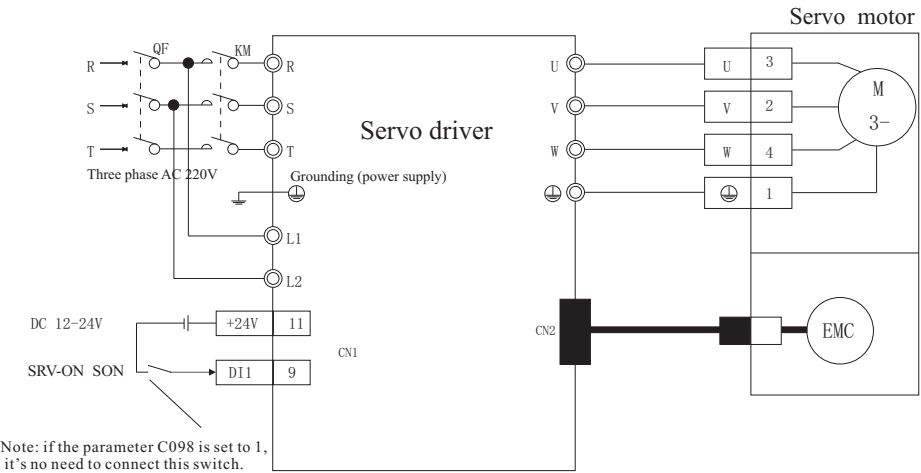
5.1.1 Wiring and check

Before electricity, please confirm the motor:

- 1) When motor no-load, do not add load on the motor shaft, if it has already installed on the machine please release the connector.
- 2) Because of impact when motor deceleration or accelerate, it must fix motor.

Wiring as following figure, please check the following items before electricity:

- 1) Connection is correct or not? Especially the R, S, T and U, V, W wiring is corresponding with the motor
- 2) Input voltage is correct or not?
- 3) Encoder cable connection is correct or not?



5.1.2 Inching JOG test run

1. Power on.

Connect control power supply (main circuit power supply is no need to connect), Driver display is lighted. If have alarm, please check connection. Then connect main circuit power supply, POWER indicator light lighted.

2. Parameter setting

Setting parameter according to the form:

Parameter	Name	Setting value	Default value	Parameter specification
C004	Control mode	1	0	Set as speed control
C025	Speed instruction sources	3	3	Set as JOG source
C060	Speed command acceleration time	suitable	0	Reduce impact of acceleration
C061	Speed instruction deceleration time	suitable	0	Reduce impact of speed
C076	JOG run speed	100	100	Inching JOG speed
C097	Ignore the driving ban	3	3	Ignore forward rotate driving ban (CCWL) and reversal driving ban(CWL)
C098	Force enable	1 or 0	0	Force enable,if add enable,set to 0. if no add,set to 1.
C100	Digital input DI,Function1	1	1	DI 1 Set to SRV-ON SON

3. Run

After confirm the absence of alarm and any unusual situation,SRV-ON and RUN indicator are light in a state of zero velocity.In the auxiliary function,enter" $d-JOG$ ", and" M "key to enter JOG run mode.Unit is r/min,Speed command provide by key.Then enter \blacktriangle and keeping,motor run forward-rotating (CCW) according to JOG speed.Loose button, motor stop.To press \blacktriangledown and keeping,motor run reversal(CW) according to JOG speed,loosen key, motor stop and keep zero speed.JOG speed is setting by Parameter C076.

5.1. 3 keyboard speed regulation run

1. Power on

Connect control power supply (main circuit power supply is no need to connect),drive display is lighten.If have alarm,please check connection.Then connect main circuit power supply,POWER indicator lighten.

2. Parameter setting

Setting parameter according to the form:

Parameter	Name	Setting value	Default value	Parameter specification
C004	Control mode	1	0	Set as speed control
C025	Speed instruction sources	4	3	Set as JOG source
C097	Ignore the driving ban	3	3	Ignore forward rotate driving ban (CCWL) and reversal driving ban(CWL)
C098	Force enable	1 or 0	0	Force enable,if add enable,set to 0. if no add,set to 1.
C100	Digital input DI,Function1	1	1	DI 1 Set to SRV-ON SON

3. Run

After confirm the absence of alarm and any unusual situation,SRV-ON and RUN indicator light in a state of zero velocity.In the auxiliary function enter" $d-Sr$ ", and" M "key to enter keyboard control.Unit is r/min,Speed command provided by keyboard. And use \blacktriangle , \blacktriangledown modify speed command, motor run according to setting speed.Positive number means forward rotate,negative number means reversal rotate.Min speed is 0.1r/min.

r. 50

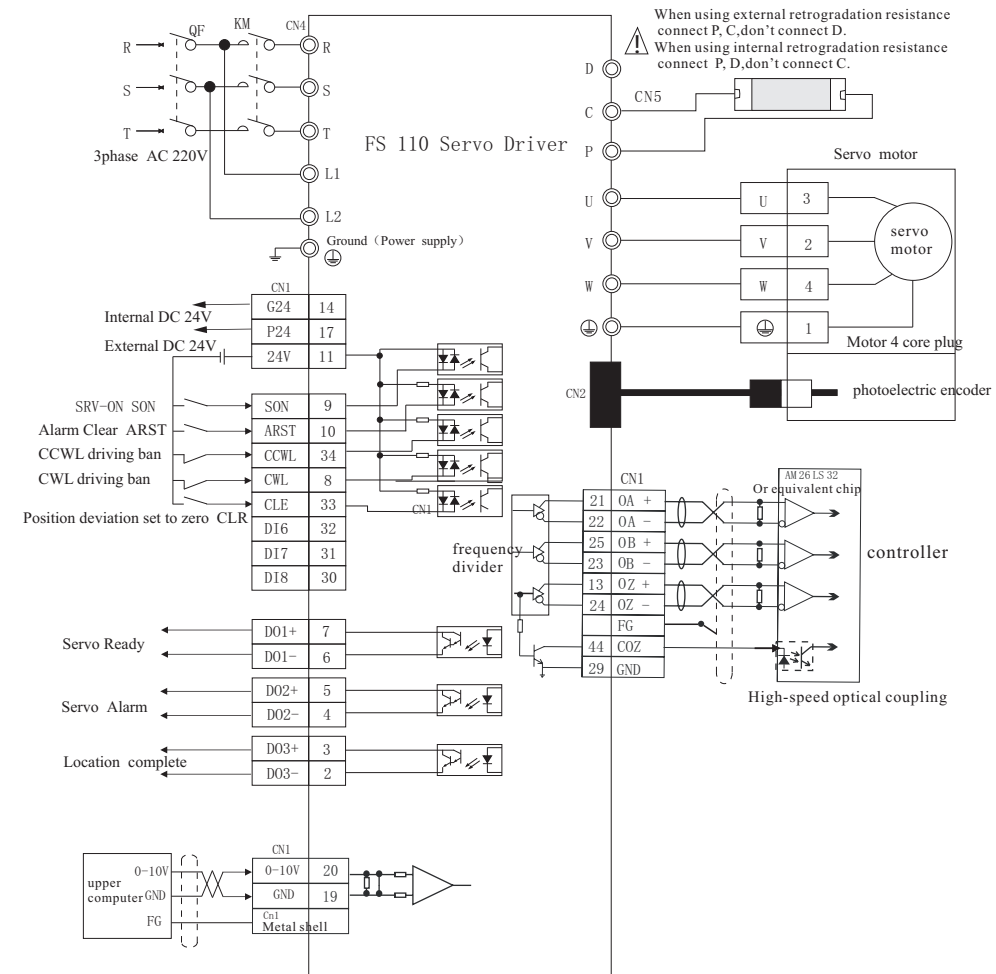
\blacktriangle
Command increase or decrease
 \blacktriangledown

5.1. 3 Analog quantity control run

Analog quantity control and position control can not effective at the same time.

1. Example

This is a simple example of analog quantity control, below is the wiring diagram.



Parameter setting example:

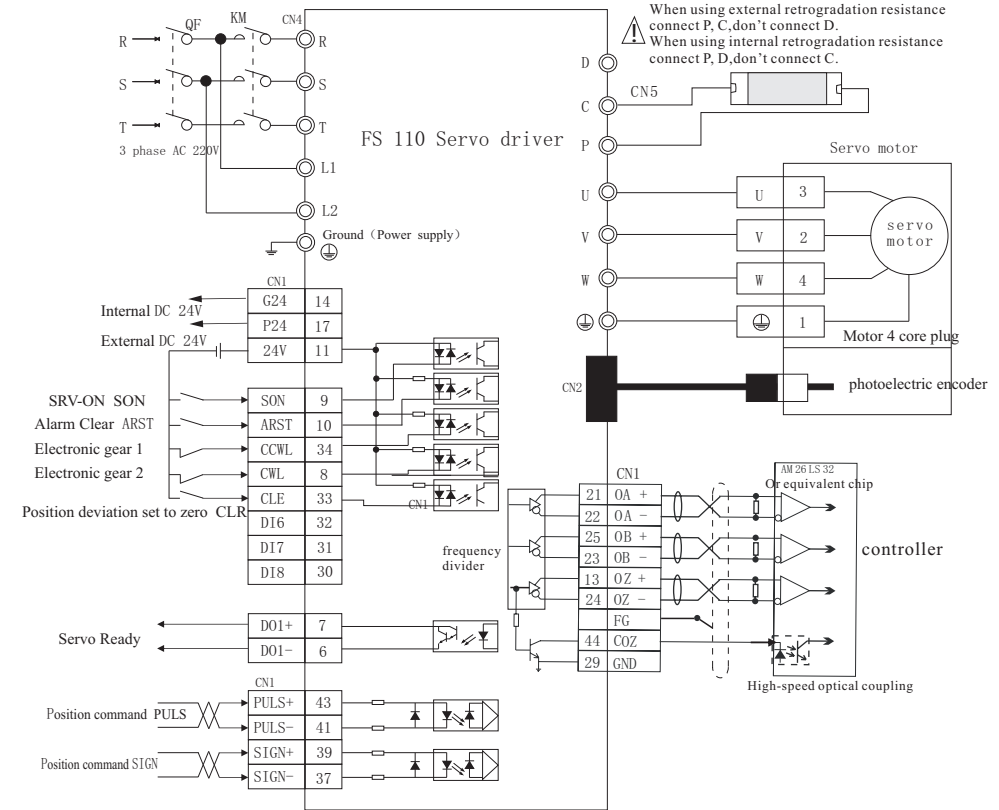
Parameter	Name	Setting value	Default value	Parameter specification
C004	Control mode	0	0	—
C097	Ignore the driving ban	0	3	Using the forward driving ban (CCWL) and reversal drive (CWL) If set to ignore, don't connect CCWL, CWL
C100	Digital input DI Function 1	1	1	DI 1 set to SRV-ON SON
C101	Digital input DI Function 2	2	18	DI 2 set to electronic gear option 1
C102	Digital input DI Function 3	3	19	DI 3 set to electronic gear option 2
C130	Digital input DO Function	1	1	DO1 set to servo ready RDY
C029	Command pulse electronic gear 1 molecules	1	40	—
C030	Command pulse electronic gear denominator	1	1	—
C035	command pulse input mode	0	0	—
C036	command pulse input direction	0	0	—
C037	command pulse input signal logic	0	0	—
C038	command pulse input signal filtering	7	7	—
C039	Command pulse input filtering mode	0	0	—
C040	Position command exponential smoothing filtering time	0	40	—

5.2 Position control

Position control is application to precision position system. Such as numerically-controlled machine, textile machinery, etc. Position command source is pulse command. It input pulse by input terminal of PULS +, PULS - and SIGN +, SIGN -.

5.2.1 Sample

This is a simple example of position control, below is the wiring diagram.



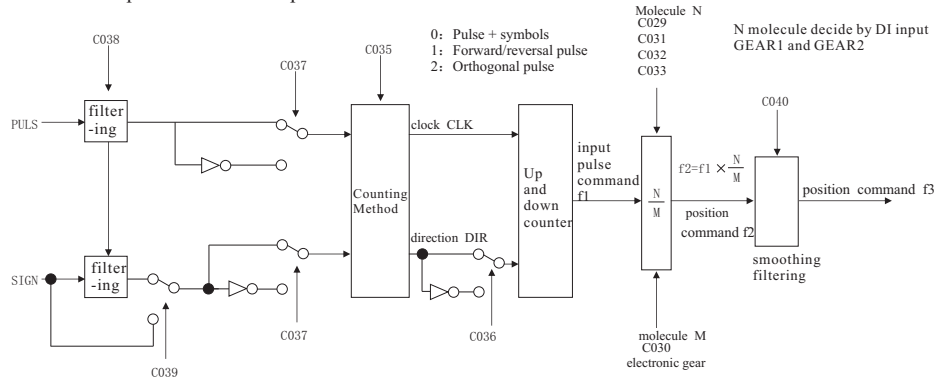
Parameter	Name	Setting value	Default value	Parameter specification
C004	Control mode	0	0	Set to position control
C097	Ignore the driving ban	0	3	Using the forward driving ban (CCWL) and reversal driving ban (CWL). If set to ignore, don't connect CCWL, CWL
C100	Digital input DI Function	1	1	DI 1 set to SRV-ON SON
C130	Digital output DO Function	1	1	DO 1 set to servo ready RDY

5.2.2 Position command

Parameter	Name	Range	Default value	Unit	Application
C029	Command pulse electronic gear molecules 1	1~32767	1	—	P
C030	Command pulse electronic gear the denominator	1~32767	1	—	P
C031	Command pulse electronic gear molecules 2	1~32767	1	—	P
C032	Command pulse electronic gear molecules 3	1~32767	1	—	P
C033	Command pulse electronic gear molecules 4	1~32767	1	—	P

C035	The command pulse input mode	0~2	0	—	P
C036	The command pulse input direction	0~1	0	—	P
C037	The command pulse input signal logic	0~3	0	—	P
C038	The command pulse input signal filtering	0~21	7	—	P
C039	Command pulse input filtering model	0~1	0	—	P
C040	Position command exponential smoothing filtering time	0~1000	0	ms	P

2. Command pulse transmission path

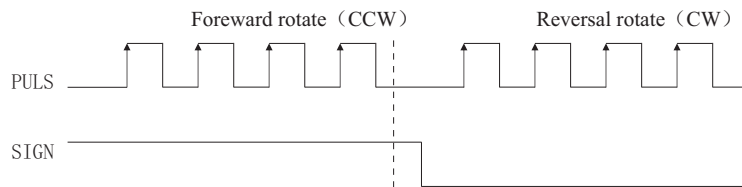


3. The command pulse input mode

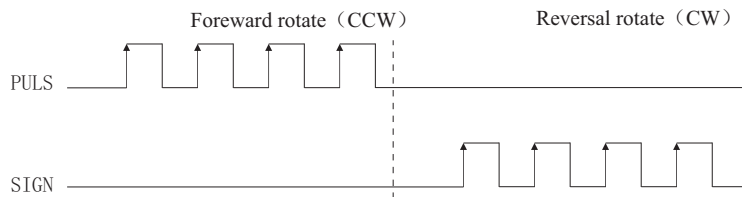
Input mode is decided by the parameters C035. It can set input signals PULS and SIGN signal phase by parameter C037. And C036 parameter is used for modify counting direction.

Pulse command form:

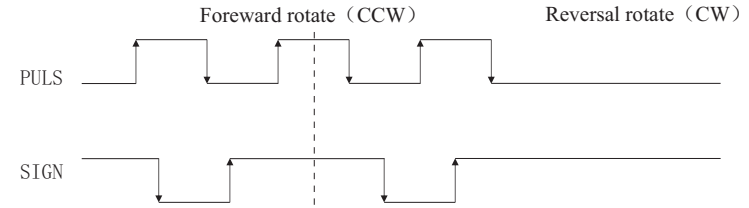
1) Pulse + direction (Parameter C035 is set to 0)



2) Forward/reverse rotate pulse (parameter C035 is set to 1)



3) Orthogonal pulse (C035 parameter is set to 2)

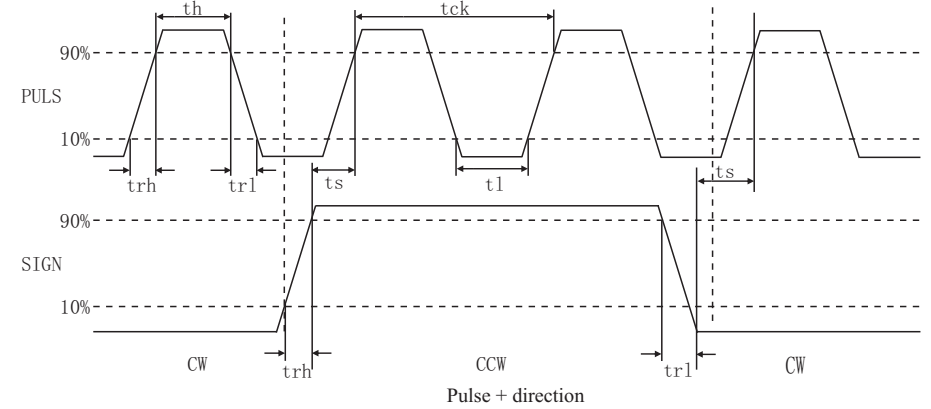


Note: the arrows represent count along, and C036 = 0, C037 = 0.

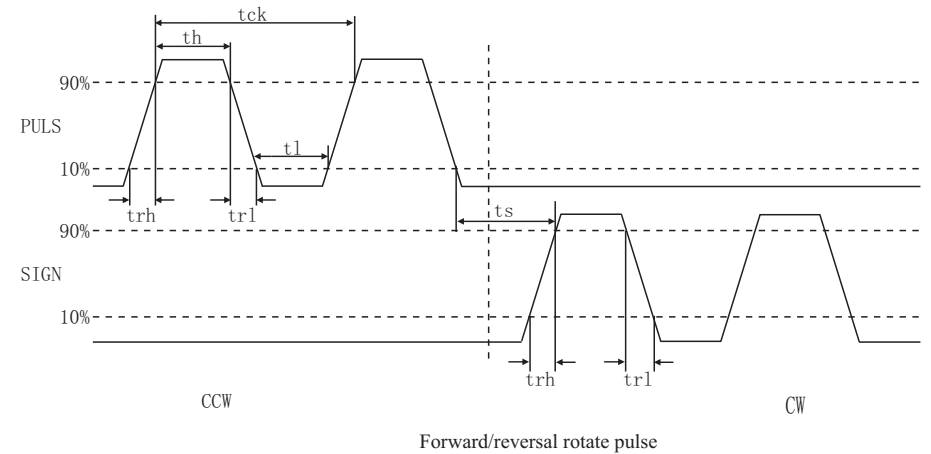
4. Pulse instruction sequence specification

Position command pulse waveform:

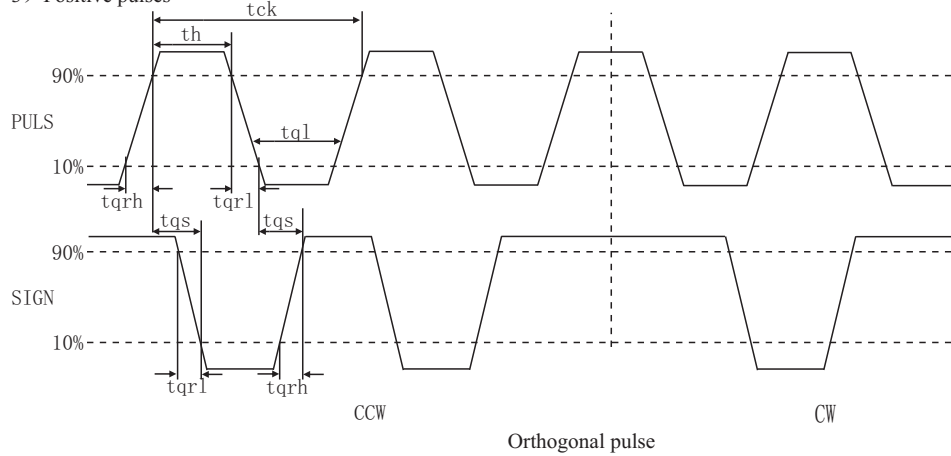
1) Pulse + direction



2) Forward/reverse rotate pulse



3) Positive pulses



Note: parameter requirement

Differenced	$t_{ck} > 2\mu s, t_h > \mu s, t_l > \mu s, t_{rh} < 0.2\mu s, t_{rl} < 0.2\mu s, t_s > 1\mu s, t_{qk} > 8\mu s, t_{qh} > 4\mu s, t_{ql} > 4\mu s, t_{qrh} < 0.2\mu s, t_{qrl} < 0.2\mu s, t_{qs} > 1\mu s$
single-ended	$t_{ck} > 5\mu s, t_h > 2.5\mu s, t_l > 2.5\mu s, t_{rh} < 0.3\mu s, t_{rl} < 0.3\mu s, t_s > 2.5\mu s, t_{qk} > 10\mu s, t_{qh} > 5\mu s, t_{ql} > 5\mu s, t_{qrh} < 0.3\mu s, t_{qrl} < 0.3\mu s, t_{qs} > 2.5\mu s$

5. Signal filtering

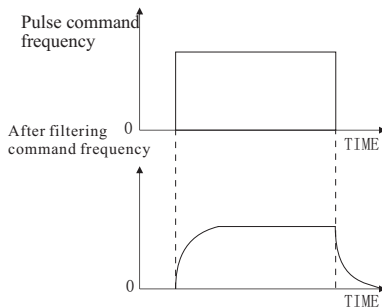
Parameters C038 is set input signal PULS and SIGN digital filtering. The larger the value, the larger filtering time constant. Maximum pulse input frequency under default value is 500 KHZ (KPPS). The larger the value but maximum pulse input frequency will decrease accordingly.

The noise used for filtering signal line is avoid count error. If there have count error, it can increase parameter.

Parameter C039 can close SIGN signal filtering.

6. Smoothing filtering

Parameter C040 is smoothing filtering to command pulse. The filter will not lost the input pulse but maybe delay. When set to 0, filter doesn't work. Parameter value means time of position command frequency from zero frequency up to 63.2%.



Filter make input pulse frequency smoothing. This filter is used to: upper controller no function of accelerate and decelerate, electronic gear is big, lower command frequency.

5.2. 3 Input electronic gear

Description of electronic gear variable are as below:

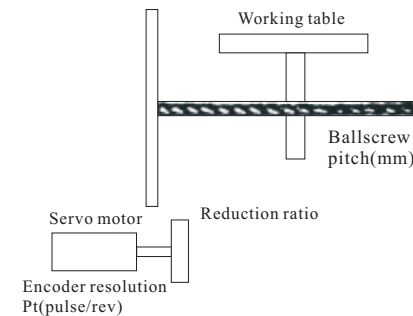
Variable	Variable Description	Numerical value
C	The encoder wire number	2500
Pt	Encoder resolution (pulse/rev)	$= 4 * C$ $= 4 * 2500$ $= 10000$ (pulse/rev)
R	Deceleration ratio	$R = B/A$, A: Motor rotation turns B: Load axis rotation turns
ΔP	Command pulse movement amount	---
Pc	Load axle command pulse number when one turn	---
Pitch	Ball bearing shaft command pulse number (mm) when one turn	---
D	Roller diameter (mm)	---

Calculation formula:

$$\text{Electronic gear ratio} \left(\frac{N}{M} \right) = \frac{\text{Encoder one turn resolution (Pt)}}{\text{Load axle one turn command pulse number (Pc)} \times \text{reduction ratio (R)}}$$

$$\text{Load axle one turn command pulse number (Pc)} = \frac{\text{Amount of load axle one turn movement}}{\text{Amount of command pulse movement} (\Delta P)}$$

1. Electronic gear application to ballscrew



For ballscrew load,

$$\text{Electronic gear ratio} \left(\frac{N}{M} \right) = \frac{Pt}{Pc \times R}$$

$$Pc = \frac{\text{Pitch}}{\Delta}$$

Encoder line number C = 2500 line, decelerate ratio 1/1, Pitch = 8 mm, one pulse movement $\Delta P = 0.001$ mm,
How to calculate electronic gear ratio.

Calculation steps:

Calculate the encoder resolution (Pt)

$$Pt = 4 \times C = 4 \times 2500 = 10000 \text{ (pulse/rev)}$$

Calculate load axle one turn command pulse number (Pc)

$$Pc = \frac{\text{Pitch}}{\Delta P} = \frac{8\text{mm}}{0.001\text{mm}} = 8000$$

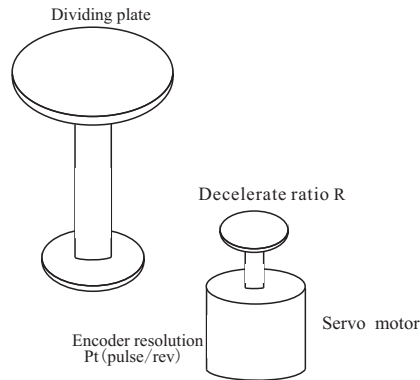
Calculation electronic gear ratio

$$\text{Electronic gear ratio } \frac{N}{M} = \frac{Pt}{Pc \times R} = \frac{10000}{8000 \times (1/1)} = \frac{5}{4}$$

Setting parameter (molecular 1 as an example)

Molecule N=5, denominator M=4, Set C029=5 and C030=4.

2. Electronic gear application of index plate



For dividing plate load,

$$\text{Electronic gear ratio } \frac{N}{M} = \frac{Pt}{Pc \times R}$$

$$Pc = \frac{360^\circ}{\Delta P}$$

For example:

Encoder line number C = 2500 line, decelerate ratio 1/3, pulse movement = $0.1 \Delta P$, calculation electronic gear ratio.

Calculate the encoder resolution (Pt)

$$Pt = 4 \times C = 4 \times 2500 = 10000 \text{ (pulse/rev)}$$

Calculate bearing axle one turn command pulse number (Pc)

$$Pc = \frac{360^\circ}{\Delta P} = \frac{360^\circ}{0.1^\circ} = 3600$$

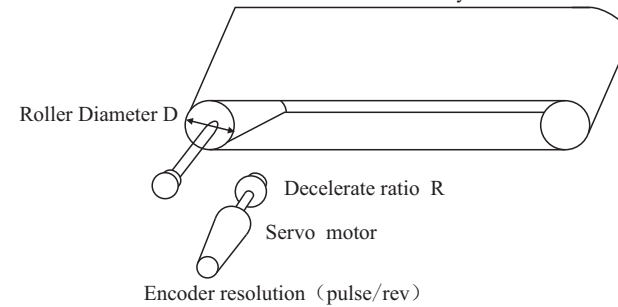
Calculate electronic gear ratio

$$\text{Electronic gear ratio } \frac{N}{M} = \frac{Pt}{Pc \times R} = \frac{10000}{3600 \times (1/3)} = \frac{25}{3}$$

Set the parameter:

Molecule N=25, denominator M=3, Set C029=25 and C030=3

3. Electronic gear application to the conveyor belt conveyor



$$\text{Electronic gear ratio } \frac{N}{M} = \frac{Pt}{Pc \times R}$$

$$Pc = \frac{\pi D}{\Delta P}$$

For example:

Encoder line number C = 2500 line, reduction ratio 1/10, roller diameter D = 200 mm, a pulse movement $\Delta P = 0.01$ mm. Calculate electronic gear ratio.

Calculate the encoder resolution (Pt)

$$Pt = 4 \times C = 4 \times 2500 = 10000 \text{ (pulse/rev)}$$

Calculate bearing axle one turn command pulse number (Pc)

$$Pc = \frac{\pi D}{\Delta P} = \frac{3.14 \times 200}{0.01} = 62800$$

Calculation electronic gear ratio

$$\text{Electronic gear ratio } \frac{N}{M} = \frac{Pt}{Pc \times R} = \frac{10000}{62800 \times (1/10)} = \frac{2500}{157}$$

Set parameter:

Molecule N = 2500, the denominator M = 2500, set C029 = 2500 and C030 = 157.

4. Relationship of motor rotating circles and electronic gear ratio

$$\text{Motor rotating circles} = \frac{\text{Pulse} \times N}{Pt \times M}$$

5. Relationship of motor rotation speed and electronic gear ratio

$$\text{Motor speed (r/min)} = \frac{f \text{ (Hz)} \times 60 \times N}{Pt \times M}$$

“f” is the input pulse frequency, the unit Hz (PPS)

For example, encoder line number C = 2500 line, N = 3, M = 1, f = 100 KHZ (KPPS)

$$\text{Motor speed r/min} = \frac{100 \times 10^3 \times 60 \times 3}{10000 \times 1} = 1800 \text{ (r/min)}$$

6. Electronic gear ratios switch

Driver provide four groups of electronic gear molecular N, it can change online, and decide by input DI GEAR1、GEAR2 .Denominator M is all same..

DI signal (Note)		Input electronic gear molecular N	Input electronic gear denominator M
GEAR2	GEAR1		
0	0	Molecular 1 (Parameter C029)	Denominator (parameter C030)
0	1	Molecular 2 (Parameter C031)	
1	0	Molecular 3 (Parameter C032)	
1	1	Molecular 1 (Parameter C033)	

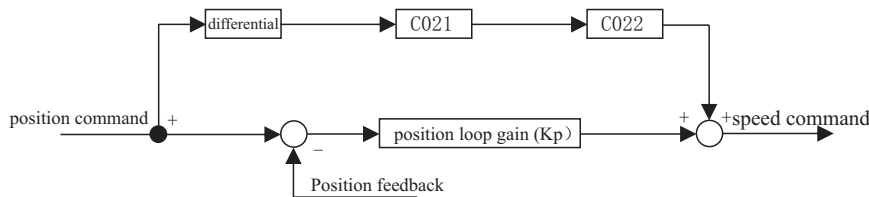
Note: 0 means OFF, 1 means ON

5.2. 4 Position control gain

Parameter	Name	Range	Default value	Unit	Application
C009	Position loop gain	1~1000	40	1/s	P
C021	Position loop feedforward gain	0~100	0	%	P
C022	Position loop feedforward filter time constant	0.20~50.00	1.00	ms	P

Because the position loop is including speed loop .Internal loop first,and then external loop.First of all, set load moment of inertia ratio.Adjust the speed loop gain, speed loop integral time constant.And adjust the position loop gain.

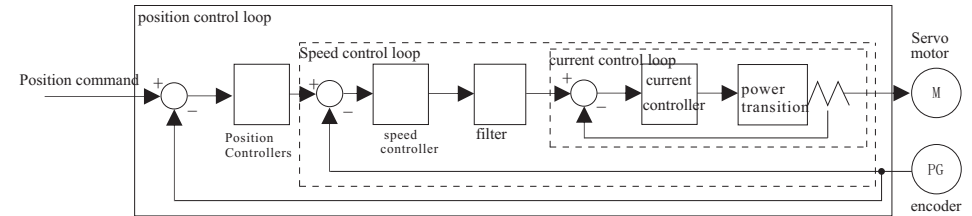
The following is the position controller of the system.Increase of position loop gain Kp can improve bandwidth of position loop,but it's limited by bandwidth of speed loop.If need to improve the position loop gain, it must improve speed loop bandwidth first.



Feedforward can reduce the phase lag of position loop control and position tracking error with shorter positioning time.Feedforward is increase,tracking error of position control will reduce.But too large feedforward will make the system unstable.If the electronic gear ratio is more than 10,it will make noise.General application can set C021 to 0%.If need high response, low tracking error,it can increase but can't over 80%.And adjust the position loop feedforward filter time constant(Parameter C022).

5.3 Gain adjustment

Driver is include current control loop, speed control loop and position control loop this three control loops. Control diagram is as follows:



In theory, bandwidth of internal control loop must higher than external.Otherwise the whole control system will unstable and due to vibration or poor response.So the three control loop bandwidth relationship is as follows:

$$\text{Current loop bandwidth} > \text{Speed loop bandwidth} > \text{Position loop bandwidth}$$

(Users only need to adjust the speed control loop and position control loop.)

5.3. 1 Gain parameter

Parameter	Name	Range	Default value	Unit	Application
C005	Speed loop gain	1~3000	40	Hz	P, S
C006	Speed loop integral time constant	1.0~1000.0	20.0	ms	P, S
C009	Position loop gain	1~1000	40	1/s	P
C017	Load rotational inertia ratio	0.0~200.0	1.5	times	P, S

Symbols are defined as follows:

Kv: Speed loop gain;

Ti: Speed loop integral time constant;

Kp: Position loop gain;

G: Load rotational inertia ratio (C017) ;

JL: Load rotational inertia convert to the motor shaft;

JM: Rotational inertia of the motor rotor.

1. Speed loop gain Kv

Speed loop gain Kv decide response bandwidth of the speed loop.When there don't have vibration or noise, increase the speed gain value,the response speed will faster,and will follow speed command better. But if increase too much,it will easy to cause mechanical resonance.Speed loop bandwidth is calculate by the following formula:

$$\text{Speed loop bandwidth (Hz)} = \frac{1+G}{1+JL/JM} \times K_V \text{ (Hz)}$$

If load rotational inertia ratio (G) is sett correctly (G=JL/JM),speed loop bandwidth is equal to speed loop gain(Kv).

2. Speed loop integral time constant Ti

Speed loop integral can eliminate the steady-state error effectively,and reflect imperceptible speed changes fast.

When there don't have vibration or noise, reduce speed loop integral time constant T_i to increase system rigidity and reduce the steady-state error. If load rotational inertia ratio is too large or mechanical resonance, and must confirm speed loop integral time constant is large enough. Otherwise it will cause mechanical resonance. If load rotational inertia ratio G is set correctly ($G=JL/JM$), speed loop integral time constant T_i is calculate by the following formula:

$$T_i \text{ (ms)} \geq \frac{4000}{2\pi \times K_v \text{ (Hz)}}$$

3. Position loop gain K_p

Position loop gain K_v decide reaction speed of position loop. When there don't have vibration or noise to increase the position gain value, the reaction speed will faster, and reduce error of position tracking so that save position time. But if increase too much, it will easy to cause mechanical resonance or positioning overshoot. Position loop bandwidth must lower than speed loop bandwidth:

$$\text{Position loop bandwidth (Hz)} \leq \frac{\text{Speed loop bandwidth (Hz)}}{4}$$

If load rotational inertia ratio G is setting correctly ($G=JL/JM$), to calculate position loop gain K_p :

$$K_p \text{ (1/s)} \leq 2\pi \times \frac{K_v \text{ (Hz)}}{4}$$

5.3. 2 Gain adjustment steps

The choice of position and speed bandwidth must be decided by mechanical rigidity and applications, conveying machinery connected by belt is low rigidity, it can be set to a low bandwidth; The ball screw mechanical driven by the gear reducer stiffness is medium. Can be set to medium bandwidth; Direct to driving ball threaded screw or linear motor is high stiffness, can be set to high bandwidth. If the mechanical characteristics is unknown, can gradually increase the gain in order to improve the bandwidth until resonance, and reduce gain.

In servo gain, if change a parameter and other parameters also need to adjust. Please don't big change a parameter.

Improved response	Reduce the response to control vibration and overshoot
1. Improve the speed loop gain K_v 2. Reduce the speed loop integral time constant T_i 3. Improve the position loop gain K_p	1. Reduce the position loop gain K_p 2. Increase the speed loop integral time constant T_i 3. Reduce the speed loop gain K_v

Speed control gain adjustment steps

1. Set the load rotational inertia ratio.
2. Set the speed loop integral time constant to larger values.
3. Turn up speed loop gain if no vibration or abnormal noise. If vibrate, turn down a little.
4. Turn down speed loop integral time constant if no vibration. If vibrate, turn up a little.
5. If there can not turn up the gain because of mechanical system resonance and can't get response. Adjust the torque filtering time constant, and repeat above steps to improve responsiveness.

Position control gain adjustment steps

1. Set the load rotational inertia ratio.
2. Set the speed loop integral time constant to larger values.
3. Turn up speed loop gain if no vibration or abnormal noise. If vibrate, turn down a little.

4. Turn down speed loop integral time constant if no vibration. If vibrate, turn up a little.
5. Turn up the position loop gain, if no vibration, turn down a little.
6. If there can not turn up the gain because of mechanical system resonance and can't get response. Adjust the torque filtering time constant, and repeat above steps to improve responsiveness.
7. If you need tracking error by shorter time and smaller position, it can adjust the position feedforward appropriately. Please refer to section 5.2.4.

5.4 Resonance suppression

When the mechanical system occur resonance because of servo system is too large rigidity or too fast response. It can improve by gain reduced. Driver provide low pass filter. It can suppressing resonance without change the gain.

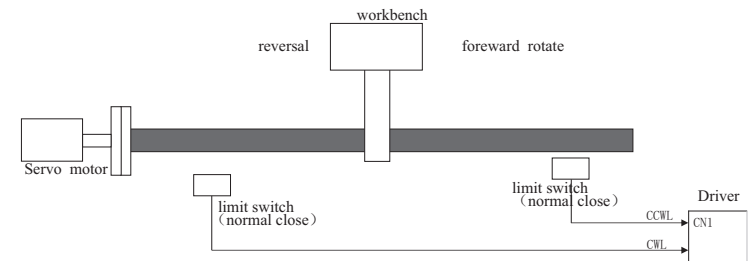
Parameter	Name	Range	default value	unit	Application
C007	Torque filtering time constant	0.10~50.00	2.50	ms	ALL

Settings by the parameter C007. Low pass filter is default effective. Low-pass filter can suppress the high frequency resonance, noise. When machine is high frequency vibration. Adjust torque filter time constant T_f . It may eliminate the vibration. The smaller the value, the easier to control response. But it limited by mechanical conditions; The larger value, the easier to suppress the high frequency vibration, but can't be too large.

$$T_f \text{ (ms)} \geq \frac{1000}{2\pi \times 2 \times K_v \text{ (Hz)}}$$

5.5 Overtravel protection

Overtravel protection is safety function when machinery move beyond the safety range, to limit switch action, and stop motor. As following:



The limit switch is recommended to use normally closed contact. Closed in safety range. Break when over travel. Connect to the forward driving ban (CCWL) and the reversal driving ban (CWL). It can set to use and ignored by parameter C097. If set to use, it must connect limit signal; Setting to ignored is no need this signal. Ignored parameters default value CCWL and CWL. If need to use, must change Parameter C097. It's allowed to exit over travel state by input reversal command even when over travel.

C097	reversal driving ban (CWL)	forward driving ban (CCWL)
0	use	use
1	use	ignore
2	ignore	use
3 (default)	ignore	ignore

5.6 Torque limitation

For the purpose to protect mechanical, it can limit the output torque.

5.6.1 Torque limit parameters

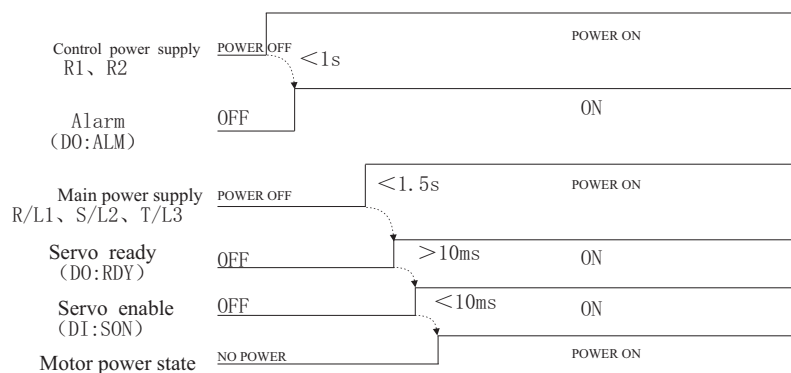
Parameter	Name	Range	Default value	Unit	Application
C065	Internal forward rotate (CCW) torque limit	0~300	300	%	ALL
C066	Internal reversal (CW) torque limit	-300~0	-300	%	ALL
C067	external forward rotate (CCW) torque limit	0~300	100	%	ALL
C068	external reversal (CW) torque limit	-300~0	-100	%	ALL
C069	test run torque limit	0~300	100	%	ALL

5.7 Operation time sequence

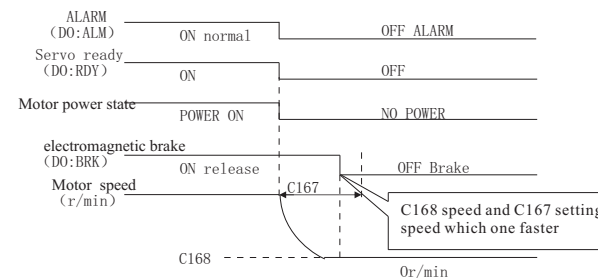
5.7.1 Power on sequence

1. Control power supply R1, R2 connect with main power supply R/L1, S/L2, T/L3. If only connect with control circuit power, servo ready to stop (RDY) OFF.

2. Main power supply will delay time about 1.5 seconds when power on, servo signal ready (RDY) ON. This time can accept SRV-ON (SON) signal, detect that SRV-ON is effective, power circuit start and motor motivation, going to running state. Detected that SRV-ON is ineffective or alarm, power circuit will shut down, and motor is in the free state.

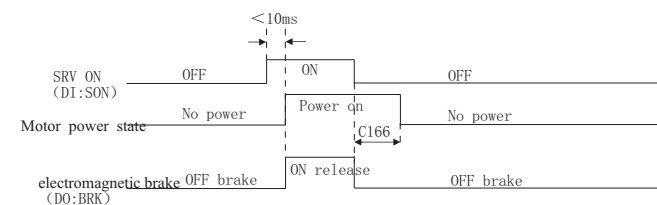


5.7.2 Alarm sequence when the servo ON



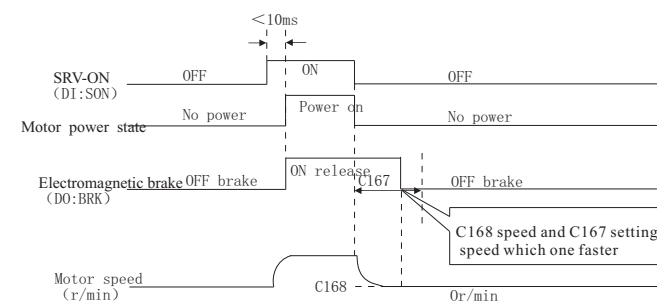
5.7.3 Action sequence when servo motor static ON/OFF

Action sequence when the motor speed is lower than the parameters C165:



5.7.4 Action sequence when motor servo running ON/OFF

Action sequence when the motor speed is higher than parameter C165:



5.8 Electromagnetic brake

The electromagnetic brake (keep brakes, brake losing electricity) is used to lock the vertical or tilting work table that connect with motor, to prevent work table fall off when servo motor power off. It need to choose a motor with brake. The brake only used to keep balance of work table, it can not used to reduce speed and stop work.

5.8.1 Electromagnetic braker parameter

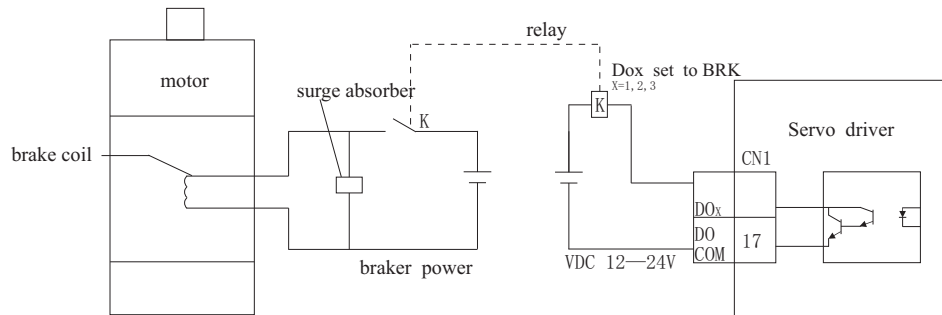
Parameter	Name	Range	fault value	unit	application
C165	Motor static speed testing point	0~1000	5	r/min	ALL
C166	Electromagnetic brake delay time when motor static	0~2000	0	ms	ALL
C167	Electromagnetic brake delay time when motor run	0~2000	500	ms	ALL
C168	Electromagnetic run speed when motor run	0~3000	100	r/min	ALL

5.8.2 Using electromagnetic braker

Below is the brake wiring diagram, driver brake release signal BRK connect with breaker coil. Relay contact connect with brake power. Brake power provided by the user with enough capacity. Suggest install surge absorber or diode. Pay attention that it will cause brake delay.

After motor stop (speed is slower than C165) servo OFF, motor will go on electrify. Brake release and brake. It will power off after several time stable (time determined by the parameters C166).

Motor is operating (speed is faster than C165) servo OFF, and cut off the motor current, brake continue to release status. After delay a period of time, it will brake. Delay time is parameter C167 or parameter C168, to select min one.



6.1 Parameter list

Applicable column means control mode, P is position control, S is speed control, T is torque control, ALL means position, speed, torque control are all suitable. Parameter values "*" means the factory default values may be different.

6.1.1 0 section parameter

Parameter	Name	Range	fault value	unit	Application	
C000	Code	0~9999	315	—	ALL	
Management parameter classification, it avoid parameter error-correction. Set to 333, you can view and modify parameter 0, 1, 2 paragraph. If set to other number, it can view, but cannot be modified. Some special operation need to set up suitable password.						
C001	Driver code	*	*	—	ALL	
Drive model has been set up in factory, the user don't modify. L08: FS110-08F L12: FS110-12F L16: FS110-16F L20: FS110-20F						
C002	Motor code	*	*	—	ALL	
Motor model has been set up in factory. See section 8.4 motor adapter table. When change different type of motor, it's need to modify parameter ,and specific operation please refer to section 4.7.						
C003	Software release	*	*	—	ALL	
Software release number, cannot be modified.						
C004	Control mode	Position control	0	0	—	ALL
		Speed control	1			
0: Position control 1: Speed control						
C005	The speed loop gain	0~3000	40	Hz	P, S	
Proportional gain of speed regulator. Increase parameter can make the response speed too fast, and too easy to cause vibration and noise. If C017 (rotational inertia ratio) is set correctly, the parameter value is same with speed response bandwidth.						
C006	Speed loop integral time constant	1.0~1000.0	20.0	ms	P, S	
Integral time constant of speed regulator, decrease parameter value can reduce the speed control error, increase rigidity. If too small is easy to cause vibration and noise. Set to maximum points (1000.0) is said to cancel the integral, speed regulator is P controller.						
C007	Time constant of torque filtering	0.01~50.00	2.50	ms	ALL	
Low pass filter of torque can restrain mechanical vibrations. The larger value, the earlier to restrain vibration. if too large will cause slow response and vibration. The smaller value, the faster response, but limit by mechanical conditions. When load inertia is small, it can set smaller values. When load inertia is larger, it can set larger value.						
C009	Position loop gain	1~1000	40	1/s	P	
Proportional gain of position controller: Increase the parameter value can reduce the location tracking error and improve response. If too large may lead to overshoot or oscillation.						
C017	Rotational inertia ratio of load	0.0~200.0	1.0	times	P, S	
Ratio of load rotational inertia (convert to motor shaft) and motor rotational inertia.						
C019	Speed detection filter time constant	0.50~50.00	2.50	ms	P, S	

The larger parameter value, the smoother detection. The smaller parameter value, the faster test response. Too small may lead to noise and too large may lead to oscillation.

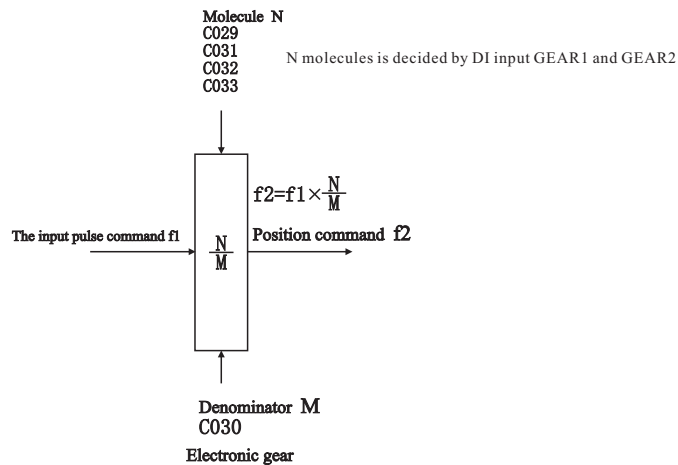
C021	Position loop feedforward gain	0~100	0	%	P	
Feedforward can reduce tracking error when position control. When set to 100, error is always 0 in any frequency instruction pulse.						
C022	Position loop feedforward filter time constant	0.02~50.00	1.00	ms	P	
Filter of position loop feedforward is make feedforward control stability.						
C025	Speed command source	JOG speed command	3	3	—	S
		Keyboard speed command	4			
		Demonstrate speed command	5			
Set the source of speed command when speed control. 3. JOG speed command, it need to set when inching (JOG). 4. Keyboard speed command, it need to set when keyboard adjustment (Sr). 5. Demonstration speed command, it need to set when speed control demo, and speed command will change automatically.						
C029	Command pulse electronic gear molecule 1	1~32767	1	—	P	

Used to step the input pulse or frequency doubling, it's easy to match with all kinds of pulse source. Command pulse electronic gear molecular N is determined by the DI input GEAR1, GEAR2. The denominator set by parameter M C030.

DI signal (Note)		Command pulse electronic gear molecular N
GEAR2	GEAR1	
0	0	Molecular 1 (parameters C029)
0	1	Molecular 2 (parameters C031)
1	0	Molecular 3 (parameters C032)
1	1	Molecular 4 (parameters C033)

Note: 0 means OFF, 1 is ON.

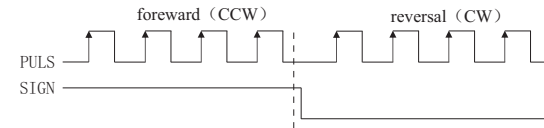
Input pulse get position command by change of N/M, ratio range: $1/50 < N/M < 200$



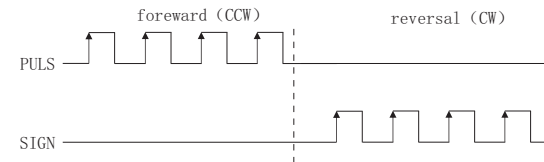
C030	Command pulse electronic gear denominator	1~32767	1	—	P	
Command pulse electronic gear denominator M. Usage reference parameters C029.						
C031	Command pulse electronic gear molecule 2	1~32767	1	—	P	
Reference parameters C029						
C032	Command pulse electronic gear molecule 3	1~32767	1	—	P	
Reference parameters C029						
C033	Command pulse electronic gear molecule 4	1~32767	1	—	P	
Reference parameters C029						
C035	Command pulse input mode	Pulse + symbols	0	0	—	P
		Orthogonal/reverse pulse	1			
		orthogonal pulse	2			

Set the command pulse input mode:

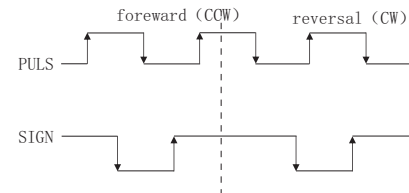
0: pulse + direction (Parameters C035 set to 0)



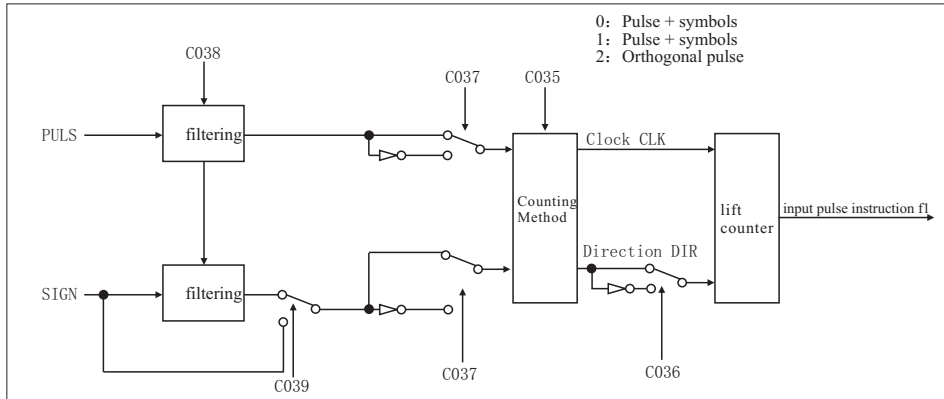
1: Forward/reverse pulse (Parameter C035 is set to 1)



2: Positive pulses (Parameter C035 is set to 2)



Note: the arrows represent count along, and C036 = 0, C037 = 0.
Command input pulse diagram:



0: Pulse + symbols
1: Pulse + symbols
2: Orthogonal pulse

It must save after parameter modified, then can power on.

C036	Command pulse input direction	Normal direction	0	0	—	P
		Reverse direction	1			

0: Normal direction
1: Reverse direction

C037	command pulse input signal logic	0~3	0	—	P
------	----------------------------------	-----	---	---	---

Set pulse input signal PULS and phase position of SIGN signal to adjust count down and count direction.

C037	PULS signal	SIGN signal
0	same-phase	same-phase
1	reverse-phase	same-phase
2	same-phase	reverse-phase
3	reverse-phase	reverse-phase

It must save after parameter modified, then can power on.

C038	command pulse input signal filtering	0~21	7	—	P
------	--------------------------------------	------	---	---	---

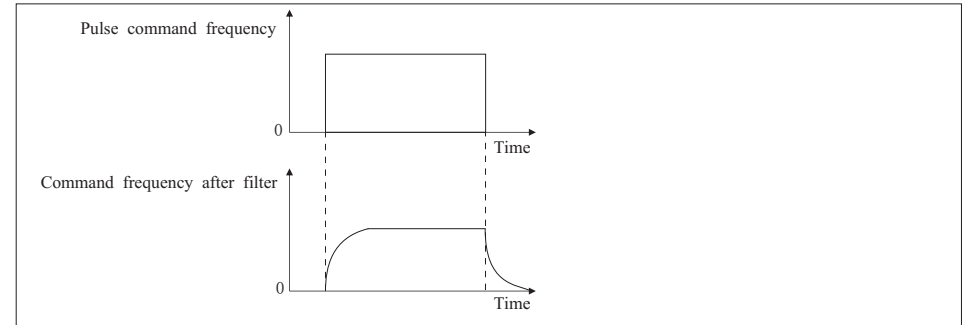
Digital filtering to input signal PULS and SIGN signal, the larger the value, the larger filter time constant. Max.pulse input frequency is 500Hz(kpps)when default value,the larger valur,max.pulse input frequency will reduce. It's used for reduce noise of signal line.If wrong,can increase parameter suitable. Must keeping parameter after changed,then can power on.

C039	command pulse input signal filter mode	0~1	0	—	P
------	--	-----	---	---	---

0:Digital filtering to PULS and SIGN signal
1:Digital filtering to PULS signal.
It must save after parameter modified, then can power on.

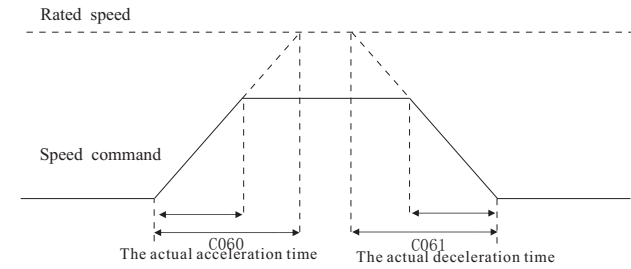
C040	Position command exponential smoothing filtering time	0~1000	0	ms	P
------	---	--------	---	----	---

Smooth filtering to command pulse.Filter don't lose input pulse but delay.
If set to 0,filter have no effect.
Filter is used to:
1.Upper controller have no function to accelerate and decelerate.
2.Electronic gear is large. (N/M > 10)
3.Command frequency is low.
4.Motor step leap or unsustainable when running.



C060	Speed command acceleration time	0~30000	0	ms	S
------	---------------------------------	---------	---	----	---

Set motor the acceleration time from zero speed to rated speed. If command speed is lower than rated speed,acceleration time will corresponding to shorten. It's used to speed control,but no effect to position control. If driver and host device consist to position control,it should set parameter to 0.



C061	Speed command deceleration time	0~30000	0	ms	S
------	---------------------------------	---------	---	----	---

Set motor the deceleration time from zero speed to rated speed. If command speed is lower than rated speed,deceleration time will corresponding to shorten. It's used to speed control,but no effect to position control. If driver and external position loop use together,it should set parameter to 0.

C065	Internal forward rotate (CCW) torque limit	0~300	300	%	ALL
------	--	-------	-----	---	-----

Set internal torque limit of motor CCW direction. This limit is effective in any time. If setting value is over than max overload capability that allowed,the actual limit is max overload that allowed.

C066	Internal reversal rotate(CW) torque limit	-300~0	-300	%	ALL
------	---	--------	------	---	-----

Set internal torque limit of motor CW direction. This limit is effective in any time. If setting value is over than max overload capability that allowed,the actual limit is max overload that allowed.

C067	External forward rotate(CCW) torque limit	0~300	100	%	ALL
------	---	-------	-----	---	-----

Set external torque limit of motor CCW direction. When TCCW (forward rotate torque limit) is ON,this limit have effect. When limit effect,actual torque limit is min one of max overload capability、internal forward torque limit、external forward torque limit.

C068	External reversal rotate (CW) torque limit	-300~0	-100	%	ALL																																
Set external torque limit of motor CW direction. When TCW (reversal rotate torque limit) is ON, this limit has effect. When limit effect, actual torque limit is min one of max overload capability, internal forward torque limit, external forward torque limit.																																					
C069	Test run torque limit	0~300	100	%	ALL																																
Torque limit when setting test run (speed JOG run, keyboard speed control, demo mode). Nothing on direction of rotation, it's limit both forward rotate and reversal rotate. Internal /external torque limit are effect.																																					
C070	Forward rotate (CCW) torque overload alarm	0~300	300	%	ALL																																
When set forward rotate (CCW) torque overload, it's percentage of rated torque. When motor forward rotate is over than C070, C072, driver alarm, number is Err29, motor stop.																																					
C071	Reversal rotate (CW) torque overload alarm	-300~0	-300	%	ALL																																
When set reversal rotate (CW) torque overload, it's percentage of rated torque. When motor forward rotate is over than C071, C072, driver alarm, number is Err29, motor stop.																																					
C072	Testing time of torque overload alarm	0~10000	0	10ms	ALL																																
Reference parameter C070 and C071 instructions. Shielding torque overload alarm when set to 0.																																					
C075	Maximum speed limit	0~5000	3500	r/min	ALL																																
Set servo motor the highest speed limit that allowed. Nothing on direction of rotation. If setted value is exceed the max. speed that allowed, the actual speed will less than max speed.																																					
C076	JOG run speed	0~5000	100	r/min	S																																
Set JOG run speed.																																					
C080	Position ultra difference detection	0.0~327.67	4.00	circle	P																																
Set range of position ultra difference alarm detection. In position control mode, when the position deviation counter value exceeds the corresponding pulse parameter values, servo motor will display position ultra difference alarm detection (Err4). Unit is circle, multiplied by the encoder resolution, pulse number can be obtained. If using 2500 line encoder, and resolution is 10000, when parameter is 4.00, it has 40000 encoder pulse.																																					
C096	Initial display project	0~22	0	—	ALL																																
Display status after driver power on.																																					
<table border="1"> <thead> <tr> <th>C096</th> <th>Display item</th> <th>C096</th> <th>Display item</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>motor speed</td> <td>12</td> <td>retain</td> </tr> <tr> <td>1</td> <td>Original position command</td> <td>13</td> <td>retain</td> </tr> <tr> <td>2</td> <td>position command</td> <td>14</td> <td>digital input DI</td> </tr> <tr> <td>3</td> <td>motor command</td> <td>15</td> <td>digital output DO</td> </tr> <tr> <td>4</td> <td>positional deviation</td> <td>16</td> <td>encoder signal</td> </tr> <tr> <td>5</td> <td>torque</td> <td>17</td> <td>absolute position one turn</td> </tr> <tr> <td>6</td> <td>peak torque</td> <td>18</td> <td>cumulative load factor</td> </tr> </tbody> </table>						C096	Display item	C096	Display item	0	motor speed	12	retain	1	Original position command	13	retain	2	position command	14	digital input DI	3	motor command	15	digital output DO	4	positional deviation	16	encoder signal	5	torque	17	absolute position one turn	6	peak torque	18	cumulative load factor
C096	Display item	C096	Display item																																		
0	motor speed	12	retain																																		
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2	position command	14	digital input DI																																		
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<table border="1"> <tr> <td>7</td> <td>current</td> <td>19</td> <td>brake load factor</td> </tr> <tr> <td>8</td> <td>peak current</td> <td>20</td> <td>control mode</td> </tr> <tr> <td>9</td> <td>pulse input frequency</td> <td>21</td> <td>alarm number</td> </tr> <tr> <td>10</td> <td>speed command</td> <td>22</td> <td>retain</td> </tr> <tr> <td>11</td> <td>torque command</td> <td>—</td> <td>—</td> </tr> </table>						7	current	19	brake load factor	8	peak current	20	control mode	9	pulse input frequency	21	alarm number	10	speed command	22	retain	11	torque command	—	—
7	current	19	brake load factor																						
8	peak current	20	control mode																						
9	pulse input frequency	21	alarm number																						
10	speed command	22	retain																						
11	torque command	—	—																						
C097	Ignore the driving ban	0~3	3	—	ALL																				
DI input forward rotate driving ban (CCWL) and reverse rotate driving ban (CWL) are used to protect limit schedule and use normally-closed switch. When input is ON, motor can run to this direction. Can not run to this direction when OFF. If can not use limit schedule protection, it can ignore and running without driving ban signal. The default is to ignore driving ban, if need to use driving ban function, please modify the parameters.																									
<table border="1"> <thead> <tr> <th>NO.</th> <th>Reversal driving ban (CWL)</th> <th>Forward driving ban (CCWL)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>use</td> <td>use</td> </tr> <tr> <td>1</td> <td>use</td> <td>ignore</td> </tr> <tr> <td>2</td> <td>ignore</td> <td>use</td> </tr> <tr> <td>3</td> <td>ignore</td> <td>ignore</td> </tr> </tbody> </table>						NO.	Reversal driving ban (CWL)	Forward driving ban (CCWL)	0	use	use	1	use	ignore	2	ignore	use	3	ignore	ignore					
NO.	Reversal driving ban (CWL)	Forward driving ban (CCWL)																							
0	use	use																							
1	use	ignore																							
2	ignore	use																							
3	ignore	ignore																							
Use: Motor run to this direction when input signal is ON; Motor can't run to this direction when OFF. Ignore: Motor can run to this direction, driving ban signal has no effect, can not connect the signal.																									
C098	Force enable	0~1	3	—	ALL																				
0: Enable is control by SON from DI; 1: Software force enable																									
6.1.1 1 section parameter																									
<table border="1"> <thead> <tr> <th>Parameter</th> <th>Name</th> <th>Range</th> <th>Default value</th> <th>Unit</th> <th>Application</th> </tr> </thead> <tbody> <tr> <td>C100</td> <td>Digital input DI1 function</td> <td>-21~2</td> <td>1</td> <td>—</td> <td>ALL</td> </tr> </tbody> </table>						Parameter	Name	Range	Default value	Unit	Application	C100	Digital input DI1 function	-21~2	1	—	ALL								
Parameter	Name	Range	Default value	Unit	Application																				
C100	Digital input DI1 function	-21~2	1	—	ALL																				
Digital input DI1 function, parameter absolute value means function, symbol means logic. Please refer to 6.2 DI function. Symbol means input logic, positive value means positive logic, negative value means negative logic. ON is effect, OFF is no effect.																									
<table border="1"> <thead> <tr> <th>Parameter</th> <th>DI input signal</th> <th>DI result</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Positive value</td> <td>open circuit</td> <td>OFF</td> </tr> <tr> <td>breakover</td> <td>ON</td> </tr> <tr> <td rowspan="2">Negative value</td> <td>open circuit</td> <td>ON</td> </tr> <tr> <td>breakover</td> <td>OFF</td> </tr> </tbody> </table>						Parameter	DI input signal	DI result	Positive value	open circuit	OFF	breakover	ON	Negative value	open circuit	ON	breakover	OFF							
Parameter	DI input signal	DI result																							
Positive value	open circuit	OFF																							
	breakover	ON																							
Negative value	open circuit	ON																							
	breakover	OFF																							
When multiple input channel function is all same, function result is logic or relation. For example set C100 and C101 to 1 (SON function). Which ever DI1 or DI2 is ON, SON has effect. Input function which have not be select, the result is OFF (no effect).																									
C101	Digital input DI2 function	-21~21	2	—	ALL																				
Digital input DI2 function, parameters refer to C100.																									
C102	Digital input DI3 function	-21~21	3	—	ALL																				
Digital input DI3 function, parameters refer to C100.																									
C103	Digital input DI4 function	-21~21	4	—	ALL																				
Digital input DI4 function, parameters refer to C100.																									

C104	Digital input DI5 function	-21~21	20	—	ALL													
Digital input DI5 function.Refer to parameter C100 .																		
C110	Digital input DI1 filter	0.1~100.0	2.0	ms	ALL													
DI 1 input digital filtering time constant. The smaller parameter value, the faster signal response speed; The larger parameter value, the slower signal response speed, but better to filter out the noise.																		
C111	Digital input DI2 filter	0.1~100.0	2.0	ms	ALL													
DI 2 input digital filtering time constant.Refer to parameter C110.																		
C112	Digital input DI3 filter	0.1~100.0	2.0	ms	ALL													
DI 3 input digital filtering time constant.Refer to parameter C110.																		
C113	Digital input DI4 filter	0.1~100.0	2.0	ms	ALL													
DI 4 input digital filtering time constant.Refer to parameter C110.																		
C114	Digital input DI5 filter	0.1~100.0	2.0	ms	ALL													
DI 5 input digital filtering time constant.Refer to parameter C110.																		
C130	Digital output DO1 function	-12~12	2	脉冲	ALL													
Digital input DO1 function, parameter absolute value means function, symbol means logic. Please refer to 6.3 DO function. 0 is force OFF, 1 is force ON. Symbol means input logic, positive value means positive logic, negative value means negative logic.																		
		<table border="1"> <thead> <tr> <th>Parameter</th> <th>Function</th> <th>DO output signal</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Positive value</td> <td>ON</td> <td>breakover</td> </tr> <tr> <td>OFF</td> <td>cut-off</td> </tr> <tr> <td rowspan="2">Negative value</td> <td>ON</td> <td></td> </tr> <tr> <td>OFF</td> <td>breakover</td> </tr> </tbody> </table>				Parameter	Function	DO output signal	Positive value	ON	breakover	OFF	cut-off	Negative value	ON		OFF	breakover
Parameter	Function	DO output signal																
Positive value	ON	breakover																
	OFF	cut-off																
Negative value	ON																	
	OFF	breakover																
C131	Digital output DO2 function	-12~12	-3	pulse	ALL													
Digital output DO2 function.Refer to parameter C130.																		
C132	Digital output DO3 function	-12~12	8	r/min	ALL													
Digital output DO2 function.Refer to parameter C130.																		
C150	Positioning complete range	0~32767	10	r/min	P													
Set the range of positioning complete pulse under position control. When residue pulse number in error counter is less or equal to setting value, digital output DO COIN(complete position)ON, or OFF. Comparator can return difference, setting by C151.																		
C151	Position complete return difference	0~32767	5	—	P													
Refer to C150.																		
C154	Arrived Speed	-5000~5000	500	—	ALL													
When motor speed is faster than this parameter, digital output DO ASP(Arrived speed)ON, or OFF. Comparator can return difference, setting by C155.																		
		<table border="1"> <thead> <tr> <th>C156</th> <th>C154</th> <th>Comparator</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>>0</td> <td>Speed regardless of direction</td> </tr> <tr> <td rowspan="2">1</td> <td>>0</td> <td>Only test forward speed</td> </tr> <tr> <td><0</td> <td>Only test reversal speed</td> </tr> </tbody> </table>				C156	C154	Comparator	0	>0	Speed regardless of direction	1	>0	Only test forward speed	<0	Only test reversal speed		
C156	C154	Comparator																
0	>0	Speed regardless of direction																
1	>0	Only test forward speed																
	<0	Only test reversal speed																

C155	arrived speed return difference	0~5000	30	r/min	ALL
Refer to parameter C154.					
C156	arrived speed polarity	0~1	0	ms	ALL
Refer to parameter C154.					
C163	Position deviation clear way	0~1	0	ms	P
Clear position deviation counter when position control, use DI CLR(Position deviation clear) Position deviation clear is happened in: 0:CLR ON level 1:CLR top edge (OFF become to ON)					
C165	Motor static speed testing point	0~1000	5	r/min	ALL
Motor static testing. Motor speed is slow than parameter value, consider that motor is static. Only used for electromagnetic brake timing judgment.					
C166	Electromagnetic brake delay time when motor static	0~2000	0	—	ALL
When system from enable state to not enable or alarm, set the delay time from electromagnetic brake(DO output terminal BRK OFF) to cut off current when motor static.. Cut off current when braker safety, to avoid tiny displacement or work down. Parameter should small than delay time.					
C167	Electromagnetic brake waiting time when motor run	0~2000	500	—	ALL
When system from enable state to not enable or alarm, set the delay time from cut off current to electromagnetic brake(DO output terminal BRK OFF) when motor run. Motor from adjust state to slow speed, then brake to avoid damage of braker. Actual action time is which one C167 or motor slow down to C168.					
C168	Electromagnetic brake movement speed when motor run	0~3000	100	—	ALL
Refer to parameter C167.					

6.2 DI function list

No.	Symbol	DI function	Function declaration															
0	NULL	no function	Input state have no effect to system.															
1	SON	Servo enable	OFF: Servo driver no enable,motor have no current. ON: Servo driver enable,motor connect current.															
2	ARST	Alarm clear	When alarm,if this alarm is allowed to clear,input rising edge(OFF become to ON) Alarm clear,only have part of alarm can be clear.															
3	CCWL	Forward rotate driving ban	<p>OFF: Forbid forward rotate driving (CCW); ON: Allowed forward rotate driving (CCW)</p> <p>Used to mechanical limit protection,controlled by C097. If use this function,it need to change C097.</p> <table border="1"> <thead> <tr> <th>C097</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>If use reversal rotate driving ban,must connect with normally-closed contact of travel switch.</td> </tr> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td>Ignore the reverse driving ban function, motor will run forward.This signal have no effect,no need to connect.</td> </tr> <tr> <td>3 (default)</td> <td></td> </tr> </tbody> </table>	C097	Description	0	If use reversal rotate driving ban,must connect with normally-closed contact of travel switch.	2		1	Ignore the reverse driving ban function, motor will run forward.This signal have no effect,no need to connect.	3 (default)						
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0	If use reversal rotate driving ban,must connect with normally-closed contact of travel switch.																	
2																		
1	Ignore the reverse driving ban function, motor will run forward.This signal have no effect,no need to connect.																	
3 (default)																		
4	CWL	Reversal rotate driving ban	<p>OFF: Forbid reversal rotate driving (CW) ; ON: Allowed reversal rotate driving (CW)</p> <p>Used to mechanical limit protection,controlled by C097. If use this function,it need to change C097.</p> <table border="1"> <thead> <tr> <th>C097</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>If use reversal rotate driving ban,must connect with normally-closed contact of travel switch.</td> </tr> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td>Ignore the reverse driving ban function, motor will run forward.This signal have no effect,no need to connect.</td> </tr> <tr> <td>3 (default)</td> <td></td> </tr> </tbody> </table>	C097	Description	0	If use reversal rotate driving ban,must connect with normally-closed contact of travel switch.	2		1	Ignore the reverse driving ban function, motor will run forward.This signal have no effect,no need to connect.	3 (default)						
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2																		
1	Ignore the reverse driving ban function, motor will run forward.This signal have no effect,no need to connect.																	
3 (default)																		
5	TCCW	Forward Torque limit	OFF:CCW direction torque is not limited by parameter C067. ON:CCW direction torque is limited by parameter C067. Note:No matter TCCW is effect or not,CCW direction is limited by parameter C065.															
6	TCW	Reversal Torque limit	OFF:CW direction torque is not limited by parameter C068. ON:CW direction torque is limited by parameter C068. Note:No matter TCW is effect or not,CW direction torque is limited by parameter C066.															
15	EMG	Reversal Torque limit	OFF:Allowed servo driver work. ON:Servo driver is stop and close the high voltage.															
18	GEAR1	Electronic gear Select 1	GERA1、GERA2 combine selection command pulse electronic gear molecule 1~4: <table border="1"> <thead> <tr> <th>GERA2</th> <th>GERA1</th> <th>Electronic gear molecule N</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>molecule 1 (parameter C029)</td> </tr> <tr> <td>0</td> <td>1</td> <td>molecule 2 (parameter C031)</td> </tr> <tr> <td>1</td> <td>0</td> <td>molecule 3 (parameter C032)</td> </tr> <tr> <td>0</td> <td>1</td> <td>molecule 4 (parameter C033)</td> </tr> </tbody> </table>	GERA2	GERA1	Electronic gear molecule N	0	0	molecule 1 (parameter C029)	0	1	molecule 2 (parameter C031)	1	0	molecule 3 (parameter C032)	0	1	molecule 4 (parameter C033)
GERA2	GERA1	Electronic gear molecule N																
0	0	molecule 1 (parameter C029)																
0	1	molecule 2 (parameter C031)																
1	0	molecule 3 (parameter C032)																
0	1	molecule 4 (parameter C033)																
19	GEAR2	Electronic gear Select 2																
			Note: 0 is OFF, 1 is ON.															

20	CLR	Position deviation clear	Clear position deviation error counter.Clear mode is setting by parameter C163. Position clear is happen: C163=0, CLR ON level; C163=1, CLR rising edge (OFF change to ON on moment)
21	INH	Pulse input ban	OFF: Position command pulse allowed to pass; ON: Position command pulse is forbidden.

6.3 DO functional table.

No.	Symbol	DI function	Function declaration
0	OFF	Always no effect	force output OFF
1	ON	Always effect	force output ON
2	RDY	Servo ready	OFF: Servo main power have not close or alarm. ON: Servo main power is normal,and have no alarm.
3	ALM	Alarm	OFF: Alarm; ON: No alarm
5	COIN	Location complete	When position control: OFF: positional deviation is larger than parameter C150; ON: position deviation is smaller than parameter C150
6	ASP	Speed reached	OFF: Motor speed is slower than parameter C154; ON: Motor speed is faster than parameter C154 With polarity setting function, prefer to parameter C154.
8	BRK	Electromagnetic brake	OFF: Electromagnetic brake is brake; ON: Electromagnetic brake release
11	TRQL	Torque limit	OFF: The motor torque have not reach to limit value; ON: The motor torque have reach to limit value Torque limit way can setting by parameter C064.

7.1 Alarm table

Alarm code	Alarm name	Alarm details	Alarm Clear
Err--	No alarm	Work normally	—
Err 1	Overspeed	Motor speed is faster than max.limit value	NO
Err 2	Main circuit overvoltage	Main circuit power voltage is exceed rated value	NO
Err 4	Position error	Positon error counter is exceed rated value.	CAN
Err 7	Abnormal driving ban	CCWL、CWL driving ban input all invalid	CAN
Err 8	Position deviation counter overflow	absolute value of position deviation counter value is exceed 2 ³⁰	CAN
Err 9	Encoder signal failure	Encoder signal loss	NO
Err11	Power module failure	Power module have failure	NO
Err12	Overcurrent	Motor current is too high	NO
Err13	Overload	Motor overload	NO
Err14	Brake peak power overload	Brake instantaneous overload in short time is too heavy	NO
Err15	Encoder counting error	Encoders count abnormal	NO
Err16	Motor thermal overload	Electric heating value is exceed set value (It test) ²	NO
Err17	Brake average power overload	Brake evaluate overload for a long time is too heavy	NO
Err18	Power module overload	Power module output evaluate overload is too heavy	NO
Err20	EEPROM error	EEPROM reading and writing error	NO
Err21	Logic circuit error	Processor peripheral logic circuit fault	NO
Err23	AD conversion error	Circuit or current sensor error	NO
Err24	Low voltage of control power supply	LDO fault of control circuit	NO
Err29	Torque overload alarm	Motor overload is exceed setting value and duration	CAN
Err30	Encoder Z signal is loss	Encoder Z signal does not appear	NO
Err31	Encoder signals U, V, W error	encoder signals U, V, W errors or poles don't match	NO
Err32	Encoder signals U, V, W illegal code	U、V、W Signal is the high level or low level	NO
Err33	A.B.Z encoder signal error	Electricity without a high impedance state in the sequence	NO

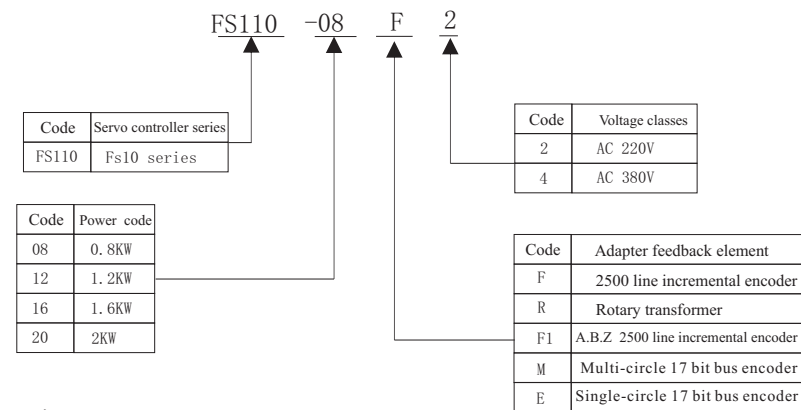
7.2 Abnormal reason and processing

Alarm code	Reason	Check	Processing
Err 1 Overspeed	Motor connection U, V, W phase sequence errors	Check U、V、W connection	Connected U, V, W wiring correctly, and corresponds to drives plug the U, V, W.
	Motor speed overshoot	Check the running status, check the parameters	To adjust the servo gain, reduce the overshoot ; It can increase the deceleration time when speed control.
	Encoder connection error	Check the encoder connection	Correct connection
Err 2 Main circuit overvoltage	Input ac power is too high	Check the power supply voltage	Voltage in accordance with product specification
	Regenerative braking failure	Regenerative braking resistor, brake is no effect or connection disconnect.	Repair
	Regenerative braking energy is too large	Check the brake load factor	Reduce the start-stop frequency; Increase the deceleration time;Reduce the torque limit; Reduce the load moment of inertia; change higher power driver and motor.

Err 4 Position error	Motor connection U, V, W phase sequence errors	Check the U, V, W connection	Connected U, V, W connection correctly,corresponds to drives plug the U, V, W
	Encoder zero change	Check the encoder zero	Reinstall the encoder and turno zero
	Encoder connection error	Check the encoder connection	Connection correctly
	Motor is stuck	Check motor and mechanical connection part	Repair
	Command pulse frequency is too high	Check the input frequency and pulse frequency doubling parameters	Reduce the input frequency; Adjust the pulse frequency doubling parameters.
	The position loop gain is too small	Check parameter C009	Increase positon loop gain
	Error test range is too small	Check parameter C079	Increase parameter C079 value
Err 7 Abnormal driving ban	SRV-ON CCWL.CWL driving ban input is invalid	Check CCWL、CWL connection	Increase the torque limit; Increase position instruction smooth filtering time; Reduce overload. Change higher power driver or motor Input CCWL.cwl signal correctly; If no need CCWL、CWL signal can set to shield parameter C097.
Err 9 Encoder signal failure	Command pulse abnormal	Check the pulse instruction	—
	Encoder connection error	Check encoder connection	Correct connection
	Encoder cables and connectors bad	Check the cable and connectors	Replace the cable and connectors
	Motor model did not set up correctly	Check the motor model	Reset the motor model
Err11 Function module failure	Encoder is damaged	Check encoder	Repalce encoder
	Electrical connection short circuit between the U、V、W	Check U、V、W connection	Correct connection U, V, W wiring
	Motor winding insulation damage	Check motor	Replace motor
	Driver damage	Check driver	Motor is no problem, electric again or alarm.Maybe the drive is damaged, or change motor.
	Bad earth	Check the ground wire	Correct connection
	Get disturbed	Check the interference sources	Increase line filter, away from the interference sources
Err12 Overcurrent	Electrical wiring short circuit between the U, V, W	Check the U, V, W wiring	Correct connection U, V, W wiring
	Motor winding insulation damage	Check motor	Repair motor
	Driver damage	Check driver	Motor is no problem, electric again or alarm.Maybe the drive is damaged, or change motor.
Err13 Overload	Exceed rated load continuous operation	Check the load factor	Reduce the load or replace high power drive
	System instability	Check motor running oscillation	Reduce the system gain
	Acceleration and deceleration is too fast	Check motor running smooth	Increase the deceleration time
	Encoder zero change	Check the encoder zero	Reinstall the encoder and zero
Err14	Input ac power is too high	Check the power supply voltage	Voltage in accordance with product specification
	Regenerative braking failure	Regenerative braking resistor, brake pipe failure and connection to disconnect	Repair

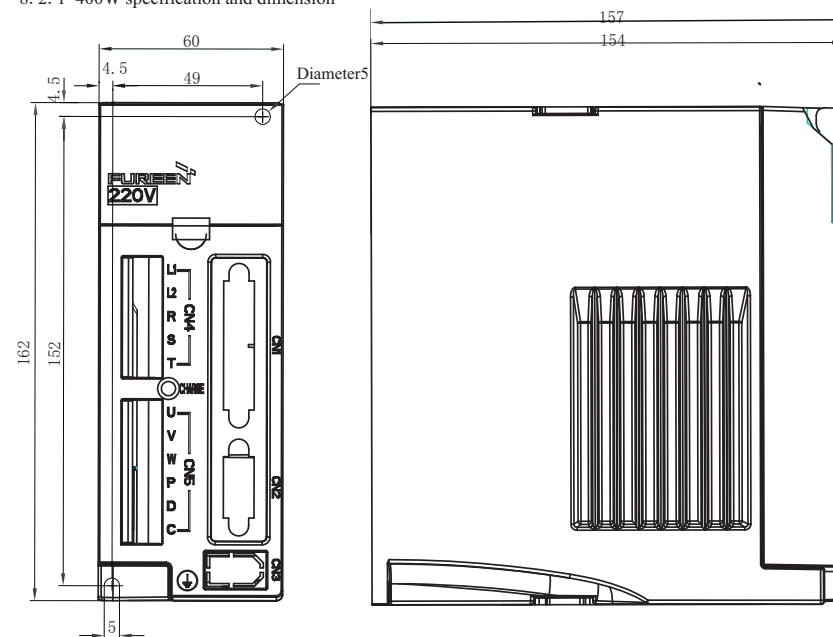
Brake peak power overload	Regenerative braking energy is too large	Check the brake load factor	Reduce the start-stop frequency ; Increase the deceleration time; Change higher power driver and motor
Err15 Encoder counting error	Encoder connection error	Check the encoder connection	Reinstall the encoder and zero
	Imperfect earth	Check the ground wire	Correct connection
	Get disturbed	Check the interference source	Repair
	Encoder problem	Wrong line number and poles;Encoder and Z signal error;Encoder damage.	Replace encoder
Err16 Motor thermal overload	Exceed rated overload running long time	Check the load rate and the motor temperature rise	Reduce overload or change higher power driver
	Encoder zero change	Check encoder zero	Reinstall the encoder and turn to zero
Err17 Brake average power overload	Input ac power is too high	Check the power supply voltage	Voltage in accordance with product specification
	Regenerative braking energy is too large	Check the brake load factor	Reduce the start-stop frequency; Increase the deceleration time. Reduce the torque limit; Reduce the load moment of inertia; Change higher driver and motor
Err18 Power module overload	Exceed rated overload running long time	Check current	Reduce the overload; Change higher driver and motor
	The encoder zero change	Check encoder zero	Reinstall the encoder and zero
Err20 EEPROM error	EEPROM chip damage	Power on and check again	Failure doesn't disappear please replace driver
Err21 Logic error	Control circuit fault	Power on and check again	Failure doesn't disappear please replace driver
Err23 AD conversion error	Current sensor and connector problem	Check the main circuit	Replace driver
	AD Converter and analog amplifying circuit problem	Check the control circuit	Replace driver
Err24 Low voltage control power supply	Control circuit LDO fault	Check control panel power supply	Replace driver
Err29 Torque overload alarm	Occur accident large load	Check overload	Adjust overload
	Check C070、C071、C072 setting is not reasonable	Check parameter	Adjust parameter
Err30 Lose encoder Z signal	Encoder problem	Check the encoder signal Z	Replace encoder
	Encoder cables and connector problem	Check the cable and connector	Replace cable and connectors
	Drive interface circuit fault	Check the control circuit	Replace driver
Err31 Encoder UVW signal Illegal codes	Encoder problem	Wrong line number and poles; encoder UVW signal error;encoder damage	Replace driver
Err32 Encoder UVW signal Illegal codes	Encoder connection error	Check the encoder connection	Correct connection, including the shielded wire
	Encoder problem	Check the encoder UVW signal	Replace encoder
Err33 A.B.Z encoder signal error	Encoder connection error	Check the encoder connection	Correct connection, including the shielded wire
	Encoder problem	Check the encoder signal	Correct connection, including the shielded wire
	Motor model is set incorrect	Check motor model,confirm motor save line encoder	Reset the motor model

8.1 Driver model

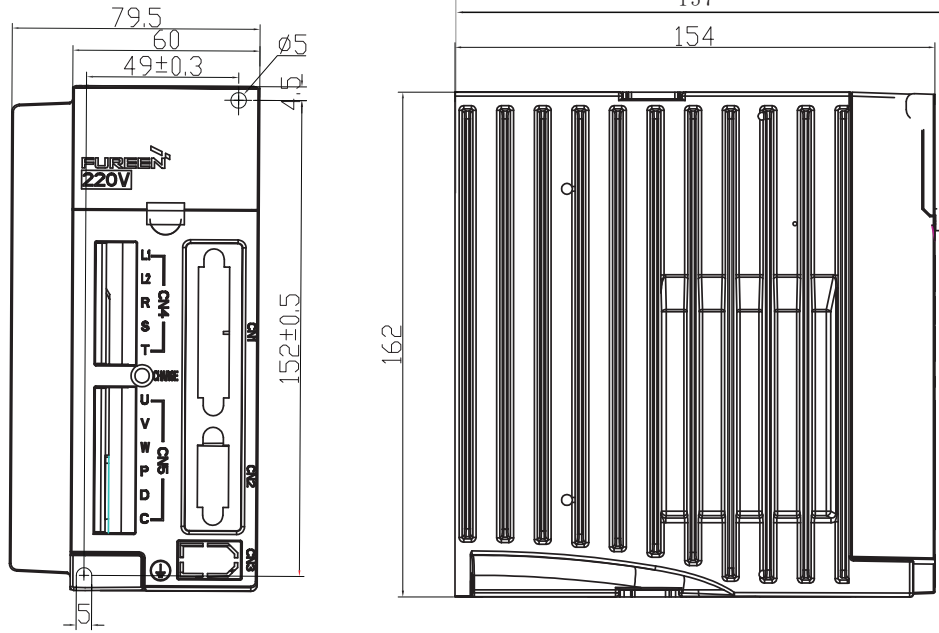


8.2 Driver size

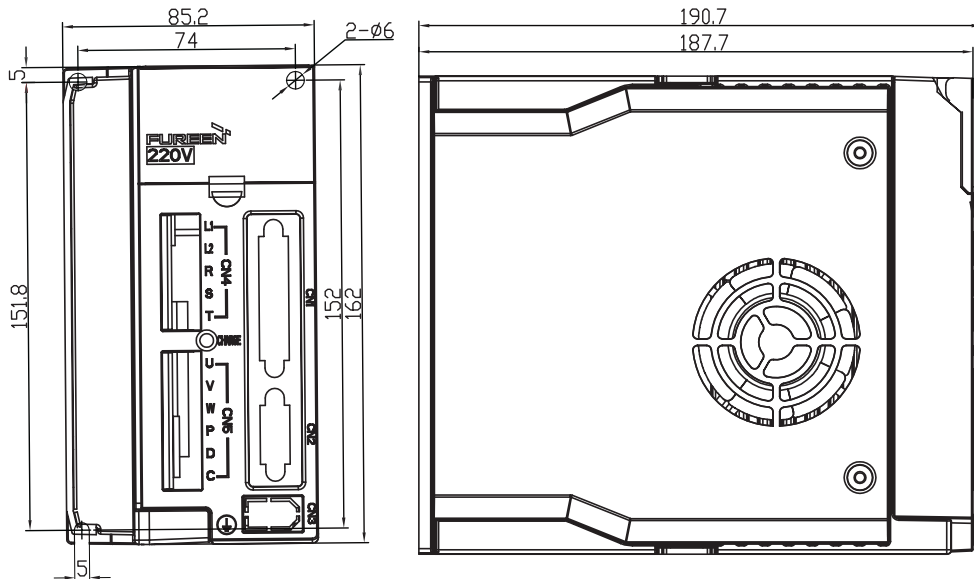
8.2.1 400W specification and dimension



8.2.2 750W Specification and Dimension



8.2.3 Over 1500W Specification size



8.3 Driver Specification

TYPE	FS110-08F	FS110-12F	FS110-16F	FS110-20F
Input power	3 phase AC220V -15%~+10% 50/60Hz		3 phase AC380V -15%~+10% 50/60Hz	
Environment	Temp	Work: 0~40 C Store: -40~50 C		
	Humidity	Work: 40%~80% (No condensation) Store: under 93% (No condensation)		
Protection class	IP 20			
Control mode	PWM sine wave vector control			
Regenerative brake	Built-in			
Feedback system	2500 incremental encoder, A.B.Z incremental encoder			
Control mode	Position			
Analog input	-10V~+10V, input impedance 10K			
Digital input	5 Programmable input terminal (photoelectric isolation), Function: SRV-ON, Alarm clear, CCWL, CWL, Forward rotate torque limit, Reversal rotate torque, Emergency stop, Electronic gear selection 1, Electronic gear selection 2, Position deviation clear, Pulse input ban.			
Digital output	3 Programmable input terminal (photoelectric isolation), Function: Servo ready, Alarm, Location complete, Speed reached, Electromagnetic brake, Torque limiting			
Encoder signal output	Signal type	A, B, Z differential output line driver, Z signal collector open circuit output.		
Unit	Input frequency	Differential input: ≤500kHz (kpps), Single-ended input: ≤200kHz (kpps)		
	Instruction mode	Pulse + symbols: Forward/reverse pulse; Orthogonal pulse		
	Electronic gear ratio	1~32767/1~32767		
Monitoring function	Revolving speed, Current position, Positional deviation, Motor torque, motor current, Instruction pulse frequency.			
Protective function	Overspeed, overvoltage, overcurrent, overload, abnormal braking, abnormal encoder, position exceeding tolerance			
Character	Speed frequency response	>300Hz		
	Speed fluctuation ratio	<±0.03% (load 0~100%); <±0.02% (power supply -15~+10%)		
	Speed ratio	1: 5000		
Environment	Temperature	Run: 0 ~ 40 °C; Store: -40 ~ 50 °C		
	Humidity	Run: 40% ~ 80% (no condensation); Under 90% (no condensation)		
	Protection class	IP20		

8.4 Adapt motor table

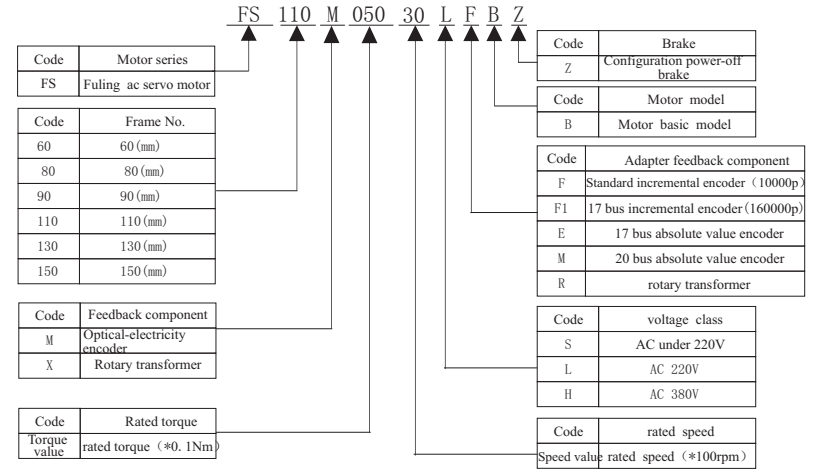
Motor Parameter					Driver Configuration			
Motor Code [Note1]	Motor model [Note2]	Rated torque (N. m)	Rated speed (r/min)	Rated power (KW)	FS110-08F	FS110-12F	FS110-16F	FS110-20F
061	FS60-M00630L	0.637	3000	0.2	●	●	●	●
062	FS60-M01330L	1.27	3000	0.4	●	●	●	●
063	FS60-M01930L	1.91	3000	0.6	●	●	●	●
081	FS80-M01330L	1.3	3000	0.4	●	●	●	●
082	FS80-M02430L	2.4	3000	0.75	●	●	●	●
083	FS80-M03530L	3.5	3000	1.0	●	●	●	●
091	FS90-M02430L	2.4	3000	0.75	●	●	●	●
092	FS90-M03520L	3.5	3000	0.8	●	●	●	●
093	FS90-M04025L	4	3000	1.0	●	●	●	●
101	FS110-M02030L	2	3000	0.6	●	●	●	●
102	FS110-M04030L	4	3000	1.2		●	●	●
103	FS110-M05030L	5	3000	1.5		●	●	●
104	FS110-M06020L	6	2000	1.2		●	●	●
105	FS110-M06030L	6	3000	1.6		●	●	●
301	FS130-M04025L	4	2500	1.0		●	●	●
302	FS130-M05020L	5	2000	1.0		●	●	●
303	FS130-M05025L	5	2500	1.3		●	●	●
304	FS130-M06025L	6	2500	1.5		●	●	●
305	FS130-M07720L	7.7	2000	1.6			●	●
306	FS130-M07725L	7.7	2500	2.0				●
307	FS130-M07730L	7.7	3000	2.4				●
308	FS130-M10015L	10	1500	1.5			●	●
309	FS130-M10025L	10	2500	2.6				●
310	FS130-M15015L	15	1500	2.3				●

● means can adapt.

Note 1: Motor code is setting by driver parameter C002

Note 2: Same motor can adapt various driver, high class driver can provide higher overload multiples, adapt frequent start-stop, heavy load situation.

8.5 Servo motor model



8.6 Servo motor wiring

8.6.1. Servo motor terminal:

Terminal symbol	Terminal serial number	Terminal instruction
U	2	Motor U phase power input
V	3	Motor V phase voltage input
W	4	Motor W phase power input
⊕	1	Motor casing grounding terminal

8.6.2. brake

Terminal symbol	Terminal serial number	Terminal instruction
DC+	1	Brake power
DC-	2	
⊕	3	Motor casing grounding terminal

8.6.3 60/80/90 series servo motor encoder aviation plug definition

Terminal symbol	Terminal serial number	Terminal instruction
5V	2	encoder 5V power supply input
0V	3	
A+	9	encoder A phase output
A-	13	
B+	4	encoder B phase output
B-	14	
Z+	5	encoder Z phase output
Z-	7	
U+	6	encoder U phase output
U-	8	
V+	10	encoder V phase output
V-	12	
W+	11	encoder W phase output
W-	15	
FG	1	encoder casing

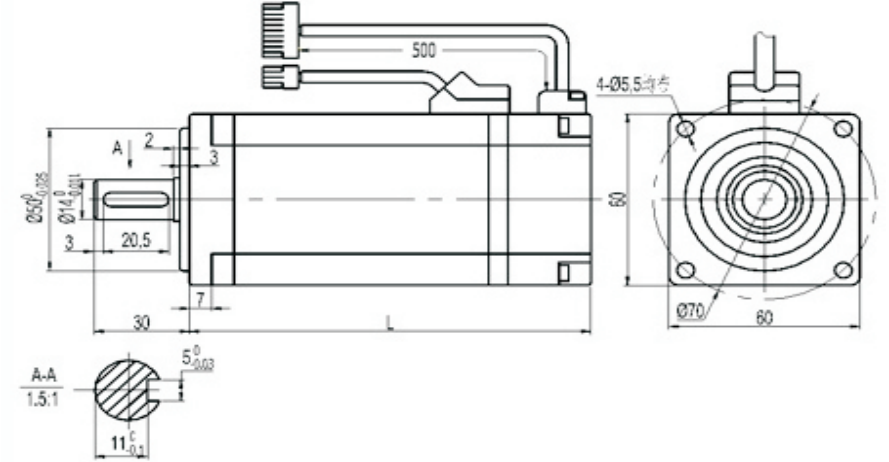
8.6.4 110/130/150 series servo motor encoder aviation plug definition

Terminal symbol	Terminal serial number	Terminal instruction
5V	2	encoder 5V power supply input
0V	3	
A+	4	encoder A phase output
A-	7	
B+	5	encoder B phase output
B-	8	
Z+	6	encoder Z phase output
Z-	9	
U+	10	encoder Uphase output
U-	13	
V+	11	encoder V phase output
V-	14	
W+	12	encoder W phase output
W-	15	
FG	1	encoder casing

8.7 Servo motor parameter

8.7.1 60 series motor parameter

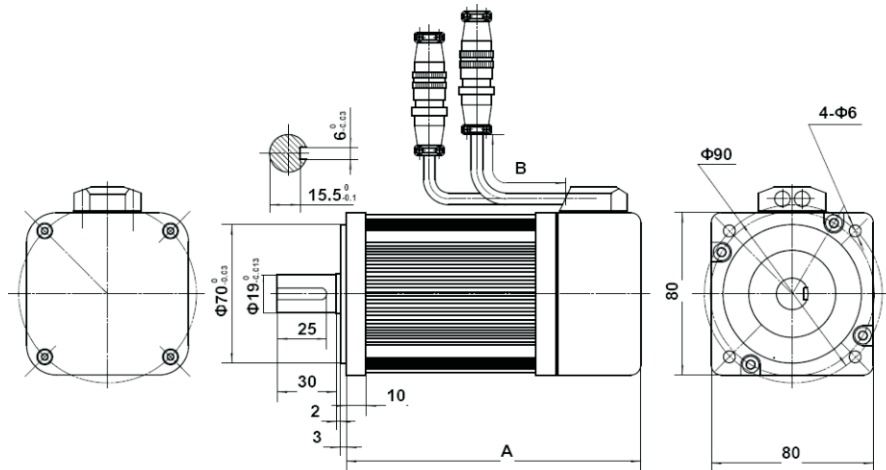
Motor model	FS60-M00630L	FS60-M01330L	FS60-M01930L
Power (KW)	0.2	0.4	0.6
Rated torque (N.m)	0.637	1.27	1.91
Rated speed (r/min)	3000	3000	3000
Rated current (A)	1.4	2.5	3.2
Rotor inertia (kg.m ²)	0.17×10^{-4}	0.33×10^{-4}	0.438×10^{-4}
Motor weight (kg)	1.11	1.33	1.78
Encoder line number	2500		
Number of pole-pairs	4		
Insulation class	B		
Protection class	IP 65		



Rated torque (N.m)	0.637	1.27	1.91
LA	102	122	144
LB	30	30	30
LC	3	3	3
LD	7	7	7
LE	50	50	50
LF	60	60	60
LG	70	70	70
LZ	4.5	4.5	4.5
S	14	14	14
S1	14.9	14.9	14.9

8.7.2 80 series motor parameter

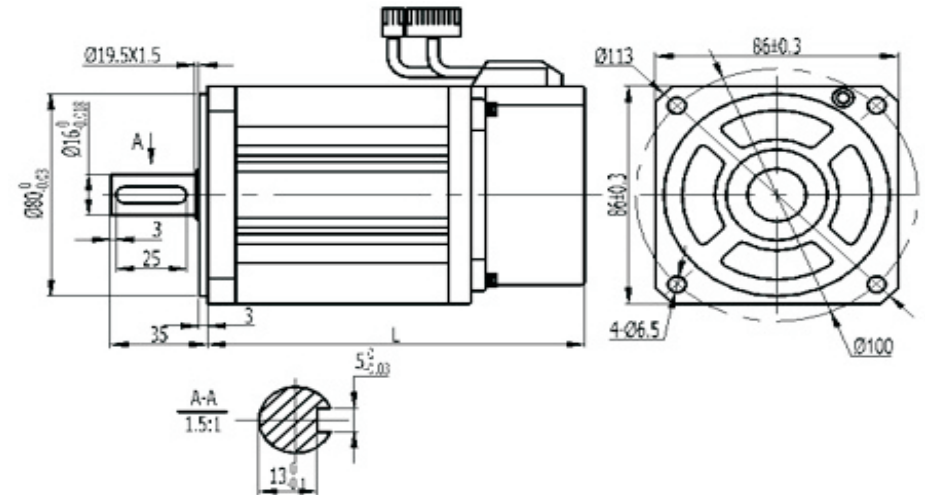
Motor model	FS80-M01330L	FS80-M02430L	FS80-M03330L
Power (KW)	0.4	0.75	1.0
Rated torque (N. m)	1.3	2.4	3.3
Rated speed (r/min)	3000	3000	3000
Rated current (A)	2.6	4.2	4.8
Rotor inertia (kg. m ²)	0.74×10^{-4}	1.2×10^{-4}	1.58×10^{-4}
Motor weight (kg)	2.2	2.8	3.3
Encoder line number	2500		
Number of pole-pairs	4		
Insulation class	B		
Protection class	IP 65		



Rated torque (N. m)	1.3	2.4	3.3
A (mm)	128	150	165
B (mm)	500	500	500

8.7.3 90 series motor parameter

Motor model	FS90-M02430L	FS90-M03520L	FS90-M04025L
Power (KW)	0.4	0.75	1.0
Rated torque (N. m)	2.4	3.5	4
Rated speed (r/min)	3000	2000	2500
Rated current (A)	3	3	4
Rotor inertia (kg. m ²)	2.45×10^{-4}	3.4×10^{-4}	3.7×10^{-4}
Motor weight (kg)	3.4	3.8	4.13
Encoder line number	2500		
Number of pole-pairs	4		
Insulation class	B		
Protection class	IP 65		

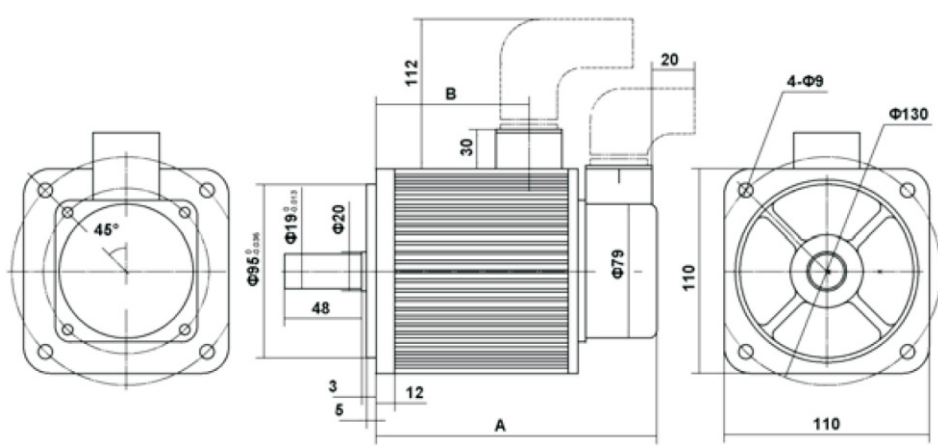


90series motor parameter total length size: (unit: mm)

90 base motor length	L
FS90-M02430L	149
FS90-M03520L	171
FS90-M04025L	181

8.7.4 110 series motor parameter

Motor model	FS110-M02030L	FS110-M04030L	FS110-M05030L	FS110-M06020L	FS110-M06030L
Power (KW)	0.6	1.2	1.5	1.2	1.6
Rated torque (N.m)	2	4	5	6	6
Rated speed (r/min)	3000	3000	3000	2000	3000
Rated current (A)	4.0	6.0	7.0	6.0	8.5
Rotor inertia (kg.m ²)	0.425×10^{-3}	0.828×10^{-3}	0.915×10^{-3}	1.111×10^{-3}	1.111×10^{-3}
Motor weight (kg)	4.2	6.0	6.8	7.8	7.8
Encoder line number	2500				
Number of pole-pairs	4				
Insulation class	B				
Protection class	IP 65				
Brake	Voltage: 24VDC (-15%~+10%), Current≤0.6A, brake torque≥8Nm, Rotational inertia: 0.64×10^{-4} kg.m ²				



Rated torque (N.m)	2	4	5	6
A (mm) no brake	158	185	200	217
A (mm) include brake	200	227	242	259
B (mm)	76	102	118	134

8.7.5 130 series motor parameter

Motor model	FS130-M04025L	FS130-M05020L	FS130-M05025L	FS130-M06025L
Power (KW)	1.0	1.0	1.3	1.5
Rated torque (N.m)	4	5	5	6
Rated speed (r/min)	2500	2000	2500	2500
Rated current (A)	5.0	5.5	6.0	7.0
Rotor inertia (kg.m ²)	1.101×10^{-3}	1.333×10^{-3}	1.333×10^{-3}	1.544×10^{-3}
Motor weight (kg)	6.0	6.9	6.9	7.6
Encoder line number	2500			
Number of pole-pairs	4			
Insulation class	B			
Protection class	IP 65			
Brake	Voltage: 24VDC (-15%~+10%), Current≤0.6A, brake torque≥12Nm, Rotational inertia: 1.67×10^{-4} kg.m ²			

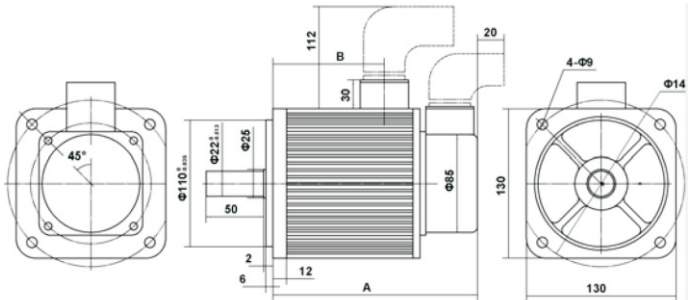
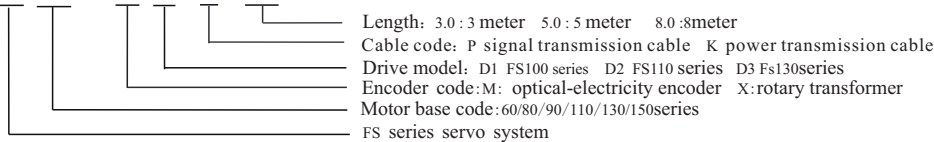
Motor model	FS130-M07720L	FS130-M07725L	FS130-M07730L	FS130-M10015L
Power (KW)	1.6	2.0	2.4	1.5
Rated torque (N.m)	7.7	7.7	7.7	10
Rated speed (r/min)	2000	2500	3000	1500
Rated current (A)	6.5	8.5	10.5	6.5
Rotor inertia (kg.m ²)	2.017×10^{-3}	2.017×10^{-3}	2.017×10^{-3}	2.595×10^{-3}
Motor weight (kg)	8.6	8.6	8.6	10.6
Encoder line number	2500			
Number of pole-pairs	4			
Insulation class	B			
Protection class	IP 65			
Brake	Voltage: 24VDC (-15%~+10%), Current≤0.6A, brake torque≥12Nm, Rotational inertia: 1.67×10^{-4} kg.m ²			

Motor model	FS130-M10025L	FS130-M15015L	FS130-M15025L
Power (KW)	2.6	2.3	3.9
Rated torque (N.m)	10	15	15
Rated speed (r/min)	2500	1500	2500
Rated current (A)	11.5	9.5	17.0
Rotor inertia (kg.m ²)	2.595×10^{-3}	4.32×10^{-3}	4.32×10^{-3}
Motor weight (kg)	10.6	14.6	14.6
Encoder line number	2500		
Number of pole-pairs	4		
Insulation class	B		
Protection class	IP 65		
Brake	Voltage: 24VDC (-15%~+10%), Current≤0.6A, brake torque≥12Nm, Rotational inertia: 1.67×10^{-4} kg.m ²		

9.1 FS series servo motor cable naming rule

FS100/110 series servo motor cable naming:

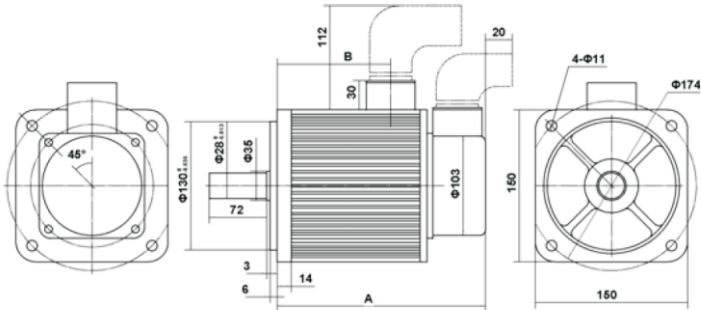
FS 110 - M D2 P 3.0



Rated torque (N.m)	4	5	6	7.7	10	15
A (mm) no brake	163	171	181	195	219	267
A (mm) include brake	205	213	223	237	261	309
B (mm)	80	89	98	112	136	184

8.7.6 150 series motor parameter

Motor model	FS150-M15025L	FS150-M18020L	FS150-M23020L	FS150-M27020L
Power (KW)	3.8	3.6	4.7	5.5
Rated torque (N.m)	15	18	23	27
Rated speed (r/min)	2500	2000	2000	2000
Rated current (A)	16.5	16.5	20.5	26.0
Rotor inertia (kg. \dot{m}^2)	6.15×10^{-3}	6.33×10^{-3}	8.94×10^{-3}	11.19×10^{-3}
Motor weight (kg)	15.7	17.8	21.4	23.7
Encoder line number	2500			
Number of pole-pairs	4			
Insulation class	B			
Protection class	IP 65			
Brake	Voltage: 100VDC (-15%~+10%), Current $\leq 0.4A$, brake torque $\geq 30Nm$, Rotational inertia: $6 \times 10^{-4} kg.m^2$			



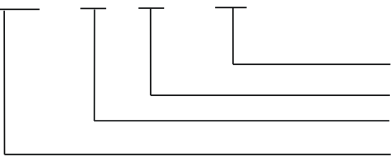
Rated torque (N.m)	15	18	23	27
A (mm) no brake	231	250	280	306
A (mm) include brake	293	312	342	368
B (mm)	146	166	196	222

FS110/130/150-M/D1K-3.0	
FS110/130/150-M/D1K-5.0	
FS110/130/150-M/D1K-8.0	
FS110/130/150-M/D1P-3.0	
FS110/130/150-M/D1P-5.0	
FS110/130/150-M/D1P-8.0	
FS110/130/150-M/D2P-3.0	
FS110/130/150-M/D2P-5.0	
FS110/130/150-M/D2P-8.0	
FS60/80/90-M/D2K-3.0	
FS60/80/90-M/D2K-5.0	
FS60/80/90-M/D2K-8.0	
FS60/80/90-M/D2P-3.0	
FS60/80/90-M/D2P-5.0	
FS60/80/90-M/D2P-8.0	
FS60/80/90-M/D2P-3.0	
FS60/80/90-M/D2P-5.0	
FS60/80/90-M/D2P-8.0	

9. 2 FS series servo system upper computer cable naming rule

FS100 series servo system upper computer cable naming:

FS100 - N1 P - 1.5



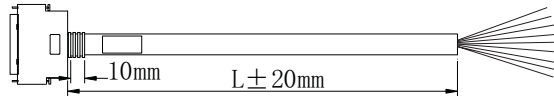
Length: 1.5 meter

Cable code: P signal transmission cable

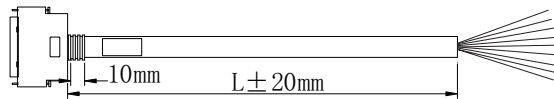
Position signal types: N1: single-ended signals;
N2: the differential signal

FS100 series servo system

FS100-N1P-1.5



FS100-N2P-1.5



Warranty Certificate

Customer:	
Detailed address:	
Postcode:	Contact person:
TEL:	FAX:
Model number:	
Power:	
Contract number:	Purchase Date:
Service unit	
Contact person:	TEL:
Repairman:	TEL:
Repair date:	
What do you think of our service:	
<input type="checkbox"/> VERY GOOD <input type="checkbox"/> GOOD <input type="checkbox"/> NOT BAD <input type="checkbox"/> BAD	
Other opinions:	
Customer signature:	Date: