ESDC AC SERVO DRIVER

Servo Driver Operation Manual

GUANGDONG ELESY ELECTRIC CO.,LTD

(2012 Revision)

SAFETY NOTES

The ESDC series general servo driver, which adopts DSP+FPGA system framework, has a series of virtues: it speeds up the process of data collection and processing, with high integration level and reliability; it has abundant interfaces for digital and analog input, which can match diversified upper control devices; its optimized control algorithm makes accurate full-digital control of torque, speed and position come true, which can be used in various manufacturing fields.

Before storing, installing, wiring, operating, checking and repairing, make sure to understand and obey the following important notes, so as to operate the product safely.

DANGER	Incorrect handling may cause dangerous situation resulting in personal injury or death.
WARNING	Incorrect handling may cause dangerous situation resulting in personal injury and device damage.
NOTICE	Neglect of this notice may cause undesired results or situation.
FORBIDDEN	Strictly forbidden actions, or the device may be damaged or discarded as useless.

1. Product inspection

WARNING
● AC servo drive must operate with matched servo motor. ● Products being damaged or out of order can't be used, or it may cause fire or equipment failure. ● If using your own motor, please contact our company's technicians, or normal operation of the driver can't be guaranteed.

2. Product installing

DANGER
● Don't expose the product to steam, corrosive and combustible gas, otherwise it may cause electric shock or fire. ● Don't use the product in the place with direct sunlight or lots of dust, salinity and metal powder. ● Don't use the product in the place with drippy water, oil and medicine.

3. Wiring

DANGER
● Brake resistor must be connected in the designed way, otherwise it may cause damage to the driver. ● Don't join up the driver of 220V with the power supply of 380V, or there are danger of machine damage, electric shock and fire. ● Confirm the one-to-one correspondence between the U,V,W output terminals and the U,V,W binding posts, otherwise the motor may overspeed and cause damage to the machine and personal injury. ● The grounding terminal must be grounded correctly; bad ground may cause electric shock or fire.

4. Notes for operation

NOTICE
● Before power on, please make sure the servo driver and servo motor have already been installed and fixed correctly, and the power voltage and wiring is right. ● Before using the driver, confirm the machine's couplings or belts are separated, and set the driver's parameter to suitable value. Test the servo motor to confirm it is operating correctly, and then connect to the load; otherwise it may cause machine damage and breakdown. ● Before operating, please confirm the emergency switch can be turned on at any time to stop the machine.

FORBIDDEN
● Don't touch any rotating part of the motor; otherwise it may cause personal injury. ● When the equipment is running, don't move the stub cable, otherwise it may cause personal injury or machine damage. ● When the equipment is running, don't touch the drive and motor otherwise it may cause electric shock or scald. ● Don't turn on and off the power frequently. If necessary, please control the frequency is below once every minute.

5. Trouble handling

⚠NOTICE
● Except the specified professional staff, please don’t connect, install, operate, dismantle and repair the machine, for there are risks of electric shock and causing damage to the equipment. ● Please don't reform the driver by oneself for there is danger of electric shock and personal injury. ● Don’t touch the circuit board with hand directly, or it may destroy the board because of electrostatic induction. ● When the equipment gives an alarm signal, check it and clear the trouble. Reset the alerting signal before restarting. ● Be far away from the machine when restart it after unexpected power cut, to prevent accidents.

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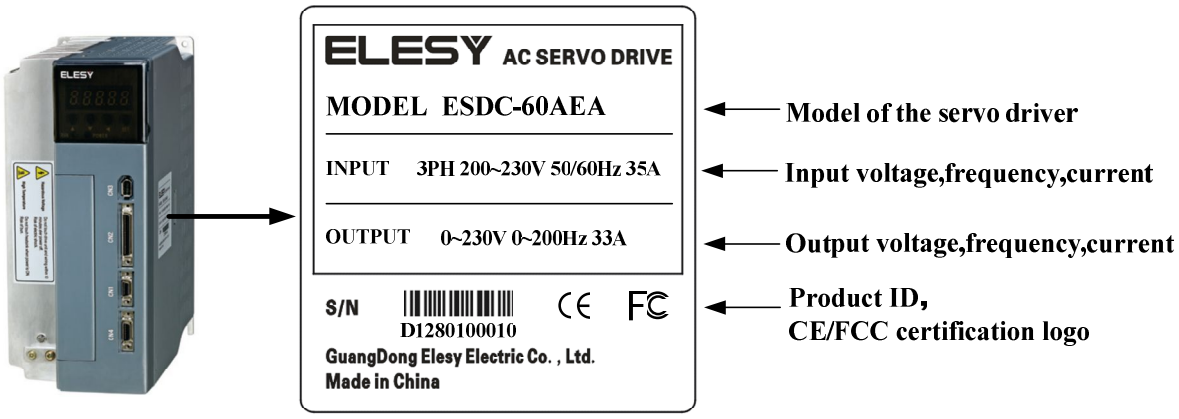
Chapter 1 Product introduction

1.1 Nameplate and model introduction

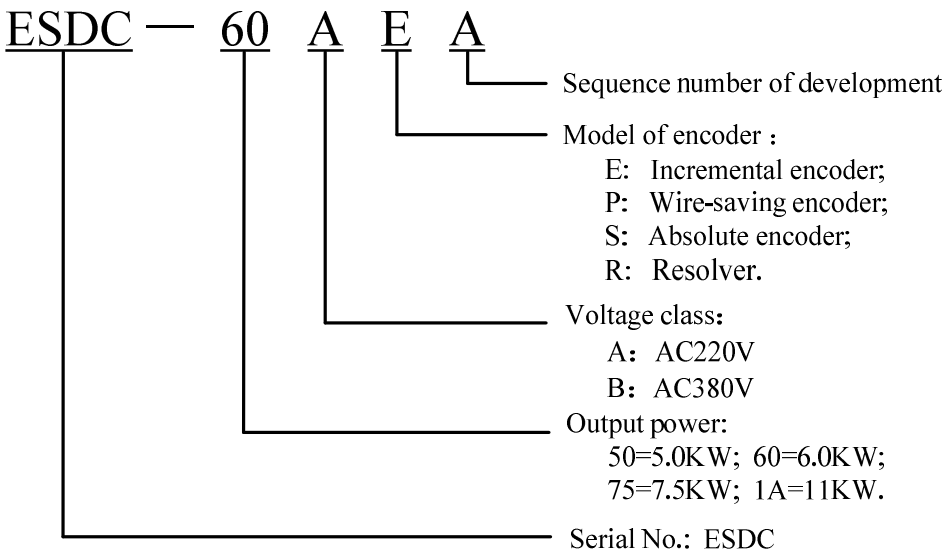
1. Nameplate

Figure 1-1 Servo driver nameplate description



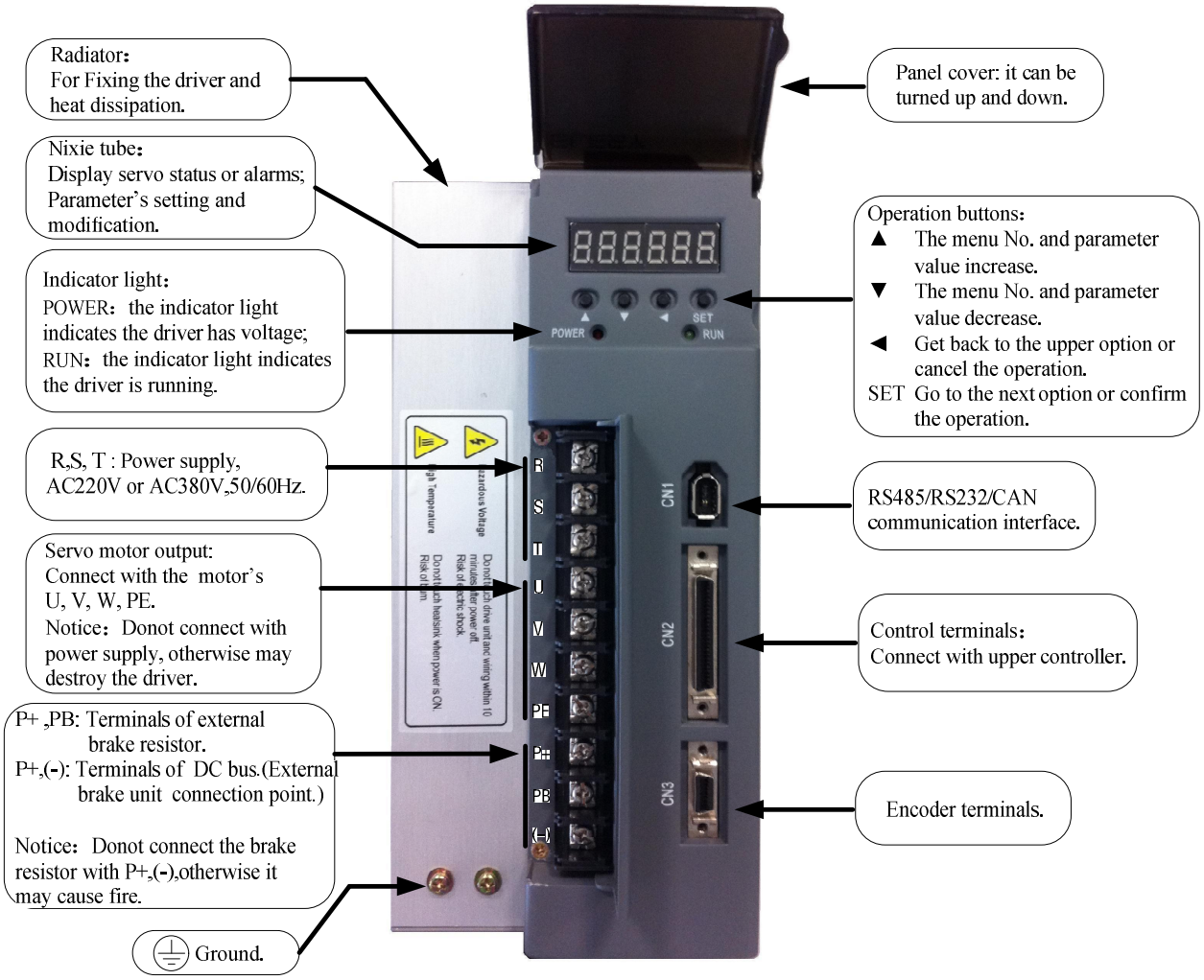
2. Model

Figure 1-2 Servo driver model description



1.2 Each part name of servo driver

Figure 1-3 Names of the servo driver's parts



1.3 Technical specification of servo driver

Power		Three-phase AC220V (-15~+10%),50/60Hz	Three-phase AC380 (-15~+10%),50/60Hz
Environment	**Temperature**	Operation temperature: 0~40℃; Storage temperature: -40~50℃.	
	Humidity	<90% (No moisture condensation)	
	Vibration	<0.5G(4.9m/S2) 10～60Hz , operate discontinuously.	
Control mode		①Position control mode; ②Internal speed control mode; ③Speed trial run control mode; ④JOG trial run; ⑤Analog speed control mode; ⑥Torque control mode; ⑦Open-loop operation.⑧Position&speed mixed control mode; ⑨Speed&torque mixed control mode;⑩Torque&position mixed control mode.	
Regenerative brake		External brake resistor (P+,PB); External brake unit (P+,(-)).	
Feature	**Response**	≥400Hz	
	Speed volatility	<0.03(Load: 0~100%)	
	Speed control range	1:5000	
	Pulse frequency	Differential Input:≤500Kpps; Open-collector input:≤200Kpps.	
Control input		7 programmable DI input: 1.Servo on; 2.Alarm clear; 3. CCW drive prohibition; 4.CW drive prohibition; 5.Position deviation counter clear; 6.Pulse command inpu prohibition; 7.Zero speed clamp; 8.CCW forward torque limit; 9.CW reversed torque limit; 10.Control mode switching; 14.Internal speed selection 1; 15.Internal speed selection 2; 16.Internal speed selection 3; 17.Internal torque selection 1; 18.Interna torque selection 2; 19.Electronic gear ratio selection 1; 20.Electronic gear ratio selection 2; 21.Speed direction selection 1; 22.Speed direction selection 2； 23. Speed command reverse.	
Control output		4 programmable DO output: 1.Servo ready; 2.Alarm output; 3.Positioning completion 4.Electromagnetic brake; 5.Speed reached signal; 6.Torque reached signal.	
Position control mode		Input pulse types	①Pulse+direction; ②CCW pulse/CW pulse; ③Two-phase quadrature pulse.
		Electronic gear ratio	Range:1～65535/1～65535
		Feedback pulse	Adjustable according to the encoder resolution.
Speed control mode		①Eight-optional internal speed; ②External -10V~10V analog signal control.	
Torque control mode		①Four-optional internal torque; ②External -10V~10V analog signal control.	
Acceleration/Deceleration time		Range: 1~10000ms (0~Rated speed/Rated speed~0) .	
Torque limitation		Range: -300~+300%.	
Monitoring		Speed; Feedback pulse; Position command; Position deviation; Torque; Current; Pulse frequency; Control mode; I/O signal status; Temperature; Busbar voltage,Etc.	
Protection		Overspeed; Overvoltage; Undervoltage; Overcurrent; Overload; Encoder abnormity; Overheating; Excessive position deviation; Braking abnormity; Input power phase loss Etc.	
Operation&Display		6-bits LED nixie tube, 4 buttons, 2 indicator lights.	
Applicable load inertia		Less than three times of the inertia of motor.	
Communication		RS485/RS232	

Chapter 2　Installation

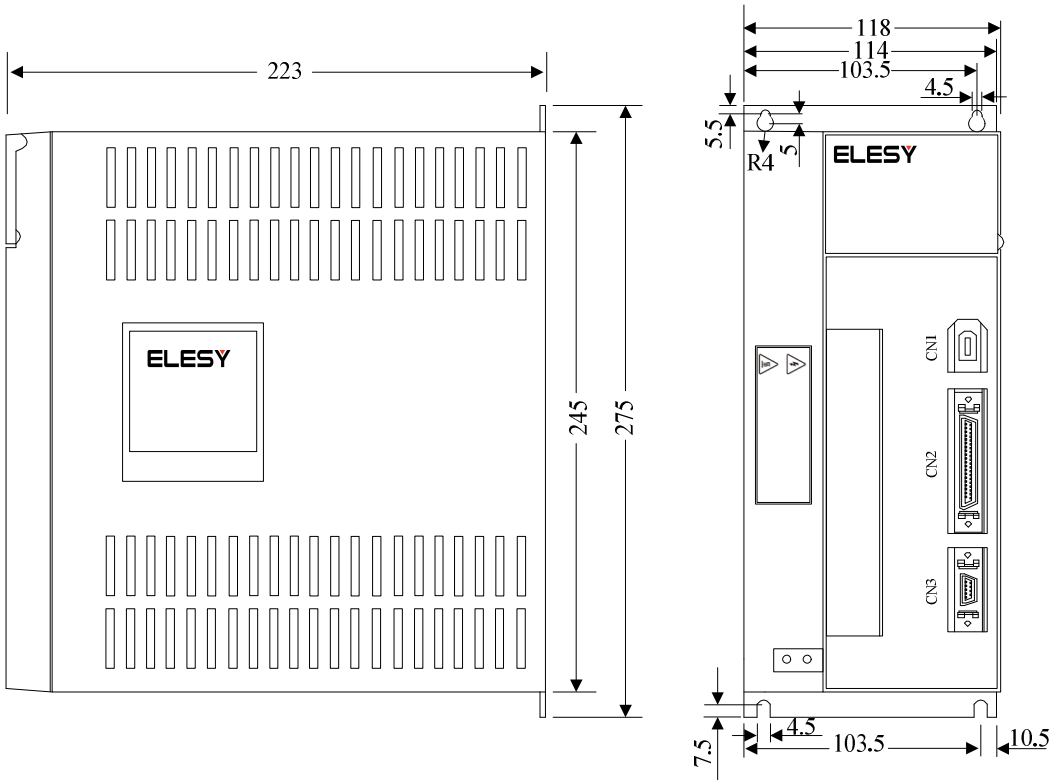
1. Installation site

Item	ESDC servo driver
Operating temperature&humidity	0~40℃(No freezing); Less than 90%RH (No moisture condensation).
Storage temperature& humidity	-40~50℃; Less than 0%RH (No moisture condensation).
Air environment	Confirm there is no corrosive gas, inflammable gas, oil mist, dust, etc. inside the cabinet.
Installation environment	Should be installed in the place where there is no high- radiation equipment, vapor, water-drop, floating metal particle, electromagnetic noise jamming.
Altitude	Elevation: 1000m below.
Vibration	Less than 0.5G(4.9m/S2) 10～60Hz,operate discontinuously.

2. Installation dimension

It can be installed in the way of base plate installation, and the installation direction is upwards perpendicular to fitting surface. Figure 2-1 shows the baseplate installation way.

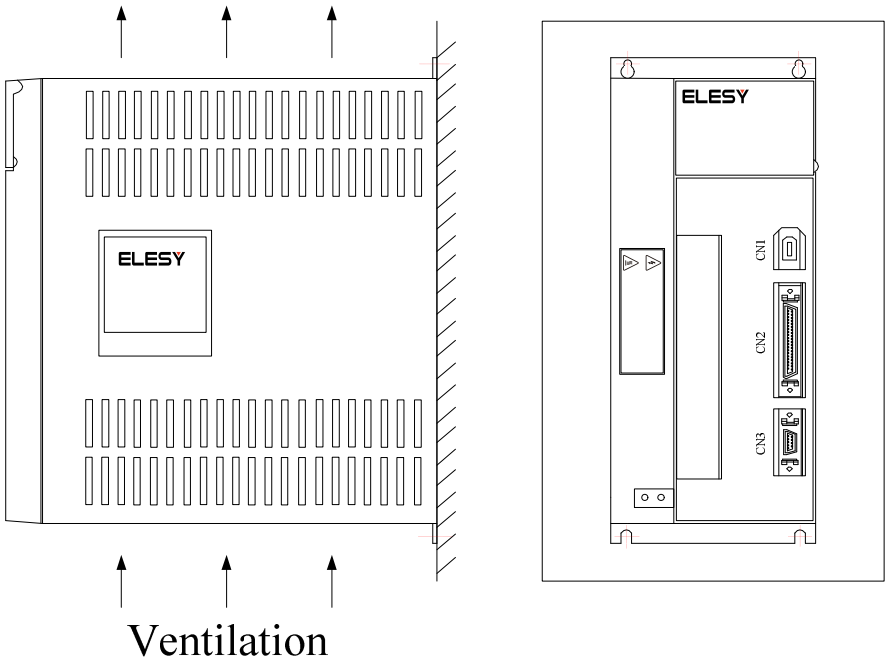
Figure 2-1 the driver's structure and installation dimension（unit: mm）



3. Installation direction

As figure 2-2 shows, the installation direction should be perpendicular to the wall's direction. Adopt mounting holes in the four corners to fix the servo driver on the wall firmly. If necessary, please install an air fan to apply forced-cooling to the servo driver.

Figure 2-2 Installation direction of the driver



4. Installation interval

The installation interval for single driver is shown in figure 2-3, and that for multi drivers is shown in figure 2-4. Please leave enough space as far as possible in practical installation, so as to guarantee good heat dissipation condition.

Figure 2-3 Installation intervals for single driver

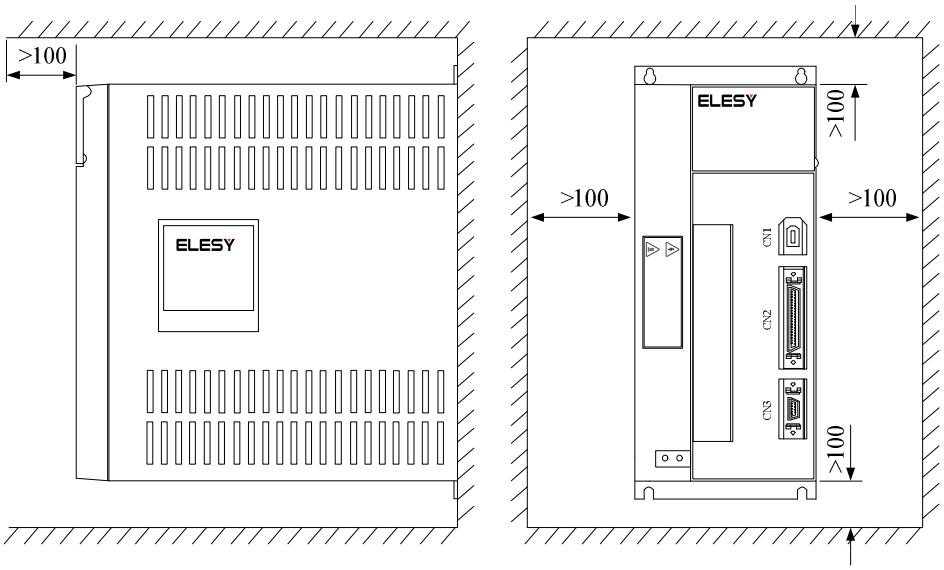
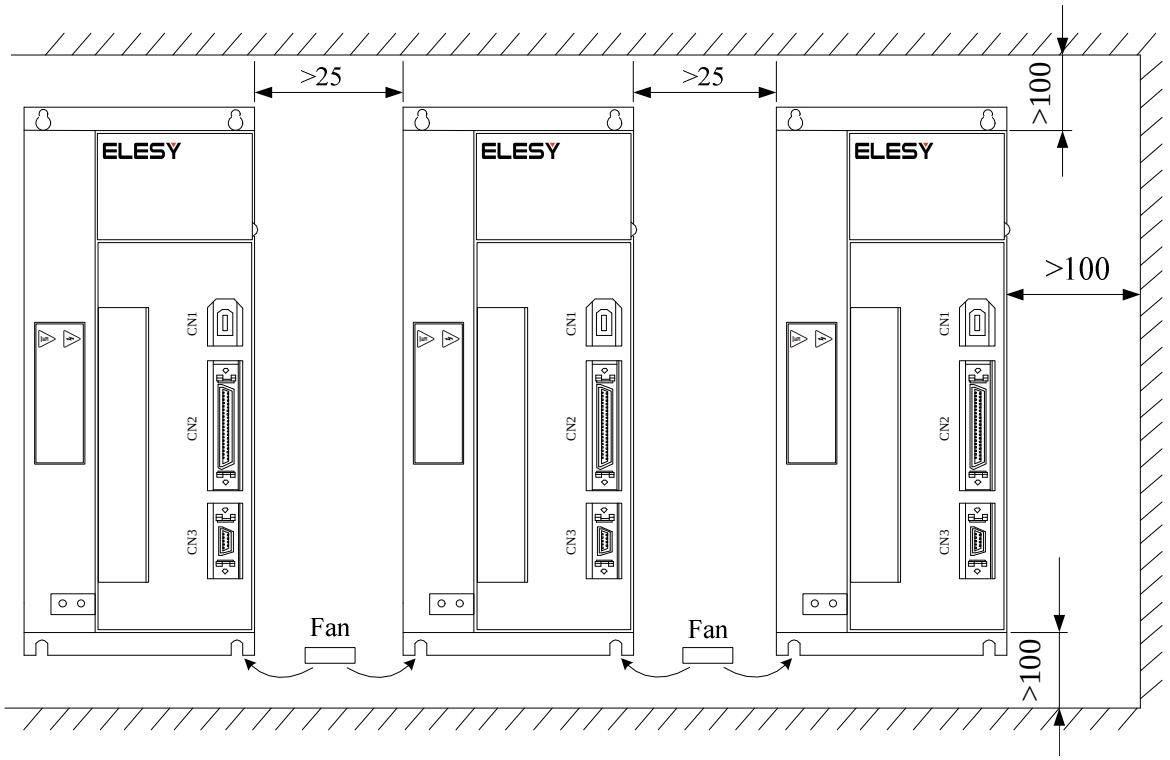


Figure 2-4 Installation intervals for multi drivers



WARNING	➢ For avoiding the environmental temperature of the servo driver rising too high, there should be convection wind blowing to radiator of driver inside the electric cabinet.

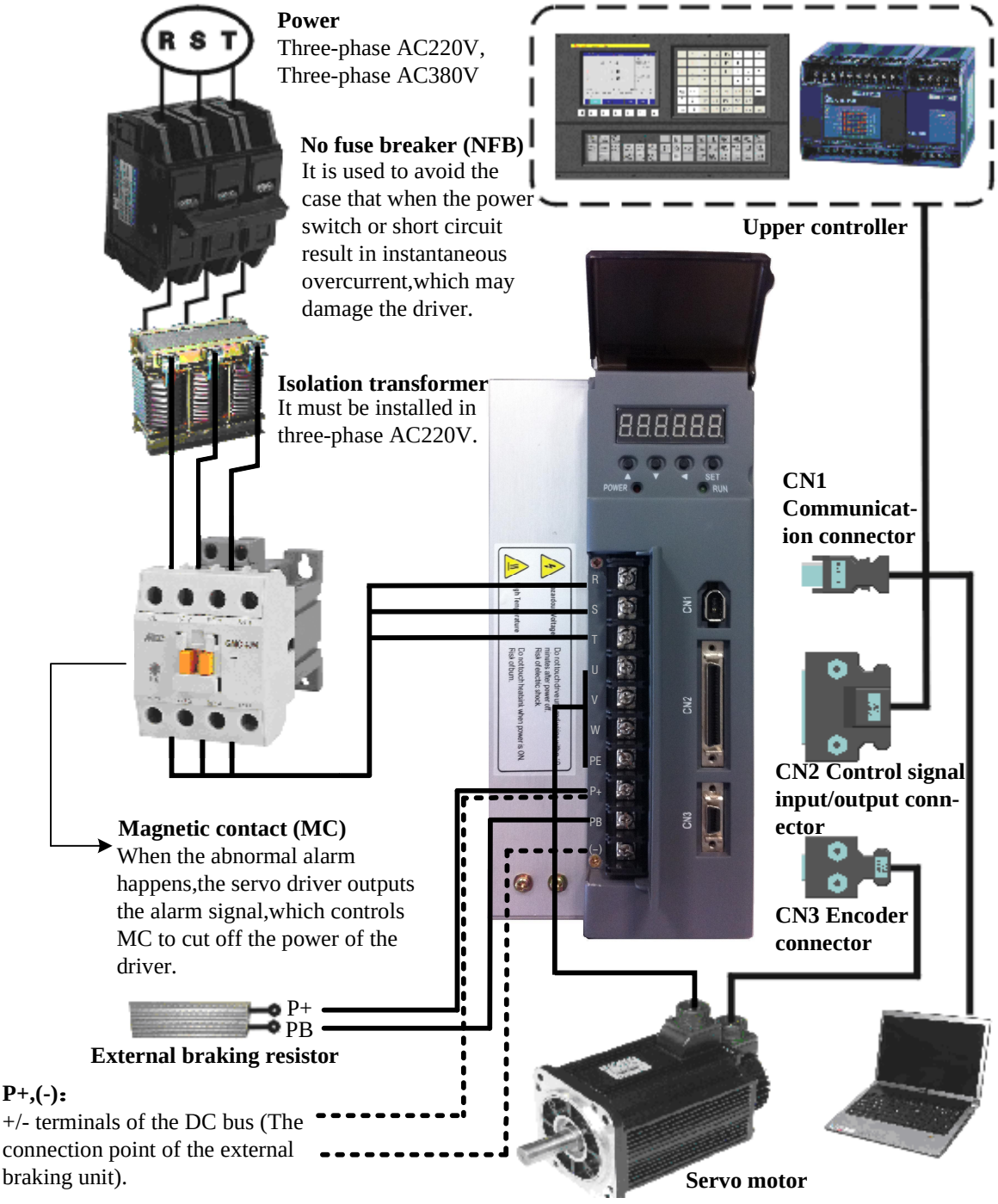
While installing multi drivers, as shown in figure 2-4, please leave room larger than 25mm in each of the two crosswise sides, and more than 100mm in each of the two vertical sides. Please keep the temperature inside the electric closet in balance, for avoiding local temperature of the servo driver rising too high. If necessary, please install forced-cooling convectional fan in the electric closet above the servo driver to pump air out.

Chapter 3 Wiring

3.1 Connection of peripheral equipments

The application of servo driver should be equipped with some peripheral equipment. Using proper peripheral equipment can guarantee the driver's stable operation; otherwise it may reduce the driver's service life, even damage the servo driver.

Figure 3-1 Connection of peripheral equipment



⚠ WARNING	➢ Braking resistor should be connected in strict accordance with the manual requests. P+ and PB can't be short circuit, otherwise the driver will be destroyed after power-on. ➢ Please don't connect the braking resistor to the DC bus P+, (-), otherwise it may cause fire! ➢ After the driver is powered down, the terminals of DC bus P +,(-) maybe retain the residual voltage, please do not touch it until you confirm the residual voltage is less than 36V, otherwise it may cause electric shock. ➢ Before power on, please check whether R, S, T wiring is correct. ➢ Check whether U,V,W,PE wiring is correct .Three-phase terminal sequence can't be swapped to reverse the motor . ➢ There is large volume electrolytic capacitor in the servo driver, so high voltage will exist even after power down. Please don't touch the driver or motor in five minutes after outage.

3.2 Power supply wiring

ESDC series servo driver according to different specifications respectively using three-phase AC220V (e.g.: ESDC-60AEA) and three-phase AC380V (e.g.: ESDC-60BEA) power supply. Generally, three-phase AC220V is obtained from three-phase AC380V through the transformer.

Figure 3-2 Wiring diagram of three-phase AC220V

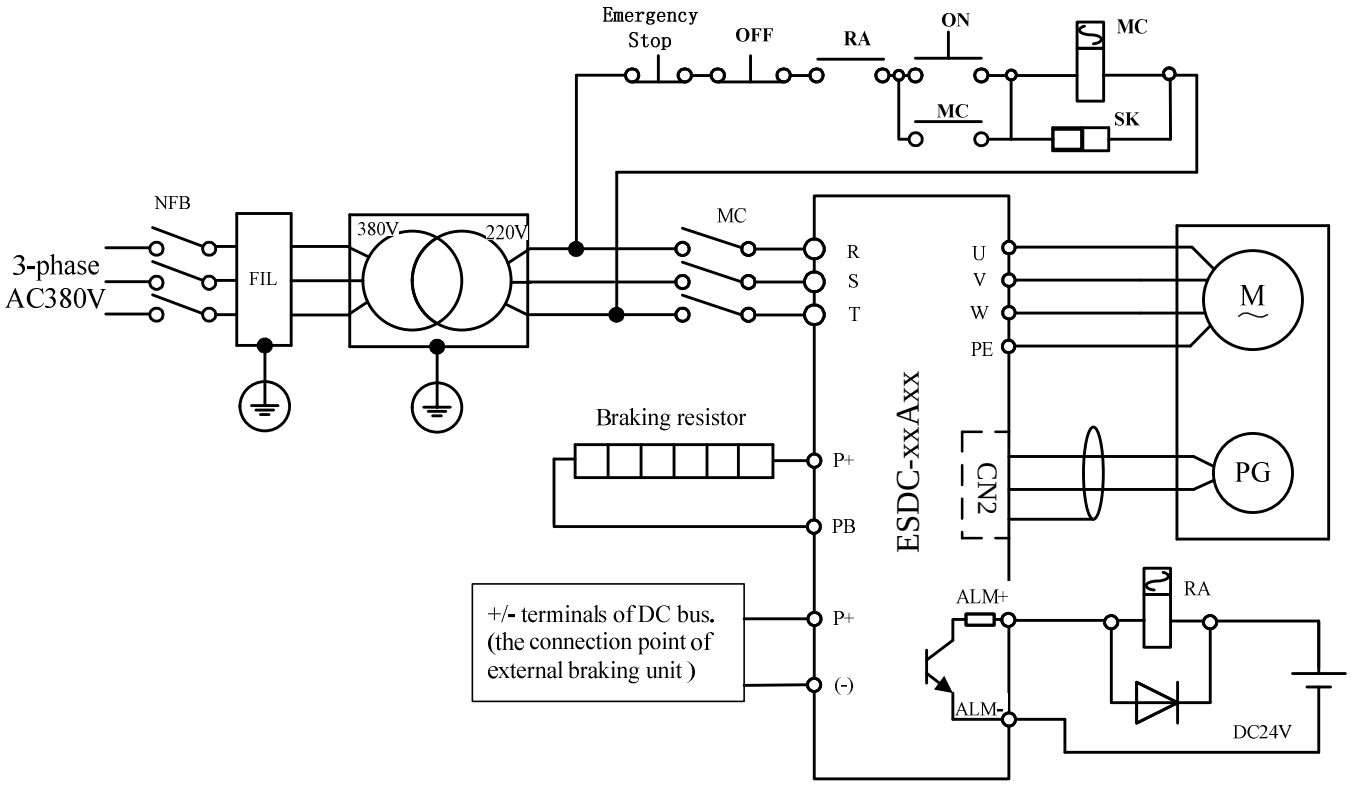
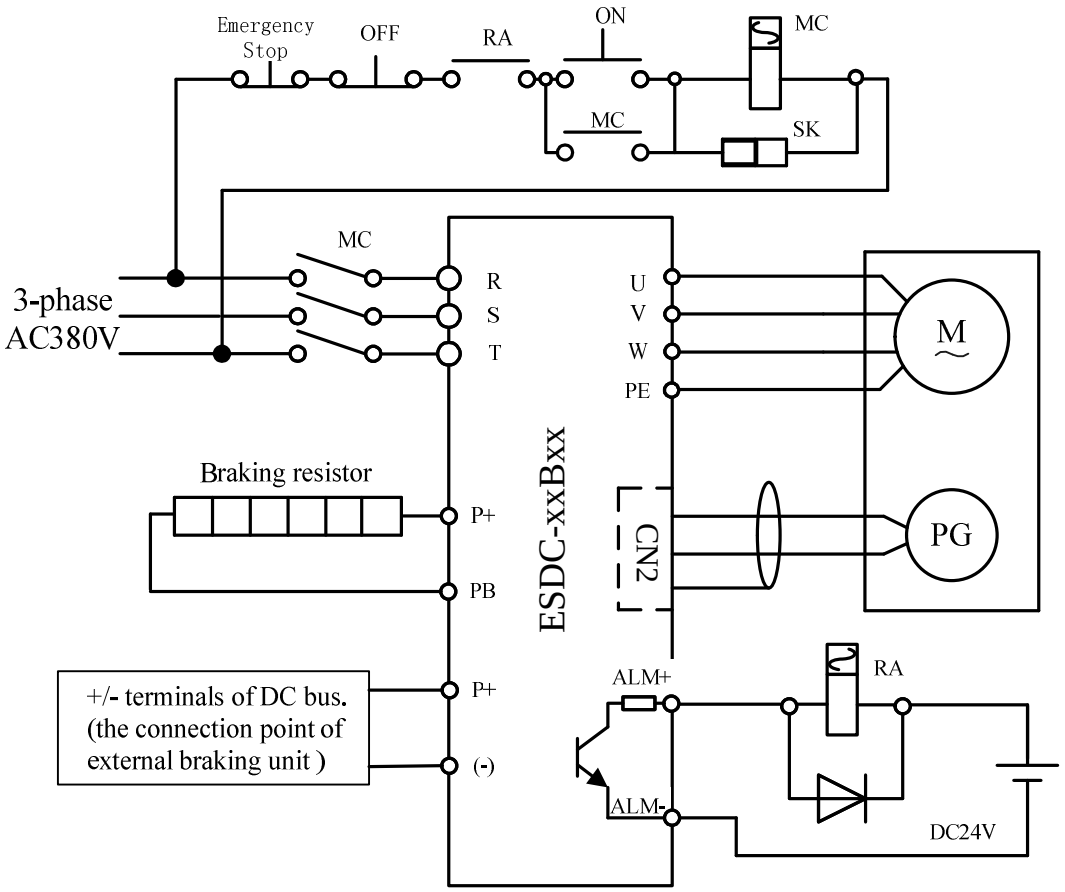


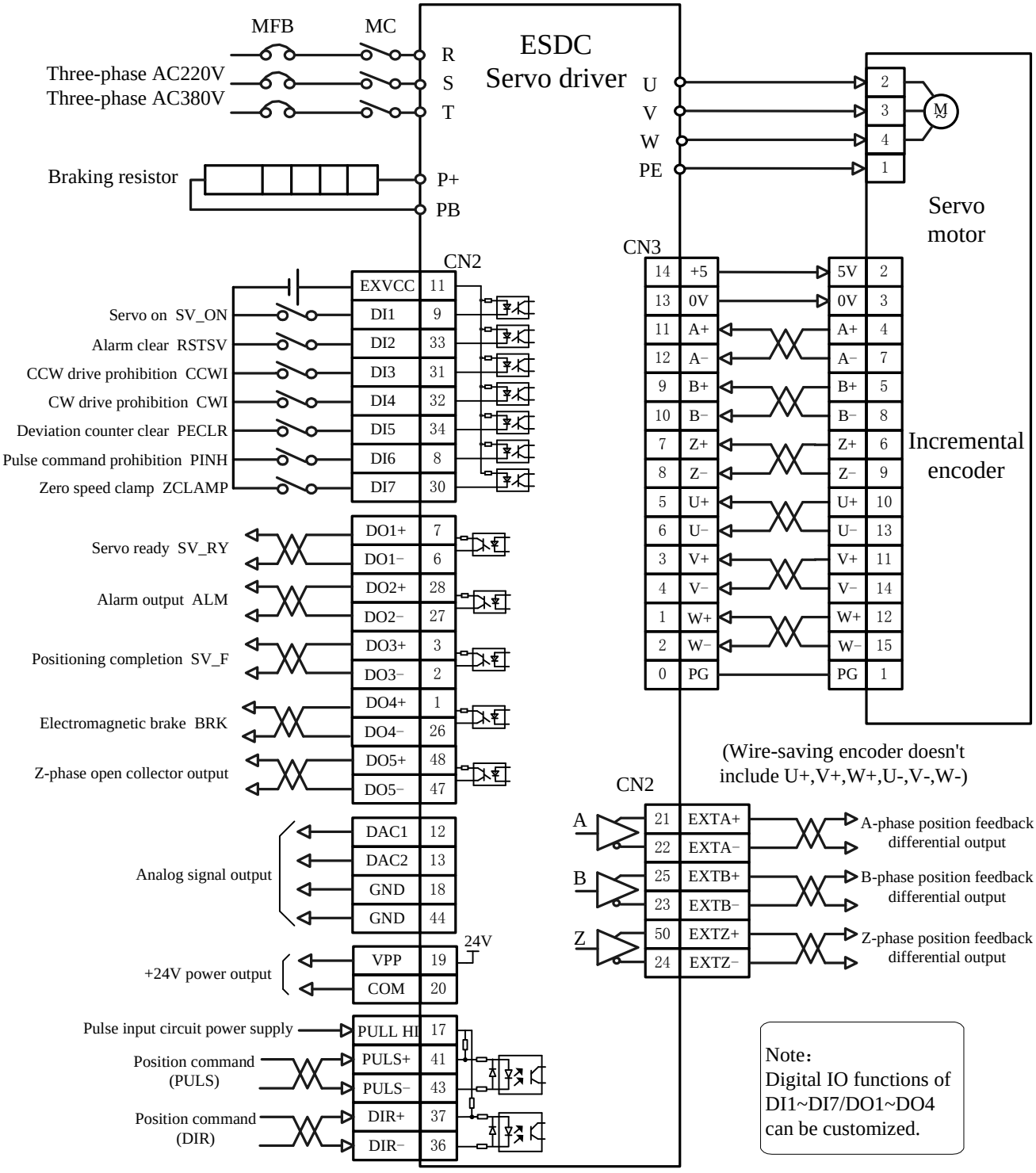
Figure 3-3 Wiring diagram of three-phase AC380V



3.3 Standard wiring of the servo driver

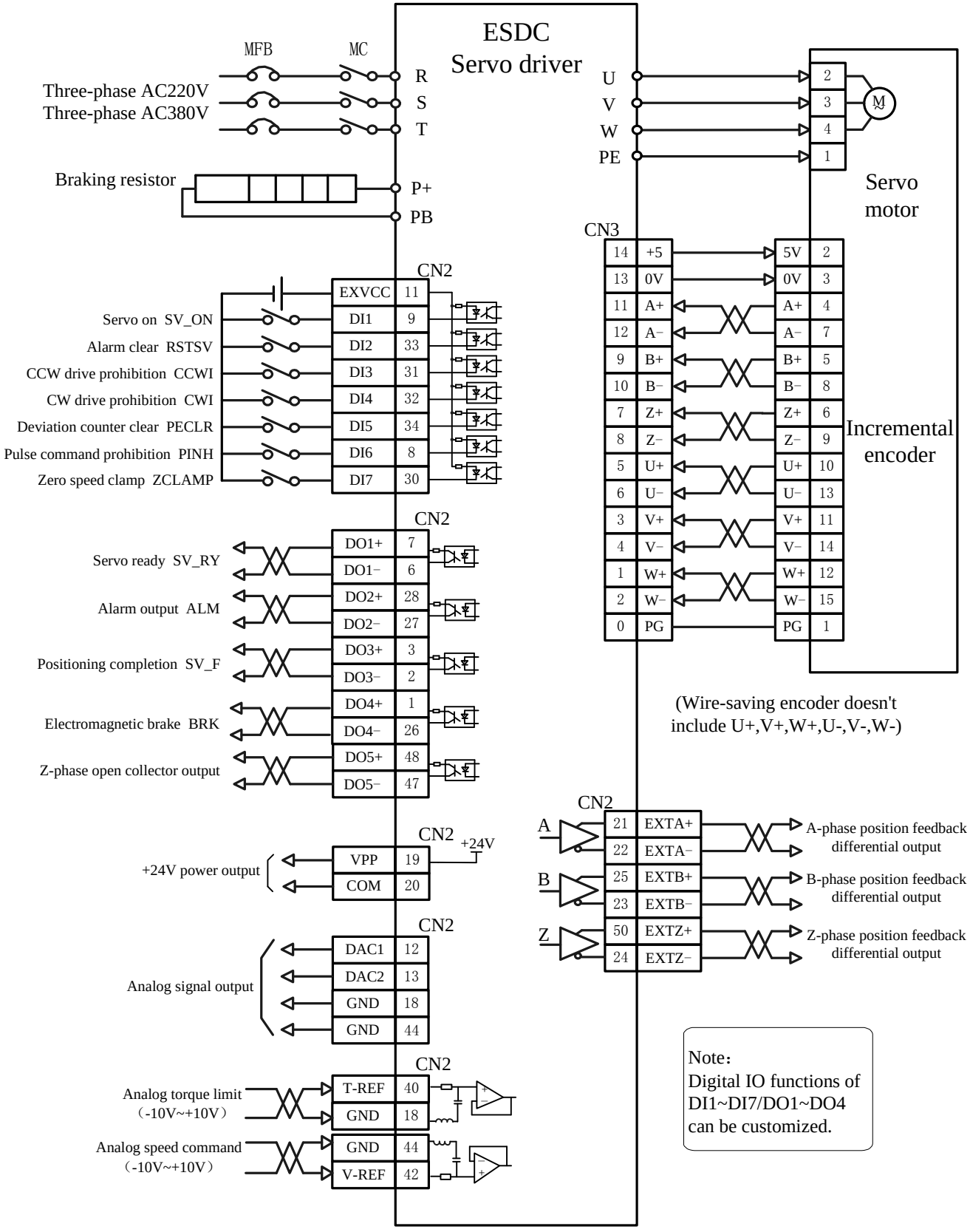
3.3.1 Position control mode

Figure 3-4 Wiring diagram of position mode



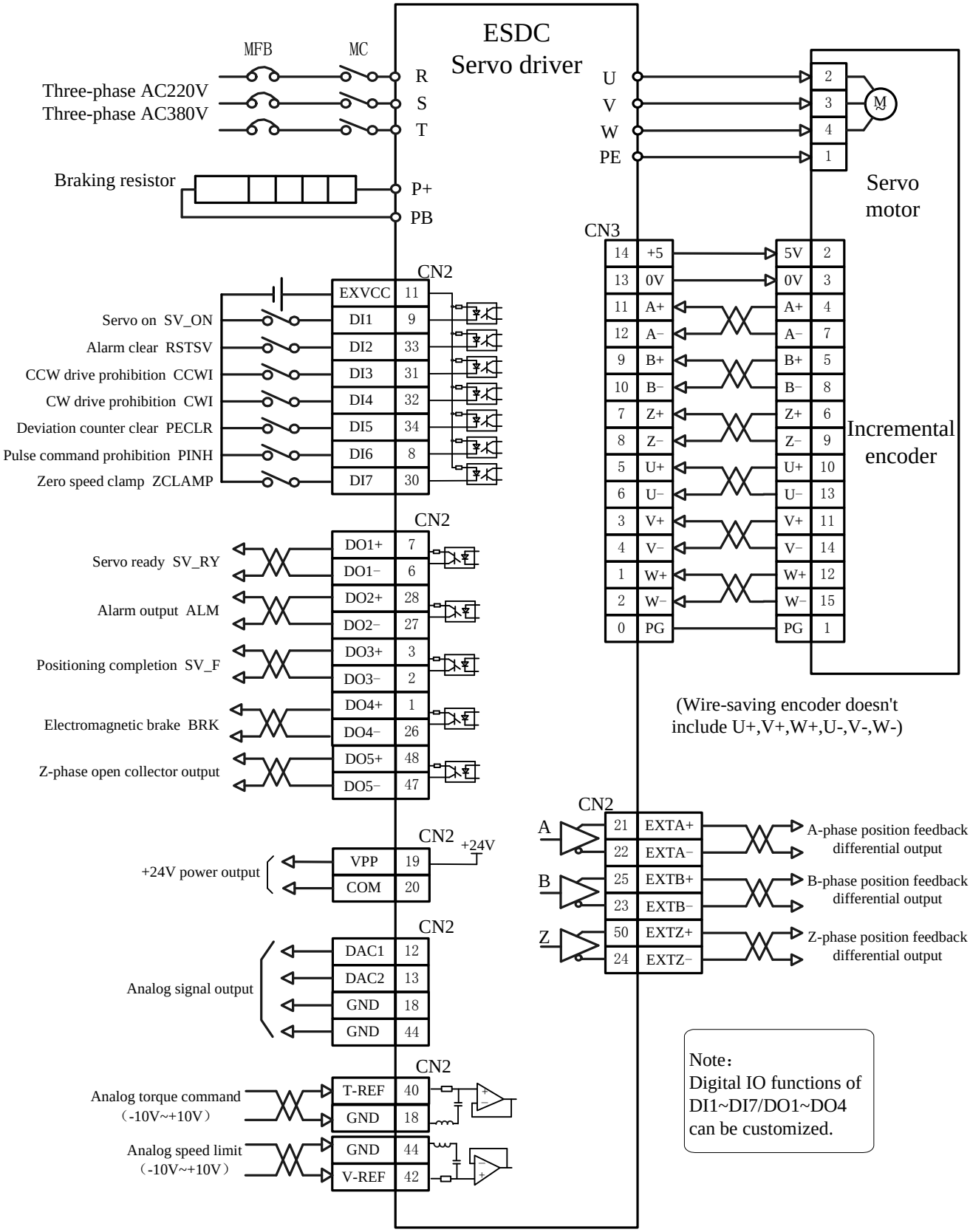
3.3.2 Speed control mode

Figure 3-5 Wiring diagram of speed mode



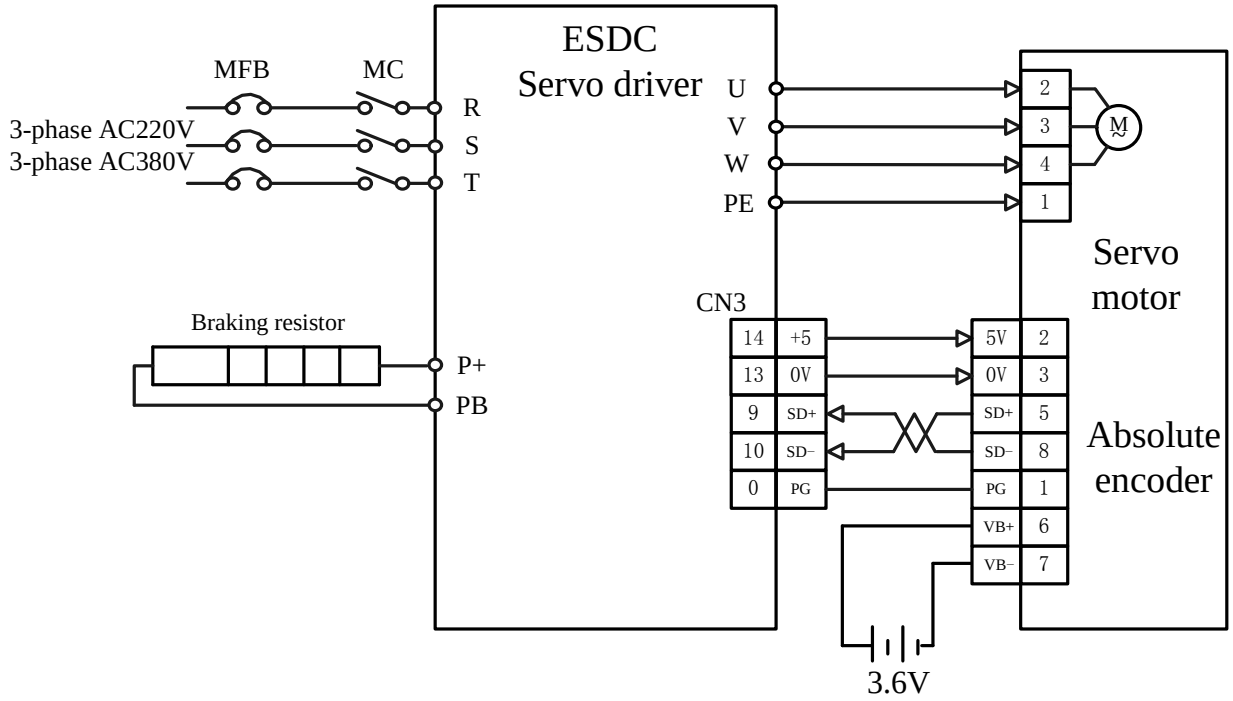
3.3.3 Torque control mode

Figure 3-6 Wiring diagram of torque mode



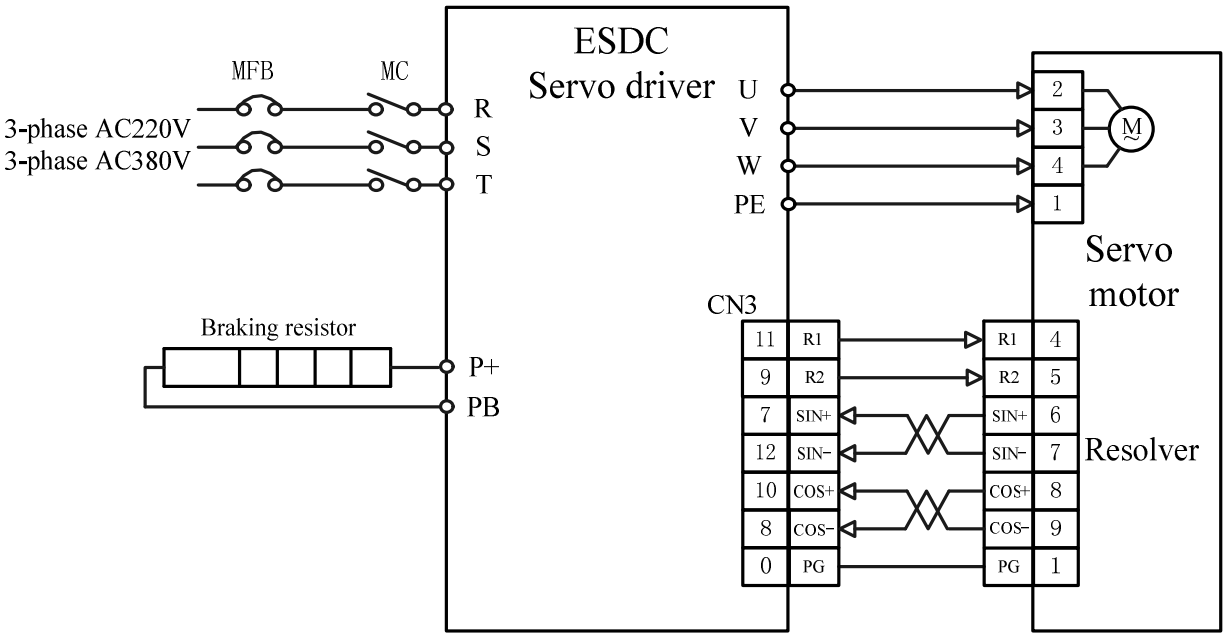
3.3.4 Absolute encoder wiring

Figure 3-7 Wiring diagram of absolute encoder



3.3.5 Resolver wiring

Figure 3-8 Wiring diagram of resolver



Chapter 4 Interface

4.1 Signal definition of power terminals

<table>
<tr><th rowspan="2">Sign</th><th rowspan="2">Name</th><th rowspan="2">Function</th><th colspan="6">Wire diameter requirements</th></tr>
<tr><th colspan="3"><25.0A</th><th colspan="3">≥25.0A</th></tr>
<tr><td>R,S,T</td><td>Power supply</td><td>Supply power to servo driver.</td><td colspan="3">4.0 mm^2</td><td colspan="3">6.0 mm^2</td></tr>
<tr><td>U,V,W,PE</td><td>Motor connection terminals</td><td>Connect to servo motor's U,V,W,PE .</td><td colspan="3">4.0 mm^2</td><td colspan="3">6.0 mm^2</td></tr>
<tr><td>P+,(-)</td><td>DC BUS terminals</td><td>Common DC bus input point.(External braking unit connection point.)</td><td colspan="6">≥6.0 mm2 (The external brake unit model selection please consult factory.)</td></tr>
<tr><td>⏚</td><td>Ground terminals</td><td>Connect with motor ground.</td><td colspan="6">≥2.0 mm2</td></tr>
<tr><td rowspan="3">P+,PB</td><td rowspan="3">Braking resistor terminals</td><td rowspan="3">Used to connect external braking resistor.</td><td colspan="6">Braking resistor model selection</td></tr>
<tr><td>ESDC50A</td><td>ESDC60A</td><td>ESDC50B</td><td>ESDC75B</td><td>ESDC1AB</td></tr>
<tr><td colspan="2">30Ω/500W</td><td colspan="3">40Ω/500W</td></tr>
</table>

4.2 Signal definition of communication connector

Figure 4-1 Communication connector CN1 plug

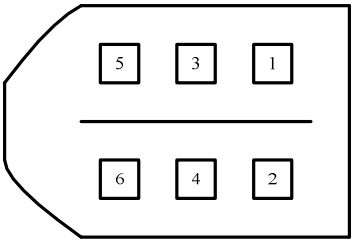


Figure 4-2 Wiring diagram of driver CN1 plug (RS232 interface) and PC

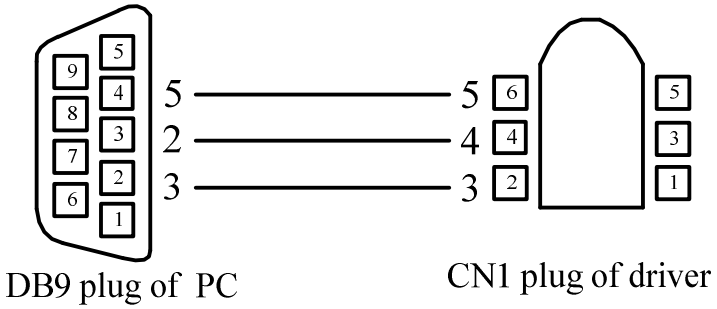
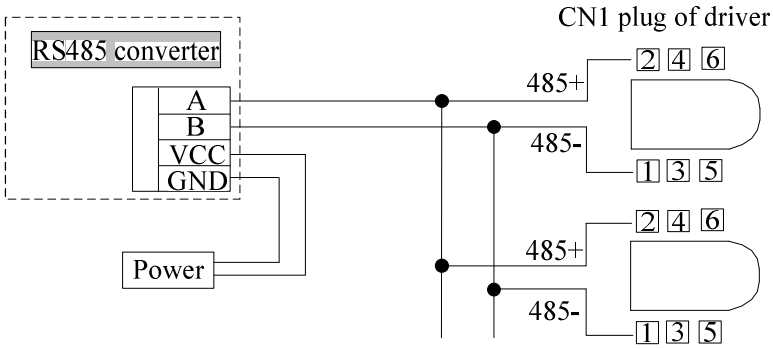


Figure 4-3 Wiring diagram of driver CN1 plug and RS485 converter



Servo driver provides RS485 and RS232 two kinds of communication interface. Adoption of international standard MODBUS communication protocol. Through the RS485 interface can simultaneously achieve asynchronous serial half-duplex communication with 32 servo drivers. The cable length is related to the baud rate and the cable diameter. For example, if the baud rate is 9600bps and AWG26 cable is chosen, the maximum communication distance is 1Km.

Table 4-1 Signal definition of CN1

Pin	Name	Sign	Functions
CN1-1	RS485 differential signal -	RS-485-	RS-485 and CAN shared data bus. Users can choose either one by internal jumper.
	CAN differential signal -	CANL	
CN1-2	RS485 differential signal +	RS-485+	
	CAN differential signal +	CANH	
CN1-3	RS-232 data receiving	RXD232	Data receiving terminal of driver RS232 interface, connect to PC data transmitting terminal.
CN1-4	RS-232 data transmitting	TXD232	Data transmitting terminal of driver RS232 interface, connect to PC data receiving terminal.
CN1-5	RS-232 signal ground	GND	RS-232 signal ground.
CN1-6	+5V	+5V	Standby power.

4.3 Signal definition of CN2 connector

Figure 4-4 shows CN2 plug of the servo driver (in the face of soldering lug of the pin). It uses SCSI 50P connector.

Figure 4-4 CN2 plug of servo driver

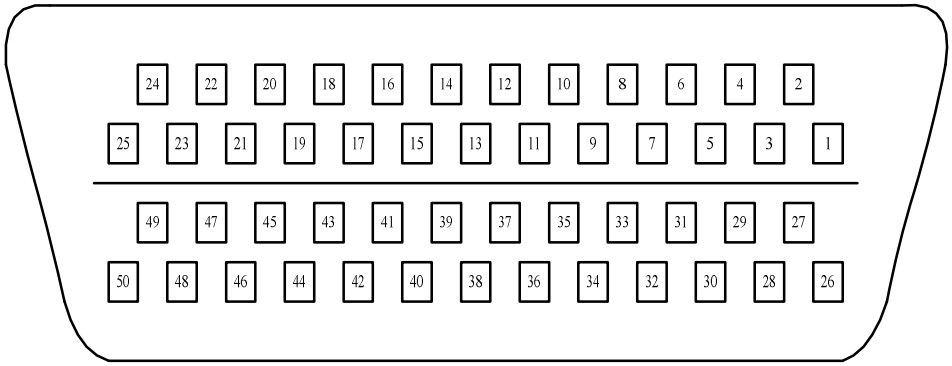


Table 4-2 Signal definition of CN2 plug

Pin	Name	Application way	Functions
CN2-11	EXVCC	P,S,T	I/O input circuit external power supply, +12V~+24V
CN2-9	DI1	P,S,T	Photoelectric isolation programmable digital input pins. Functions of DI1~DI7 can be customized by parameters Pn301~Pn307.
CN2-33	DI2		
CN2-31	DI3		
CN2-32	DI4		
CN2-34	DI5		
CN2-8	DI6		
CN2-30	DI7		
CN2-41	PULS+	P	External pulse command input: 1） Pulse + Direction; 2） CCW Pulse /CW Pulse; 3） Two-phase quadrature pulse.
CN2-43	PULS-		
CN2-37	DIR+		
CN2-36	DIR-		
CN2-17	PULL HI	P	Pulse input circuit power supply. When pulse input using open collector connection, the pin is connected to an external DC24V power.
CN2-19	VPP	P,S,T	The +24V voltage is supplied by driver. Maximum permissible current is 100mA.
CN2-20	COM		The ground of VPP .
CN2-12	DAC1	S,T	Analog signal output: -10V～+10V
CN2-13	DAC2		
CN2-40	T-REF	S,T	Analog torque command input:-10V～+10V
CN2-42	V-REF		Analog speed command input:-10V～+10V
CN2-18	GND	S,T	Analog ground.
CN2-44	GND		
CN2-7	DO1+	P,S,T	Photoelectric isolation programmable digital output pins. Functions of DO1~DO4 can be customized by parameters Pn309~Pn312.
CN2-6	DO1-		
CN2-28	DO2+		
CN2-27	DO2-		
CN2-3	DO3+		
CN2-2	DO3-		
CN2-1	DO4+		
CN2-26	DO4-		
CN2-48	DO5+	P,S,T	Z-phase open collector output.
CN2-47	DO5-		
CN2-21	EXTA+	P,S,T	Position feedback pulse A phase differential output.
CN2-22	EXTA-		
CN2-25	EXTB+	P,S,T	Position feedback pulse B phase differential output.
CN2-23	EXTB-		
CN2-50	EXTZ+	P,S,T	Position feedback pulse Z phase differential output.
CN2-24	EXTZ-		

4.4 Signal definition of encoder feedback terminals

Figure 4-5 shows connection terminals of servo driver CN3, which uses SCSI 14P connector.

Figure 4-5 CN3 plug of servo driver

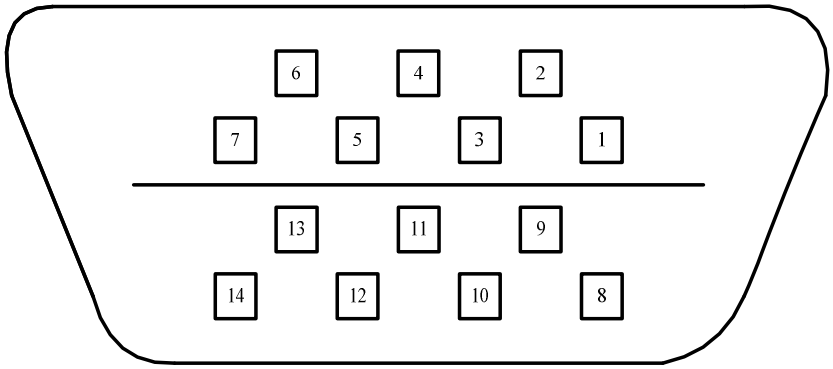


Table 4-3 Signal definition of CN3 plug

Pin	Name and sign			
	Incremental encoder	Wire-saving encoder	Absolute encoder	Resolver
CN3- 1	Encoder W+ input: W+			
CN3- 2	Encoder W- input: W-			
CN3- 3	Encoder V+ input: V+			
CN3- 4	Encoder V- input: V-			
CN3- 5	Encoder U+ input: U+			
CN3- 6	Encoder U- input: U-			
CN3- 7	Encoder Z+ input: Z+			Analog input SIN+: SIN+
CN3- 8	Encoder Z- input: Z-			Analog input COS-: COS-
CN3- 9	Encoder B+ input: B+		Encoder SD+ input: SD+	R2
CN3-10	Encoder B- input: B-		Encoder SD- input: SD-	Analog input COS+: COS+
CN3-11	Encoder A+ input: A+			R1
CN3-12	Encoder A- input: A-			Analog input SIN-: SIN-
CN3-13	Encoder power negative : 0V			
CN3-14	Encoder power positive : +5V			

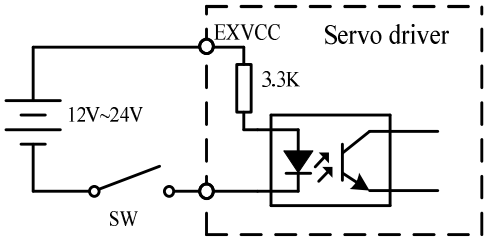
4.5 Digital input/output interface principle

4.5.1 Digital input interface principle

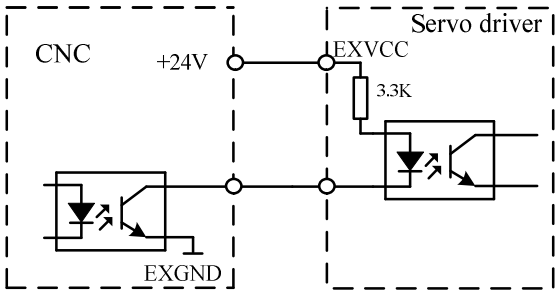
The digital input signals with two connections as follows.

Figure 4-6 Digital input interface

Relay circuit example.



Open-collector example.



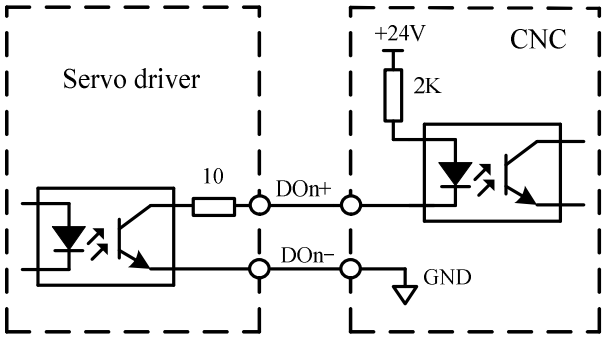
- The input power (DC12～24V) is supplied by user, the power load capacity is 100mA and above.
- If power polarity reversed, servo drive will fail to work.

4.5.2 Digital output interface principle

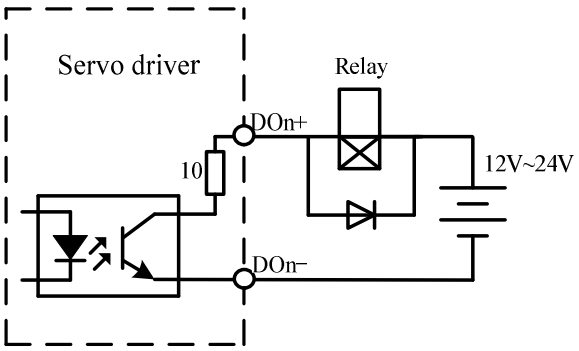
Servo digital outputs are all couple-terminal open-collector output. In order to guarantee reliability of signal transmission, all the output signals are valid only when the optical coupler is turned on. All signal outputs is Darlington driver structure, and wiring is showed as followings.

Figure 4-7 Digital output interface

External optical coupler output examples.



External relay output examples.



- The power is supplied by users. Notice that the servo driver will be damaged if the power polarity is reversed.
- The maximum power supply voltage is +24V.
- The output is open-collector form, with the maximum current of 150mA.
- If the load is an inductive load such as relay, it is necessary to wire a diode parallel with the load. If the diode is in a wrong direction, the servo driver will be damaged.

4.6 Position pulse command input interface principle

1. Pulse command input interface

User can use both differential input connection and open-collector single input connection

Figure 4-8 Pulse command differential input

The maximum frequency is 500Kpps. In order to transmit pulse quantity correctly, differential driving mode is recommended.

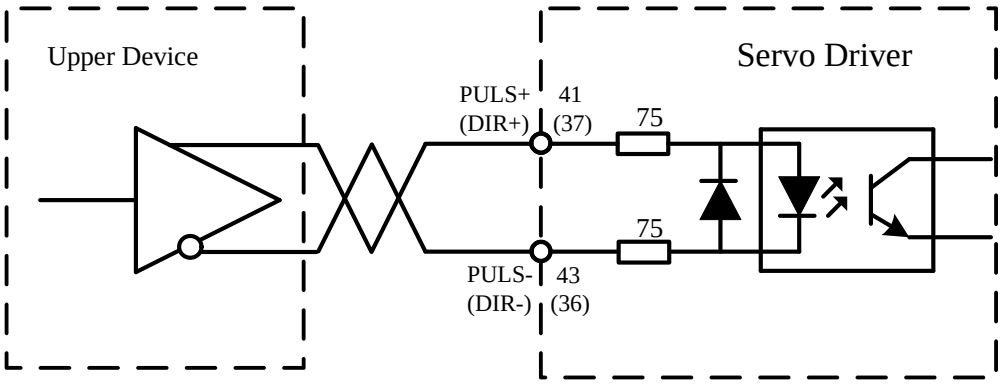


Figure 4-9 Pulse command input with internal power (open-collector input)

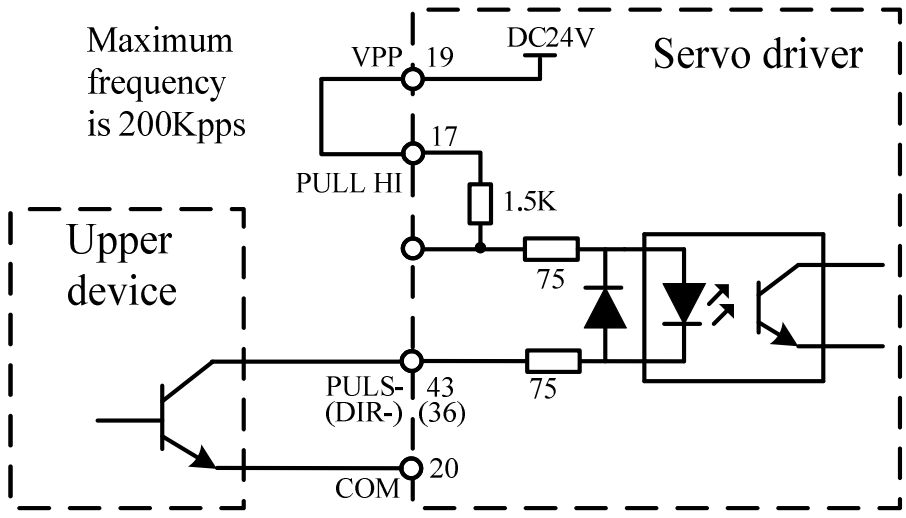
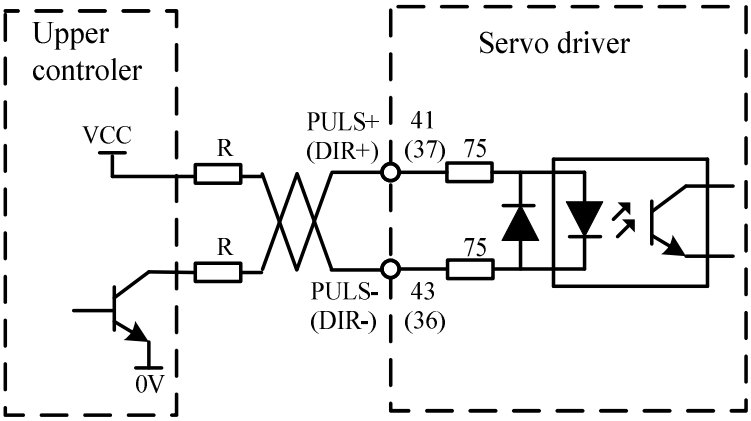


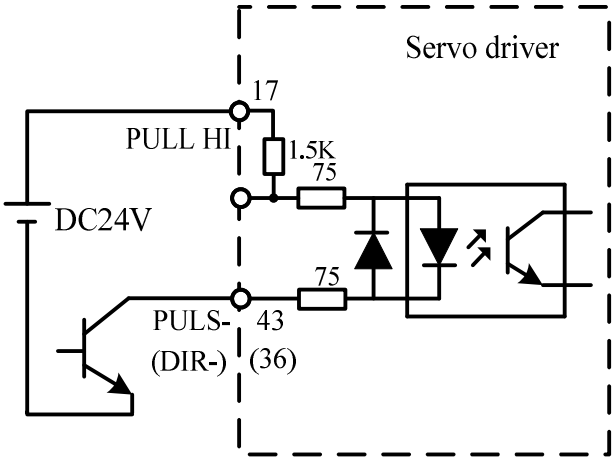
Figure 4-10 Pulse command input with external power (open-collector input)

Use external adjusting resistance. Circumscribed resistance R should be adjusted by VCC makes the driving current to meet 6~10mA.The maximum input pulse frequency is 200Kpps.

VCC	R
24V	1K Ω
12V	680 Ω
5V	100 Ω



Use internal adjusting resistance which is 1.5KΩ.The maximum input pulse frequency is 200Kpps.



- Because the driver provides internal power supply, external power supply is not necessary.
- In order to improve the anti-interference ability, differential connection is recommended.
- Single-terminal mode will reduce the reception range of command pulse frequency.

2. Position pulse command types

These types command pulse can be received, which is selected by Pn014, and every type can be reversed by setting Pn015.

Table 4-4 Position pulse input types

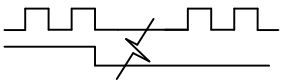
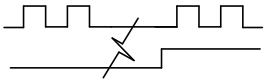
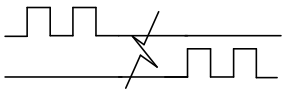
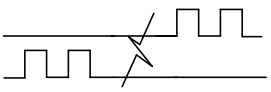
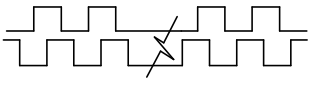
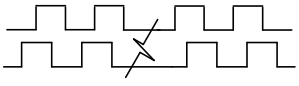
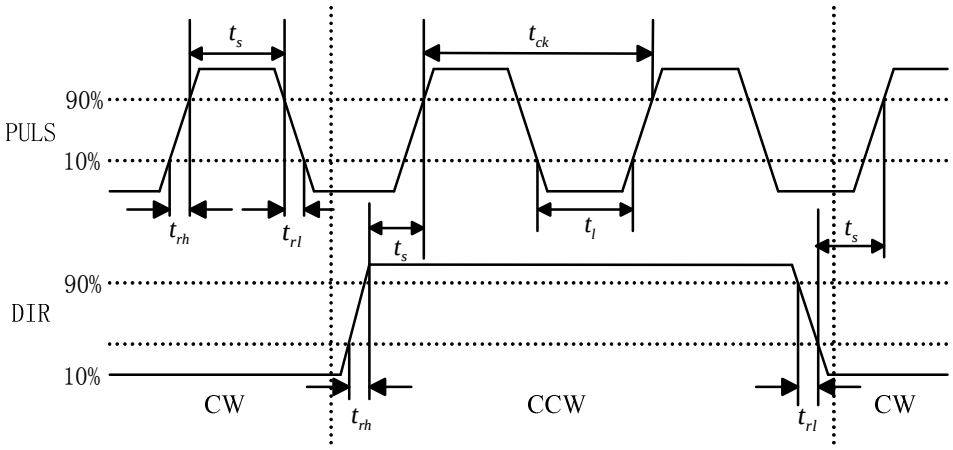
Pn-014	Pulse types	Pn-015=0		Pn-015=1	
		Run in CCW direction (Anti-clockwise)	Run in CW direction (Clockwise)	Run in CCW direction (Anti-clockwise)	Run in CW direction (Clockwise)
Pn-014=0	Pulse + direction				
Pn-014=1	CCW /CW pulse				
Pn-014=2	Two phase quadrature pulse				

Table 4-5 Pulse input timing parameters

Parameters	Differential driving input	Single terminal driving input
t_{ck}	>2μS	>5μS
t_h	>1μS	>2.5μS
t_l	>1μS	>2.5μS
t_{rh}	<0.2μS	<0.3μS
t_{rl}	<0.2μS	<0.3μS
t_s	>1μS	>2.5μS
t_{qck}	>8μS	>10μS
t_{qh}	>4μS	>5μS
t_{ql}	>4μS	>5μS
t_{qrh}	>0.2μS	<0.3μS
t_{qrl}	>0.2μS	<0.3μS
t_{qs}	>1μS	>2.5μS

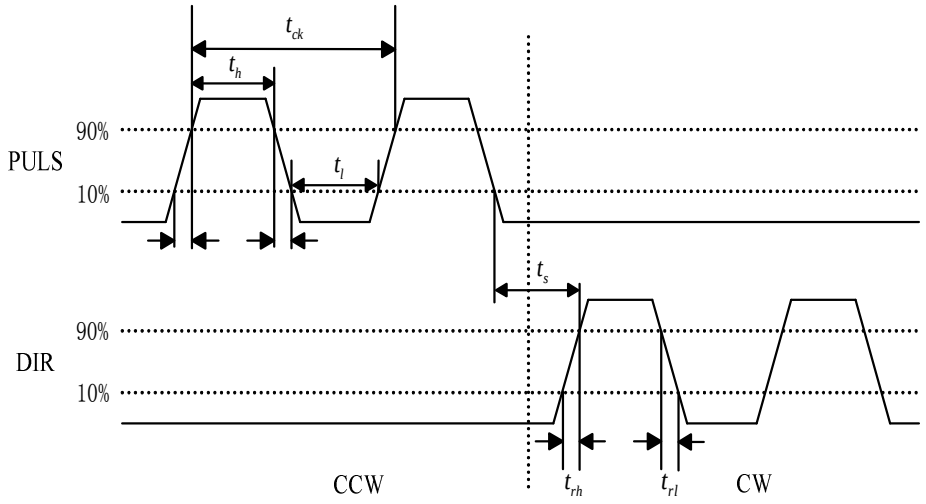
(1) Pulse + direction input timing diagram (The maximum frequency is 500KHZ).

Figure 4-11 Pulse + direction input timing diagram



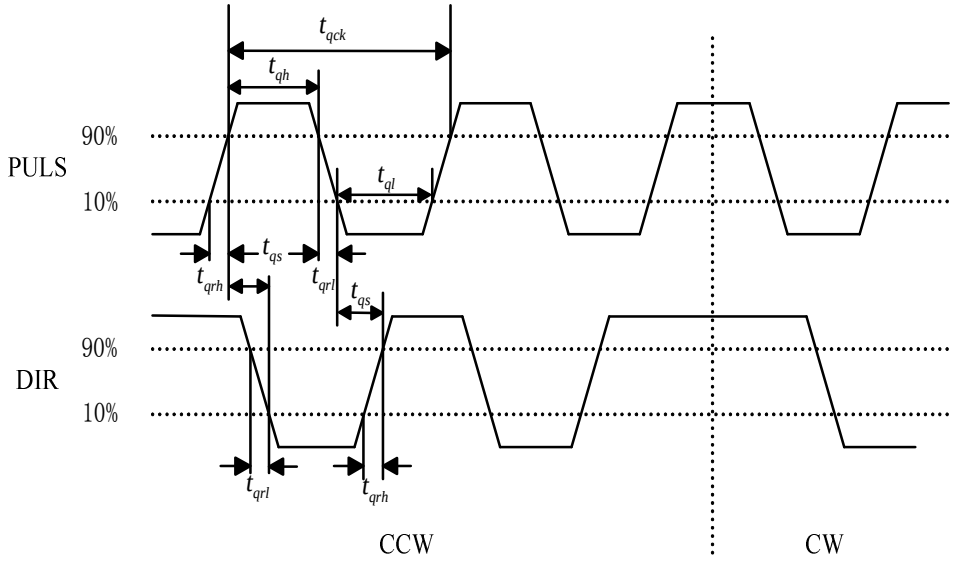
(2) CCW pulse/CW pulse input timing diagram (The maximum frequency is 500KHZ).

Figure 4-12 CCW/CW pulse input timing diagram



(3) Two phase quadrature pulse input timing diagram (The maximum frequency is 300KHZ).

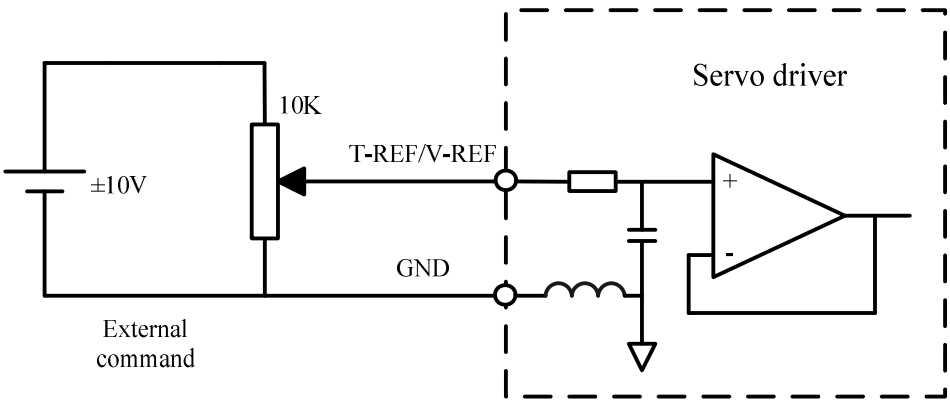
Figure 4-13 Two phase quadrature pulse input timing diagram



4.7 Analog input/output interface principle

4.7.1 Analog command input interface principle

Figure 4-14 Analog input interface



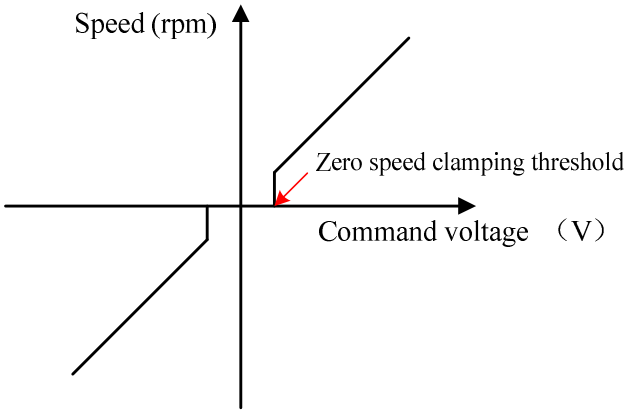
- Analog input voltage range is -10V~+10V，and the driver may be damaged if the voltage value is in excess of this range.
- The analog interface is not isolated. The analog ground line and the negative terminal of the analog input are connected in the driver side.
- Zero offset exists in the analog input. In the analog speed/torque control mode, even if the analog command voltage is 0V, sometimes motor still rotates at tiny speed, because of common ground voltage difference. It can be compensated automatically or manually by parameter setting.

  1) Auto compensation: Enter into menu of ‘AU-’. Choose the submenu of ‘AU-SEt’, and press ‘SET’ key, until

‘donE’ is displayed on nixie tube, compensation value will be write to parameter ‘Pn-043’ (analog speed mode) or ‘Pn-045’ (analog torque mode).Then enter into menu of ‘EE-’,select the item of ‘EE-SEt’, save parameter values to non-volatile memory.

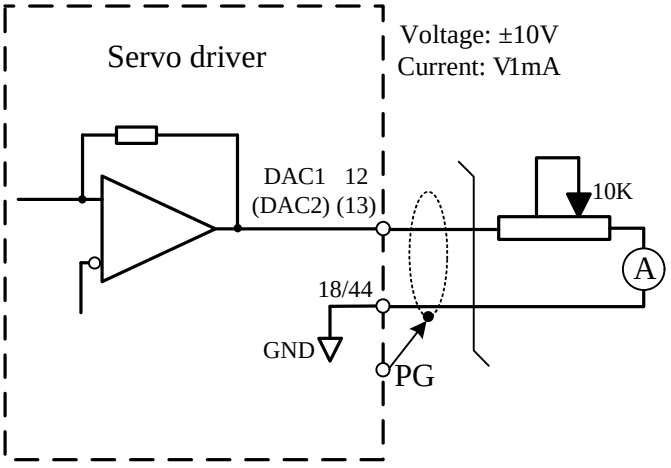
2) Manual compensation: Enable the servo driver, the motor runs in the analog speed mode. The speed command offset can be observed by ‘DP-CS’, and then users can manually change the value of ‘Pn043’ based on the observed offset. If the motor runs in the analog torque mode， the torque command offset can be observed by ‘DP-Ct’, and then users can manually change the value of ‘Pn045’ based on the observed offset.

3) When the analog input voltage is 0V, parameter Pn044 can be used to make motor stop stably in analog speed mode. If the analog input voltage (absolute value) is smaller than the setting value, the motor will be locked. In analog torque mode, the parameter Pn046 is used. Method of operation refers to analog speed mode.



4.7.2 Analog output interface principle

Figure 4-15 Analog output interface



Analog output parameter settings and description refer to chapter 7.

4.8 Encoder signal input/output interface principle

4.8.1 Encoder signal output interface principle

Position output signals EXTA+/EXTA-,EXTB+/EXTB-,EXTZ+/EXTZ- use differential output way. The wiring diagram is shown below.

Figure 4-16 Position feedback pulse photocoupler connection

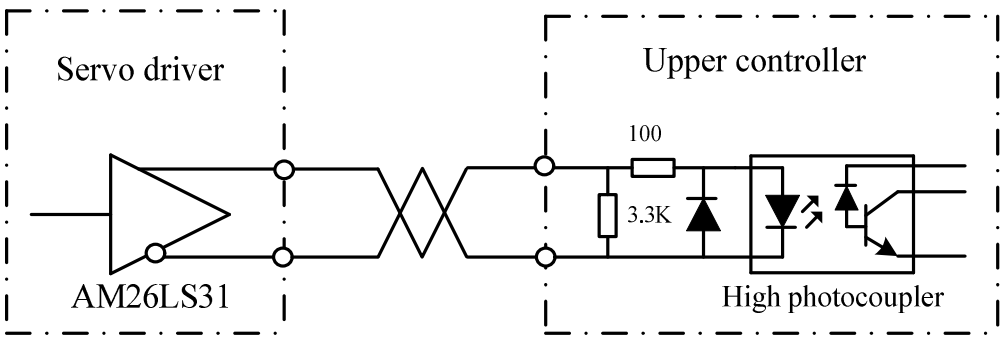
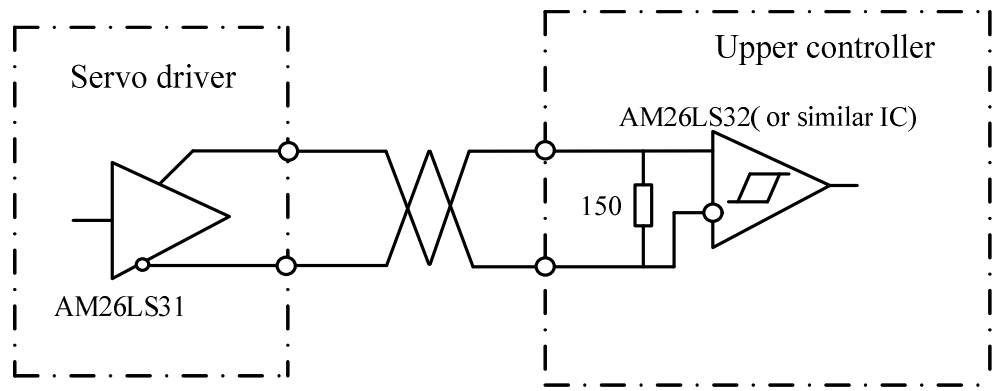
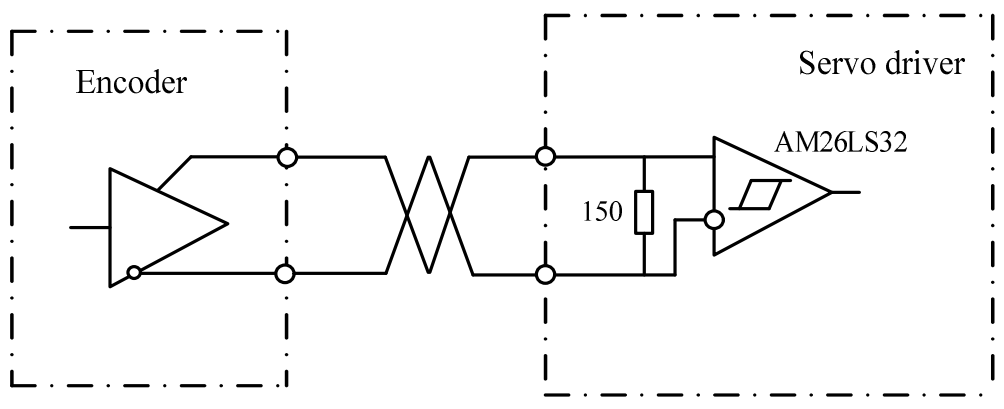


Figure 4-17 Position feedback pulse differential connection



4.8.2 Encoder signal input interface principle (CN3)

Figure 4-18 Encoder signal input interface

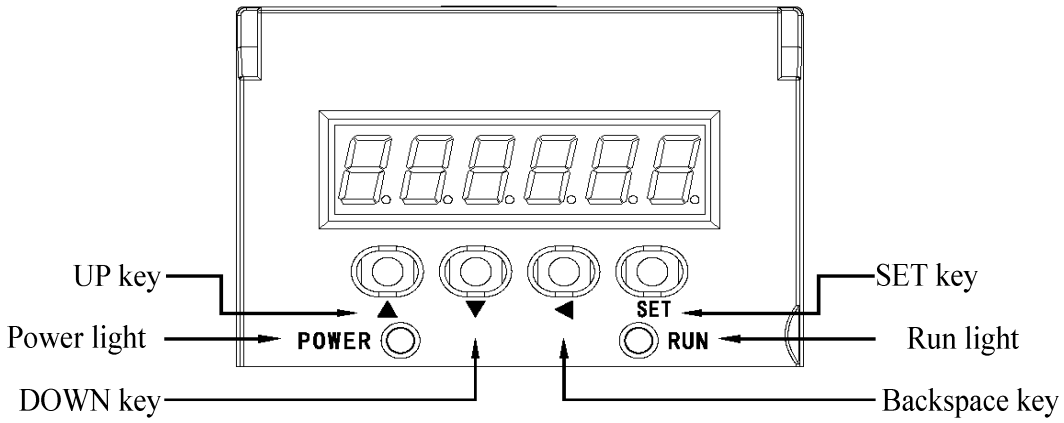


Chapter 5 Panel operation

5.1 Overview

The driver panel is made up of 6 bits 8-segment LED nixie tubes, 4 keys and 2 indicator lights. They are used for displaying various status of the driver and setting parameters.

Figure 5-1 Operation panel



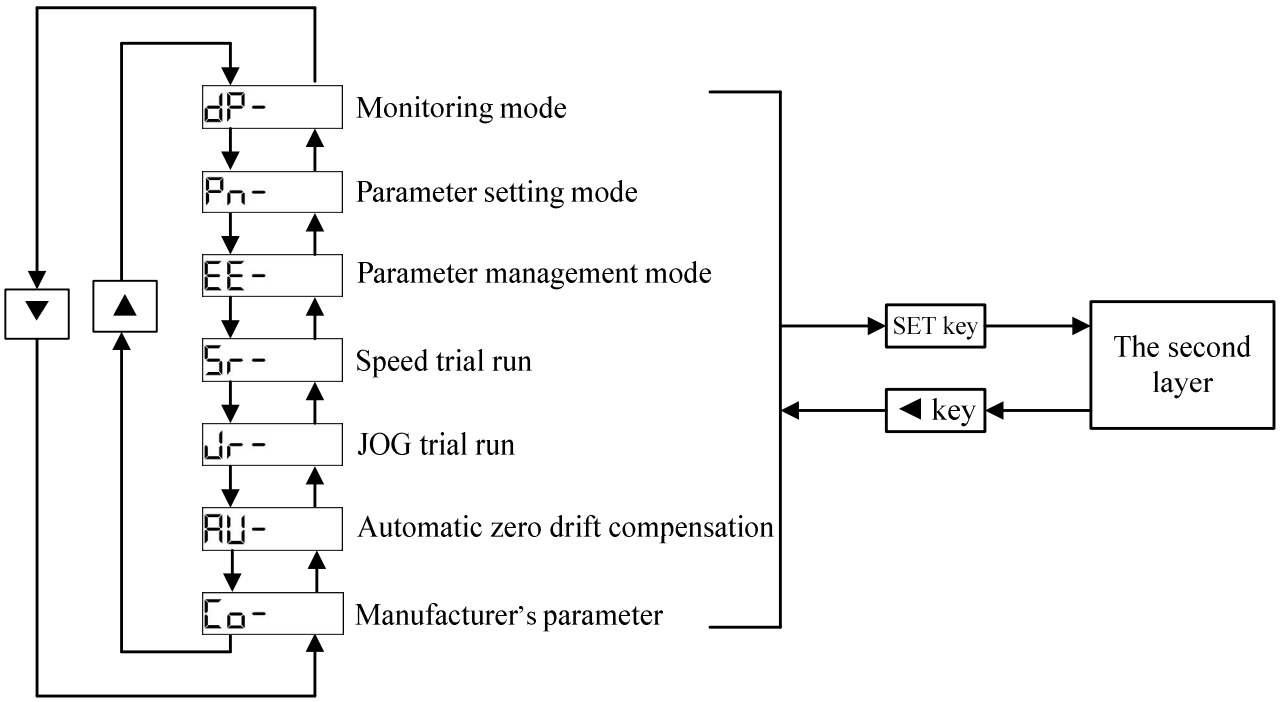
The specific function of each part is illustrated as follows:

Name	Functions
Display	The 6 bits 8-segment digital tubes are used for displaying monitoring value, setting value, parameter value and alarm information.
▲ key	Change menu, parameter number or increase the parameter values.
▼ key	Change menu, parameter number or decreases the parameter values.
◀ key	Return to upper layer menu, or cancel operation.
SET key	Enter the next layer menu, digital tube shift ,or input confirmed.
POWER	The indicator light up means the drive is powered up.
RUN	The indicator light up means the drive is enabled.

5.2 Menu structure

The driver’s operation adopts multilayer menu structure, and the first layer is main menu, including seven submenus of fundamental function.

Figure 5-2 Block diagram of the first layer operation menu



As shown in figure 5-2. By pressing '▲' key or '▼' key, users can switch among sub-items; by pressing SET key, users can enter the second layer menu of corresponding sub-items; by pressing '◄' key in the second layer's menu, users can return to the first layer's menu.

5.2.1 Monitoring menu group (dP-)

After power-on, the driver enters into monitoring mode automatically, and nixie tube displays the monitoring item which was set in advance (the power-on monitoring item was set by parameter Pn-003) .

Users can also select dP- in the first layer menu, and press 'SET' key to enter monitoring mode. In this mode, there are 27 monitoring items for users' choosing by '▲' key or '▼' key, and when press 'SET' key once the driver will display specific monitoring value.

The following diagram shows the operation of the monitoring mode.

Figure 5-3 Operation chart of monitoring mode

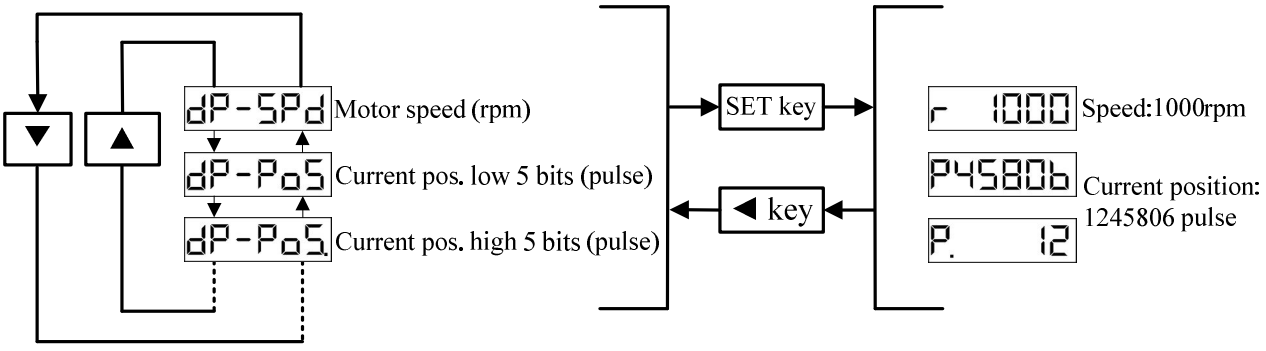


Table 5-1 Monitoring items' symbol and description

Symbol	Communication address	Parameter description	Unit	Display example
dP-SPd	0x0400	Motor speed	rpm	r 1000
dP-PoS	0x0401	Current position low 5 bits	pulse	P45806
dP-PoS.	0x0402	Current position high 5 bits	$\times 10^5$ pulse	P. 12
dP-CPo	0x0403	Position commamd low 5 bits	pulse	C45810
dP-CPo.	0x0404	Position commamd high 5 bits	$\times 10^5$pulse	C. 12
dP-EPo	0x0405	Position deviation low 5 bits	pulse	E 4
dP-EPo.	0x0406	Position deviation high 5 bits	$\times 10^5$ pulse	E. 0
dP-tr9	0x0407	Motor torque	%	t 79
dP- I	0x0408	Motor current	A	I b.3
dP- InH	0x0409	Digital input status of DI5~DI7	N/A	In 111
dP-Cnt	0x040A	Current control mode	N/A	Cnt 0
dP-Fr9	0x040B	Position command pulse frequency	kHz	F 12.6
dP- CS	0x040C	Speed command	rpm	r. -375
dP- Ct	0x040D	Torque command	%	t. -57
dP-APo	0x040E	Rotor absolute position	pulse	A 5203
dP- InL	0x040F	Digital input status of DI1~DI4	N/A	In1111
dP-oUt	0x0410	Digital output status	N/A	ot 1100
dP-Cod	0x0411	Encoder UVW signal	N/A	Cd 101
dP- Id	0x0412	CPLD software version	N/A	Id 2
dP-Err	0x0413	Alarm code	N/A	Err 0
dP-CCr	0x0414	Reserved	N/A	P83547
dP- Cr	0x0415	Reserved	N/A	-83547
dP-rES	0x0416	Encoder calibration pulse	pulse	r 247
dP-ALC	0x0417	Absolute encoder inner alarms	N/A	H 2
dP-Abr	0x0418	absolute encoder laps information	r	r 277
dP- tn	0x0419	Servo driver temperature	°C	t 47
dP-UdC	0x041A	Bus voltage	V	U 310

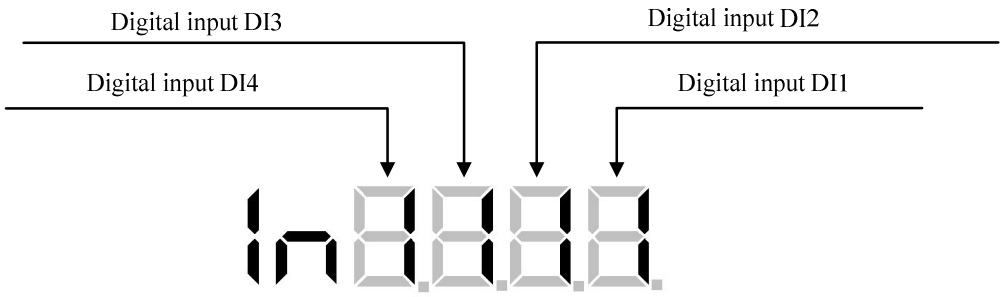
Instructions to some items in the ‘dP-’ menu group:

1. Position command pulse ‘dP-Cpo’ is the value of input pulse magnified by electronic gear ratio.
2. Current position feedback by motor encoder is composed of ‘dP-PoS.’ and ‘dP-PoS’ . For example, the current position pulse in the above table is calculated as following:

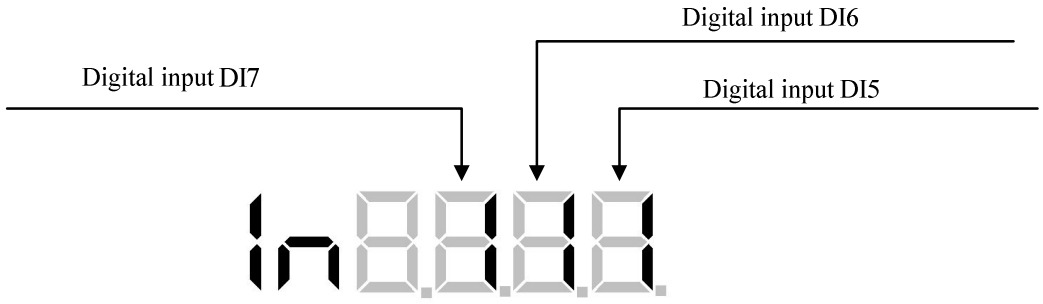
   P. 12 × 100000 + P45806 = 1245806 (pulse)

   Position command and position deviation similar.
3. Current control mode ‘dP-Cnt’ displays: 0-Positional control mode; 1-Internal speed control mode; 2-Speed trial run control mode; 3-JOG trial run; 5-Analog speed control mode; 6-Torque control mode; 7-Open-loop operation mode.
4. If display numbers go up to 6 digits (e.g. -12345), it will not display prompting character.
5. Position command pulse frequency ‘dP-Frq’ is the actual pulse frequency before electronic gear magnifying. The minimum value is 0.1 kHz. Positive rotation displays positive number, and reverse rotation displays negative number.
6. Alarm code displays ‘dP-Err’. For the specific meaning of alarm codes, please read chapter 8.
7. Digital input port (DIn) high status ‘dP-InH’ and low status ‘dP-InL’ display as follows. Input port (DIn) functions can be customized. (1-Invalid; 0-Valid.)

   Digital tube definition of ‘dP-InL’:

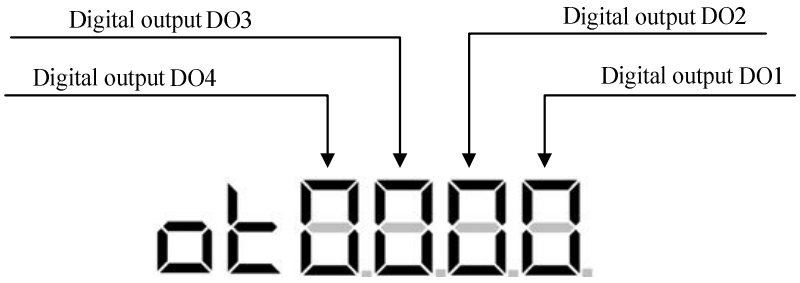


   Digital tube definition of ‘dP-InH’:



8. Digital output port (DOn) status as shown below. Output port (DOn) functions can be customized. (1-Invalid; 0-Valid.)

   Digital tube definition of ‘dP-oUt’:



9. Display of the encoder UVW status ‘dP-Cod’: Each signal corresponding to a digital tube display, the digital tube is 0 means the terminal is OFF (digital signal 0), while the digital tube is 1 means the terminal is ON (digital signal 1). The detailed correspondence is shown as following table:

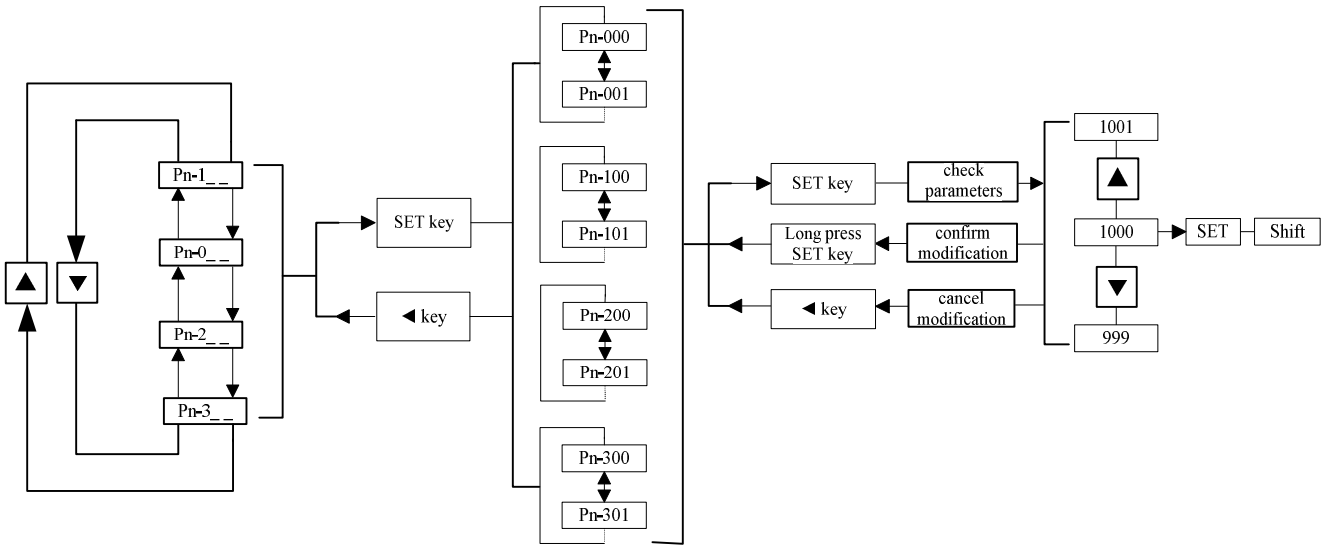
Display item	Digital tube display	Meaning
dP-Cod Encoder UVW signal	Cd0000	Encoder U phase
	Cd0001	Encoder V phase
	Cd0010	Encoder W phase

5.2.2 Parameter setting mode (Pn-)

Select ‘Pn-’ in main menu, and press ‘SET’ key to enter parameter setting mode. The ‘SET’ key can be used to shift the digital tube in the parameter setting mode. Digital tube flashes when shift to it,and ‘▲/▼’ key are used to increase/decrease the value of the digital tube. Long press the ‘SET’ key to confirm the change of parameter’s value, while the ‘◄’ key cancel the change.

‘Pn-0_ _’ segment parameters are password-protected. User password is 288. Correct password can access the segment parameters.

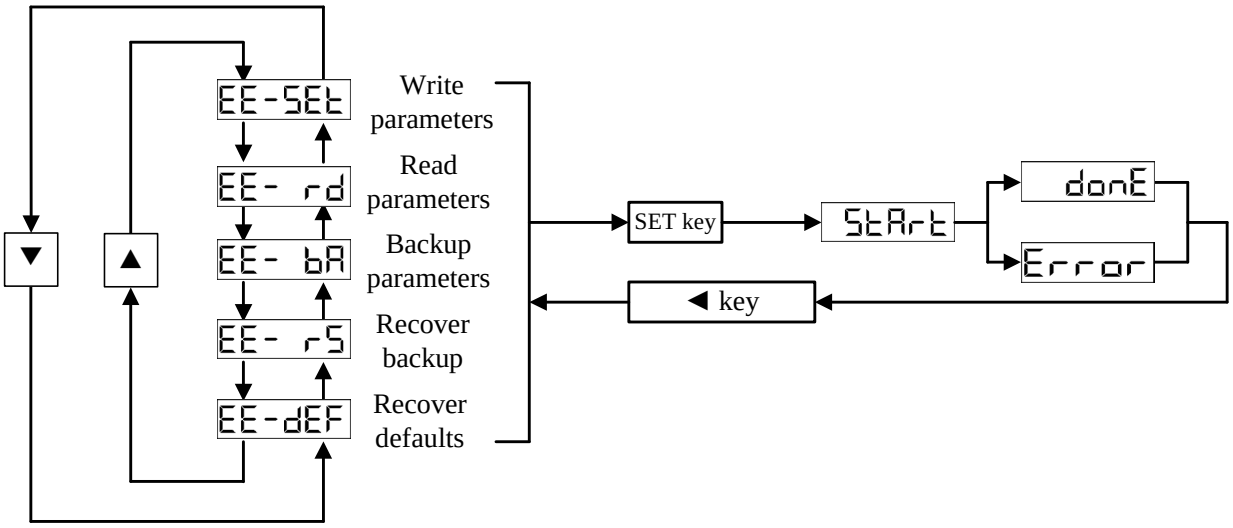
Figure 5-4 Block diagram of parameter setting



5.2.3 Parameter management (EE -)

As shown in following figure, select operation mode in ‘EE-’ parameter management secondary menu, press ‘SET’ key, and then nixie tube will show ‘StArt’, which means the operation selected is carrying out. If operation succeeds, ‘donE’ will show in 1~3 seconds; If ‘Error’ is shown, it means operation failure, and users need to undertake the selected operation again.

Figure 5-5 Operation diagram of parameter management



1. **EE-SEt:** Write parameters. Save the current parameter values to non-volatile memory, for avoiding losing parameters because of power-off.
2. **EE-rd:** Read parameters. Read the parameters inside non-volatile memory to parameter table, which equals to the effect of driver’s power-on again.
3. **EE-bA:** Backup parameters. Copy current parameter values into the backup area, used in conjunction with recover backup.
4. **EE-rS:** Recover backup. Recover parameters into parameter table from the backup area.
5. **EE-dEF:** Recover defaults. Recover parameters of parameter table and non-volatile memory to its defaults from factory.

Operation Instruction of recover defaults: Set motor model parameter Pn-001 according to the motor adapter table (Appendix). Enter into the EE- menu group and select EE-dEF , press ‘SET’ key. If operation succeeds, ‘donE’ will show in 1~3 seconds, power on again.

5.2.4 JOG trial run mode (Jr-)

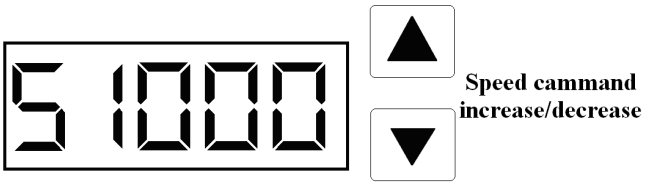
The operation steps are as follows:

1. Set parameter of ‘Pn-004’ as 3 to select JOG trial run mode.
2. Modify parameter ‘Pn-022’, and set suitable JOG speed.
3. Enter into menu of ‘Jr-’, the nixie tube will display ‘Jr - 120’, the numerical part of which is speed value set by parameter ‘Pn-022’.At the moment, pressing ‘▲’ key and hold, motor will rotate in the direction of CCW at constant setting speed. Release the button, motor will be in the state of zero-speed locked. While pressing ‘▼’ key and hold, motor will rotate in the direction of CW at constant setting speed. Release the button, motor will be in the state of zero-speed locked.

5.2.5 Speed trial run mode (Sr-)

The operation steps are as follows:

1. Set parameter of ‘Pn-004’ as 2 to select speed trial run mode.
2. Enter into menu of ‘Sr-’.Set speed command by ‘▲’ and ‘▼’,motor will rotate at the set speed. Positive means motor rotates in the direction of CCW, while negative means in the direction of CW. Minimum given speed is 1rpm.



5.2.6 Automatic zero drift compensation (AU-)

In analog speed/torque control mode, even if the analog command voltage is 0V, sometimes motor still rotates at tiny speed because of common ground voltage difference. It can be compensated automatically.

Operation steps are as follows:

Enter into menu of ‘AU-’. Choose the item of ‘AU-SEt’, press ‘SET’ key. Zero drift compensation complete when ‘donE’ is shown on nixie tube, and compensation value will be write to parameter ‘Pn-043’ (speed mode) or ‘Pn-045’ (torque mode).Then enter into menu of ‘EE-’,select the item of ‘EE-SEt’, save parameter values to non-volatile memory.

Chapter 6 Communication

6.1 ModBus overview

Servo driver provides RS485, RS232 and CAN three kinds of communication interface. Adopt of international standard Modbus communication protocol. Through the RS485 interface can simultaneously achieve asynchronous serial half-duplex communication with 32 servo drivers.

The following functions can be realized：

- Read/Write servo driver’s parameters.
- Monitor the work status of the servo driver.
- Control the running of the servo driver.

6.2 ModBus protocol

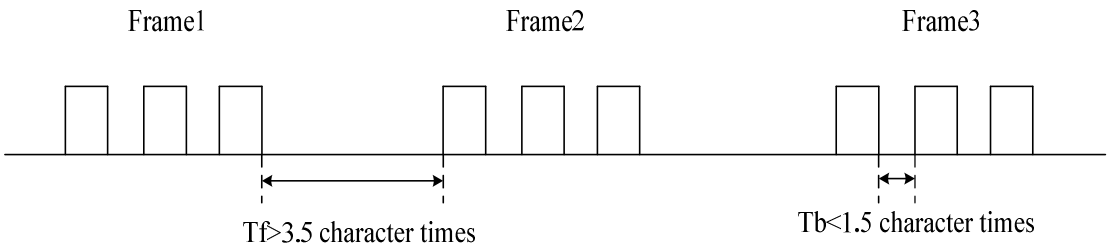
1. Communication mode

Two different serial transmission modes are defined：The ASCII mode and the RTU mode。Through the parameter ‘Pn102’ set the transmission mode and the format for each byte, the parameter’s description is specified in next chapters.

(1) The RTU transmission mode:

In RTU mode, message frames are separated by a silent interval of at least 3.5 character times. If a silent interval of more than 1.5 character times occurs between two characters, the message frame is declared incomplete and should be discarded by the receiver. Frame format is shown below.

Figure 6-1 Frame format of RTU mode



MODBUS message

Start	Address	Function	Data	CRC	End
⩾3.5 chars	1 char	1 char	N chars	2 chars	⩾3.5 chars

(2) The ASCII transmission mode:

In ASCII mode, a message is delimited by specific characters as Start-of-frames and End-of-frames. A message must start with a ‘colon’ (:) character (ASCII 3A hex), and end with a ‘carriage return – line feed’ (CR LF) pair (ASCII 0D and 0A hex). A typical message frame is shown below.

Figure 6-2 Frame format of ASCII mode

Start	Address	Function	Data	LRC	End
1 char :	2 chars	2 chars	2×N chars	2 chars	2 chars CR,LF

Each data byte needs two characters for encoding. For example, the data byte 12h (ASCII 31 and 32 hex).

Table 6-1 ASCII coded table

Character	‘0’	‘1’	‘2’	‘3’	‘4’	‘5’	‘6’	‘7’
ASCII coded	30h	31h	32h	33h	34h	35h	36h	37h
Character	‘8’	‘9’	‘A’	‘B’	‘C’	‘D’	‘E’	‘F’
ASCII coded	38h	39h	41h	42h	43h	44h	45h	46h
Character	‘:’	‘CR’	‘LF’					
ASCII coded	3Ah	0Dh	0Ah					

2. Protocol description

Read function code: 03h.
Write function codes: 06h and 10h.

(1) Read data frame description (03h).

	The RTU mode	The ASCII mode
Start	≥3.5 character times.	‘Colon’ (:), ASCII 3Ah.
Address	Slave address (parameter Pn-100),1 char.	Slave address (parameter Pn-100),2 chars.
Function	Function code, 03h.	Function code, 30h and 33h.
Data 1	Read parameters start address,1 word. The high-order byte is appended first, followed by the low-order byte.	Read parameters start address, 4 chars.
Data 2	The number of reading data words (≤16), 1 word. The high–order byte is appended first, followed by the low–order byte.	The number of reading data words (≤16), 4 chars.
CRC/LRC	CRC Checking,1 word. The low–order byte is appended first, followed by the high–order byte.	LRC Checking ,2 chars.
End	≥3.5 character times.	‘Carriage return - line feed’ (CR LF), ASCII 0Dh and 0Ah.

Response: The correct communication process returns the following frame. Slave returns error messages if the communication abnormality.(Description in next chapters.)

	The RTU mode	The ASCII mode
Start	≥3.5 character times.	‘Colon’ (:), ASCII 3Ah.
Address	Slave address (parameter Pn-100),1 char.	Slave address (parameter Pn-100),2 chars.
Function	Function code, 03h.	Function code, 30h and 33h.
Data length	The number of returned data bytes, 1 char.	The number of returned data bytes, 2 chars.
Data	The returned parameter values.	The returned parameter values.
CRC/LRC	CRC Checking, 1 word. The low–order byte is appended first, followed by the high–order byte.	LRC Checking ,2 chars.
End	≥3.5 character times.	‘carriage return - line feed’ (CR LF), ASCII 0Dh and 0Ah.

(2) Write data frame description (06h).

	The RTU mode	The ASCII mode
Start	≥3.5 character times.	‘Colon’ (:), ASCII 3Ah.
Address	Slave address (parameter Pn-100),1 char.	Slave address (parameter Pn-100),2 chars.
Function	Function code, 06h.	Function code, 30h and 36h.
Data 1	Write parameters start address, 1 word. The high-order byte is appended first, followed by the low-order byte.	Write parameters start address, 4 chars.
Data 2	Parameter values.	Parameter values.
CRC/LRC	CRC Checking, 1 word. the low–order byte is appended first, followed by the high–order byte.	LRC Checking ,2 chars.
End	≥3.5 character times.	‘carriage return - line feed’ (CR LF), ASCII 0Dh and 0Ah.

Response: The correct communication process returns the same frame as received. Slave returns error messages if the communication abnormality. (Description in next chapters.)

(3) Write data frame description (10h).

	The RTU mode	The ASCII mode
Start	≥3.5 character times.	‘colon’ (:) , ASCII 3Ah.
Address	Slave address (parameter Pn-100),1 char.	Slave address (parameter Pn-100),2 chars.
Function	Function code, 10h.	Function code, 31h and 30h.
Data 1	Write parameters start address,1 word. The high-order byte is appended first, followed by the low-order byte.	Write parameters start address, 4 chars.
Data 2	The number of writing data words (≤16), 1 word. The high–order byte is appended first, followed by the low–order byte.	The number of writing data words (≤16), 4 chars.

Data 3	The number of writing data bytes (≤32), 1 char.	The number of writing data bytes (≤32), 2 chars.
Data x	Parameter Values (≤16 words).	Parameter Values.
CRC/LRC	CRC Checking, 1 word. The low–order byte is appended first, followed by the high–order byte.	LRC Checking ,2 chars.
End	≥3.5 character times.	'Carriage return - line feed' (CR LF), ASCII 0Dh and 0Ah.

Response: The correct communication process returns the frame as follows. Slave returns error messages if the communication abnormality. (Description in next chapters.)

Correct response: Start + Address + Function code (10h) + Write parameters start address + The number of writing data words + CRC/LRC + End

(4) Communication abnormality.

Response frame format:

	The RTU mode	**The ASCII mode**
Start	≥3.5 character times.	'Colon' (:), ASCII 3Ah.
Address	Slave address (parameter Pn-100),1 char.	Slave address (parameter Pn-100),2 chars.
Function	Function code,83h/86h/90h。	Function code,38h&33h/38h&36h/39h&30h。
Error code	Error code,1 char.	Error code,2 chars.
CRC/LRC	CRC Checking, 1 word. the low–order byte is appended first, followed by the high–order byte.	LRC Checking ,2 chars.
End	≥3.5 character times.	'carriage return - line feed' (CR LF), ASCII 0Dh and 0Ah.

Error code:

Error code	Description
01h	CRC/LRC error.
02h	Parity error.
03h	Function code is not valid or unknown.
04h	Value range of parameter exceeded.
05h	Unrecognized parameter address.
06h	Data cannot be transferred or stored to the memory because of busy.
07h	Frame length error.
08h	Parameter is password protected, and can not be modified.

(5) Other communication functions.

Address	Definition	Description
1000h	Write parameters (EE-Set）	Save parameter values to non-volatile memory when write to the address 01h.Write other data returns an error message.
		Read the address. 0. Operation is successfully. 1. Operation has not been completed
1001h	Read parameters (EE-rd)	Read the parameters inside non-volatile memory to parameter table when write to the address 01h.Write other data returns an error message.
		Read the address,ditto.
1002h	Backup parameters (EE-bA)	Copy current parameter values into the backup area when write to the address 01h.Write other data returns an error message.
		Read the address,ditto.
1003h	Recover backup (EE-rS)	Recover parameter values into parameter table from the backup area when write to the address 01h.Write other data returns an error message.
		Read the address,ditto.
1004h	Recover defaults (EE-dEF)	Recover parameters of parameter table and non-volatile memory to its defaults from factory when write to the address 01h.Write other data returns an error message.
		Read the address,ditto.
1005h	Speed of 'Sr' mode	Write the address modify the speed of 'Sr' mode (Pn004=2,speed trail run control mode.)
		Read the address returns the speed of 'Sr' mode.
1006h	JOG operation	Write the address.(Pn-004=3) 0. Motor stop rotating; 1. Motor rotate in the direction of CW; 2. Motor rotate in the direction of CCW.
		Read the address returns the state of JOG. 0. Motor is in the state of zero-speed locked; 1. Motor rotate in the direction of CW; 2. Motor rotate in the direction of CCW.

(6) ModBus communication example.

① **Read parameters**

e.g.: Read the values of ‘Pn-004’ and ‘Pn-005’ of servo driver.(Pn004=1,Pn005=150)

The RTU mode:

Send message format: 01h 03h 00h 04h 00h 02h 85h CAh

Correct response: 01h 03h 04h 00h 01h 00h 96h 2Bh 9Dh

Error response: 01h 83h 01h 80h F0h (Error code 01h: CRC error)

The ASCII **mode:**

Send message format: 3Ah 30h 31h 30h 33h 30h 30h 30h 34h 30h 30h 30h 32h 46h 36h 0Dh 0Ah

Correct response: 3Ah 30h 31h 30h 33h 30h 34h 30h 30h 30h 31h 30h 30h 39h 36h 36h 31h 0Dh 0Ah

Error response: 3Ah 30h 31h 38h 33h 30h 31h 37h 42h 0Dh 0Ah (‘30h 31h’->01h: LRC error)

② **Write parameters.**

e.g.: Modify the value of ‘Pn-200’ to 100. (Communication address refer to chapter 7)

The RTU mode (Function code 06h):

Send message format: 01h 06h 02h 00h 00h 64h 89h 99h

Correct response: 01h 06h 02h 00h 00h 64h 89h 99h

Error response: 01h 86h 02h C3h A1h (Error code 02h: Parity error)

The RTU mode (Function code 10h):

Send message format: 01h 10h 02h 00h 00h 01h 02h 00h 64h 84h 7Bh

Correct response: 01h 10h 02h 00h 00h 01h 00h 71h

Error response: 01h 90h 02h CDh C1h (Error code 02h: Parity error)

The ASCII mode:

Send message format: 3Ah 30h 31h 30h 36h 30h 32h 30h 30h 30h 30h 36h 34h 39h 33h 0Dh 0Ah

Correct response: 3Ah 30h 31h 30h 36h 30h 32h 30h 30h 30h 30h 36h 34h 39h 33h 0Dh 0Ah

Error response: 3Ah 30h 31h 38h 36h 30h 32h 37h 37h 0Dh 0Ah ('30h 32h'->02h: Parity error)

Note: The slave address of above instance is 01h. (Pn-100=1)

3. CRC checking

The RTU mode includes an error–checking field that is based on a Cyclical Redundancy Checking (CRC) method performed on the message contents. The CRC field checks the contents of the entire message. It is applied regardless of any parity checking method used for the individual characters of the message. The CRC field contains a 16–bit value implemented as two 8–bit bytes. When this is done, the low–order byte of the field is appended first, followed by the high–order byte.

CRC generation function (Generating polynomial = $x^{16} + x^{15} + x^2 + 1$ **):**

```
unsigned char* ParaDate;
unsigned char DataLen;
unsigned int CRC16(unsigned char* ParaDate, unsigned char DataLen)
{
    unsigned int CRC_reg=0xFFFF;
    while(DataLen--)
    {
        CRC_reg ^= *ParaDate++;
        for(int i=0;i<8;i++)
        {
            if(CRC_reg & 0x01) {CRC_reg=( CRC_reg>>1)^0xa001;}
            else {CRC_reg= CRC_reg>>1;}
        }
    }
    return CRC_reg;
}
```

4. LRC checking

In ASCII mode, messages include an error–checking field that is based on a Longitudinal Redundancy Checking (LRC) calculation that is performed on the message contents, exclusive of the beginning 'colon' and terminating CR LF pair characters. It is applied regardless of any parity checking method used for the individual characters of the message. The LRC is calculated by adding together successive 8–bit bytes of the message, discarding any carries, and then two's complementing the result. In ASCII mode, the resulting LRC is ASCII encoded into two bytes and placed at the end of ASCII mode frame prior to the CR LF.

Chapter 7 Parameters

7.1 Parameter summary

The defaults in the following table apply to 180EMA-255D motor. Different model of motors have different parameter values. If there are any differences, please take the display value of servo driver as the standard.

Abbreviation of control mode:

P: Represents position control mode.

S: Represents speed control mode.

T: Represents torque control mode.

Group 0 (Pn-000~Pn099)						
Parameter code	Communication address	Name	Range	Default	Unit	Application mode
Pn000	0x0000	Password	0~9999	288	N/A	P,S,T
Pn001	0x0001	Motor model	0~59	42	N/A	P,S,T
Pn002	0x0002	Software version (read-only)	*	*	N/A	P,S,T
Pn003	0x0003	Power-on initial display settings	0~26	0	N/A	P,S,T
Pn004	0x0004	Control mode	0~10	0	N/A	P,S,T
Pn005	0x0005	Speed proportional gain	5~1000	150	Hz	P,S,T
Pn006	0x0006	Speed integral time constant	1~1000	30	ms	P,S,T
Pn007	0x0007	Torque command filter	0~500	75	%	P,S,T
Pn008	0x0008	Speed feedback filter	1~500	75	%	P,S,T
Pn009	0x0009	Position proportional gain	1~2000	40	1/S	P
Pn010	0x000A	Position loop feed forward gain	0~100	0	%	P
Pn011	0x000B	Position feed forward filter coefficient	1~1200	300	Hz	P
Pn012	0x000C	Electronic gear ratio numerator 1	1~65535	1	pulse	P
Pn013	0x000D	Electronic gear ratio denominator	1~65535	1	pulse	P
Pn014	0x000E	Position command input types	0~2	0	N/A	P
Pn015	0x000F	Inverse the direction of position command	0~1	0	N/A	P
Pn019	0x0013	Position command smooth filter	0~20000	0	0.1mS	P
Pn020	0x0014	Drive forbid control	0~1	1	N/A	P,S
Pn022	0x0016	JOG run speed	-3000~3000	120	rpm	S
Pn023	0x0017	Maximum speed limit	0~6000	1500	rpm	P,S,T
Pn025	0x0019	Speed command setting	0~1	1	N/A	S

Pn031	0x001F	Analog speed command filter coefficient	1~100	100	%	S
Pn032	0x0020	Analog torque command filter coefficient	1~100	100	%	T
Pn033	0x0021	Torque control parameter	0~7	0	N/A	T
Pn034	0x0022	Internal CCW torque limit	0~300	300	%	P,S,T
Pn035	0x0023	Internal CW torque limit	-300~0	-300	%	P,S,T
Pn036	0x0024	External CCW torque limit	0~300	300	%	P,S,T
Pn037	0x0025	External CW torque limit	-300~0	-300	%	P,S,T
Pn038	0x0026	Torque limit for speed trial run and JOG run	0~300	100	%	S
Pn041	0x0029	Analog torque command gain	0~1000	100	%	T
Pn042	0x002A	Speed command direction	0~1	0	N/A	S
Pn043	0x002B	Analog speed zero drift compensation value	-5.000~ 5.000	0.000	V	S
Pn044	0x002C	Analog speed zero speed clamping threshold	-5.000~ 5.000	0.050	V	S
Pn045	0x002D	Analog torque zero drift compensation value	-5.000~ 5.000	0.000	V	T
Pn046	0x002E	Analog torque zero speed clamping threshold	-5.000~ 5.000	0.050	V	T
Pn047	0x003F	Position command control parameter	0~7	0	N/A	P
Pn049	0x0031	In torque mode the permitted time for overspeed	0~10000	5000	ms	T
Pn050	0x0032	Encoder type	0~4	0	N/A	P,S,T
Pn051	0x0033	Analog speed command gain	0~1000	100	%	S
Pn052	0x0034	Torque/speed acceleration time	0~16000	100	ms	S,T
Pn053	0x0035	Torque/speed deceleration time	0~16000	100	ms	S,T
Pn057	0x0039	Force driver to enable	0~10	3	N/A	P,S,T
Group 1 (Pn-100~Pn-127)						
Parameter code	Communication address	Name	Range	Default	Unit	Application mode
Pn100	0x0100	Slave address	0~32	1	N/A	P,S,T
Pn101	0x0101	Modbus baud rate	0~5	1	bps	P,S,T
Pn102	0x0102	Transmission mode of Modbus	0~8	6	N/A	P,S,T
Pn104	0x0104	Communication protocol	0~2	0	N/A	P,S,T

Pn105	0x0105	Communication interface	0~1	0	N/A	P,S,T
Pn106	0x0106	Input IO signal source	0~127	0	N/A	P,S,T
Pn107	0x0107	Communication response delay time	0~32767	0	ms	P,S,T
Pn109	0x0109	DI signal status software control	0~127	127	N/A	P,S,T
Group 2 (Pn-200~Pn-263)						
Parameter code	Communication address	Name	Range	Default	Unit	Application mode
Pn200	0x0200	Internal speed 1	-5000~5000	10	rpm	S
Pn201	0x0201	Internal speed 2	-5000~5000	50	rpm	S
Pn202	0x0202	Internal speed 3	-5000~5000	100	rpm	S
Pn203	0x0203	Internal speed 4	-5000~5000	500	rpm	S
Pn204	0x0204	Internal speed 5	-5000~5000	0	rpm	S
Pn205	0x0205	Internal speed 6	-5000~5000	0	rpm	S
Pn206	0x0206	Internal speed 7	-5000~5000	0	rpm	S
Pn207	0x0207	Internal speed 8	-5000~5000	0	rpm	S
Pn233	0x0221	Internal torque 1	-300~300	100	%	T
Pn234	0x0222	Internal torque 2	-300~300	100	%	T
Pn235	0x0223	Internal torque 3	-300~300	100	%	T
Pn236	0x0224	Internal torque 4	-300~300	100	%	T
Pn250	0x0232	Electronic gear ratio numerator 2	1~65535	1	pulse	P
Pn251	0x0233	Electronic gear ratio numerator 3	1~65535	1	pulse	P
Pn252	0x0234	Electronic gear ratio numerator 4	1~65535	1	pulse	P
Pn253	0x0235	Undervoltage alarm delay time	0~32767	400	0.5ms	P,S,T
Pn254	0x0236	Range of positioning completion	0~32767	3300	pulse	P
Pn255	0x0237	Detection range of position deviation alarm	0~32767	400	100 pulse	P
Pn256	0x0238	Speed arrival signal threshold	-5000~5000	500	rpm	S
Pn257	0x0239	Detection range of overspeed	0~5000	0	rpm	S
Pn258	0x023A	Delay time of servo on	0~ 32767	0	0.1ms	P,S,T
Pn259	0x023B	Torque arrival signal threshold	0~300	100	%	T
Pn260	0x023C	Alarm clear restrictions	0~20	5	N/A	P,S,T
Pn261	0x023D	Analog output monitor	0~55h	0	N/A	P,S,T

Pn262	0x023E	DAC1 analog output proportion	-100~100	100	%	P,S,T
Pn263	0x023F	DAC2 analog output proportion	-100~100	100	%	P,S,T
Pn264	0x0240	Temperature of turning on the fan	30~70	45	°C	P,S,T
Group 3 (Pn-300~Pn-331)						
Parameter code	Communication address	Name	Range	Default	Unit	Application mode
Pn300	0x0300	Digital input DI filter time	0~100	0	ms	P,S,T
Pn301	0x0301	Digital input DI1 function	0~27	1	N/A	P,S,T
Pn302	0x0302	Digital input DI2 function	0~27	2	N/A	P,S,T
Pn303	0x0303	Digital input DI3 function	0~27	3	N/A	P,S,T
Pn304	0x0304	Digital input DI4 function	0~27	4	N/A	P,S,T
Pn305	0x0305	Digital input DI5 function	0~27	5	N/A	P,S,T
Pn306	0x0306	Digital input DI6 function	0~27	6	N/A	P,S,T
Pn307	0x0307	Digital input DI7 function	0~27	7	N/A	P,S,T
Pn309	0x0309	Digital output DO1 function	0~7	1	N/A	P,S,T
Pn310	0x030A	Digital output DO2 function	0~7	2	N/A	P,S,T
Pn311	0x030B	Digital output DO3 function	0~7	3	N/A	P,S,T
Pn312	0x030C	Digital output DO4 function	0~7	4	N/A	P,S,T
Pn313	0x030D	Reverse digital input DI1~DI4	0~15	0	N/A	P,S,T
Pn314	0x030E	Reverse digital input DI5~DI7	0~7	0	N/A	P,S,T
Pn315	0x030F	Reverse digital output DO1~DO4	0~15	0	N/A	P,S,T
Pn316	0x0310	Masking alarm	0~31	15	N/A	P,S,T
Pn318	0x0312	zero speed detection point of electromagnetic brake	0~5000	15	rpm	P,S,T
Pn319	0x0313	Delay time of electromagnetic brake	0~30000	0	ms	P,S,T
Pn320	0x0314	Waiting time of electromagnetic brake	0~30000	500	ms	P,S,T
Pn321	0x0315	Electromagnetic brake operation speed	0~5000	100	rpm	P,S,T
Pn322	0x0316	Position feedback pulse division numerator	1~32767	1	pulse	P,S,T
Pn323	0x0317	Position feedback pulse division denominator	1~32767	1	pulse	P,S,T
Pn324	0x0318	The width of Z phase pulse	0~127	0	×50us	P,S,T

Pn325	0x0319	Reverse position feedback pulse	0~1	0	N/A	P,S,T

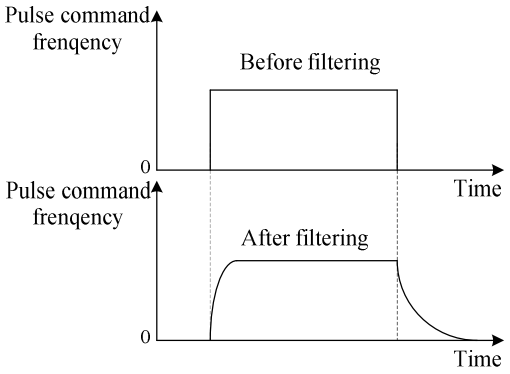
7.2 Parameter function explanation

1. Parameters of group 0

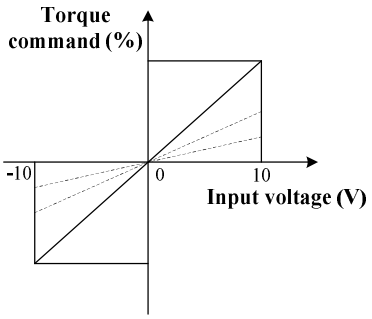
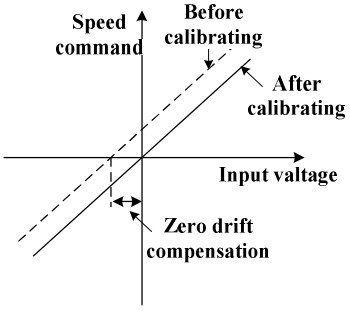
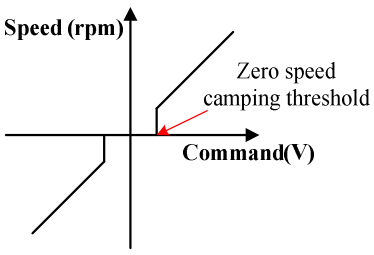
<table>
<tr><th>Parameter code</th><th>Name</th><th>Function</th><th>Range/ Default</th></tr>
<tr><td>Pn000</td><td>Password</td><td>User password is 288 which can modify parameters ‘Pn000~Pn057’ of group 0.The wrong password can not visit those parameters.</td><td>0~9999
[288]</td></tr>
<tr><td>Pn001</td><td>Motor model</td><td>Set the corresponding motor model code according to the motor adaptation table (Appendix), and it can be used to recover the default settings of the correlated parameters.</td><td>0~59
[42]</td></tr>
<tr><td>Pn002</td><td>Software version (read-only)</td><td>The version code for the driver software, it is read-only parameter which can’t be modified.</td><td>*
[*]</td></tr>
<tr><td>Pn003</td><td>power-on initial display settings</td><td>Used to select the initial display content when power-on.
<table>
<tr><td>0:Motor speed.</td><td>13:Torque command.</td></tr>
<tr><td>1:Current position low 5 bits.</td><td>14:Rotor absolute position.</td></tr>
<tr><td>2:Current position high 5 bits.</td><td>15:Digital input status of DI1~DI4.</td></tr>
<tr><td>3:Position command low 5 bits.</td><td>16:Digital output status.</td></tr>
<tr><td>4:Position command high 5 bits.</td><td>17:Encoder UVW signals.</td></tr>
<tr><td>5:Position deviation low 5 bits</td><td>18:CPLD software version.</td></tr>
<tr><td>6:Position deviation high 5 bits.</td><td>19:Alarm code.</td></tr>
<tr><td>7:Motor torque.</td><td>20:Reserved</td></tr>
<tr><td>8:Motor current.</td><td>21:Reserved</td></tr>
<tr><td>9:Digital input status of DI5~DI7.</td><td>22:Encoder zero calibration</td></tr>
<tr><td>10:Current control mode.</td><td>23:Absolute encoder inner alarms.</td></tr>
<tr><td rowspan="2">11:Position command pulse frequency.</td><td>24:Absolute encoder laps information.</td></tr>
<tr><td>25:Servo driver temperature.</td></tr>
<tr><td>12:Speed command.</td><td>26:Bus voltage.</td></tr>
</table></td><td>0~26
[0]</td></tr>
</table>

<table>
<tr><th>Parameter code</th><th>Name</th><th>Function</th><th>Range/ Default</th></tr>
<tr><td>Pn004</td><td>Control mode</td><td>Used to set control mode. (If the setting value is 8, 9 or 10, refer to the CMODE signal in chapter 7.3.)<table><tr><td>0:Position control mode.</td><td>6: Torque control mode.</td></tr><tr><td>1:Internal speed control mode.</td><td>7: Open-loop control mode.</td></tr><tr><td>2:Speed trial run control mode.</td><td>8: Position/speed mode.</td></tr><tr><td>3:JOG trial run control mode.</td><td>9: Speed/torque mode.</td></tr><tr><td>5:Analog speed control mode.</td><td>10:Torque/position mode.</td></tr></table></td><td>0~10
[0]</td></tr>
<tr><td>Pn005</td><td>Speed proportional gain</td><td>● The higher the speed proportional gain is, the greater the servo stiffness is, the faster the speed response is. If it’s over high, noise and vibration will easily generated.
● Under the condition of not shocking, set the value relatively high as possible.</td><td>5~1000
[150]</td></tr>
<tr><td>Pn006</td><td>Speed integral time constant</td><td>● It is the integral time constant for the speed regulator. The lower the value sets，the faster the integral speed is, the greater the stiffness is. If it’s too small, noise and vibration will easily generate.
● Under the condition of not shocking, reduce the value as possible</td><td>1~1000
[30]</td></tr>
<tr><td>Pn007</td><td>Torque command filter</td><td>● Set the features of torque command filter, which can restrain resonance produced by torque fluctuations. (Motor generates shake and sharp noise.)
● If the motor generates vibration and noise, please reduce the parameter value.
● The smaller the value is, the lower the cut-off frequency is, and the lower the noise is. If the load inertia is too big, reduce the parameter value properly. If the value is too small, the response will slow down and cause instability.
● To the contrary, the larger the value is, the higher the cut-off frequency is, and the faster the response is. If you need relatively higher machinery stiffness, increase the setting value properly.</td><td>0~500
[75]</td></tr>
<tr><td>Pn008</td><td>Speed feedback filter</td><td>● Set the features of speed detection low pass filter.
● The smaller the value is, the lower the cut-off frequency is, and the lower the noise is. If the load inertia is too big, reduce the parameter value properly. If the value is too small, the response will slow down and cause instability.
● To the contrary, large value will make higher cut-off frequency and faster speed feed response. If you need relatively higher speed response, increase the setting value properly.</td><td>1~500
[75]</td></tr>
</table>

Parameter code	Name	Function	Range/ Default
Pn009	Position proportional gain	The proportional gain of position loop adjuster. The larger the value is, the higher the gain proportion is, the larger the stiffness is, and the smaller the position tracking error is. However, the setting value is over large, it may produce vibration and overshoot.	1~2000 [40]
Pn010	Position loop feed forward gain	● Feed forward gain of position loop. The Larger the parameter value is, the smaller the system position tracking error is, and the faster the response is. When the value is set at 100%, it means position hysteresis is always zero at any command pulse frequency. ● If the feed forward gain of position loop is too large, the system position loop will be unstable and produce shakes. Generally speaking, the position loop feed forward gain is zero.	0~100 [0]
Pn011	Position feed forward filter coefficient	The cut-off frequency of position loop feed forward low pass filter. It is used to increase the stability of compound position control.	1~1200 [300]
Pn012	Electronic gear ratio numerator 1	The following is the example of incremental encoder: ● Take fractional frequency or frequency doubling on position command pulse, to match with various pulse sources conveniently and get the pulse resolution ratio which uses demand. ● P×G=N×C×4 P: Input position pulse. G: Electronic gear ratio G= $\frac{Pn012}{Pn013}$ N: Rotation numbers of motor. C: Encoder line number， the system: C=2500. ● Recommended range: 1/50≤G≤50.	1~65535 [1]
Pn013	Electronic gear ratio denominator		1~65535 [1]
Pn014	Position command input types	Set input types of position command pulse: 0:Pulse + Direction. 1:CCW/CW pulse. 2:Two-phase quadrature pulse.	0~2 [0]
Pn015	Inverse the direction of position command	Set the direction of position command: 0: normal. 1: inverse the direction of position command pulse. (Used for position mode, please refer to chapter 4.6)）	0~1 [0]

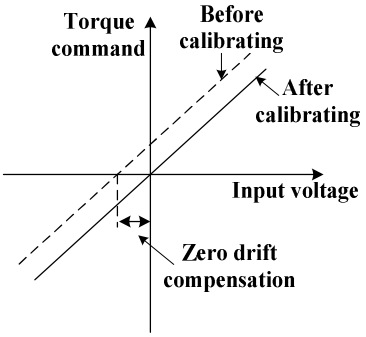
Parameter code	Name	Function	Range/ Default
Pn019	Position command smooth filter	● Smooth filter the command pulse with the exponential acceleration and deceleration. ● The filter will not lose input pulse, but the command may be lagged. ● The filter is used: 1.Upper controller don't have acceleration or deceleration features. 2.Electronic gear ratio is relatively large (>10). 3.Command frequency is relatively low. 4.Jump or jitter when motor runs. ● The filter is out of use when it is set to zero. 	0~20000 [0]
Pn020	Drive forbid control	0: CCW+CW input forbid is valid; 1: CCW+CW input forbid is invalid.	0~1 [1]
Pn022	JOG run speed	It is used to set the value of JOG speed.	-3000~3000 [120]
Pn023	Maximum speed limit	● Set the maximum speed limit of servo motor. ● It has no relation with rotating direction. If the value exceeds the rated speed, then actual maximum speed limit is the rated speed.	0~6000 [1500]
Pn025	Speed command setting	If the value of Pn004 is 8 or 9, the parameter is used to select source of speed command, when switch to speed mode. 0: Internal speed mode, select internal speed command according to the status of SC1, SC2 and SC3. (Refer to chapter 7.3.) 1: Analog speed mode, speed command is input by the port of V-REF.	0~1 [1]
Pn031	Analog speed command filter coefficient	Smooth analog speed command, and eliminate the effects of interference. The larger the parameter value is, the stronger the filtering effect is.	1~100 [100]
Pn032	Analog torque command filter coefficient	Smooth analog torque command, and eliminate the effects of interference. The larger the parameter value is, the stronger the filtering effect is.	1~100 [100]

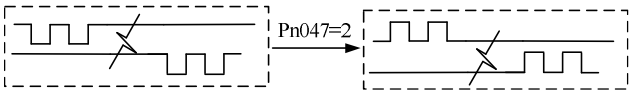
<table>
<tr><th>Parameter code</th><th>Name</th><th>Function</th><th>Range/ Default</th></tr>
<tr><td>Pn033</td><td>Torque control parameter</td><td>Bit-controlling (Pn033= bit2×4+ bit1×2+ bit0):
bit0: It is used to set the processing method when exceeding the limiting speed in torque mode.
0: Motor speed is controlled at speed limit value.
1: Alarm (Err7) if overspeed.
bit1: Speed limit of torque mode.
0: Speed limit is determined by the value of Pn023.
1: Select internal speed(Pn200~Pn203) by the status of signals SC1 and SC2 as speed limit value.
bit2: The source of torque command.
0: Torque command is input by the port of ‘T-REF’.
1: Select internal torque(Pn233~Pn236) by the status of signals TRQ1 and TRQ2 as torque command.
E.g. : bit2:bit1:bit0=1:1:1 -> Pn033=1×4+1×2+1=7;
bit2:bit1:bit0=1:0:1 -> Pn033=1×4+0×2+1=5.</td><td>0~7
[0]</td></tr>
<tr><td>Pn034</td><td>Internal CCW torque limit</td><td rowspan="2">● Set internal torque limit at the servo motors’ CCW, CW direction. The value sets the percentage of rated torque, which is effective at any time.
● If the value exceeds the maximal overload capacity the system permits, the actual torque limit will be the maximal overload capacity.</td><td>0~300
[300]</td></tr>
<tr><td>Pn035</td><td>Internal CW torque limit</td><td>-300~0
[-300]</td></tr>
<tr><td>Pn036</td><td>External CCW torque limit</td><td rowspan="2">● Set external torque limit at the servo motors’ CCW, CW direction. The value sets the percentage of rated torque, which is effective at any time.
● If the value exceeds the maximal overload capacity the system permits, the actual torque limit will be the maximal overload capacity.</td><td>0~300
[300]</td></tr>
<tr><td>Pn037</td><td>External CW torque limit</td><td>-300~0
[-300]</td></tr>
<tr><td>Pn038</td><td>Torque limit for speed trial run and JOG run</td><td>● Set the torque limit under the speed trial run mode and JOG run mode. It is independent of rotating direction and effective in two directions.
● The value is the percentage of rated torque. For example, the value should be set at 100 if it is equal to rated torque. Internal and external torque limit are still effective.</td><td>0~300
[100]</td></tr>
</table>

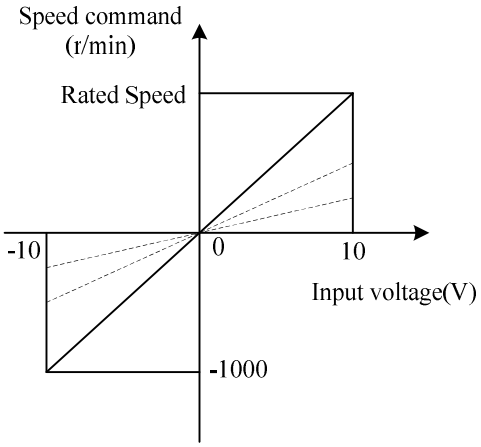
Parameter code	Name	Function	Range/ Default
Pn041	Analog torque command gain	● Set the ratio between torque command input voltage and motor actual torque command. ● Analog input voltage range:-10V~+10V. When it is set to 100%, 10V input voltage corresponding to the rated torque. 	0~1000 [100]
Pn042	Speed command direction	Speed command direction choice. 0: The direction of speed command is controlled by signal CINV; 1: The direction of speed command is controlled by signal SDIR1 and SDIR2.（Refer to chapter 7.3)	0~1 [0]
Pn043	Analog speed zero drift compensation value	● When the speed command input is zero, the speed command analog offset can be eliminated by adjusting this parameter. ● Parameter “AU-Set” can be used to automatic calibration. ● Manual compensation: Enable the servo driver, motor runs in the analog speed mode. The speed command offset can be observed by ‘DP-CS’, and then user can manually change the value of ‘Pn043’ based on the observed offset. 	-5.000~5.000 [0.000]
Pn044	Analog speed zero speed clamping threshold	Set the threshold of analog input. If the analog input is smaller than the parameter value, the motor will be locked. 	-5.000~5.000 [0.050]

<table>
<tr><th>Parameter code</th><th>Name</th><th>Function</th><th>Range/ Default</th></tr>
<tr><td>Pn045</td><td>Analog torque zero drift compensation value</td><td>

When the torque command input is zero, the torque command analog offset can be eliminated by adjusting this parameter.
Parameter “AU-Set” can be used to automatic calibration.
Manual compensation: Enable the servo driver, the motor runs in the analog torque mode. The torque command offset can be observed by “DP-Ct”, and then users can manually change the value of ‘Pn045’ based on the observed offset.



</td><td>-5.000~5.000
[0.000]</td></tr>
<tr><td>Pn046</td><td>Analog torque zero speed clamping threshold</td><td>Set the threshold of analog torque input. If the analog input is smaller than the parameter value, the motor will be locked.</td><td>-5.000~5.000
[0.050]</td></tr>
<tr><td>Pn047</td><td>Position command control parameter</td><td>Pn-047=2: Reverse the polarity of position command pulse in position mode. As follows.
 
</td><td>0~7
[0]</td></tr>
<tr><td>Pn049</td><td>In torque mode the permitted time for overspeed</td><td>In torque mode, the parameter is used to set the permitted time of exceed the speed limit.</td><td>0~10000
[5000]</td></tr>
<tr><td>Pn050</td><td>Encoder type</td><td>Set the encoder code match with encoder model.
<table>
<tr><td>0: Incremental encoder</td></tr>
<tr><td>1: Wire-saving encoder of Tamagawa.</td></tr>
<tr><td>2: Wire-saving encoder of Delta.</td></tr>
<tr><td>3: Absolute encoder.</td></tr>
<tr><td>4: Resolver.</td></tr>
</table></td><td>0~4
[0]</td></tr>
</table>

Parameter code	Name	Function	Range/ Default
Pn051	Analog speed command gain	● Set the ratio between speed command input voltage and motor actual speed command. ● Analog input voltage range:-10V~ +10V. When it is set to 100%, 10V input voltage corresponding to the rated speed. 	0~1000 [100]
Pn052	Torque/speed acceleration time	Torque/speed acceleration time.	0~16000 [100]
Pn053	Torque/speed deceleration time	Torque/speed deceleration time.	0~16000 [100]
Pn057	Force driver to enable	Pn057=2: Enable the servo driver. Pn057=3: Enable the servo driver by external digital IO input signal SV_EN. (Refer to chapter 7.3.)	0~10 [3]

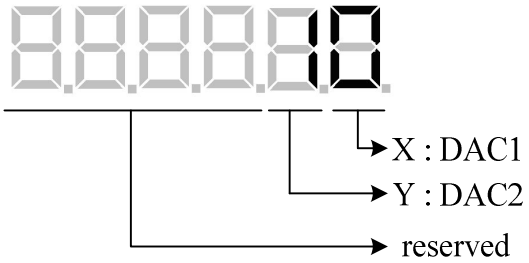
2. Parameters of group 1

Parameter code	Name	Function	Range/ Default
Pn100	Slave address	If it is set to 0 (Broadcast address), the driver receives data but does not respond.	0~32 [1]
Pn101	Modbus baud rate	Modbus baud rate setting as follows： 0: 4800bps | 1: 9600bps | 2: 19200bps 3: 38400bps | 4: 57600bps | 5: 115200bps	0~5 [1]

<table>
<tr><th>Parameter code</th><th>Name</th><th>Function</th><th>Range/ Default</th></tr>
<tr><td>Pn102</td><td>Transmission mode of Modbus</td><td>
<table>
<tr><td>0: 7-N-2(ASCII), 7 data bits, no parity, 2 stop bits, ASCII mode.</td></tr>
<tr><td>1: 7-E-1(ASCII), 7 data bits, even parity, 1 stop bit, ASCII mode.</td></tr>
<tr><td>2: 7-O-1(ASCII), 7 data bits, odd parity, 1 stop bit, ASCII mode.</td></tr>
<tr><td>3: 8-N-2(ASCII), 8 data bits, no parity, 2 stop bits, ASCII mode.</td></tr>
<tr><td>4: 8-E-1(ASCII), 8 data bits, even parity, 1 stop bit, ASCII mode.</td></tr>
<tr><td>5: 8-O-1(ASCII), 8 data bits, odd parity, 1 stop bit, ASCII mode.</td></tr>
<tr><td>6: 8-N-2(RTU), 8 data bits, no parity, 2 stop bits, RTU mode.</td></tr>
<tr><td>7: 8-E-1(RTU), 8 data bits, even parity, 1 stop bit, RTU mode.</td></tr>
<tr><td>8: 8-O-1(RTU), 8 data bits, odd parity, 1 stop bit, RTU mode.</td></tr>
</table>
</td><td>0~8
[6]</td></tr>
<tr><td>Pn104</td><td>Communication protocol</td><td>Pn-104=0: Standard MODBUS communication protocol.</td><td>0~2
[0]</td></tr>
<tr><td>Pn105</td><td>Communication interface</td><td>0: RS232.
1: RS485.</td><td>0~1
[0]</td></tr>
<tr><td>Pn106</td><td>Input IO signal source</td><td>Bit-controlling.Pn106=bit6×64+bit5×32+bit4×16+bit3×8+bit2×4+bit 1×2+bit0, bit0~bit6 correspond to DI1~ DI7:
0: The DI signal come from external terminal.
1: The DI signal is controlled by parameter ‘Pn-109’.
<table>
<tr><td></td><td>bit6</td><td>bit5</td><td>bit4</td><td>bit3</td><td>bit2</td><td>bit1</td><td>bit0</td></tr>
<tr><td></td><td>DI7</td><td>DI6</td><td>DI5</td><td>DI4</td><td>DI3</td><td>DI2</td><td>DI1</td></tr>
<tr><td>Pn106 (DI1 state is controlled by Pn109)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
</table>
</td><td>0~127
[0]</td></tr>
<tr><td>Pn107</td><td>Communication response delay time</td><td>Delay time of response to master.</td><td>0~32767
[0]</td></tr>
<tr><td>Pn109</td><td>DI signal status software control</td><td>Bit-controlling.Pn109=bit6×64+bit5×32+bit4×16+bit3×8+bit2×4+bit 1×2+bit0.
The parameter set DI status when the corresponding DI signal is controlled by parameter ‘Pn-109’. (Refer to Pn106.)
<table>
<tr><td></td><td>bit6</td><td>bit5</td><td>bit4</td><td>bit3</td><td>bit2</td><td>bit1</td><td>bit0</td></tr>
<tr><td></td><td>DI7</td><td>DI6</td><td>DI5</td><td>DI4</td><td>DI3</td><td>DI2</td><td>DI1</td></tr>
<tr><td>Pn106 (DI1 state is controlled by bit0 of ‘Pn109’)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pn109 (The status of DI1 is 0)</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>0</td></tr>
</table>
</td><td>0~127
[127]</td></tr>
</table>

3. Parameters of group 2

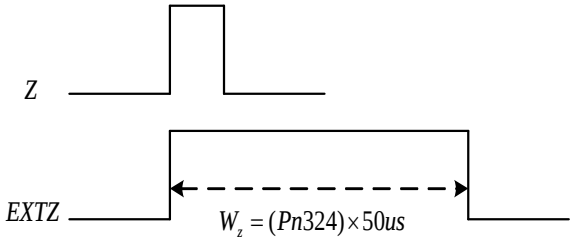
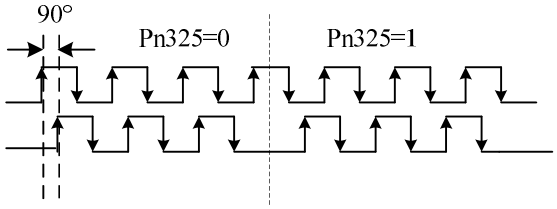
Parameter code	Name	Function	Range/ Default
Pn200	Internal speed 1	In internal speed control mode, these parameters set rotating speed. Select respective internal speed by signals SC1,SC2 and SC3.(Refer to chapter 7.3)	-5000~5000 [10]
Pn201	Internal speed 2		-5000~5000 [50]
Pn202	Internal speed 3		-5000~5000 [100]
Pn203	Internal speed 4		-5000~5000 [500]
Pn204	Internal speed 5		-5000~5000 [0]
Pn205	Internal speed 6		-5000~5000 [0]
Pn206	Internal speed 7		-5000~5000 [0]
Pn207	Internal speed 8		-5000~5000 [0]
Pn233	Internal torque 1	In internal torque control mode, select respective internal torque by signals TRQ1 and TRQ2. (Refer to chapter 7.3)	-300~300 [100]
Pn234	Internal torque 2		
Pn235	Internal torque 3		
Pn236	Internal torque 4		
Pn250	Electronic gear ratio numerator 2	Parameter description refer to ‘Pn012’ and ‘Pn013’.The selection of electronic gear ratio by input IO signals GEAR1 and GEAR2. (Refer to chapter 7.3.)	1~65535 [1]
Pn251	Electronic gear ratio numerator 3		
Pn252	Electronic gear ratio numerator 4		
Pn253	Undervoltage alarm delay time	When undervoltage signal is detected, servo driver output alarm signal after specified time is delayed.	0~30000 [400]
Pn254	Range of positioning completion	In the position control mode, servo driver output positioning completion signal ‘SV_F’ when the position deviation is equal to or less than the value of ‘Pn254’.	0~32767 [3300]
Pn255	Detection range of position deviation alarm	● In position control mode, servo driver will output the alarm signal (Err8) when the position deviation is equal to or greater than the value of ‘Pn255’. ● It will do not alarm when the parameter’s value is 0.	0~32767 [400]

Parameter code	Name	Function	Range/ Default
Pn256	Speed arrival signal threshold	● No relation with rotation direction. Comparator has hysteresis effect. ● In speed control mode, if motor speed exceeds this value, the signal 'SV_S' is ON, otherwise OFF.	-5000~5000 [500]
Pn257	Detection range of overspeed	● In speed control mode, When the count value in the speed deviation counter surpasses this parameter value, the servo driver will release overspeed alarm signal.(Err7) ● It will not alarm when the parameter's value is 0.	0~5000 [0]
Pn258	Servo on delay time	The delay time from receiving the enable signal to enable the driver.	0~30000 [0]
P-259	Torque arrival signal threshold	In torque control mode, if motor torque exceeds this value, the signal 'SV_T' is ON, otherwise OFF	0~300 [100]
Pn260	Alarm clear restrictions	Set the number of alarm clearance. Signal RSTSV is used to clear alarms, however, if the numbers of operations exceed the value of Pn260, the alarm can not be cleared. (Notice：Parts of the alarms can be cleared.)	0～20 [5]
Pn261	Analog output monitor	Hexadecimal display:  XY: (X: DAC1; Y: DAC2) 0: Motor speed (+/-10 V/ Rated speed) 1: Motor torque (+/-10 V/ Rated torque) 2: Speed command (+/-10 V/ Rated speed) 3: Torque command (+/-10 V/ Rated torque) Note: The analog output proportions refer to parameters 'Pn262' and 'Pn263'. **E.g.:** Pn261 = 10h（DAC1: motor speed output）, the output voltage of DAC1 is V1. Motor speed = (Rated speed×V1/10) ×Pn262/100.	0~55h [0]
Pn262	DAC1 analog output proportion	Refer to parameter 'Pn261'.	-100~100 [100]
Pn263	DAC2 analog output proportion	Refer to parameter 'Pn261'.	-100~100 [100]
Pn264	Temperature of turning on the fan	Fan works when the driver's temperature exceeds the value of this parameter.	30~70 [45]

4. Parameters of group 3

<table>
<tr><th>Parameter code</th><th>Name</th><th>Function</th><th>Range/ Default</th></tr>
<tr><td>Pn300</td><td>Digital input DI filter time</td><td>When there are too much noises around environment, increasing the value of Pn300 can improve reliability. If the value is too large, it will affect the response time.</td><td>0~100
[0]</td></tr>
<tr><td>Pn301</td><td>Digital input DI1 function</td><td rowspan="7">These parameters are used to set functions of digital input DI. The function codes refer to chapter 7.3. It will have no function when the parameter’s value is 0.</td><td>0~27
[1]</td></tr>
<tr><td>Pn302</td><td>Digital input DI2 function</td><td>0~27
[2]</td></tr>
<tr><td>Pn303</td><td>Digital input DI3 function</td><td>0~27
[3]</td></tr>
<tr><td>Pn304</td><td>Digital input DI4 function</td><td>0~27
[4]</td></tr>
<tr><td>Pn305</td><td>Digital input DI5 function</td><td>0~27
[5]</td></tr>
<tr><td>Pn306</td><td>Digital input DI6 function</td><td>0~27
[6]</td></tr>
<tr><td>Pn307</td><td>Digital input DI7 function</td><td>0~27
[7]</td></tr>
<tr><td>Pn309</td><td>Digital output DO1 function</td><td rowspan="4">These parameters are used to set functions of digital output DO. The function codes refer to chapter 7.4. It will have no function when the parameter’s value is 0.</td><td>0~7
[1]</td></tr>
<tr><td>Pn310</td><td>Digital output DO2 function</td><td>0~7
[2]</td></tr>
<tr><td>Pn311</td><td>Digital output DO3 function</td><td>0~7
[3]</td></tr>
<tr><td>Pn312</td><td>Digital output DO4 function</td><td>0~7
[4]</td></tr>
<tr><td>Pn313</td><td>Reverse digital input DI1~DI4</td><td>Binary display. Reverse the state of DIn if the corresponding bit is 1 , as follows.
<table>
<tr><td></td><td>bit3</td><td>bit2</td><td>bit1</td><td>bit0</td></tr>
<tr><td></td><td>DI4</td><td>DI3</td><td>DI2</td><td>DI1</td></tr>
<tr><td>Reverse DI1 and DI2</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
</table></td><td>0~15
[0000]</td></tr>
<tr><td>Pn314</td><td>Reverse digital input DI5~DI7</td><td>Binary display. Reverse the state of DIn if the corresponding bit is 1 , as follows.
<table>
<tr><td></td><td>bit3</td><td>bit2</td><td>bit1</td><td>bit0</td></tr>
<tr><td></td><td>reserve</td><td>DI7</td><td>DI6</td><td>DI5</td></tr>
<tr><td>Reverse DI5</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
</table></td><td>0~7
[0000]</td></tr>
</table>

<table>
<tr><th>Parameter code</th><th>Name</th><th>Function</th><th>Range/ Default</th></tr>
<tr><td>Pn315</td><td>Reverse digital output DO1~DO4</td><td>Binary display. Reverse the state of DOn if the corresponding bit is 1.
<table>
<tr><td></td><td>bit3</td><td>bit2</td><td>bit1</td><td>bit0</td></tr>
<tr><td></td><td>DO4</td><td>DO3</td><td>DO2</td><td>DO1</td></tr>
<tr><td>Reverse DO2</td><td>0</td><td>0</td><td>1</td><td>0</td></tr>
</table></td><td>0~15
[0000]</td></tr>
<tr><td>Pn316</td><td>Masking alarm</td><td>Binary display. Mask alarm information if the corresponding bit is 0.
<table>
<tr><td></td><td>bit3</td><td>bit2</td><td>bit1</td><td>bit0</td></tr>
<tr><td></td><td>Err13</td><td>Err3</td><td>Err12</td><td>Err11</td></tr>
<tr><td>Masking Err3</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
</table></td><td>0~31
[1111]</td></tr>
<tr><td>Pn318</td><td>zero speed detection point of electromagnetic brake</td><td>The parameter is only used to electromagnetic brake operation timing judgment. When the motor’s speed (no relation with direction) is lower than the value of this parameter think the motor is stationary. (Refer to chapter 7.4, the description of signal BRK.)</td><td>0~5000
[15]</td></tr>
<tr><td>Pn319</td><td>Delay time of electromagnetic brake</td><td>● When the system state changes from enabled to does not make or alarm. The parameter is used to set the delay time from the electromagnetic brake signal output(BRK signal OFF) to the motor current is cut off during the motor stationary (Motor speed< Pn318).
● The function makes sure that motor cut off current after brakes reliable braking to avoid slight displacement of motor or dropping. The parameter’s value should not be less than mechanical braking delay time.
● Timing refers to the description of BRK signal of chapter 7.4.</td><td>0~30000
[0]</td></tr>
<tr><td>Pn320</td><td>Waiting time of electromagnetic brake</td><td rowspan="2">● When the system state changes from enabled to does not make or alarm. The parameter is used to set the delay time from the motor current is cut off to the electromagnetic brake work (BRK signal OFF) during the motor running (Motor speed ≥ Pn318).
● The parameter makes sure that brake works after reducing the speed of the motor from the high rotation speed to low-speed to avoid damage to the brake.
● The actual delay time is the shorter of Pn320 and motor speed decelerates to the value of Pn321.
● Timing refers to the description of BRK signal of chapter 7.4.</td><td>0~30000
[500]</td></tr>
<tr><td>Pn321</td><td>Electromagnetic brake operation speed</td><td>0~5000
[100]</td></tr>
</table>

Parameter code	Name	Function	Range/ Default
Pn322	Position feedback pulse division numerator	With incremental encoder as example: Feedback pulse command f1 → Pn322/Pn323 → Feedback pulse output f2 $f2 = f1 * \frac{Pn322}{Pn323}$ ● If Pn322>Pn323, the ratio outputs as 1:1. ● f1: Encoder feedback pulses. f2:The output pulses of the driver.(EXTA+/-, EXTB+/-)	1~32767 [1]
Pn323	Position feedback pulse division denominator		1~32767 [1]
Pn324	The width of Z phase pulse	The parameter is used to set the width of zero pulse (Z pulse). With the motor speed increases the width of zero pulse narrows, the parameter is set to appropriate value in accordance with motor speed in order to match kinds of upper controller. 	0~127 [0]
Pn325	Reverse position feedback pulse	Direction of position feedback pulse: 0: Phase relationship of position feedback output signals EXTA and EXTB unchanged. 1: Phase relationship of position feedback output signal EXTA and EXTB reversed. As shown: 	0～1 [0]

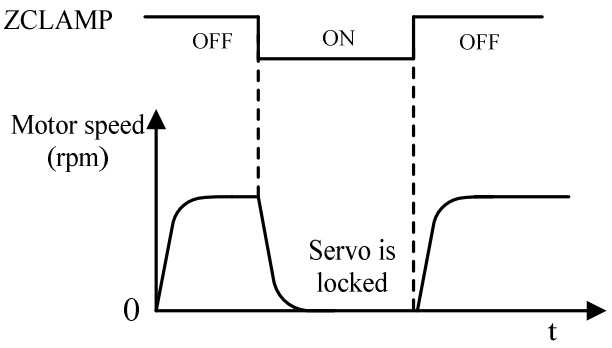
7.3 Digital input DI function explanation

Note: Digital input DI state definition.

OFF - The switch status is opened.

ON - The switch status is turned.

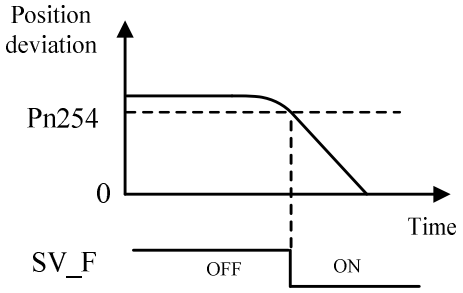
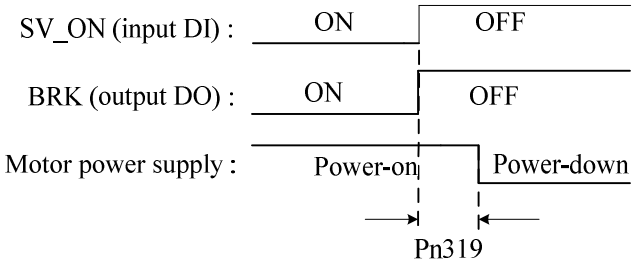
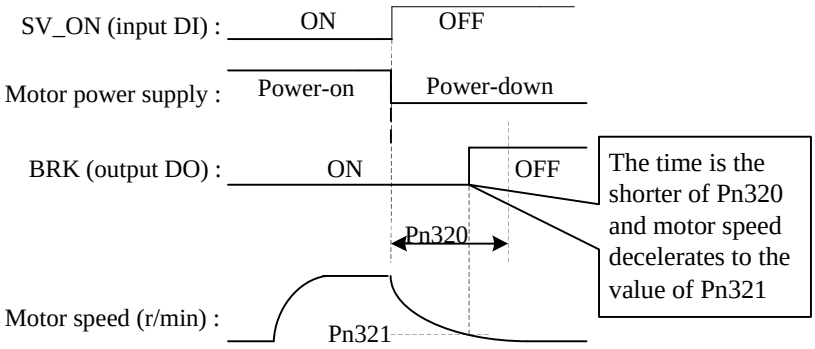
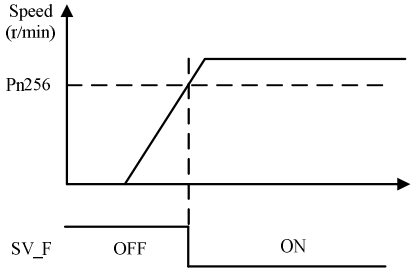
Value	Sign	Function description
1	SV_ON	Servo on. Servo enable when the signal is turned on.
2	RSTSV	Alarms clear. Parts of alarms are cleared when RSTSV signal is turned on. (The alarms can be cleared are Err3,Err7,Err8,Err9,Err14,Err15,Err16 and Err17.)
3	CCWI	CCW drives prohibition. The function is valid only when the value of Pn020 is 0. Motor rotates anti-clockwise, when detects CCWI signal is turned on the drive capability is inhibited in CCW direction.

<table>
<tr><th>Value</th><th>Sign</th><th>Function description</th></tr>
<tr><td>4</td><td>CWI</td><td>CW drives prohibition. The function is valid only when the value of Pn020 is 0. Motor rotates clockwise, when detects CWI signal is turned on the drive capability is inhibited in CW direction.</td></tr>
<tr><td>5</td><td>PECLR</td><td>Position deviation counter clear. In position control mode, turn on the signal reset position deviation counter.</td></tr>
<tr><td>6</td><td>PINH</td><td>Pulse command input prohibition. When PINH signal is ON in position mode, the external pulse input is invalid and the motor is locked.</td></tr>
<tr><td>7</td><td>ZCLAMP</td><td>Zero speed clamp. In analog speed control mode, this function is used to make motor in stopped state and servo is locked even analog input voltage is not 0V.
When ZCLAMP signal is turned on, the motor stop and is locked.
 
</td></tr>
<tr><td>8</td><td>TCCW</td><td>CCW torque limit.</td></tr>
<tr><td>9</td><td>TCW</td><td>CW torque limit.</td></tr>
<tr><td>10</td><td>CMODE</td><td>Control mode switching.
<table>
<tr><th rowspan="2">Pn004</th><th colspan="2">The state of CMODE</th></tr>
<tr><th>ON</th><th>OFF</th></tr>
<tr><td>8</td><td>Position mode</td><td>Speed mode</td></tr>
<tr><td>9</td><td>Speed mode</td><td>Torque mode</td></tr>
<tr><td>10</td><td>Torque mode</td><td>Position mode</td></tr>
</table></td></tr>
<tr><td>14
15
16</td><td>SC1
SC2
SC3</td><td>Internal speed command selection.
<table>
<tr><th>SC3</th><th>SC2</th><th>SC1</th><th>Speed command</th></tr>
<tr><td>OFF</td><td>OFF</td><td>OFF</td><td>Internal speed 1: Pn200</td></tr>
<tr><td>OFF</td><td>OFF</td><td>ON</td><td>Internal speed 2: Pn201</td></tr>
<tr><td>OFF</td><td>ON</td><td>OFF</td><td>Internal speed 3: Pn202</td></tr>
<tr><td>OFF</td><td>ON</td><td>ON</td><td>Internal speed 4: Pn203</td></tr>
<tr><td>ON</td><td>OFF</td><td>OFF</td><td>Internal speed 5: Pn204</td></tr>
<tr><td>ON</td><td>OFF</td><td>ON</td><td>Internal speed 6: Pn205</td></tr>
<tr><td>ON</td><td>ON</td><td>OFF</td><td>Internal speed 7: Pn206</td></tr>
<tr><td>ON</td><td>ON</td><td>ON</td><td>Internal speed 8: Pn207</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Value</th><th>Sign</th><th>Function description</th></tr>
<tr><td>17</td><td>TRQ1</td><td rowspan="2">Internal torque command selection.<table><tr><th>TRQ2</th><th>TRQ1</th><th>Torque command</th></tr><tr><td>OFF</td><td>OFF</td><td>Internal torque 1: Pn233</td></tr><tr><td>OFF</td><td>ON</td><td>Internal torque 2: Pn234</td></tr><tr><td>ON</td><td>OFF</td><td>Internal torque 3: Pn235</td></tr><tr><td>ON</td><td>ON</td><td>Internal torque 4: Pn236</td></tr></table></td></tr>
<tr><td>18</td><td>TRQ2</td></tr>
<tr><td>19</td><td>GEAR1</td><td rowspan="2">Electronic gear ratio selection.<table><tr><th>GEAR2</th><th>GEAR1</th><th>Electronic gear ratio</th></tr><tr><td>OFF</td><td>OFF</td><td>Pn012/Pn013</td></tr><tr><td>OFF</td><td>ON</td><td>Pn250/ Pn013</td></tr><tr><td>ON</td><td>OFF</td><td>Pn251/ Pn013</td></tr><tr><td>ON</td><td>ON</td><td>Pn252/ Pn013</td></tr></table></td></tr>
<tr><td>20</td><td>GEAR2</td></tr>
<tr><td>21</td><td>SDIR1</td><td rowspan="2">Speed direction selection.
If Pn042=0, the direction of speed command is controlled by signal CINV;
If Pn042=1, the direction of speed command is controlled by signals SDIR1 and SDIR2.<table><tr><th>SDIR2</th><th>SDIR1</th><th>The status of motor</th></tr><tr><td>OFF</td><td>OFF</td><td>The motor is locked.</td></tr><tr><td>OFF</td><td>ON</td><td>Motor rotates in the direction of CCW.</td></tr><tr><td>ON</td><td>OFF</td><td>Motor rotates in the direction of CW.</td></tr><tr><td>ON</td><td>ON</td><td>The motor is locked.</td></tr></table></td></tr>
<tr><td>22</td><td>SDIR2</td></tr>
<tr><td>23</td><td>CINV</td><td>Speed command reverse.
If Pn042=0, the direction of speed command is controlled by signal CINV. When the signal is OFF, the motor rotates in the direction of speed command .While the signal is ON, the motor rotates in the contrary direction with speed command.
If Pn042=1, the direction of speed command is controlled by signals SDIR1 and SDIR2.</td></tr>
</table>

7.4 Digital output DO function explanation

Value	Sign	Function description
1	SV_RY	Servo ready. When the main power of servo driver is supplied and the driver has not any alarm, the ON signal is output in 1.5 seconds.
2	ALM	Alarm Output. The signal state of ALM is ON when there is no alarm displays in the submenu of ‘dP-Err’.

Value	Sign	Function description
3	SV_F	Positioning completion. In position control mode, if position deviation is equal to or less than the value of Pn254, the signal state of SV_F is ON. **Note**: The value of 'Pn254' does not influence the actual location accuracy of servo system. When position deviation is greater than the value of 'Pn255', driver output position excessive deviation alarm (Err8). 
4	BRK	Electromagnetic/ Mechanical brake. (Refer to chapter 7.2.) 1. Motor in stationary state (motor speed < Pn318), timing diagram of BRK is shown below.  2.Motor in running state (motor speed ≥ Pn318), timing diagram of BRK is shown below. 
5	SV_S	Speed arrival signal. In speed control mode, when motor speed exceeds the value of Pn256, the signal state of SV_S is ON. 
6	SV_T	Torque arrival signal. In torque control mode, when motor torque exceeds the value of Pn259, the signal state of SV_T is ON. (Refer to the description of SV_S.)

Chapter 8 Alarm

Alarm code	Name	The main reason	Treatment measures
Err 0	Normal	Normal	
Err 1	IPM protection	Alarm after servo on.	Contact the manufacturer.
		Unreasonable parameter setting.	Adjust parameters.
		Driver overheating.	Please change motor and driver for high-power.
		Be disturbed.	Bad grounding.
		Alarm during start-stop process . The load inertia is too large or the acceleration/deceleration time is too short.	Reduce the load inertia. Increase acceleration/deceleration time of upper controller.
Err 2	Overcurrent	Alarm after servo on.Driver output short circuit.	Eliminate short circuit.
		Motor oscillation during operation.	Parameter unreasonable.Adjust parameters.
		Load current is too large.	Change for high-power driver.
		Poor motor insulation.	Change motor.
		Alarm during start-stop process . The load inertia is too large or the acceleration/deceleration time is too short.	Reduce the load inertia. Increase acceleration/deceleration time of upper controller.
Err 3	Undervoltage	Alarm during running .Low power supply voltage.	Check power supply voltage.
		Alarm during power on.Circuit board fault.	Contact the manufacturer.
		There is no input voltage for main circuit.	Reconfirm the power supply.
Err 4	Overvoltage	Brake resistor does not work.	Brake resistor wire break; Brake resistor is broken;
		Brake resistor capacity is too small.	Replacement of large capacity brake resistor.
		Alarm during power on.Power voltage is too high.	Check the power voltage.
Err 5	No current in analog channel A.	Circuit board fault.	Contact the manufacturer.
Err 6	No current in analog channel B.	Circuit board fault.	Contact the manufacturer.
Err 7	Overspeed	Alarm during power on.Circuit board fault.	Replacement of driver/motor.
		Encoder fault.	Replacement of encoder.
		Input command pulse frequency is too high.	Set input pulse correctly.
		Acceleration/deceleration time constant is too small, causing too large speed overshoot.	Increase acceleration/deceleration time of upper controller.
		Input electronic gear ratio is too large.	Set electronic gear ratio correctly.
		Servo motor is unstable, causing overshoot.	Adjusting the associated gain.If gain could not be set to suitable value, please reduce the load inertia.

Alarm code	Name	The main reason	Treatment measures
Err 8	Position excessive deviation	Alarm during power on.Circuit board fault.	Contact the manufacturer.
		Wrong connection of motor U,V,W leads.	Correct wiring.
		Wrong connection of encoder leads.	Change encoder line.
		Motor locked-rotor.	Check mechanism.
		Position overshoot detection range is set too small.	Increase position overshoot detection range.
		Gain value is too small.	Increase gain value.
		Torque limit is too small.	Increase torque setting value.
		External load is too large.	Change for high-power motor and driver.
Err 9	Torque command exceed limit	Torque command exceed limit of time is greater than the allowed time.	Adjust torque command.
		Parameter setting is not reasonable.	Adjust parameters.
Err 10	FPGA chip fault	Chip data-processing transmission fault.	Power-on again.
		Chip or circuit board fault.	Contact with the manufacturer.
Err 11	Encoder fault	Alarm during power on.Bad connection of encoder's wiring.	Reconnect encoder line well.
		Alarm during power on.Encoder line fault.	Change encoder line.
		Alarm during power on.Motor encoder fault.	Change motor.
		Alarm during power on.Circuit fault of driver.	Change driver.
		Alarm during running.The encoder's plug gets loose because of mechanical vibration, for it is not screwed well.	Reconnect encoder line well.
		Alarm during Operation.Encoder cable is too long, which cause the power supply voltage of encoder too low.	Shorten the cable. Adopt poly-core cable with parallel connection.
Err 12	Encoder signal transmission fault	Bad connection of encoder's wiring.	Reconnect encoder line well.
		Encoder line suffers from interference.	Shorten encoder line as far as possible, and undertake shielding measures.
		Encoder fault.	Change motor.
Err 13	Z pulse lose	Bad connection of encoder's wiring.	Reconnect encoder line well.
		Encoder fault.	Change motor.
		Circuit board fault.	Change driver.
Err 14	Motor thermal overload (I^2t)	Alarm during power on.Circuit board fault.	Change driver.
		Alarm during power on.Unreasonable parameters setting.	Adjust parameters.
		Motor exceed the rated torque running for a long time	Check load or replace high-power driver&motor.
Err 15	Driver overload protection	Motor power line not connected.Major loop of driver is not power-on.	Wiring as it is requested.
		Motor locked-rotor.	Check whether the motor is seized.
		Output current of driver is too large.	Change driver.

Alarm code	Name	The main reason	Treatment
Err 16	Software overcurrent	The instantaneous current of driver is too large.	Contact the manufacturer.
Err 17	Overload	Alarm during power on.Circuit board fault.	Change driver.
		Motor exceeds the rated torque.	Check load; Reduce the start- stop frequency; Replacement of high-power motor&driver.
		Motor oscillation.	Adjust the gain; Increase the acceleration/deceleration time. Reduce the load inertia.
		A disconnection of the UVW or Encoder wiring error.	Check the wiring.
Err 18	Brake fault	Alarm during power on.Circuit board fault.	Change driver.
		Brake resistor wiring disconnected.	Check the wiring.
		Brake resistor is broken.	Replace the brake resistor.
		Brake circuit capacity is not enough.	Reduce the start- stop frequency; Increase the acceleration/deceleration time. Reduce the load inertia. Replacement of large-capacity braking resistor.
		The power supply is too high.	Check the power supply voltage.
Err 21	Input power phase loss protection	Input power phase loss.	Check the wiring.
		Circuit board fault.	Change driver.

Notice: If there is different alarm code from the above table, please contact the manufacturer.

Chapter 9 Running and adjustment

According to the steps of *ELESY servo driver operation manual* make motor normal rotation before connected load to it. Usually, a driver should take the following tests before put into use.

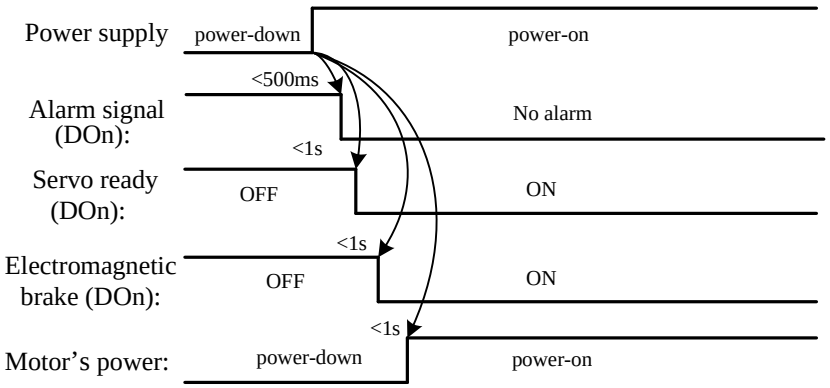
1. Wiring and inspection.
2. Power-on and adjust parameters.
3. No-load operation.
4. Control function debugging.

9.1 Power-on

1. Checking before power on.

- Whether the specifications of driver and motor match each other.
- Wiring of R,S,T and U,V,W cannot be reversed, and the terminal has not loose phenomenon.
- Check the power supply is normal or not: 3-phase 220V (ESDC-xxAxx) or 3-phase 380V (ESDC-xxBxx).
- Whether the encoder terminal wiring is correct.
- Whether the driver and motor are well grounded.

2. Power-on sequence



Digital input IO (DIn) functions are customized via the parameters 'Pn301 ~ Pn307'. Digital output IO (DOn) functions are customized via the parameters 'Pn309 ~ Pn312'.

9.2 Trial running without load

1. Speed trail run (Panel operation refer to chapter 5)

a. Set parameter of 'Pn-004' as 2 to select speed trial run control mode.

b. Enter into menu of ‘Sr-’.

c. Press ‘▲’ key to increase speed command, then enter into ‘dP-SPd’ submenu to observe whether the actual rotate speed of motor is the setting velocity.

d. Press ‘▼’ key to decrease speed command to a negative, then enter into ‘dP-SPd’ submenu to observe whether the actual rotate speed of motor is the setting velocity.

2. JOG trial run

a. Set parameter of ‘Pn-004’ as 3 to select JOG trial run control mode. Modify parameter ‘Pn-022’ to suitable JOG speed.

b. Enter into menu of ‘Jr-’.

c. Press ‘▲’ key and hold, motor will rotate in the direction of CCW at the speed of ‘Pn-022’.

d. Release the key, motor will be in the state of zero-speed locked.

e. Press ‘▼’ key and hold, motor will rotate in the direction of CW at the speed of ‘Pn-022’.

f. Release the key, motor will be in the state of zero-speed locked.

3. Internal speed running

a. Set parameter of ‘Pn-004’ as 1 to select internal speed control mode.

b. Modify internal speed through the parameters of ‘Pn200~Pn207’.

c. Set parameters of ‘Pn-302=14’, ‘Pn-303=15’ and ‘Pn-304=16’ which define DI2,DI3 and DI4 input functions for SC1, SC2 and SC3.(Refer to chapter 7)

d. Servo on. It can be reached by external digital IO input terminal (DIn), or be inner compelled by setting Pn057 as 2. Instance of external terminal input: Set parameter of ‘Pn-301=1’, the DI1 port as enable signal input. (Refer to chapter 7)

e. Select respective internal speed by signals SC1,SC2 and SC3.The corresponding relationship is as follows. (Refer to chapter 7.3.)

SC3	SC2	SC1	Speed command
OFF	OFF	OFF	Internal speed 1：Pn-200
OFF	OFF	ON	Internal speed 2：Pn-201
OFF	ON	OFF	Internal speed 3：Pn-202
OFF	ON	ON	Internal speed 4：Pn-203
ON	OFF	OFF	Internal speed 5：Pn-204
ON	OFF	ON	Internal speed 6：Pn-205
ON	ON	OFF	Internal speed 7：Pn-206
ON	ON	ON	Internal speed 8：Pn-207

Note: OFF-The switch status is opened. ON-The switch status is turned.

9.3 Control functions debugging

9.3.1 Position control

The position control wiring and pulse input form please refer to chapter 4.6.

1. No-load test. Measuring the power supply of R,S,T(3-phase 220V or 3-phase 380V) is normal or not and checking the wiring. Make sure there are no problems, power on.

2. If there is no alarm and the system is working properly. Proceed to the next step.

3. Parameter adjustment.

① Set parameter of ‘Pn-000’ as 288 to set the correct user password. Reference to the motor adapter table (Appendix) modifies the parameter of ‘Pn-001’ as the corresponding motor model code.

② Enter into the menu group of ‘EE-’ and select ‘EE-dEF’, press ‘SET’ key. If ‘donE’ is shown on nixie tube means the driver’s parameters have been recovered to factory defaults. Power-on again.

③ Please check several key parameters associated with the position control after power on again. If there is no problem enable the driver. Upper controller may send pulses after the ‘RUN’ indicator light up.

Pn-004	Control mode	Is set to: 0
Pn-005	Speed proportional gain	Default: 120~180
Pn-006	Speed integral time constant	Default: 30~60
Pn-009	Position proportional gain	Default: 40
Pn-010	Position feedforward gain	Default: 0
Pn-012	Electronic gear ratio numerator 1	Default: 1
Pn-013	Electronic gear ratio denominator	Default: 1
Pn-014	Position command pulse types	Default: 0
Pn-015	Inverse the direction of position command	Default: 0
Pn-019	Position command smooth filter	Default: 0
Pn-020	Drive forbid control	Default: 1

④ No-load test is completed, with load operation.

9.3.2 Analog speed control mode

Speed control mode wiring and analog input interface principle refer to chapter 4.7.1.

1. No-load test. Measuring the power supply of R,S,T(3-phase 220V or 3-phase 380V) is normal or not and checking the wiring.

2. Check analog speed input wiring is correct or not. Make sure there are no problems, power on.

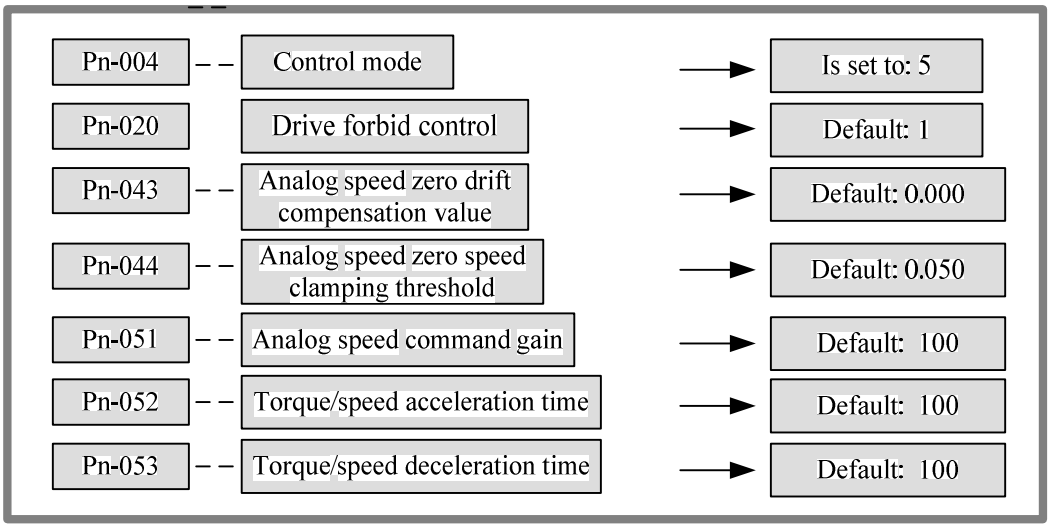
3. If there is no alarm and the system is working properly. Proceed to the next step.

4. Parameters adjustment.

① Set parameter of ‘Pn-000’ as 288 to set the correct user password. Reference to the motor adapter table (Appendix) modifies the parameter of ‘Pn-001’ as the corresponding motor model code.

② Enter into the menu group of ‘EE-’ and select ‘EE-dEF’, press ‘SET’ key. If ‘donE’ is shown on nixie tube means the driver’s parameters have been recovered to factory defaults. Power-on again.

③ Please check several key parameters associated with the speed control after power on again. If there is no problem enable the driver. Wait for the ‘RUN’ indicator light up, perform automatic zero drift compensation operation. Upper controller output analog instruction to driver after the above steps are completed. Observe the dynamic effect of motor and adjust gain for reasonable value. (Automatic zero drift compensation operation refer to chapter 5.2.6)



④ No-load test is completed, with load operation.

9.3.3 Torque control

Torque control includes internal torque control and analog torque input control. In the analog torque control mode, the wiring and analog input interface principle refer to chapter 4.1.7.

1. Internal torque control

(1) No-load test. Measuring the power supply of R,S,T(3-phase 220V or 3-phase 380V) is normal or not and checking the wiring. Make sure there are no problems, power on.

(2) If there is no alarm and the system is working properly. Proceed to the next step.

(3) Parameter adjustment.

① Set parameter of ‘Pn-000’ as 288 to set the correct user password. Reference to the motor adapter table (Appendix) modifies the parameter of ‘Pn-001’ as the corresponding motor model code.

② Enter into the menu group of ‘EE-’ and select ‘EE-dEF’, press ‘SET’ key. If ‘donE’ is shown on nixie tube means the driver’s parameters have been recovered to factory defaults. Power-on again.

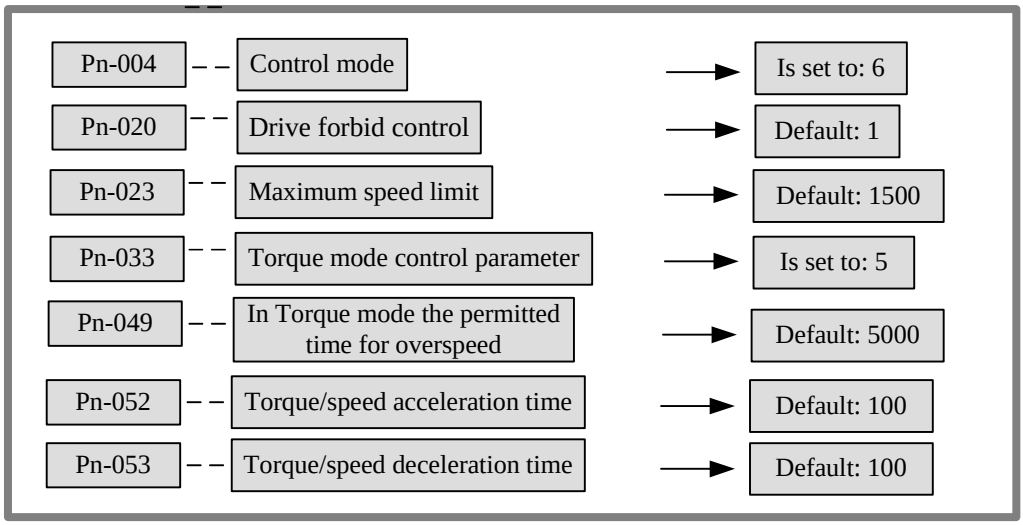
③ Modify the bit2 of parameter ‘Pn-033’ as 1 to select the internal torque as torque command.(Pn-033= bit2×4+ bit1×2+ bit0, refer to chapter 7.2.)

Set parameters of ‘Pn-302=17’ and ‘Pn-303=18’ which define ports DI2 and DI3 input functions for TRQ1 and TRQ2. Select respective internal torque by signals TRQ1 and TRQ2.The corresponding relationship is as follows. (Refer to chapter 7)

TRQ2	TRQ1	Torque command
OFF	OFF	Internal torque 1: Pn233
OFF	ON	Internal torque 2: Pn234
ON	OFF	Internal torque 3: Pn235
ON	ON	Internal torque 4: Pn236

Note: OFF-The switch status is opened. ON-The switch status is turned.

④ Please check several key parameters associated with the torque control. If there is no problem enable the driver. Wait for the ‘RUN’ indicator light up, then select internal torque command through TRQ1 and TRQ2. Observe the dynamic effect of motor and adjust gain for reasonable value.



⑤ No-load test is completed, with load operation.

2. Analog input torque control

(1) No-load test. Measuring the power supply of R,S,T(3-phase 220V or 3-phase 380V) is normal or not and checking the wiring.

(2) Check analog torque input wiring is correct or not. Make sure there are no problems, power on.

(3) If there is no alarm and the system is working properly. Proceed to the next step.

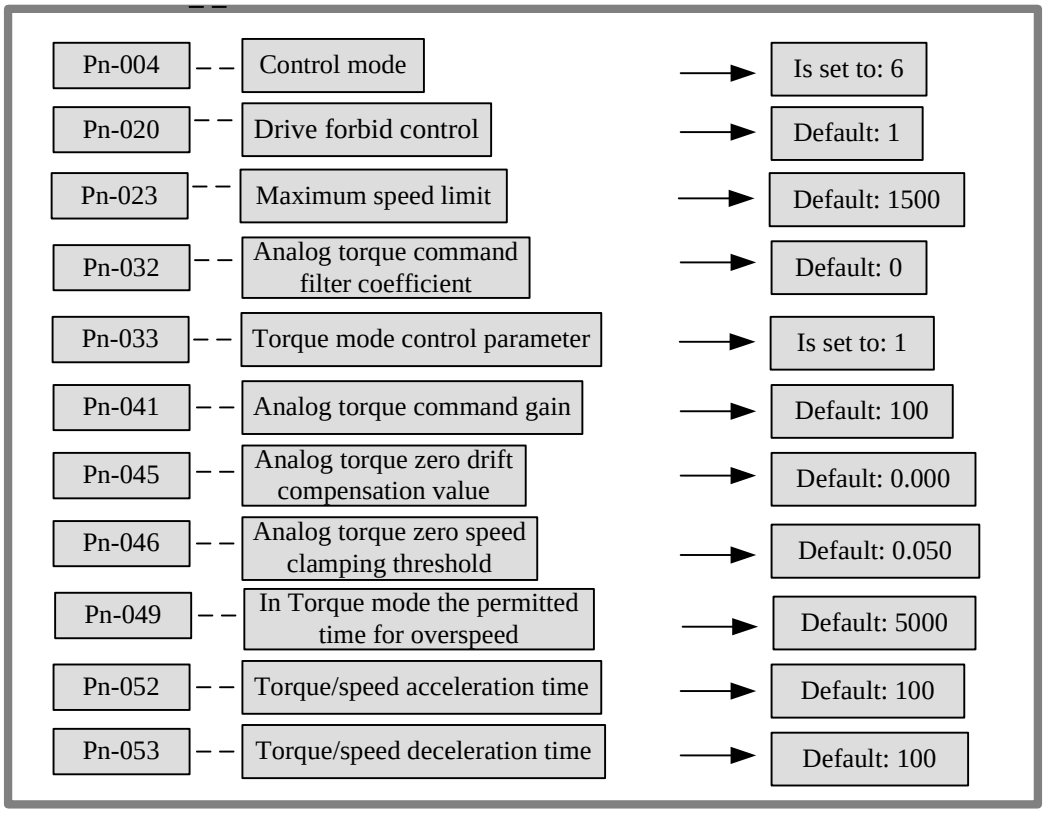
(4) Parameter adjustment.

① Set parameter of ‘Pn-000’ as 288 to set the correct user password. Reference to the motor adapter table (Appendix) modifies the parameter of ‘Pn-001’ as the corresponding motor model code.

② Enter into the menu group of ‘EE-’ and select ‘EE-dEF’, press ‘SET’ key. If ‘donE’ is shown on nixie tube means the driver’s parameters have been recovered to factory defaults. Power-on again.

③Modify the bit2 of parameter ‘Pn-033’ as 0 to select external terminal (T-REF) input torque command.(Pn-033= bit2×4+ bit1×2+ bit0, refer to chapter 7.2.)

④ Please check several key parameters associated with the torque control. If there is no problem enable the driver. Wait for the ‘RUN’ indicator light up, then perform automatic zero drift compensation operation. Upper controller output analog instruction to driver after the above steps are completed. Observe the dynamic effect of motor and adjust gain for reasonable value.



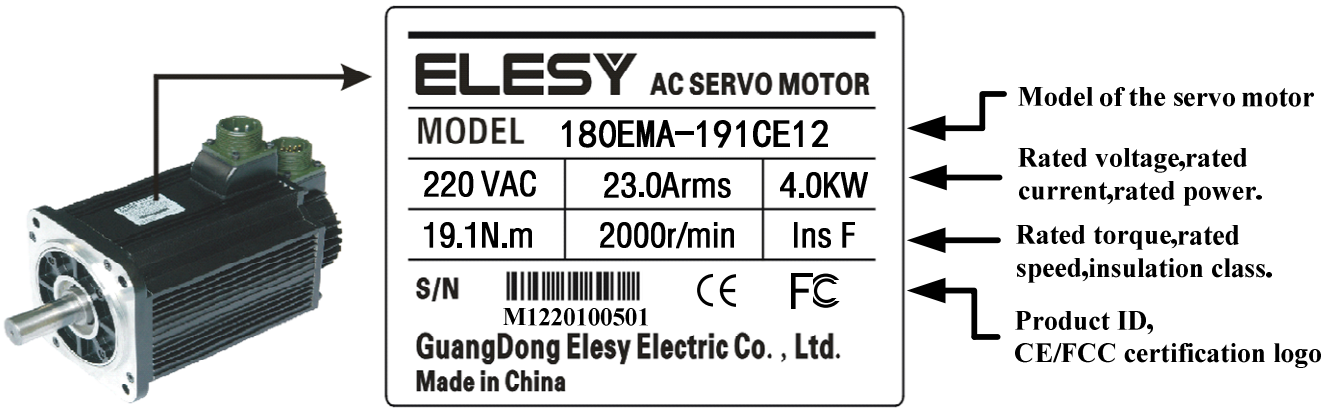
⑤ No-load test is completed, with load operation.

Chapter 10 Servo motor

10.1 Nameplate and model introduction

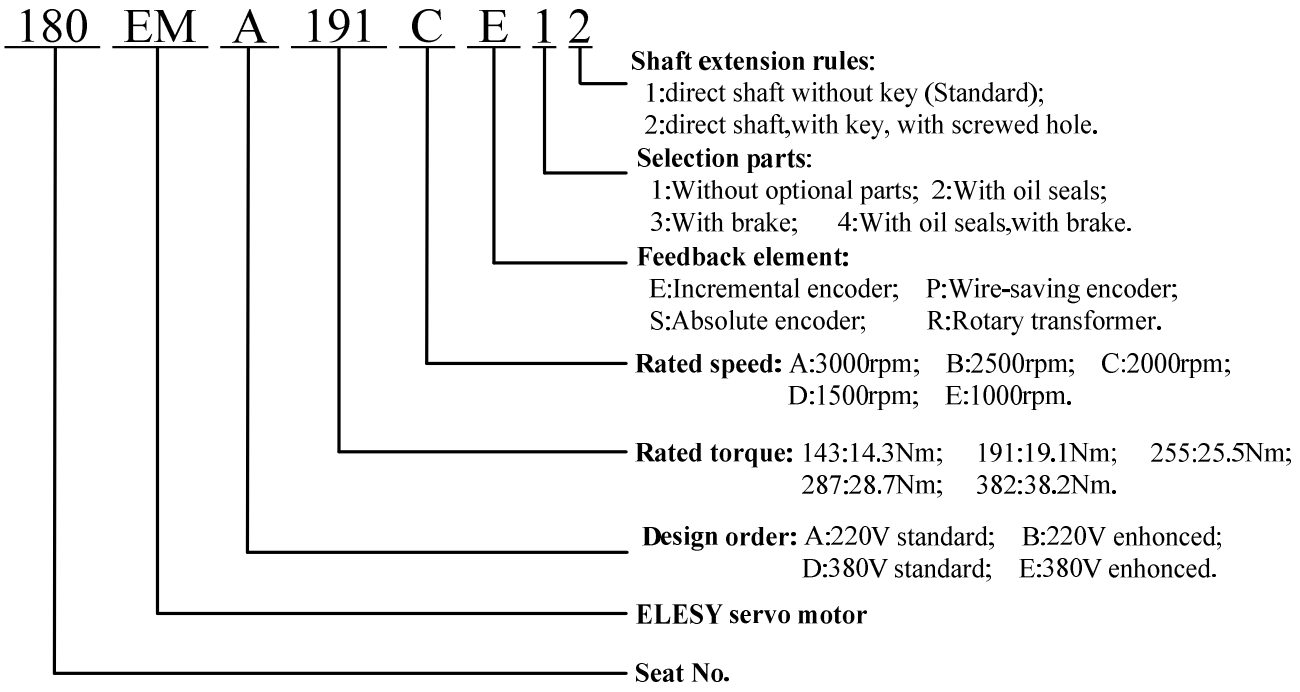
1. Nameplate

Figure 10-1 Servo motor nameplate description



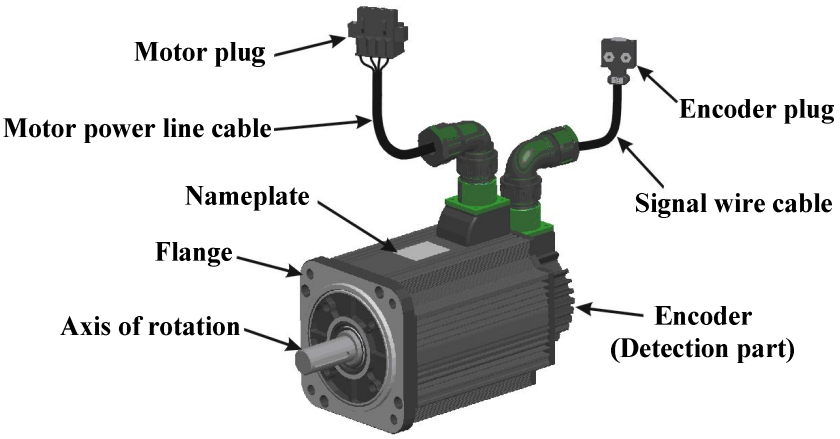
2. Model

Figure 10-2 Servo motor model description



10.2 Each part name of servo motor

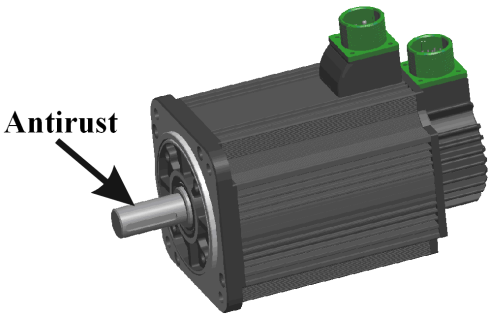
Figure 10-3 Each part name of servo motor



10.3 The installation of the servo motor

The installation of the servo motor should be in accordance with the manual. If motor is installed improperly or in the wrong place, the motor's service life would shorten, even may cause unexpected accident. The shaft end of the servo motor had been daubed with antirust additive, so please clear the antirust additive before installation.

Figure 10-4 The location of antirust



1. Installation site

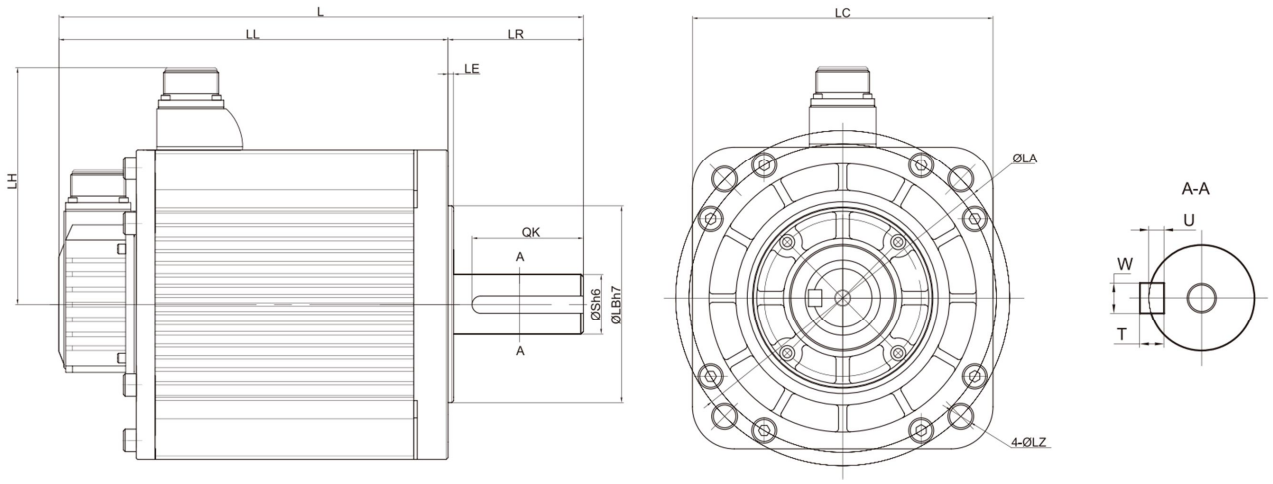
The servo motor should be installed inside the room and the following ambient conditions be satisfied:

- There is no corrosive, inflammable and explosive gas.
- Draughty, no dust and dry.
- The ambient temperature for operation is within the limit of 0～40℃.
- Storage temperature: - 10℃～50℃.
- The relative humidity keeps in the limits of 30%～95%RH; No moisture condensation.
- Be convenient for examining and clearing.

2. Installation dimension

180 series motor dimensions:

Figure 10-5 The 180 series motor installation dimensions



Servo motor model	Unit	180EMA/D-				
		143	191	255	287	382
L	mm	307(375)	322(390)	342(410)	362(430)	397(465)
LL	mm	228(296)	243(311)	263(331)	283(351)	318(386)
LH	mm	138	138	138	138	138
LR	mm	79	79	79	79	79
LA	mm	200	200	200	200	200
LB	mm	114.3	114.3	114.3	114.3	114.3
S	mm	35	35	35	35	35
LC	mm	180	180	180	180	180
LE	mm	3.2	3.2	3.2	3.2	3.2
LZ	mm	13.5	13.5	13.5	13.5	13.5
QK	mm	65	65	65	65	65
W	mm	10	10	10	10	10
T	mm	8	8	8	8	8
U	mm	5	5	5	5	5

Note: The dimensions in brackets is the size of motor with brake.

3. Installation direction

The servo motor can be installed horizontally, vertically, or in any direction.

4. Dampproof and dustproof

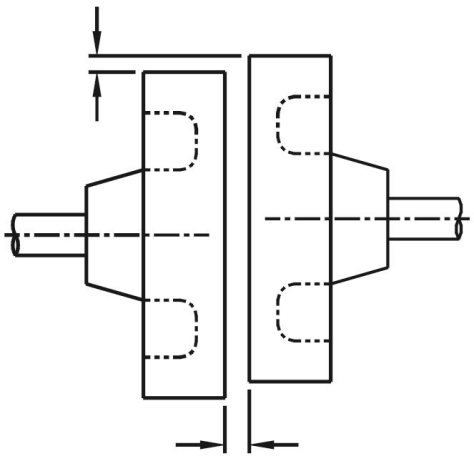
1. When being used in the place with water-drop dripping, please employ it on the base of confirming the servo motor’s protection framework (except the shaft opening part).

2. When being used in the place where there is oil-drop dripping to the shaft opening, please appoint servo motor with oil seal. Please make sure the oil level is lower than the oil seal's lip while using, and the oil seal can keep the splashing oil-foam in good condition. When using servo motor above the shaft, please confirm there is no oil-logged of the oil seal's lip.
3. When the aviation plug (the leads outlet) can only be installed upwards, please keep the cable baggy to prevent oil and water. Meanwhile, the cable mustn't be soaked in water or oil.

5. Coordination with machine

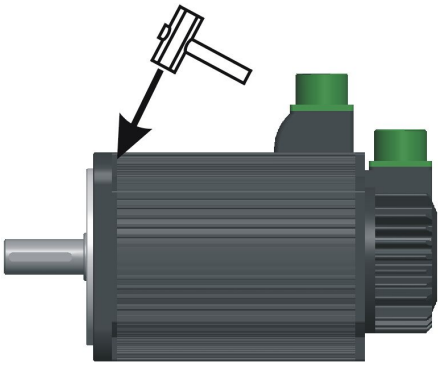
1. When connecting with machine, please use elastic couplings as far as possible, and keep the axle centre of servo motor is in a line with that of mechanical load. The installation of servo motor should meet the demand of concentricity tolerance as the following chart shows.

   To measure in the quartering of a round, the difference of the maximum and the minimum is less than 0.03mm (rotating with coupling).

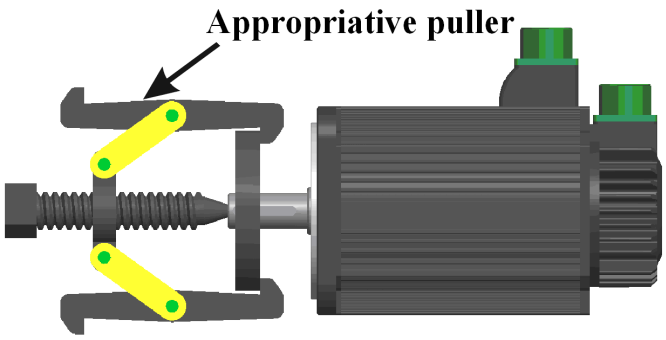


⚠ WARNING	➢ If the concentricity were out of tolerance, it would cause mechanical vibration which may damage the bearings and encoder.

2. The encoder is installed in the back end cap of the motor, connecting directly with motor shaft. Do not thump the motor. If to knock the motor is inevitable because of positioning or any other reason, please knock the front end of flange plate with rubber hammer or plastic hammer as far as possible.

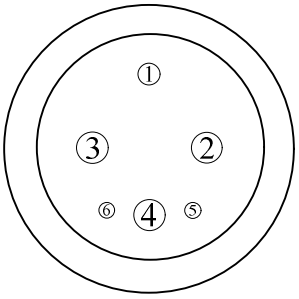


3. For removing wheel and pulley, please use an appropriative puller.



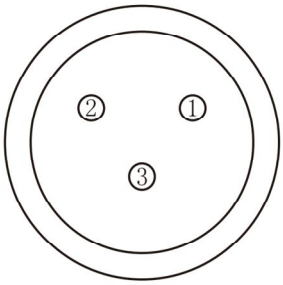
10.4 Terminal signal definition of servo motor

1. Motor connector terminals



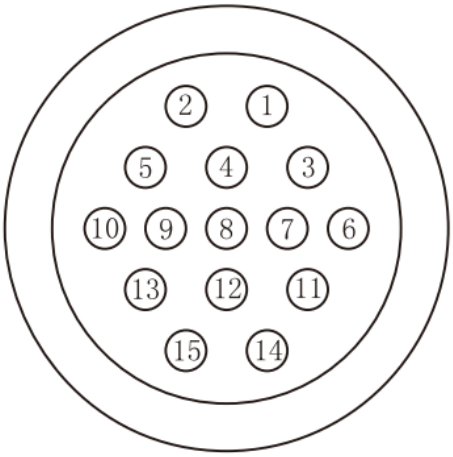
Pin	1	2	3	4
Signal definition	PE	U	V	W

2. Brake connector terminals



Pin	1	2
Signal definition	+24V	0V

3. Encoder feedback terminals



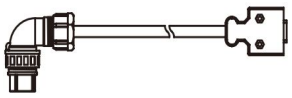
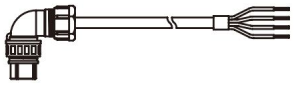
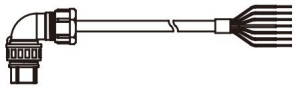
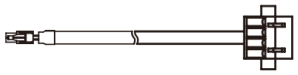
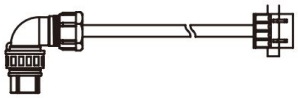
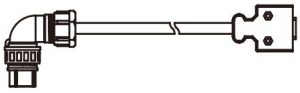
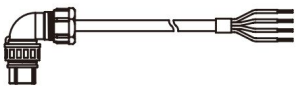
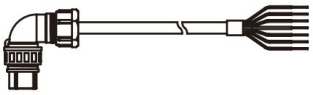
Pin	Signal definition			
	Incremental encoder	**Wire-saving encoder**	**Absolute encoder**	**Resolver**
1	FG	FG	FG	FG
2	+5V	+5V	+5V	
3	0V	0V	0V	
4	A	A		R1
5	B	B	SD+	R2
6	Z	Z	VB+	SIN+
7	A-	A-	VB-	SIN-
8	B-	B-	SD-	COS+
9	Z-	Z-		C0S-
10	U			
11	V			
12	W			
13	U-			
14	V-			
15	W-			

Appendix

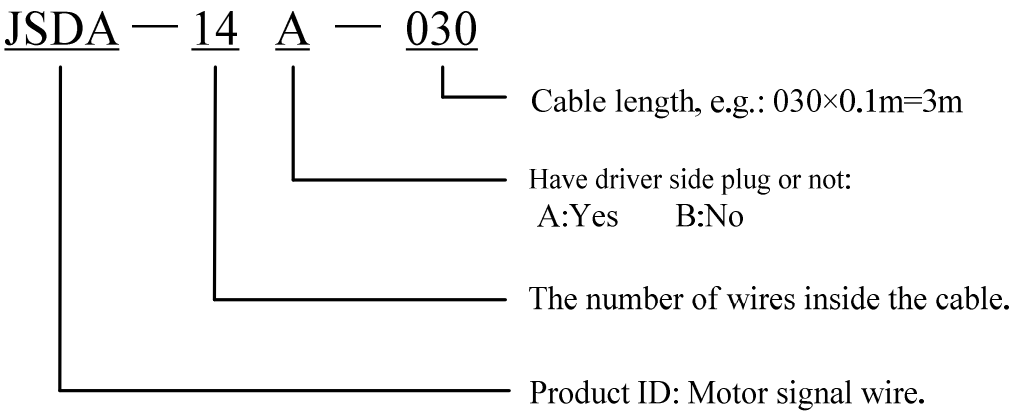
■ Motor adaptation table

Motor model code（Pn-001）	Motor model	Rated torque	Rated speed	Rated current	Rated power	Adapter driver
0	180EMD-143E	14.3Nm	1000rpm	5.2A	1.5KW	ESDC-xxBxx (AC380V)
1	180EMD-191E	19.1Nm	1000rpm	6.8A	2.0KW	
2	180EMD-239E	23.9Nm	1000rpm	8.8A	2.5KW	
3	180EMD-287E	28.7Nm	1000rpm	10.7A	3.0KW	
4	180EMD-382E	38.2Nm	1000rpm	12.3A	4.0KW	
5	180EMD-478E	47.8Nm	1000rpm	13.1A	5.0KW	
10	180EMD-159D	15.9Nm	1500rpm	6.8A	2.5KW	
11	180EMD-191D	19.1Nm	1500rpm	8.5A	3.0KW	
12	180EMD-255D	25.5Nm	1500rpm	14.1A	4.0KW	
13	180EMD-287D	28.7Nm	1500rpm	13.5A	4.5KW	
14	180EMD-382D	38.2Nm	1500rpm	15.0A	6.0KW	
15	180EMD-478D	47.8Nm	1500rpm	16.0A	7.5KW	
20	180EMD-143C	14.3Nm	2000rpm	9.2A	3.0KW	
21	180EMD-191C	19.1Nm	2000rpm	12.3A	4.0KW	
22	180EMD-239C	23.9Nm	2000rpm	16.4A	5.0KW	
23	180EMD-287C	28.7Nm	2000rpm	16.1A	6.0KW	
24	180EMD-382C	38.2Nm	2000rpm	19.3A	8.0KW	
30	180EMA-143E	14.3Nm	1000rpm	8.6A	1.5KW	ESDC-xxAxx (AC220V)
31	180EMA-191E	19.1Nm	1000rpm	11.3A	2.0KW	
32	180EMA-239E	23.9Nm	1000rpm	19.5A	2.5KW	
33	180EMA-287E	28.7Nm	1000rpm	22.5A	3.0KW	
34	180EMA-382E	38.2Nm	1000rpm	27.0A	4.0KW	
35	180EMA-478E	47.8Nm	1000rpm	31.0A	5.0KW	
40	180EMA-159D	15.9Nm	1500rpm	11.9A	2.5KW	
41	180EMA-191D	19.1Nm	1500rpm	15.0A	3.0KW	
42	180EMA-255D	25.5Nm	1500rpm	20.1A	4.0KW	
43	180EMA-287D	28.7Nm	1500rpm	21.6A	4.5KW	
44	180EMA-382D	38.2Nm	1500rpm	27.1A	6.0KW	
45	180EMA-478D	47.8Nm	1500rpm	36.2A	7.5KW	
50	180EMA-143C	14.3Nm	2000rpm	16.1A	3.0KW	
51	180EMA-191C	19.1Nm	2000rpm	22.5A	4.0KW	
52	180EMA-239C	23.9Nm	2000rpm	26.3A	5.0KW	
53	180EMA-287C	28.7Nm	2000rpm	32.3A	6.0KW	
54	180EMA-382C	38.2Nm	2000rpm	36.2A	8.0KW	

■ Cable model

Name	Model	Specification	Name	Model	Specification
Power cable	JSMA-04A□□□		Encoder cable	JSDA-14A□□□	
	JSMA-04B□□□			JSDA-14B□□□	
	JSMB-04A□□□			JSDB-09A□□□	
	JSMB-04B□□□			JSDB-09B□□□	
	JSMC-04A□□□			JSDC-09A□□□	
	JSMC-04B□□□			JSDC-09B□□□	
	JSMD-04A□□□		Resolver cable	JSRA-09A□□□	
	JSMD-04B□□□			JSRA-09B□□□	
			Absolute encoder cable	JSAB-09A□□□	
				JSAC-09A□□□	

■ Motor signal line (encoder line) cable type description



■ Motor power cable type description