This user manual describes all proceedings concerning the operations of the drive unit in detail as much as possible. However, it is impractical to give particular descriptions for all unnecessary or unallowable system operations due to the manual text limit, product specific applications and other causes. Therefore, the proceedings not indicated herein should be considered impractical or unallowable.

Dear user,

It's our great pleasure for your patronage and purchase of this DAP01 AC Spindle Servo Drive Unit made by GSK CNC Equipment Co., Ltd.

GSK PROFILE

GSK, GSK CNC Equipment Co,. Ltd, is the largest CNC system production and marketing enterprise in China at present. It is the Numerical Control industrial base of South China and the undertaking enterprise of the national 863 main project Industrialization Support Technology for Medium Numerical Control System. It is also one of the 20 key equipment manufacture enterprises in Guangdong province. It has been taking up the research and development, design and the manufacture of machine CNC system (CNC device, drive unit and servo motor) in recent 10 years. Now it has developed into a large high-tech enterprise integrated with technology, education, industry and trade by enhancing the popularization and trade of CNC machine tools. There are more than 1400 staffs in this company that involves 4 doctors, more than 50 graduate students and 500 engineers; more than 50 among these staffs are qualified with senior engineer post titles. The high performance-cost ratio products of GSK are popularized in China and Southeast Asia. And the market occupation, the turnout and sale of GSK's product rank the top for successive 7 years among the same products in domestic market from the year 2000 to 2006, which makes GSK the largest CNC manufacture base throughout China.

The main products of GSK includes: the CNC systems and devices of GSK series turning machine, milling machine, machining center, DA98, DA98A, DA98B, DA98D series full digital AC servo drive unit, DY3 series compound stepper motor drive device, DF3 series responsive stepper motor drive device, GSK SJT series AC servo motors, CT-L CNC slider and so on. The current national standard (and international standard), industry standard, as well as the enterprise standard (or enterprise internal standard) as a supplementary, are completely implemented in the production process. The capability of abundant technology development and complete production and quality system qualified by GSK will undoubtedly ensure the reliable products to serve our customers. 24~48 hours technological support and service can be easily and promptly provided by GSK's complete service mechanism and tens of service offices distributed in China and abroad. The pursuit of "excellent product and superexcellent service" has made GSK what it is now, and GSK will spare no efforts to continue to consummate this South China CNC industry base and enhance Chinese national CNC industry by GSK's management concept of "century enterprise, golden brand".

PREFACE

The installation, wiring, running, debugging, maintenance for this DAP01 Full Digital AC Spindle Servo Drive Unit are fully introduced in this manual. It will give you a complete knowledge for using this drive unit effectively. And this manual also provides some necessary knowledge and notes for using this drive unit. You must have a comprehensive understanding on the notes about this drive unit before using it.

- **All specifications and designs are subject to change without notice.**
- **We do not assume any responsibilities for the change of the product by user, therefore the warranty sheet will be void for this change.**
- **Chinese version of all technical documents in Chinese and English languages is regarded as final.**

This manual is reserved by final user.

Sincere thanks for your supporting of GSK's products.

Welcome you to give your suggestions about our product and ***User Manual*** by a telephone, fax or Email addressed on the back cover of this manual, or send a feedback to our headquarter by our local outlets.

In order to fully enable this AC spindle servo drive unit and ensure your safety, please read this manual carefully before using this product. You should operate this drive unit strictly by the precautions and operation procedures described in the manual.

WARNINGS

In order to avoid physical hurts to the operator or other personnels, pay attention to the following warning marks when reading this manual:

- **The following warnings with varying degrees of severity appear in the User Manual, which is relative to the explanation of the operation safety marks. The explanation is very important for the compliance in the operation.**

Danger **It indicates that severe injury or death may be caused if false operation is performed.**

Caution **It indicates that accidents occur if false operation is performed which may cause medium degree injury, slight hurt or material loss.**

Note **It indicates that undesirable result or situation may occur if the note is neglected.**

It indicates the key requirement or instructions of operation.

- **The following symbols indicate some operations that must not or must be performed.**

It indicates prohibition (absolutely not do).

It indicates compulsion (must do).

In addition, even items stated in the Note mark may result in serious result.

Danger

Please secure the wiring terminals by proper force

Fire may occur for wiring loosing spark if not observed

Please fix the drive unit , brake resistances on the inflammable objects and far from flammable materials

Fire may occur if not observed

Ensure the input power disconnection before wiring

Electric shock may occur if not observed

Please fix breaker,interference filter and AC reactor

Lightning strike , fault or damage may occur if not observed

Please do wiring or checkout by special electrical technicians

Electric shock or fire may occur if not observed

Move，wiring，checkout or maintenance should be done in 10 minutes after power cut off

Electric shock may occur if not observed

PE terminal of servo unit should be grounded

Electric shock may occur if not observed

Please fix emergency stop switch

Injury , fault or mechanical damage may occur if not observed

Danger

Ensure wiring correctness

Equipment damage and electric shock may occur if not observed

Secure power terminals and motor leading—out terminals

Fire may occur if not observed

Don’t open the terminal block’scover during power on or running

Electric shock may occur if not observed

Don’t touch the wiring terminals of the drive unit main circuit

Electric shock may occur if not observed

Don’t operate the switch by wet hand

Electric shock may occur if not observed

Don’t stick hands into the servo unit

Electric shock may occur if not observed

Abrupt start may occur if power is restored，so don’t operate the spindle motor coupling immediately

Injuries may occur if not observed

Don’t prevent heat dissipation or place objects inside the radiating fan or the radiator

Fire or damage may occur if not observed

Danger

Don’t place the cable by the sharp edge for loading and hauling

Electric shock， fault or damage may occur if not observed

Don’t operate the spindle driver at power on while the terminal block’s cover is dismantled

Electric shock may occur if not observed

⚠ Caution

Please do wiring between drive unit and motor strictly by the wiring diagram

Equipment damage may occur if not observed

Use the voltage levels by the manual for the terminals

Equipment damage may occur if not observed

Run with load after motor no - load trial run success

Equipment damage may occur if not observed

Please eliminate alarm prior to running after alarm occurring

Equipment damage may occur if not observed

Please connect brake resistance by wiring diagram

Equipment damage may occur if not observed

Motor should be suited with proper servo unit

Equipment damage may occur if not observed

Please don’t redo,dismantle or repair the drive unit in private

Equipment damage may occur if not observed

Don’t grip motor cables and shaft during transportation

Equipment damage may occur if not observed

⚠ Caution

Don't touch motor, brake resistance or servo unit radiator during running for the high temperature generated

Scalding may occur if not observed

Don't adjust and modify the parameters in an extreme way

Equipment damage may occur if not observed

Don't connect the power R, S, T leading-in wires to the motor U, V, W leading-out terminals

Equipment damage may occur if not observed

Don't run the drive unit if its components are lacked or damaged and contact the dealer immediately

Equipment damage may occur if not observed

The internal electronic components of a rejected drive unit can only be tackled as industrial waste and can't be repeatedly used

Accident may occur if not observed

Don't frequently switch on/ off the leading-in power

Equipment damage may occur if not observed

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CHAPTER 1 OVERVIEW

1.1 Product Brief

DAP01 AC spindle servo drive unit is a fully digital AC servo drive unit with large power, high reliability and high quality, which is exclusively developed by GSK based on China medium CNC machine tools development requirement. It is also called DAP01 drive unit or drive unit for short.

This drive unit is applied with the special digital signal processing module (DSP) massive programmable logic matrix (CPLD) and intelligent power module (IPM). Based on the advanced asynchronous motor vector control theory, this drive unit designed is qualified with the features such as small volume, simple and flexible control function, full state display, wide timing ratio and high reliability. It is suitable for the high-speed and stable spindle servo control required by the turning machines, milling machines, machine centers and so on.

In addition such functions as internal speed control, external speed control, JOG running, (Sr) trial run, spindle orientation are available by this drive unit. Different applications can be met by the proper setting of the drive unit working mode, running characteristics. And the simple operation, abundant I/O interfaces and multi-level protections provide a full guarantee for using.

JOG run

A fixed speed is preset by the user to the parameter. By the operator panel keys'▲、▼', it runs forward or reversely by the preset speed with no need for I/O signal control from CN1 interface.

(Sr) trial run

Similar to JOG run, the manual continuous acceleration, deceleration control can be obtained by the operator panel keys of '▲、▼' with no need for I/O signal control from CN1 interface.

Internal speed control

By the 7 span speeds preset written to the parameters by user, the spindle servo motor can run at 7 different speed spans by controlling the input combination of SP0, SP1, SP2 input points and it needs no external commands.

External speed control

It is also called analog instruction control mode. The precise spindle servo motor speed can be stably and smoothly adjusted by the analog voltage instructions given by upper machine or user independently.

Positioning function

This drive unit can be rapidly and precisely positioned to a preliminary position by the feedback pulses from the spindle servo motor encoder or the encoder connected to the spindle in order to change or measure the tools. This function also includes the single-point positioning, continuous multi-point positioning.

1.2 Reception Check

Check

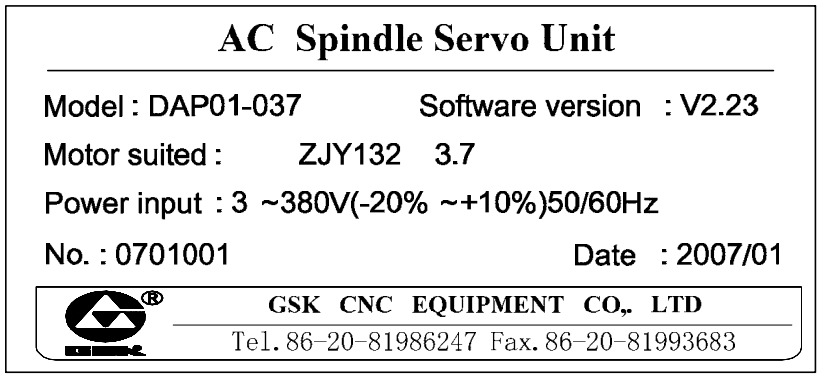
1) Whether the packing is good and goods is damaged.
2) Whether the spindle servo drive unit, spindle motor are the ordered ones by checking the nameplates of the goods.
3) Whether the accessories are complete by checking the packing list.
4) Please contact us or our suppliers if you have any questions after receiving your goods ordered.

Packing list：		
	DAP01 drive unit	1
	Suited brake resistance	1
	User manual for DAP01 drive unit	1
	Quality certificate	1

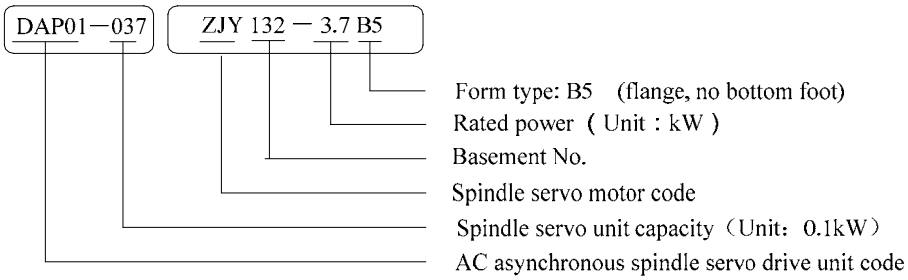
Note

The drive unit damaged or lacking of components can't be used.
Drive unit must be mated to the spindle motor with the suited performance.

Nameplate pattern

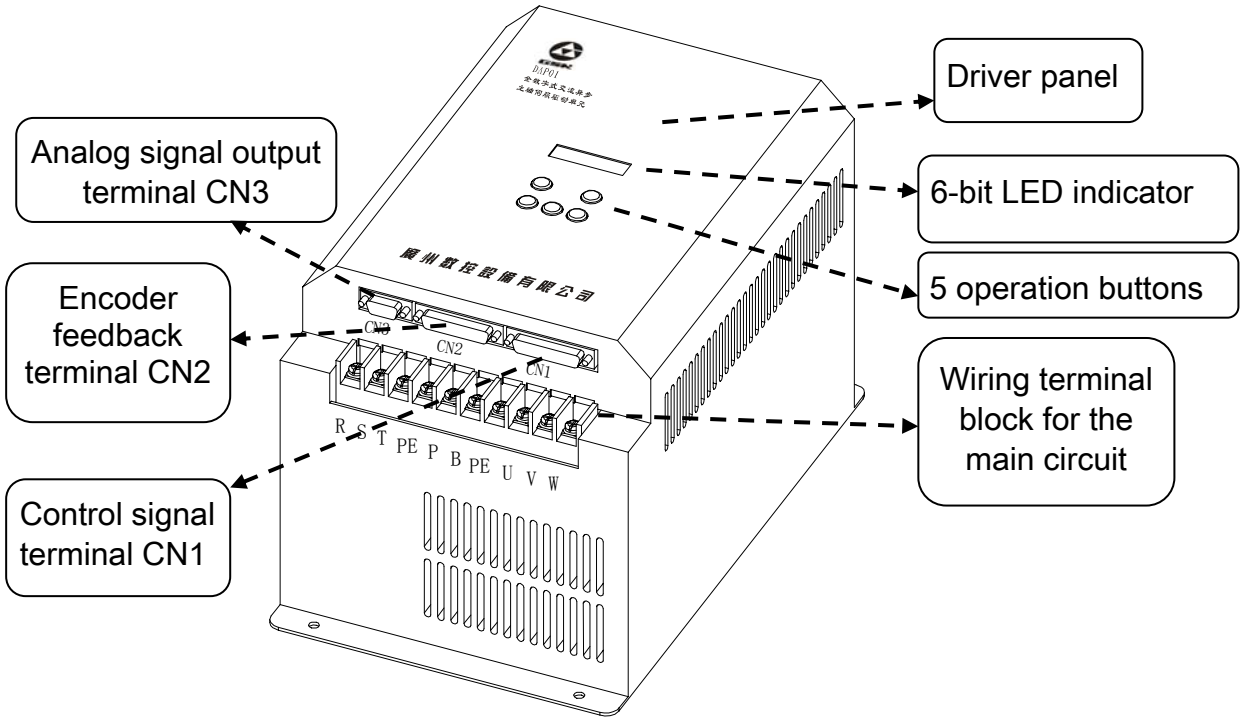


Model significance

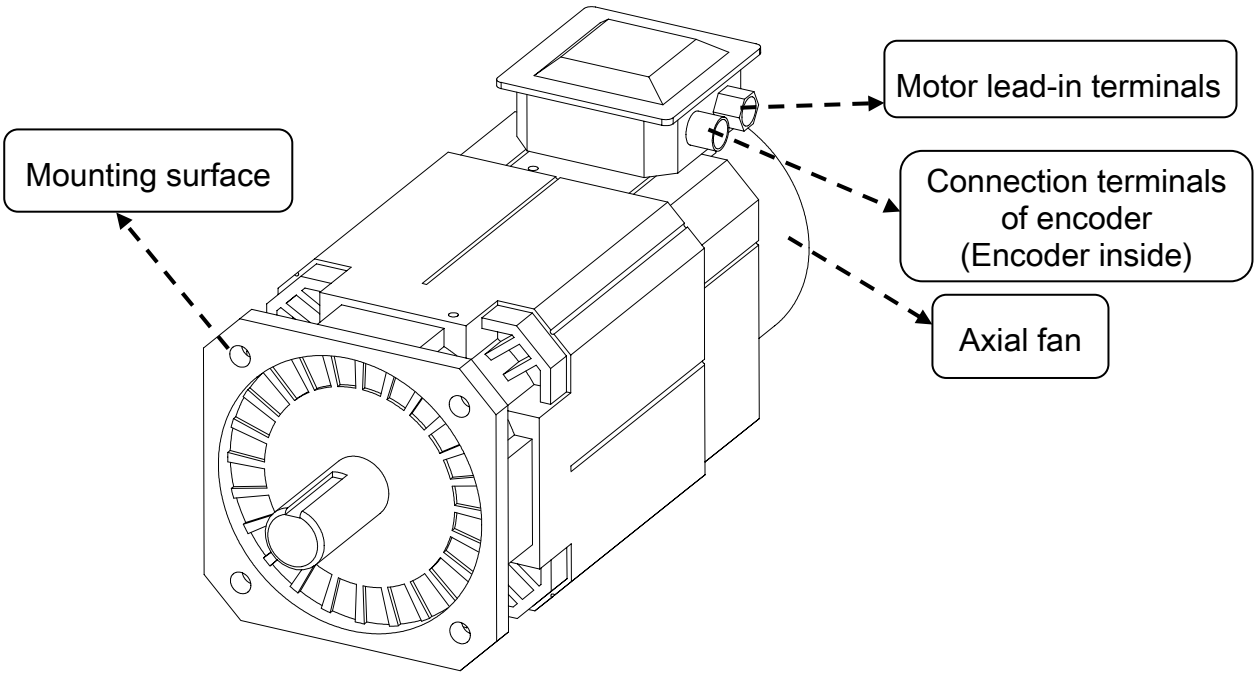


1.3 Product Outline

Spindle servo drive unit outline



Servo motor outline



CHAPTER 2 INSTALLATION AND SPECIFICATION

For the direct influence to the functions and life of this DAP01 spindle servo drive unit by the environment where it locates, do install it as the items stated below.

Note

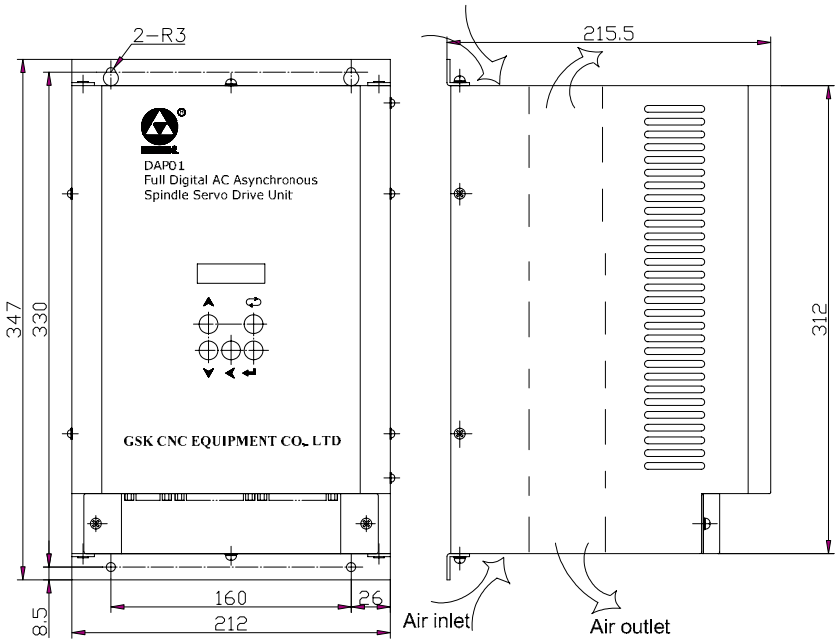
- **Be careful for the protection against rain and straight sunlight.**
- **The servo unit must be fixed in an electrical cabinet to prevent dust, corrosive gas, liquid, conductors and inflammable substances from entering it.**
- **The place where the servo unit is fixed should be ventilative, dampproof and dustproof.**
- **Don't fix the servo unit on or near the inflammable object.**
- **Please run the servo unit in a temperature below 55℃ to ensure a reliable long term use.**

2.1 Fixing Environment

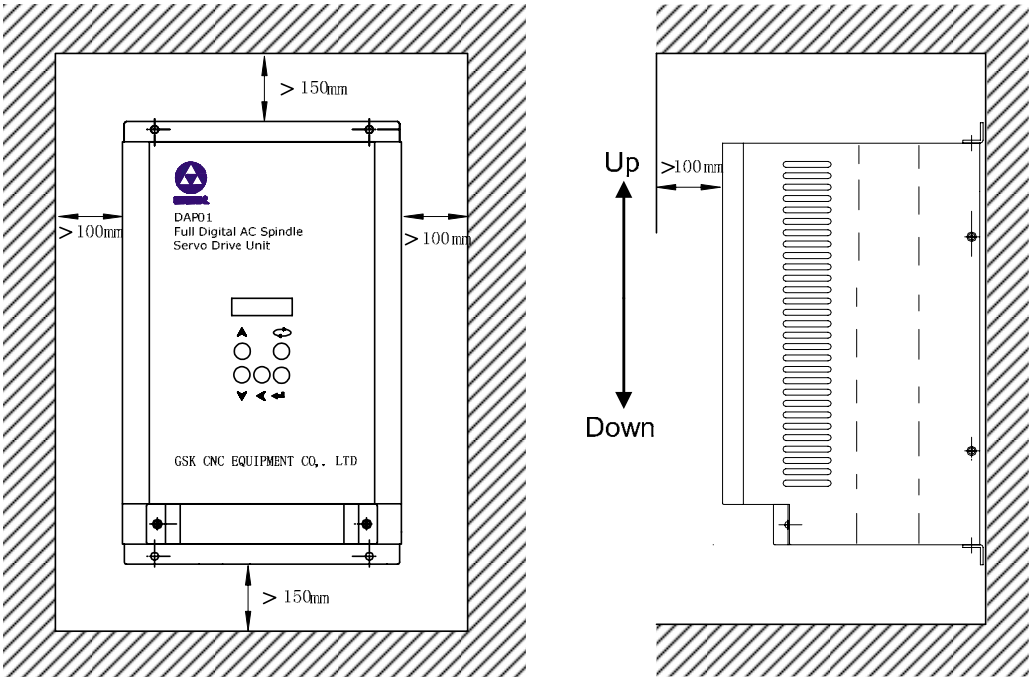
Item	DAP01 drive unit
Running temperature	-10℃～55℃（no frosting） ≤90%RH（no condensation）
Storage/delivery temperature and humidity	-40℃～80℃ ≤90%RH（no condensation）
Atmospheric environment	There should be no corrosive gas，flammable gas, oil fog or dust etc. in the cabinet.
Altitude	Altitude: below 1,000m
Vibration	≤ 0.6G（5.9m/s^2）
Atmospheric pressure	86KPa～106KPa
Guard level	IP43

2.2 Installation Dimension and Space

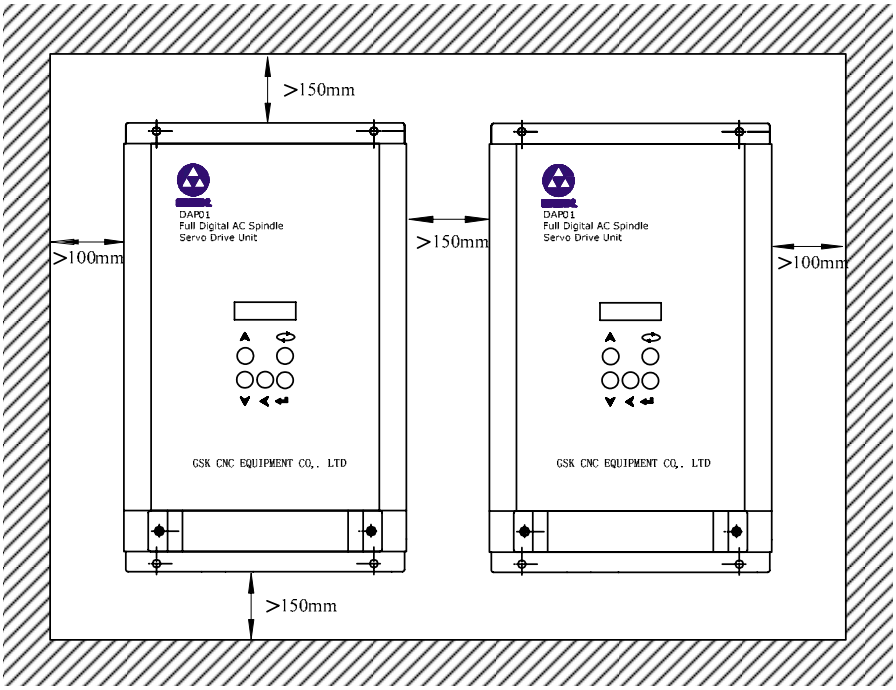
The unit is employed with bottom board installation pattern and its fixing direction is upright to the fixation plane. Face the front of the unit forward and bottom upward for heat dissipation. The fixation dimensions are shown as the right figure. (Unit: mm)



Installation clearance:



Fixing clearance for single drive unit



Fixing clearance for multiple drive units

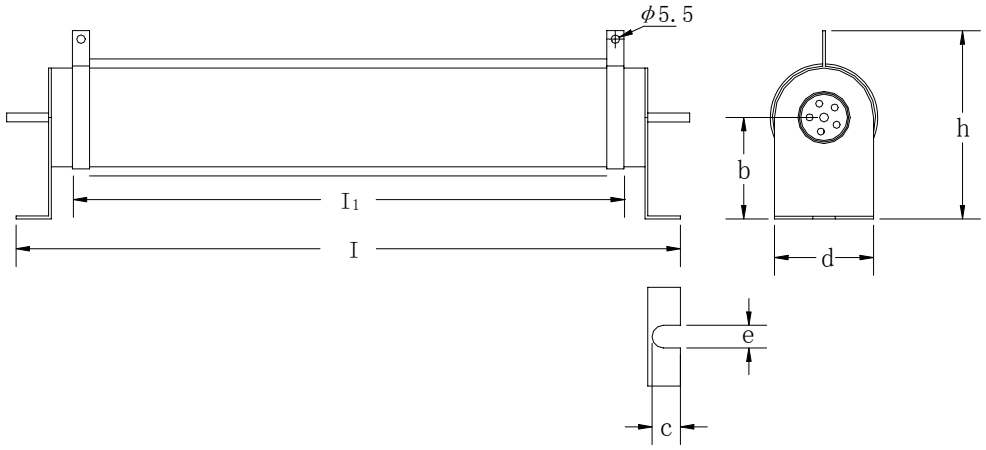
Note

- **Multiple units should only be fixed side by side for a better heat dissipation.**
- **Keep the drilling swarf, wire ends etc. out of the drive unit during the cabinet installation.**
- **Keep the oil, water, metal material etc. in the cabinet from entering the drive unit during its using.**
- **In the place that harmful gas and dust exit, do ventilate the cabinet by clean air to prevent them from entering the cabinet.**
- **Brake resistances can only be installed beside the drive unit, and they are not allowed to be installed up and down.**

2.3 Dimensions and Installation of Brake Resistance

Dimensions of brake resistance

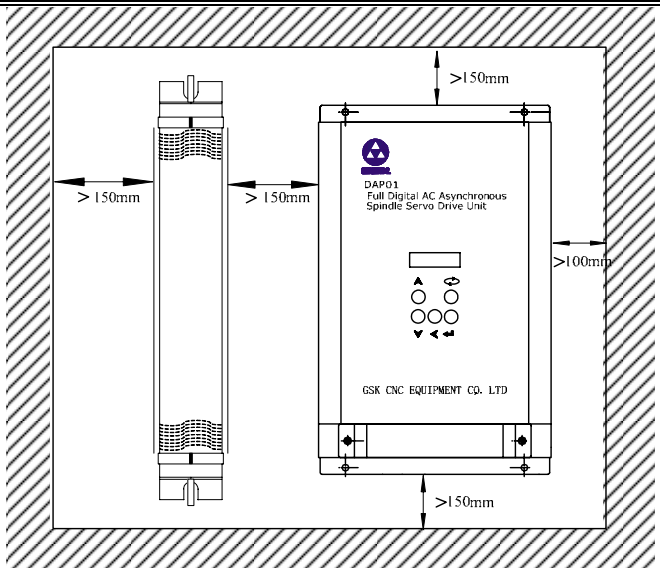
Output capacity of drive unit (kW)	Brake resistance power (W)	Brake resistance value (Ω)	Max braking current (A)	Installation dimensions (mm)						
				l	l_1	h	b	c	d	e
3.7	500	33	25	356	300	95	45	16	50	6.2
5.5			25							
7.5	1500	27	25	475	415	135	70	20	68	8.2
11			25							



Note

The brake unit begins making brake as the DAP01 drive unit bus voltage reaches 680V. If user chooses the brake resistance, it should meet the equation $\frac{680}{R} \leqslant 25A$, in which R is brake resistance value.

Installation of the brake resistance



2.4 Servo Drive Unit Specification

Drive unit model	DAP01-037	DAP01-055	DAP01-075	DAP01-110
Continuous output power (S1)	3.7kW	5.5kW	7.5kW	11kW
30min output power (S3)	5.5kW	7.5kW	11kW	15kW
Input power	3-phase AC380V（－15%～＋10%） 50/60Hz			
Working mode	Internal speed run, external speed run, Jog run, trial run			
Constant torque timing ratio	1000:1(speed range of suited motor :1.5 r/min～1500 r/min)			
Constant power timing ratio	4:1(speed range of suited motor :1500 r/min～6000r/min)			
Speed stability precision	Bottom speed (rated speed)×0.1%			
Speed control mode	Speed closed loop control with speed feedback			
External speed command input	－10V～+10V or 0 V～10V			
Speed feedback input	1024p/r Incremental rotary encoder, A/B/Z differential signal			
Positioning function	For 8 positioning points setting of motor(spindle) encoder, motor (spindle) positioning is started with positioning points chosen by external trigger signal, positioning angle error≤180º/encoder pulses			

Spindle position feedback input	Incremental rotary encoder, 128~8000p/r pulses setting, A/B/Z differential signal	
Position feedback output	Motor or spindle encoder signal 1:1 output, A/B/Z differential signal	
Control input signal	11 points input such as servo enable/ zero-speed clamping /SFR/ SRV/ speed (positioning point) selection/ positioning start	
Control output signal	6 points output such as alarm/ ready/ speed in-position/ position completion/ zero-speed output/ motor Z pulse zero	
Protection	Protections such as overvoltage, undervoltage, overspeed, overcurrent, overload, overheating, encoder abnormity	
Display	6 bits LED, software and hardware version, working mode, current speed, speed command, encoder position/ status, current, torque, I/O mode, bus voltage, alarm codes, parameters etc. can be displayed	
Operation	5 keys available for operations of working mode, content display, parameter modification and management etc.	
External energy comsumption brake resistance	33Ω/500W	27Ω/1500W
Working temperature and humidity	-10℃～55℃（no frosting）, 90%RH below（no condensation）	
Vibration	≤0.6G(5.9m/s^2)	
Protection degree	IP20	

CHAPTER 3 SYSTEM CONFIGURATION AND WIRING

⚠ Caution

- **Wiring should be done by the qualified technicians according to the user manual.**
- **The wiring or overhauling should be done in 10 minutes after the drive unit is cut off on the condition that the safe voltage has been confirmed by multimeter, or electric shock may occur.**
- **Ensure the drive unit and the spindle servo motor grounding to be right.**
- **Don't hurt or drag the cables during wiring, or electric shock may occur.**
- **Don't make the main circuit and signal cables to go through the same channel, or tied them up together. The main circuit and signal cables should be assigned separately or intersectionally with an interval of over 30 cm between them, or the drive unit may work abnormally by strong interference due to coupling generated.**
- **Don't switch ON or OFF power frequently due to the high charge current generated by the large capacitances inside the servo unit, and if ON/OFF power frequently, the main circuit elements performance in the drive unit will be decreased.**
- **Don't add device such as power capacitance, surge absorber and radio noise filter between the drive unit output terminal and the spindle servo motor.**

3.1 Peripherals Connection

Some peripherals are necessary for spindle servo unit. By choosing correct peripherals and connection by Fig.3.1, the spindle servo drive unit stable running can be ensured for a long term. Otherwise it will shorten the life of this drive unit, even damage it.

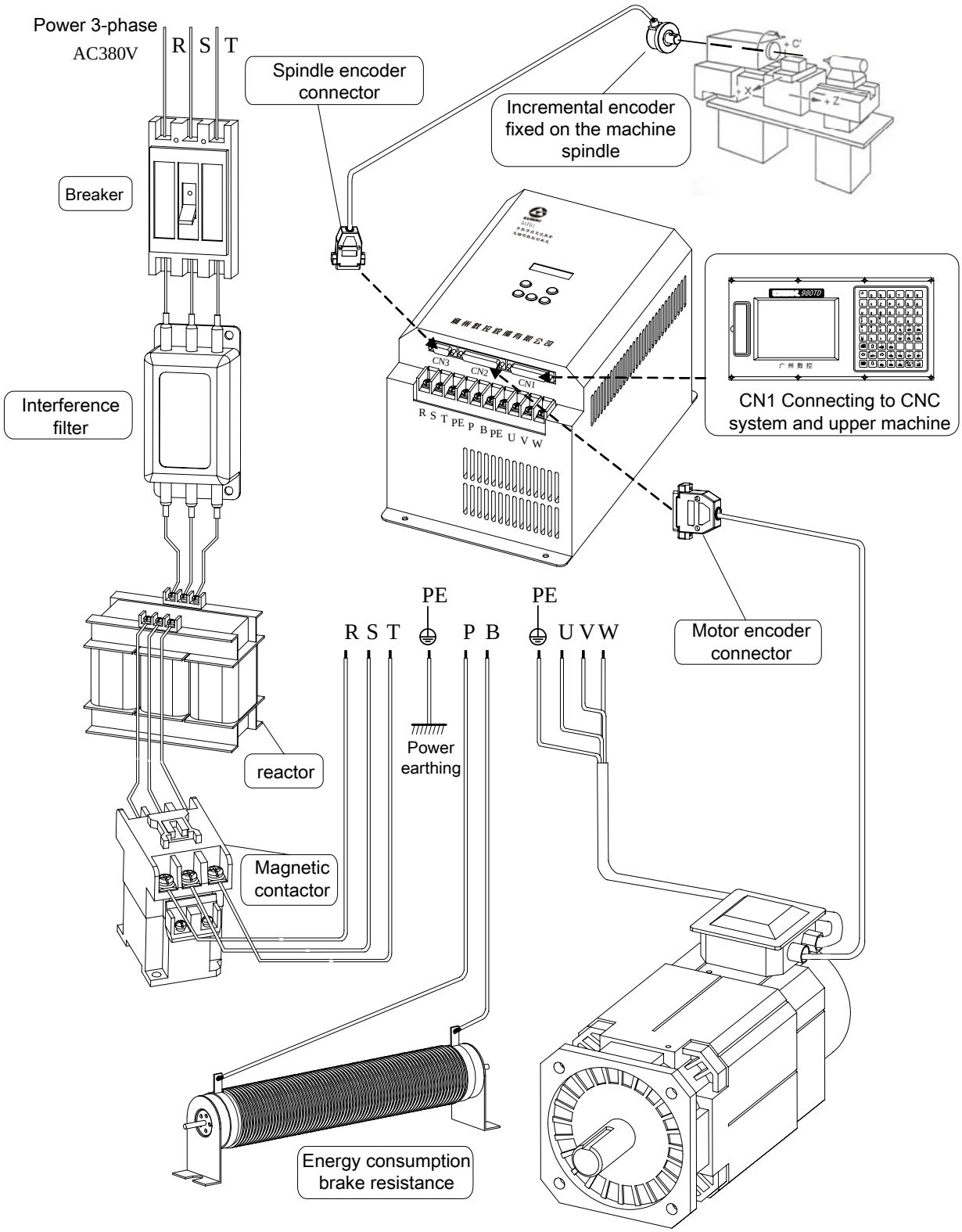
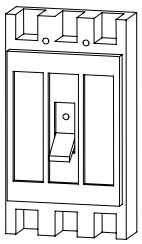
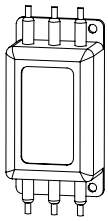


Fig.3.1 Peripherals connection



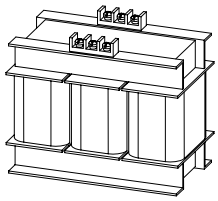
For power wires protection, used to cut off circuit as overcurrent occurs

Breaker (MCCB)



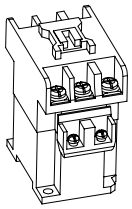
For protection against external interference from power wires

Interference filter (FIL)



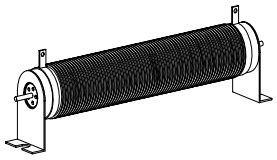
For stable motor running characteristic by improving the power factor

AC reactor



Used to switch on/off spindle servo unit power, please install surge inhibitor in using

Magnetic contactor



Don’t touch the brake resistance for its high temperature by discharging

Energy consumption brake resistance

3.2 The Interior Wiring Block Diagram of DAP01 Drive Unit

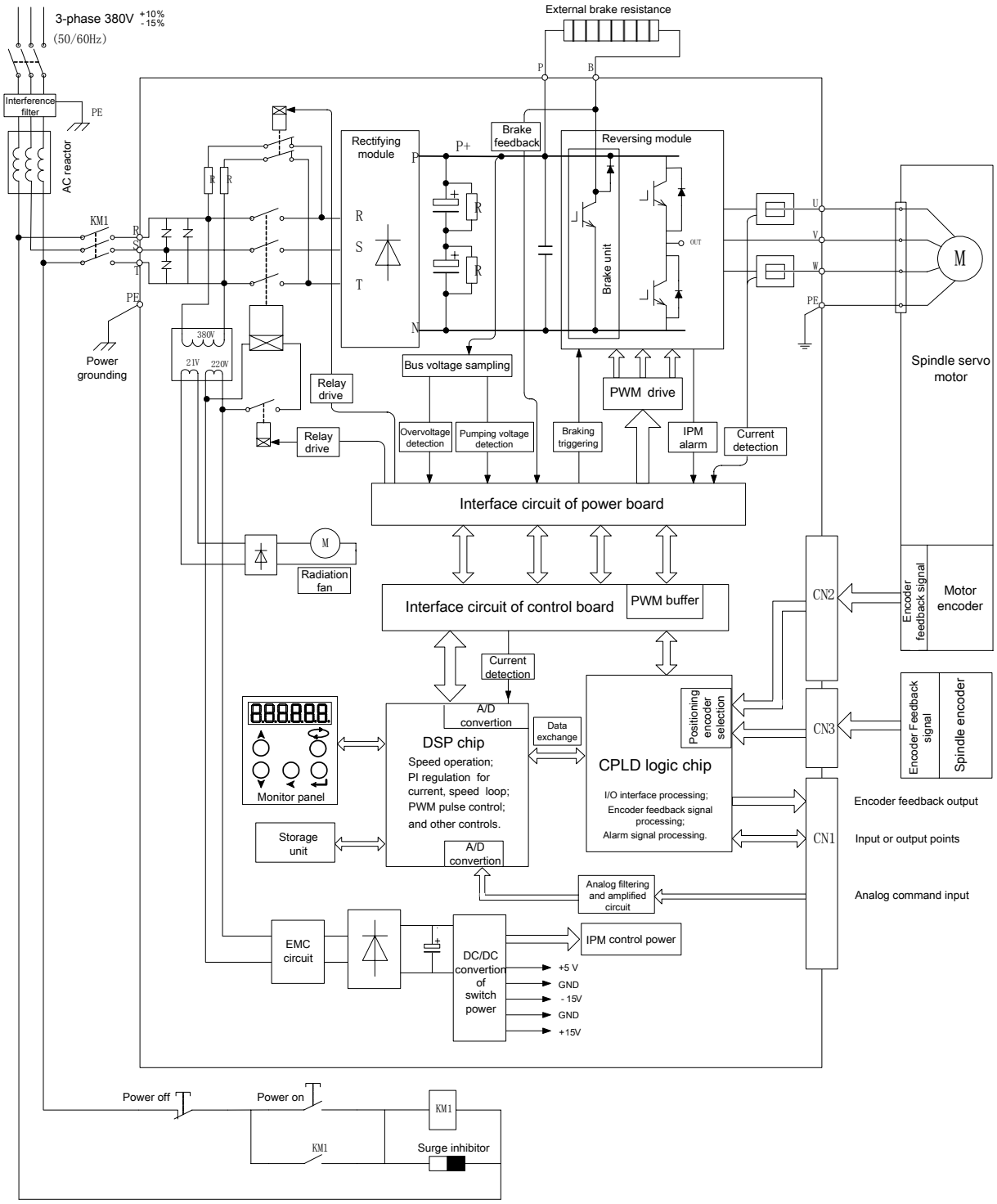


Fig.3.2 The interior wiring block diagram of DAP01 drive unit

3.3 Wiring of the Main Circuit

3.3.1 Standard wiring instance of the main circuit

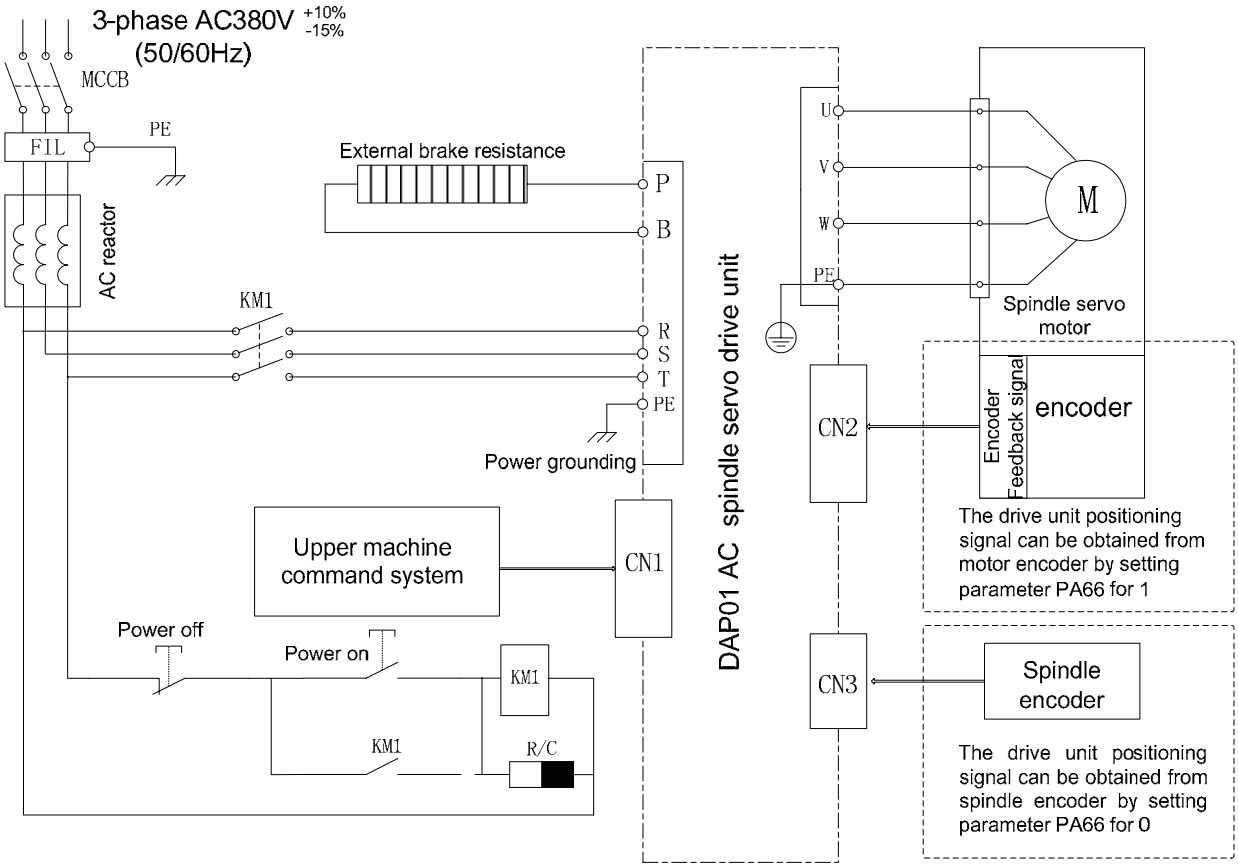


Fig.3.3 Standard wiring block diagram of the main circuit

3.3.2 Terminal functions of the main circuit

The wiring of the main circuit terminals is shown in figure above, and their functions are as following table:

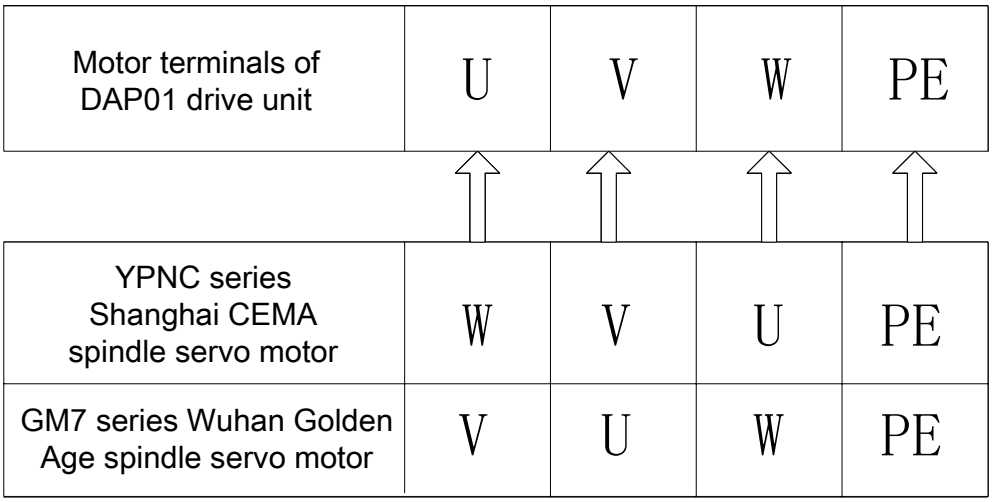
Table 3－1

Terminal	Terminal name	Function
R，S，T	AC power input terminal	3-phase AC380V (-15%～10%)
U，V，W	Motor connection terminal	This DAP01 drive unit output phase sequence may differ with the phase sequence of the motor，which can't be connected to U, V, W terminals of motor at will by user, see the following warning for operation.
P，B	Brake resistance terminal	They are used for energy consumption brake.
PE	Grounding terminal	It is connected to the grounding terminals of power and motor for grounding.

Note

Due to the different manufacture standards of the spindle motors by various manufacturers, the U, V, W output terminal phase sequence of this DAP01 drive unit does not naturally correspond with the U, V, W phase sequence of the spindle servo motor one by one as for the motor connection . Generally, when the motor is enabled, if the motor shakes or the motor rotates by a constant speed without being controlled till the Err－27 alarm is issued, it means the motor phase sequence is wrong. Please exchange the two phases of them for use after the power is cut off for 10 minutes.

As regard to Version 2.x, the corresponding connections for several spindle servo motors and DAP01 drive units are shown in the following table.



3.3.3 Cable diameters and connection terminals

The cable and connection terminal specifications for the servo unit input terminals （R，S，T） and output terminals （U，V，W）are shown in following table:

Table 3-2

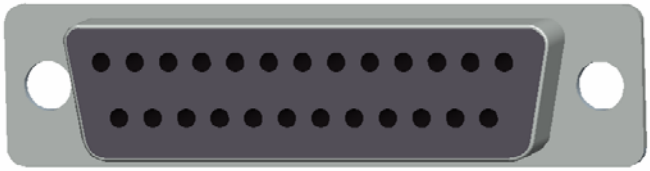
Power suited	**Terminal screw**	**Connection terminal dimensions**		**Cable diameter**		
		R,S,T	U,V,W	mm^2		
				R,S,T	U,V,W	Earthing cable diameter
DAP01-037	M5	2-4	2-4	2	2	2
DAP01-055	M5	5.5-4	2-4	3.5	2	3.5
DAP01-075	M5	5.5-4	5.5-4	3.5	3.5	3.5
DAP01-110	M6	5.5-6	5.5-6	5.5	5.5	8

3.4 I/O Signals and Connection

3.4.1 Wiring for feedback signal

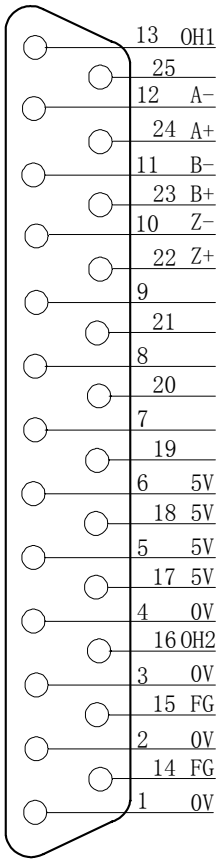
There are 2 feedback signal interfaces in DAP01 spindle servo drive unit, CN2 (DB25 female socket) and CN3 (DB9 female socket), i.e. for motor encoder feedback signal, spindle encoder feedback signal (encoder directly connected to the machine spindle as shown in Fig.3.1). User can choose motor encoder feedback signal or spindle encoder feedback signal as positioning encoder

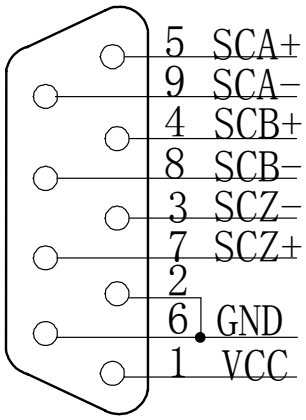
signal by setting parameter PA66 for 1 or 0 correspondingly. If positioning is not needed, motor encoder will do. If the automatic tool change for precision positioning is needed, the motor and spindle transmission ratio 1：1 should be ensured when there is no encoder fixed on spindle. Or the spindle encoder must be fixed as a positioning encoder.



Feedback signal interface CN2 of motor encoder

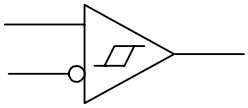
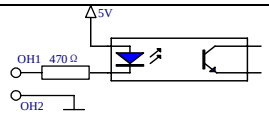
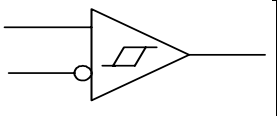
Feedback signal interface CN3 of spindle encoder





The interfaces of CN2 and CN3 should be connected to signal output terminals of the incremental encoder having 1024, 2500, 5000 pulses, just set the parameter PA67 for the corresponding pulse value for using.

Table 3—3

Interface	Terminal name	Terminal meaning	Interior circuit principle
CN2	A+/A-	A+/A- differential signal input terminal of motor encoder	
	B+/B-	B+/B- differential signal input terminal of motor encoder	
	Z+/Z-	Z+/Z- differential signal input terminal of motor encoder	
	OH1/OH2	Input terminals of overheat protector for spindle servo motor, and OH2 connecting inside 5V grounding	
	5V/0V	DC 5V power for motor encoder	
	FG	Grounding of signal cable shielding	
CN3	SCA+/SCA-	A+/A- differential signal input terminal of spindle encoder	
	SCB+/SCB-	B+/B- differential signal input terminal of spindle encoder	
	SCZ+/SCZ-	Z+/Z- differential signal input terminal of spindle encoder	
	VCC/GND	DC 5V power for spindle encoder	

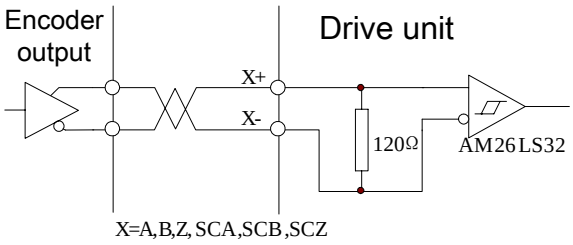


Fig.3.4 Wiring principle of encoder feedback signal cables

Note

- **The cable length between the drive unit and spindle motor should be within 20 meters.**
- **The distance between feedback cables of encoder and main circuit cables should be over 30cm, their cables should not go through the same tunnel or be tied up together.**
- **Twisted shield cable with the sectional sizes 0.15mm²～0.20mm² should be employed for feedback signal cable, and the shielding tier should be connected with FG terminal.**
- **The main circuit cables and wires should be well fixed as well as not to be adjacent to controller radiator or motor for their insulation protection against heating.**
- **If thermal resistance or other thermal protection switch is not fixed inside the motor, there will be an Er-5 alarm, and parameter PA73 is needed to be modified to shield the overheating alarm of the motor.**

The following wiring for GOLDEN AGE spindle servo motor encoder in Fig.3.5 is an example of motor encoder wiring. If other motor or self-made feedback signal cable is used, refer to this for encoder wiring.

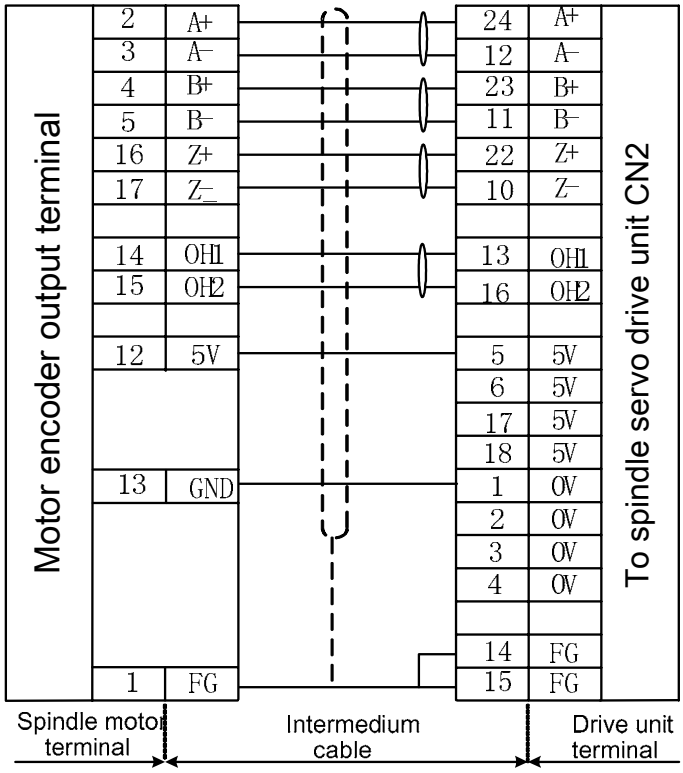


Fig. 3.5 Standard wiring for motor feedback signal cables

A standard wiring instance for spindle encoder by Japan Tamagawa TS5308N512 encoder:

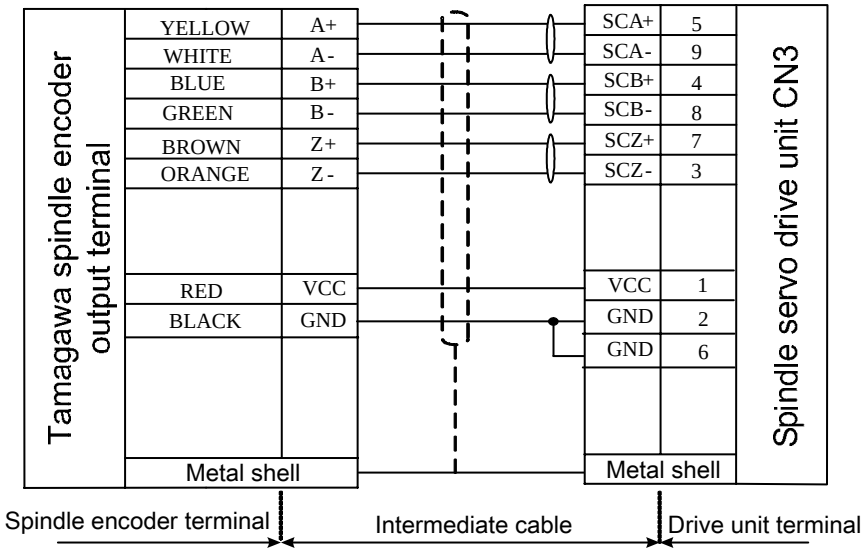
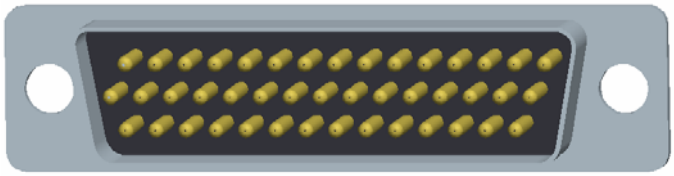
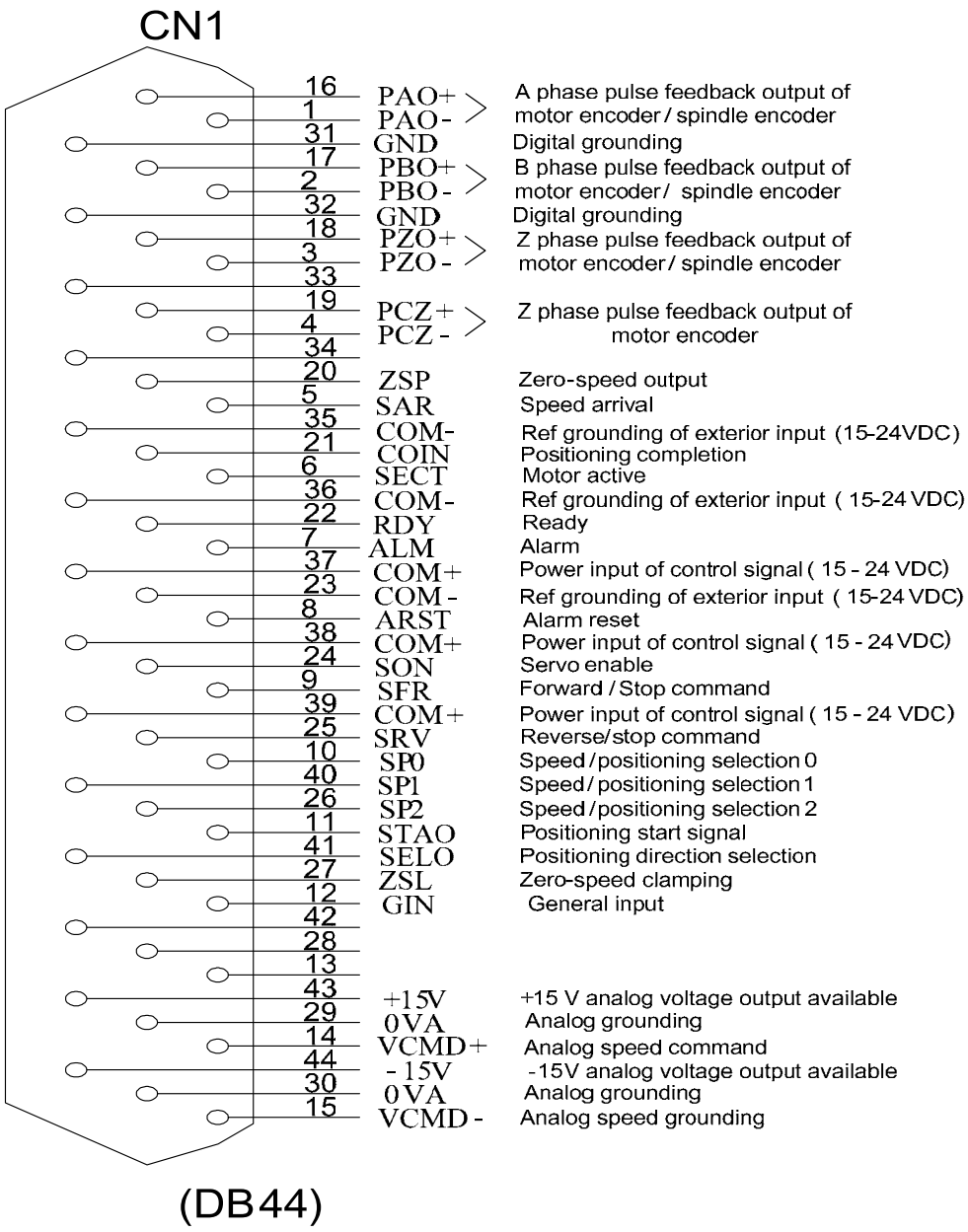


Fig. 3.6 Standard wiring diagram for spindle encoder feedback signal cables

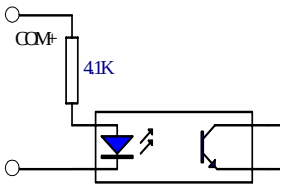
3.4.2 Wiring for control signal

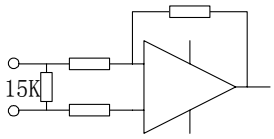
The control circuit interface is CN1 (DB44 male socket), the shielded or twisted-pair cable should be employed for the connection.



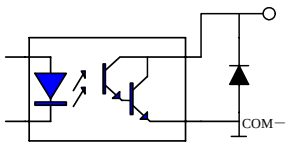


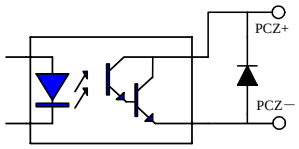
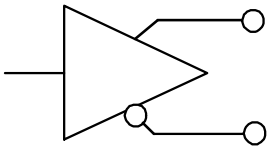
Description of input signal functions

Pinout No.	Sign	Function	Interior circuit principle
24	SON	Servo enable signal: When the input terminal is at low level, the motor is excited for ready state, once a command is entered, the motor starts to run (SRV or SFR signal is needed for motor excitation when the drive unit is running at the external speed control mode); When the input terminal is at high level, the motor is in free state that the running is disabled.	A pole side is connected to COM+ via a serial 4.1kΩ resistance for an interior photoelectric coupling; K pole side is connected to input terminal for a photoelectric coupling. 
9	SFR	SFR/stop signal: Err-7 alarm is issued if SFR and SRV signals are effective at the same time.	
25	SRV	SRV/stop signal: Err-7 alarm is issued if SFR and SRV signals are effective at the same time.	
11	STAO	Positioning start signal: As this input terminal is at low level, the servo unit executes positioning function, if it finds the positioning point, the control will be clamped at this point.	
41	SECO	Positioning direction selection signal	
10	SP0	As the double terminals for internal speed/positioning selection, SP0, SP1,SP2 are only regarded as the combination terminals for internal speed, see details in parameter PA22. See parameter PA58～PA65 for the 8-point positioning combination terminals for external speed.	
40	SP1		
26	SP2		
27	ZSL	Zero-speed clamping signal As this point is at low level, the motor is clamped at the zero-speed and excited, and the speed command is ineffective.	

8	ARST	Alarm reset signal: When an alarm is issued by drive unit, the alarm signal will be cleared by entering this signal after the fault is eliminated. **Note: Only No.1～No.9 alarm can be reset by this signal. Those alarms over No.9 can only be reset by repowering.**	
12	GIN	Reserved.	
14 15	VCMD＋ VCMD－	Analog speed command input terminal: The command voltage 0V～+10VDC or -10V～+10VDC can be set by parameter PA46.	

Description of output signal functions

Pinout No.	Sign	Function	Interior circuit principle
5	SAR	Speed arrival signal: If the actual speed reaches the range of the speed specified, low level signal is output without the CCW and CW rotation direction. See parameter PA31.	E pole side is connected to COM- for two interior photoelectric couplings; pole C is output terminal, its maximum load current ≤100mA 
6	SECT	Reserved.	
7	ALM	Alarm output signal: When the alarm is issued by drive unit, the output level is reversed. The output level can be set by parameter PA72.	
20	ZSP	Zero-speed output signal: When actual speed≤zero-speed output threshold value (set by parameter PA32), the low level signal is output.	
21	COIN	Positioning completion signal: When positioning error is within the positioning window area, the low level signal is output. The completion range is set by parameter PA56.	
22	RDY	Ready signal: When the servo is enabled and motor is excited, low level signal is output.	

19 4	PCZ+ PCZ-	Z phase pulse feedback output of motor encoder	Maximum load current ≤100mA 
16 1	PAO+ PAO-	A phase differential output of motor encoder/ spindle encoder, see PA69～PA71.	The interior is the output of differential chip 26LS31.
17 2	PBO+ PBO-	B phase differential output of motor encoder/ spindle encoder, see PA69～PA71.	
18 3	PZO+ PZO-	Z phase differential output of motor encoder/ spindle encoder, see PA69～PA71.	

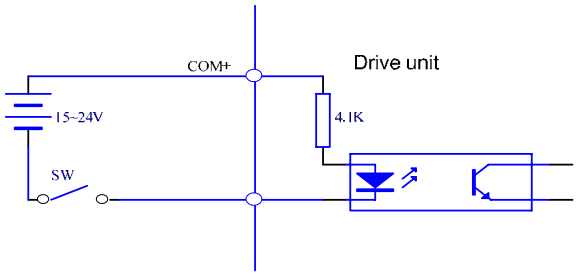
Other signals

Pinout No.	Sign	Function	Interior circuit principle
43	＋15V	+15V voltage output with maximum output current 30mA	
44	－15V	-15V voltage output with maximum output current 30mA	
29 30	0VA	Interior analog grounding	
37 38 39	COM+	The 15～24V external DC power, with the input current over 100mA, is used for driving the photoelectric coupler of the input terminal.	
35 36 23	COM－	15V～24V external power grounding	

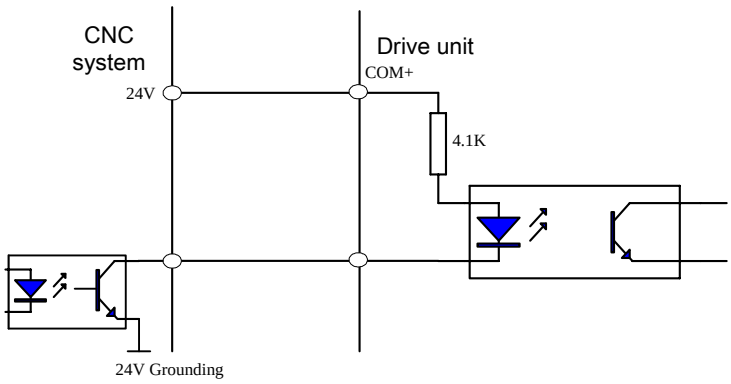
3.4.3 Connection principle of input and output points

Instances of input terminals wiring

1. External switching volume instance



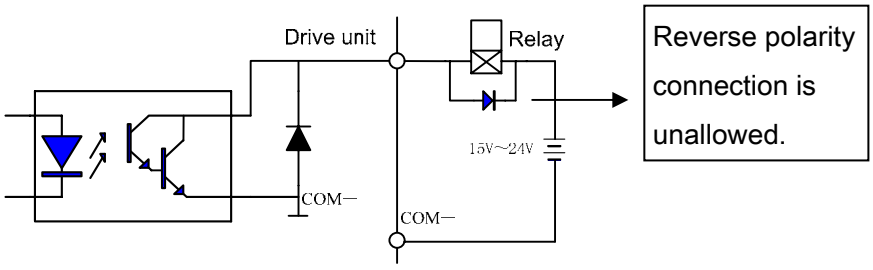
2. External CNC photoelectric coupler instance



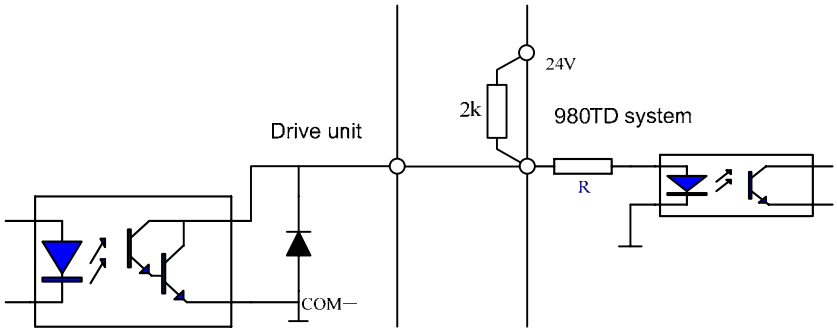
Note **Drive unit doesn't work if the power poles are reversely connected.**

Instances of output terminal connection

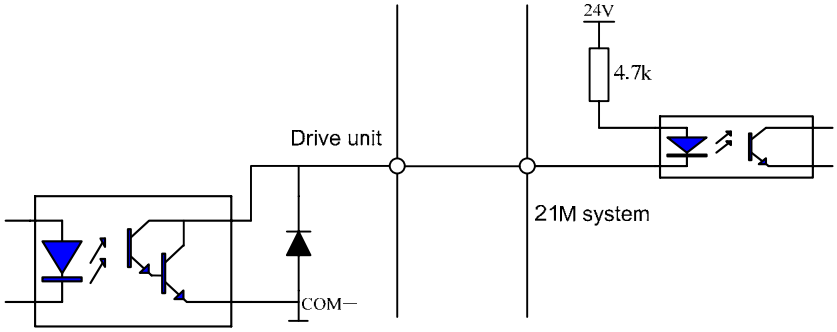
1. Instance of output terminal to relay



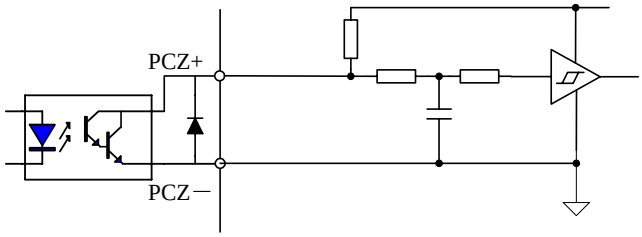
2. Instance of output terminal to 980TD turning machine

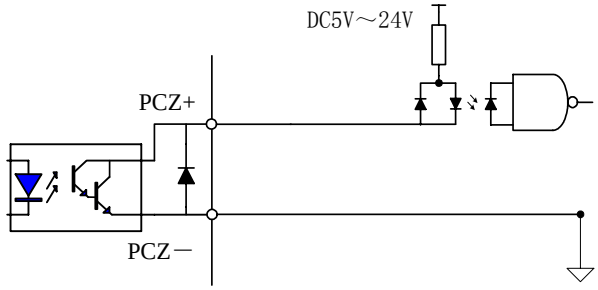


3. Instance of output terminal to GSK21M milling machine



4. PCZ signal output connection instance

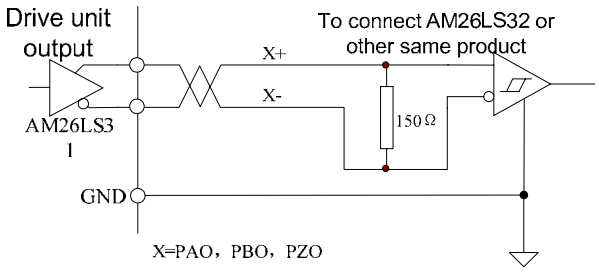


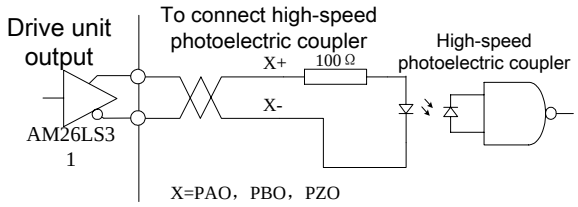


Note

- **Interface output type is collector open circuit with the max. current 100mA, and the max. external DC power voltage is 25V. If the load exceeds them or output is connected directly with power supply, the servo unit may be damaged;**
- **If the load is an inductive one, the both terminals of load must be reversely connected with parallel freewheeling diodes. If freewheeling diode is connected reversely, the servo unit will be damaged.**

Connection instance of encoder output





Note

- **There should be an interval of over 30cm between the control signal cables and the main circuit cables and they are not allowed to go through the same tunnel or tied up together to protect against interference.**
- **The length of control signal cable should be within 3m.**

3.5 Standard Wiring Instances

3.5.1 Standard wiring of trial speed run (Sr-) mode

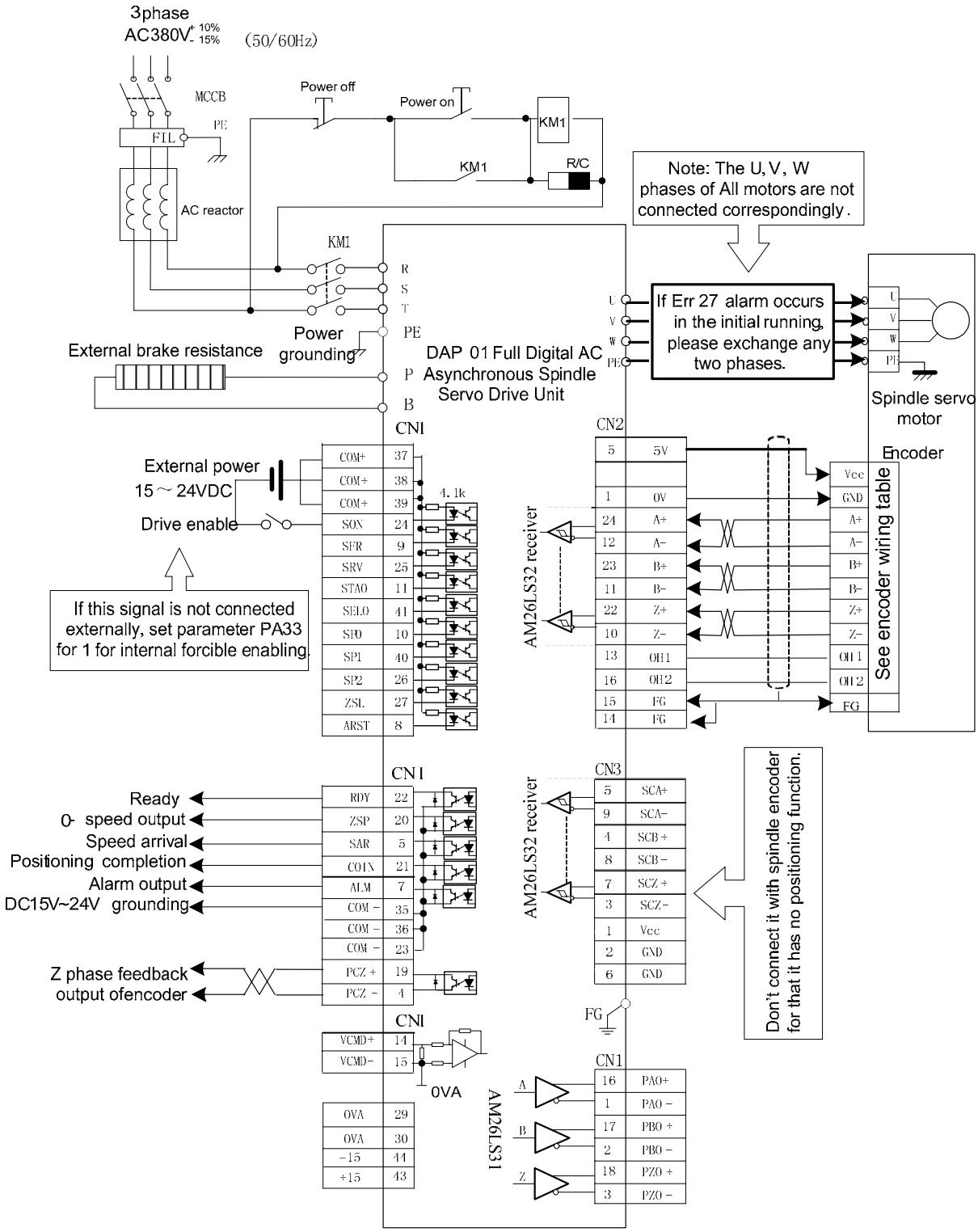


Fig.3.7 Standard wiring diagram of trial speed run mode

When the parameter PA4 is set for 2, i.e. in speed trial run mode:

1. **The spindle servo motor is run by enable signal (SON) given by CN1 interface.**
2. **To set parameter PA33 for 1 without connecting CN1 to force the internal enable for spindle motor running. See details in 5.2.3 for its operation.**

Refer to Section 5.2.3 for its operations.

3.5.2 Standard wiring of speed JOG- mode

When the parameter PA4 is set for 3, i.e. in speed JOG- run mode, its wiring is identical with that of speed trial mode in Fig.3.1X:

1. **The spindle servo motor is run by enable signal (SON) given by CN1 interface.**
2. **To set parameter PA33 for 1 without connecting CN1 to force the internal enable for spindle servo motor running. See details in 5.2.2 for its operation.**

Refer to Section 5.2.3 for its operations.

3.5.3 Standard wiring of internal speed control mode

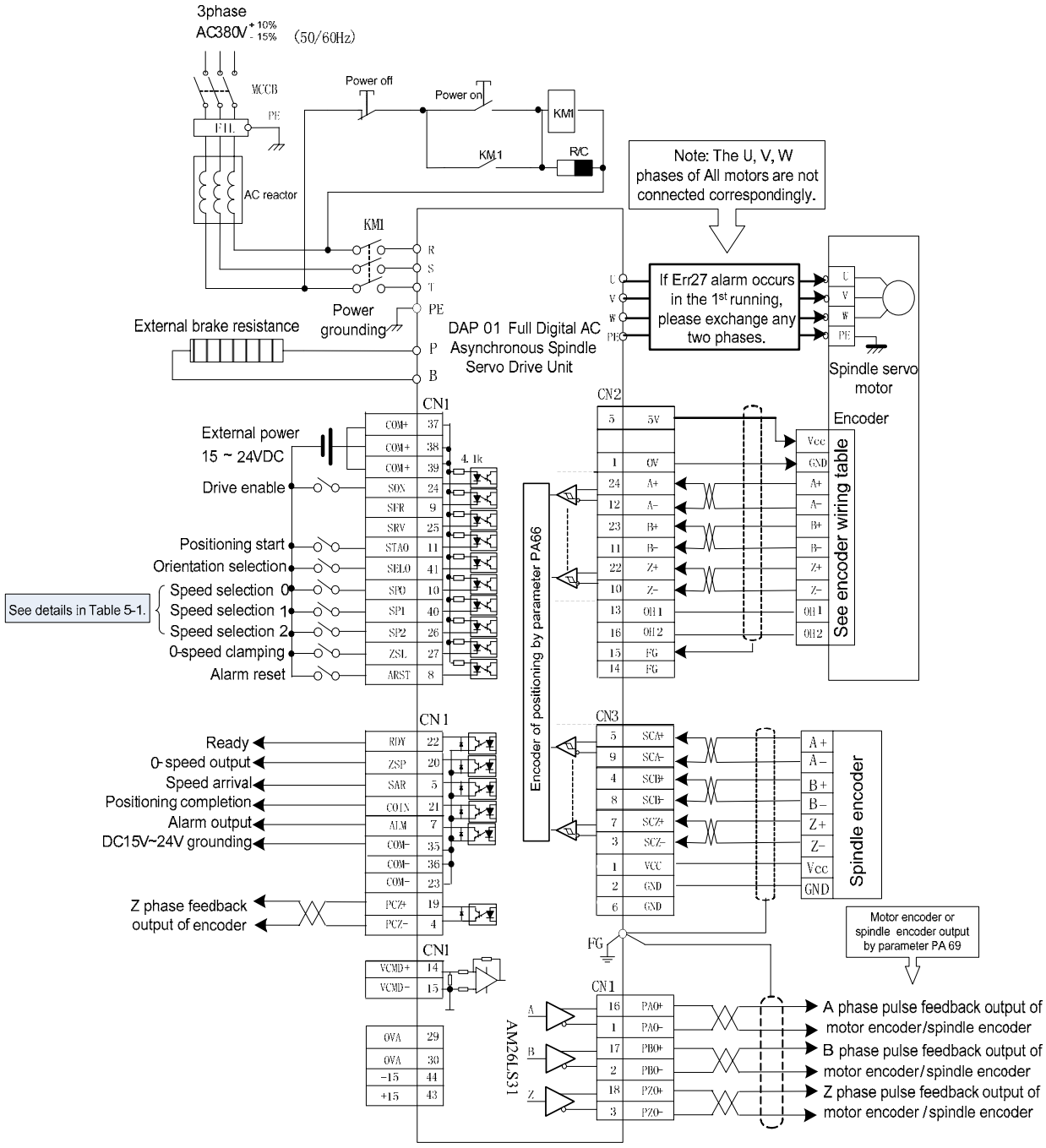


Fig.3.9 Standard wiring diagram of internal speed control mode

When the parameter PA4 is set for 1 and PA22 for 0, the drive unit is in internal speed mode, and the motor commands in this mode are got by the combination of SP0, SP1, SP2 input points, select the setting values of parameter PA24~PA30.
See details for it in Section 5.2.5.

Spindle encoder is recommended for accurate position. On the condition that the transmission ratio of the motor and the spindle is 1:1, the positioning is allowed to be performed only by motor encoder. If the spindle transmission clearance is large, it is recommended that the synchronous belt transmission be applied to avoid the spindle inaccurate positioning by this large clearance.

3.5.4 Standard wiring of external speed control mode

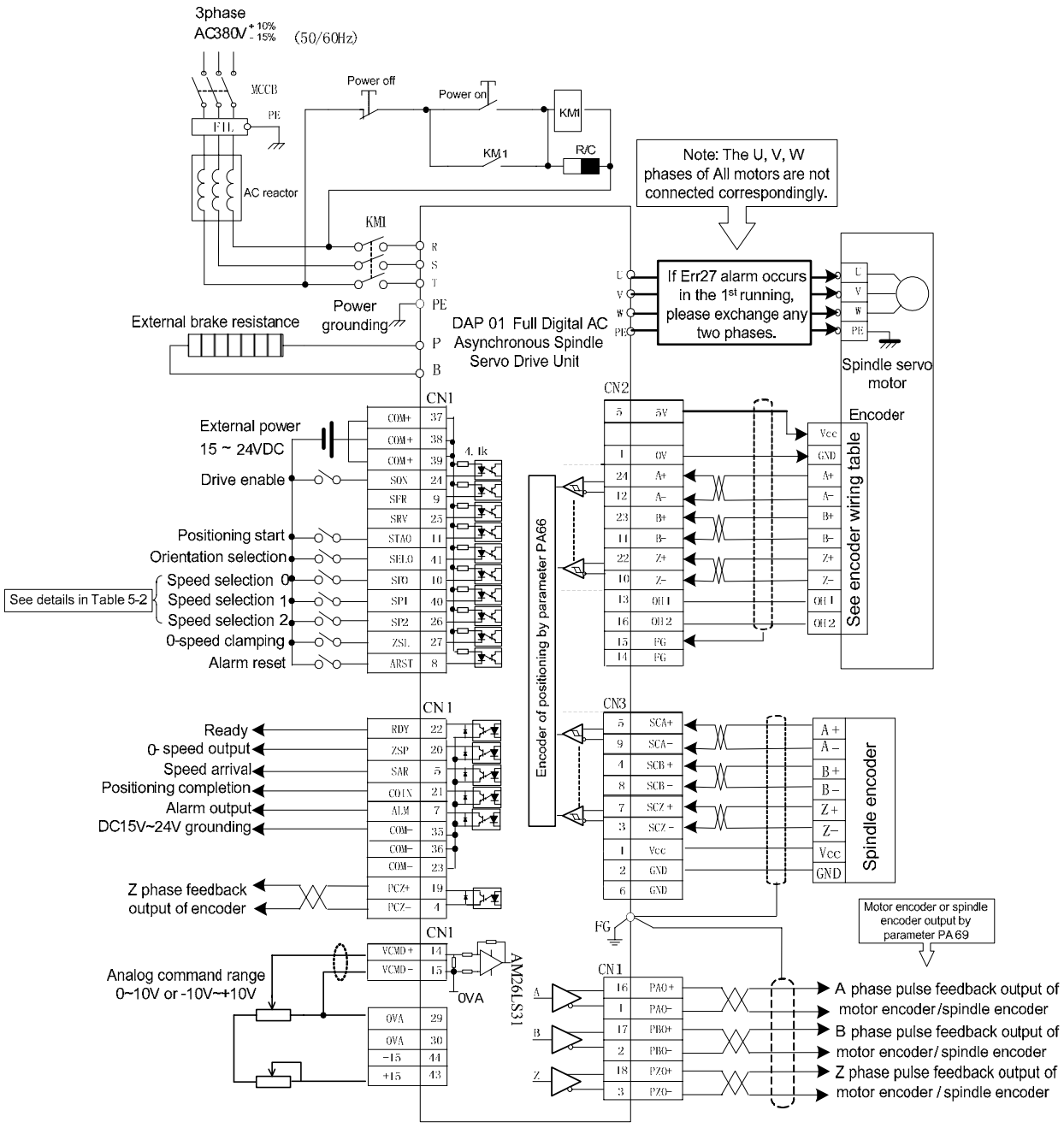


Fig.3.10 Standard wiring diagram of external speed control mode

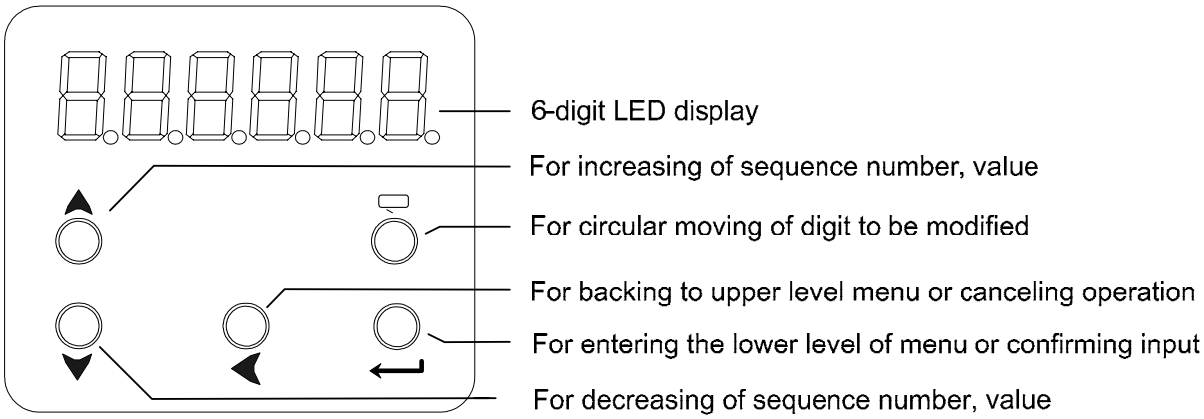
When the parameter PA4 is set for 1 and PA22 for 1, the drive unit is in external speed mode, if the command (－10V～＋10V) is entered and the servo enable (SON) is ON, i.e. low level is effective, the motor is not excited, only SFR signal is ON, is the motor excited. Once the analog command is entered, the motor runs immediately. See Section 5.2.4.

Spindle encoder is recommended for accurate position. On the condition that the transmission ratio of the motor and the spindle is 1:1, the positioning is allowed to be performed only by motor encoder. If the spindle transmission clearance is large, it is recommended that the synchronous belt transmission be applied to avoid the spindle inaccurate positioning by this large clearance.

CHAPTER 4 DISPLAY AND OPERATION

4.1 Operator Panel

The operation of DAP01 servo unit is very easy that the functions required can be set by only 5 keys. The outline of its panel is as following:



While the data is being displayed by the LED nixie tube, the decimal point of the digit to be modified flickers and the decimal point in the ultra right nixie tube lights up after the data modification, by pressing ↵ key for the confirmation for the modification, this decimal point restores to flickering. If alarm occurs, the alarm code will be displayed by LED. The fault can be resolved by user according to the alarm code.

4.2 Parameter Structure

The operation of DAP01 is performed by 3 level menus: the first level is the main menu which involves 8 modes; the second level is function menu under the modes; the 3rd level is data level. As is shown in Fig.4.1, after the power-on initialization in drive unit, press ◄ key to enter the first level main menu, the press ▲ or ▼ key to select a mode in 8 modes. Only 5 modes are effective in this version: i.e. Monitor mode（dP）、Parameter setting（PA）、Parameter management（EE）、Speed trial run（Sr）、JOG run（Jr）. And the other 3 modes are reserved for further development that is unallowed for operation. After a mode is selected, press ↵ key to enter the lower menu of this mode; press ◄ key to return to the upper menu if you want to return. If the ↵ key is repressed, the control enters the bottom data level of the 3rd level.

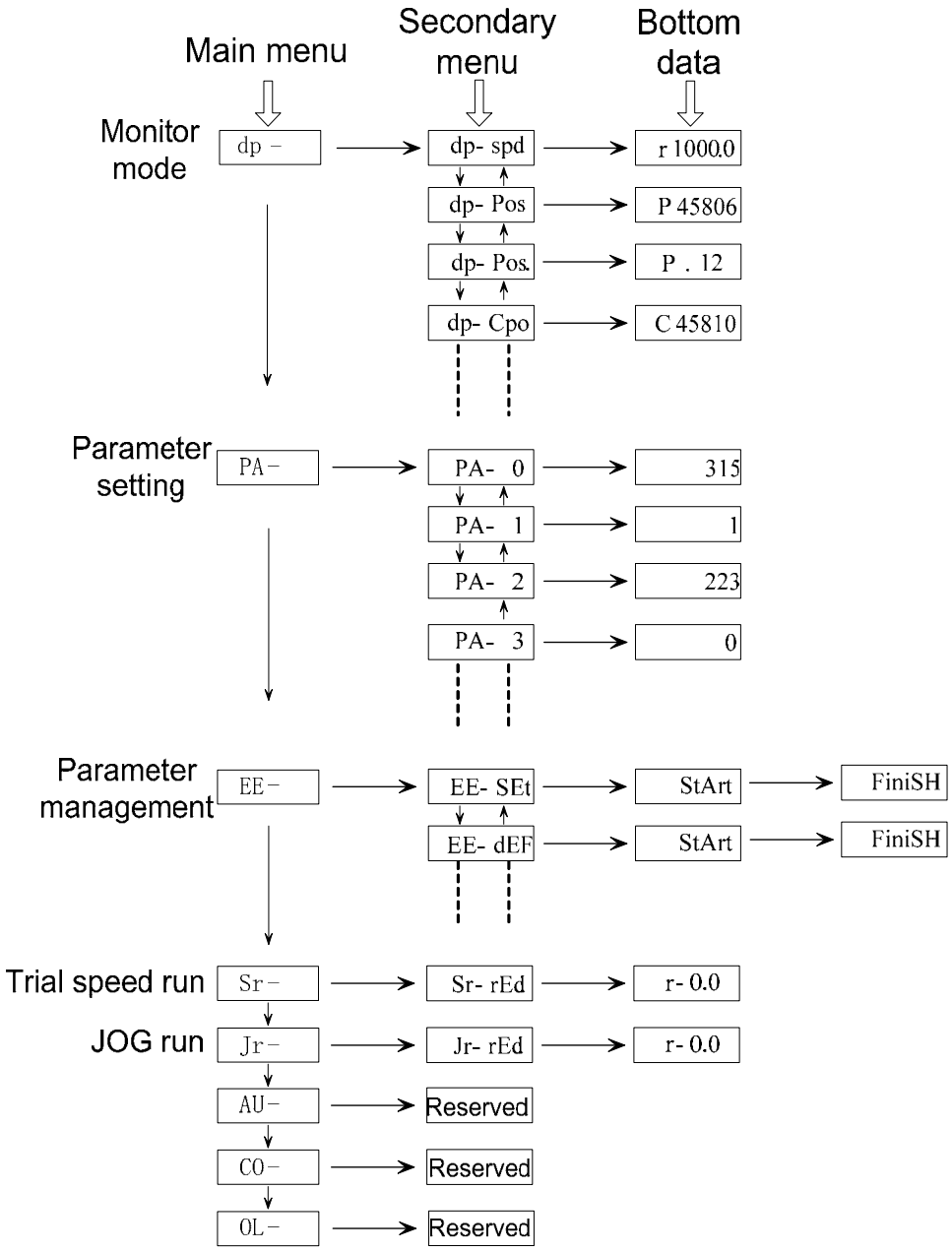


Fig.4.1 Parameter structure diagram

4.3 Monitor Mode

There are 25 monitor modes in this drive unit, in which the current position type dP-PoS, position command type dP-CPo, position error type dP-EPo, position command pulse frequency type dP-Fr9 are used for advanced development of this spindle servo drive unit that can't be monitored by user.

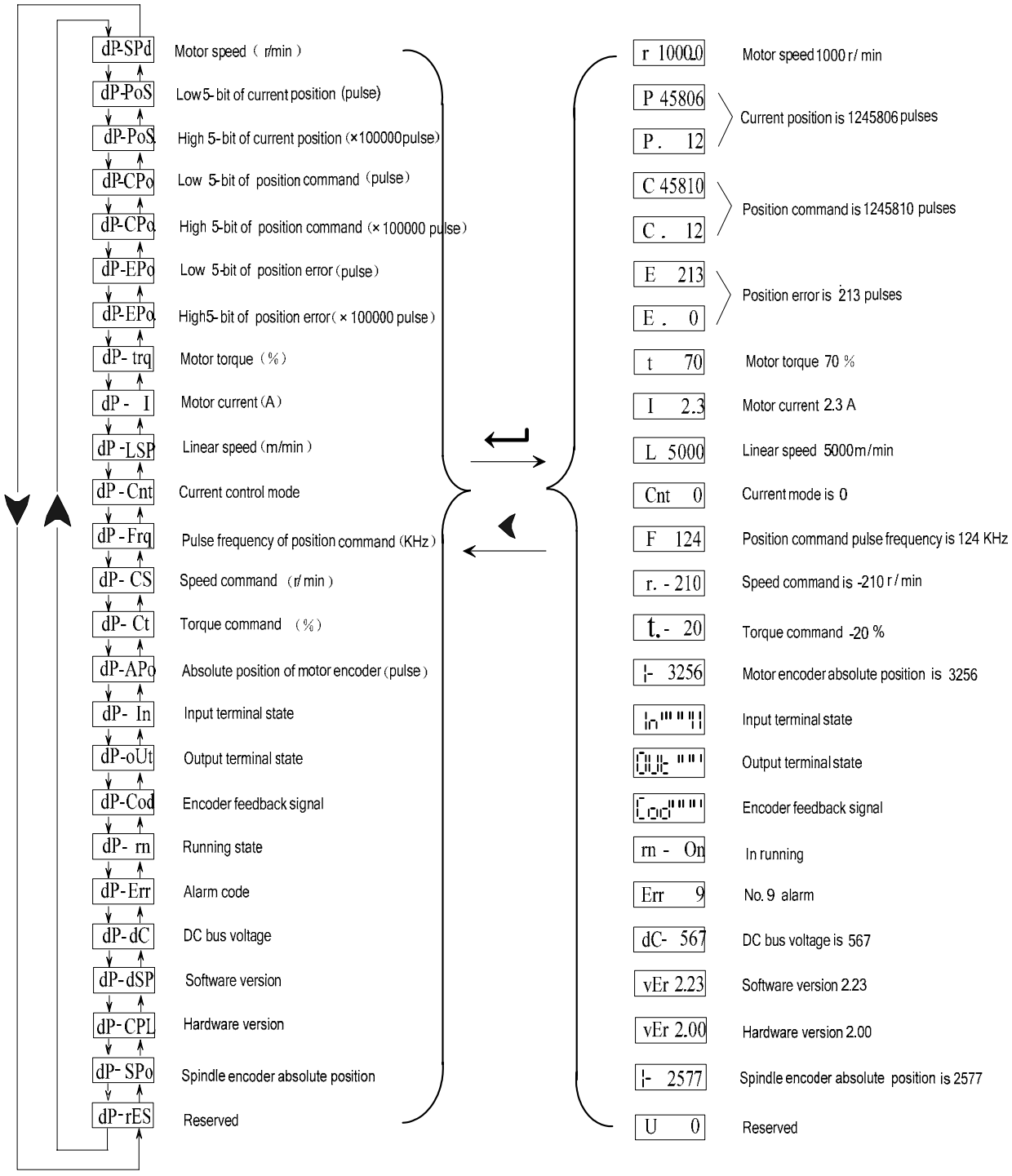


Fig. 4.2 Monitor modes block diagram

4.4 Parameter Setting

Prior to parameter setting, modify the user password parameter PA-0 for 315 according to the parameter table in Section 6.2. Then press '↵' key to confirm the setting. The instance for

parameter setting is as following:

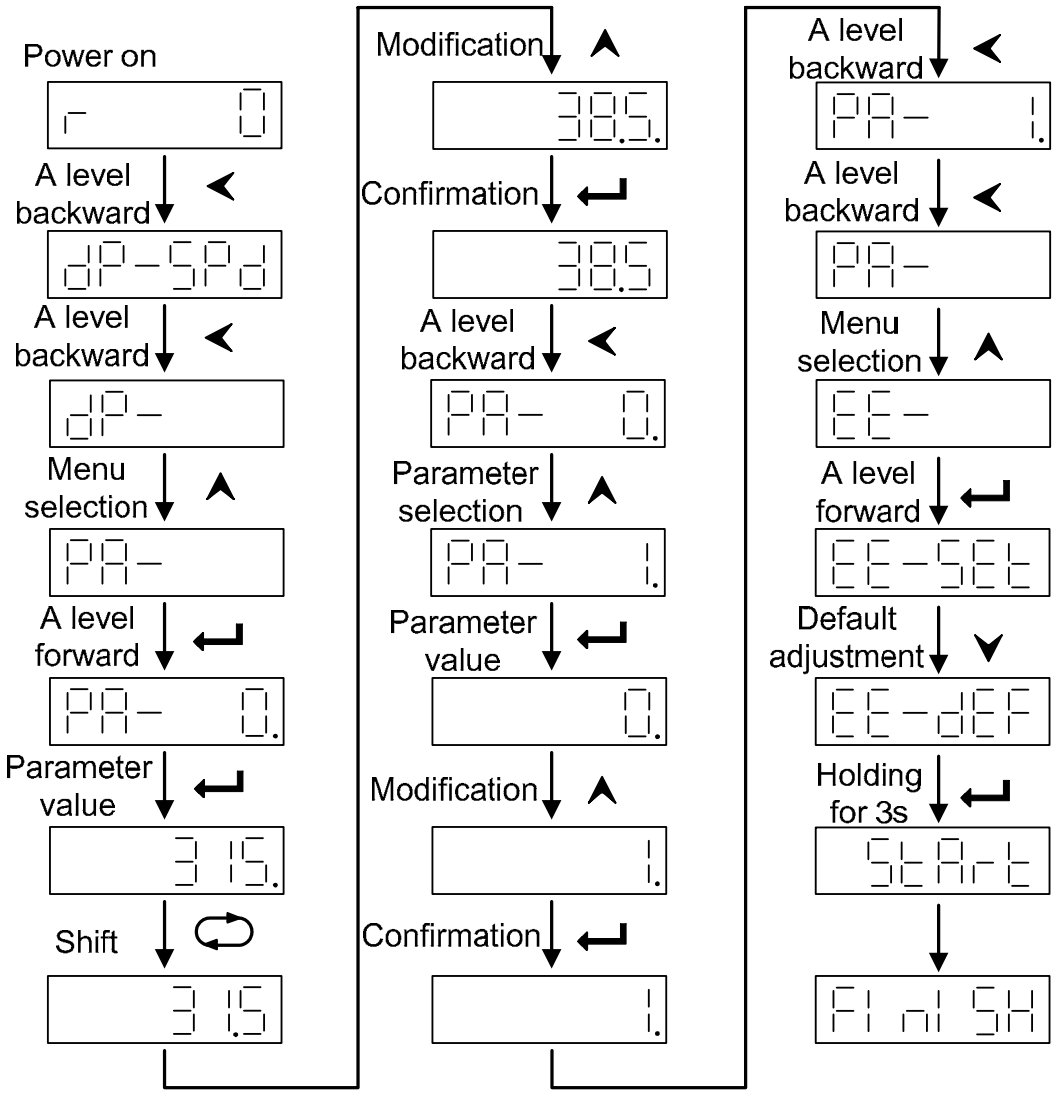


Fig.4.3 Adjustment steps for motor default parameters

The shift function by ' ⮌ 'key in parameter setting provides an easy way for parameter setting: e.g. for the current parameter PA-7, there are two ways to modify it:

A: Directly press ▲ key to find PA-37

B: If the current parameter is PA- 7., press "⮌" key for once, the decimal point shifts one digit left and it changes for PA- .7, then press ▲ key for 3 times, the parameter changes for PA- 37, press ↵ key, and the parameter PA-37 will be found immediately.

Still an example: to change the value -2045 of PA24 for 2045, the steps are as follows:

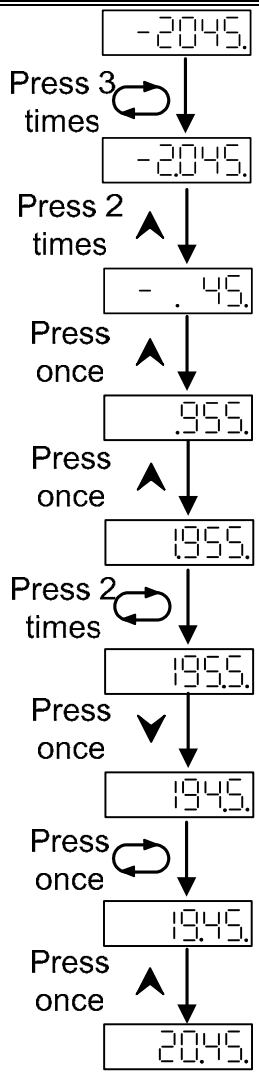


Fig.4.4 Shift key operation instance

Press ' ⮌ 'key continuously for 3 times, the LED decimal point of digit "2" flickers, while that of digit "5" doesn't. Press ▲ key twice, it turns to -45, press ▲ key again, i.e. －45+1000＝955, it displays 955. Then modify the number for 2045 bit by bit, so the modification can be finished by this method.

The decimal point can only move on the right 2 LED nixie tubes while modifying parameter No., this is because that the parameter to be modified only contains 2 digits(less than 100). As for modifying the parameter values, the decimal point may be moved on the right 4 LED nixie tubes.

4.5 Parameter Management

The parameter management is mainly used for memory and EEPROM operation. Select “EE-” in the first level and press ↵ key to enter parameter management mode. 5 operation modes can be selected by ▲ or ▼ key. e.g. for “parameter writing”, select “EE-Set”，then press ↵ and hold it on for over 3 second, the monitor displays “StArt” that means the parameter is being written into EEPROM. After 1~2 seconds, the monitor displays “FInISH” if the writing is successful, otherwise“ErrOr” is displayed. Press ◄ key to back to operation selection mode.

EE－SEt: Parameter writing It means to write the parameters in the memory into EEPROM parameter area. The parameters modified by user only change the parameter values in the memory that they will restore to their original values after power is on again. If the parameter values are changed permanently, parameter writing should be executed to write the parameters in the memory into the EEPROM parameter area, so the modified parameter values will be valid after power is on again.

EE－rd: Parameter reading It means to read the data in EEPROM parameter area into the memory. The process will be executed automatically when power is on. At the beginning, the parameters in the memory are the same as that of EEPROM parameter area. If the parameters are modified by user, the parameter values in the memory will be changed. If the user is not satisfied with the modified parameter values or the parameters are disordered, the parameter reading can be executed to read the data in EEPROM parameter area into the memory to recover the original parameters as power is supplied.

EE－bA: Parameter backup (reserved)
EE－rS: Backup restoration (reserved)

EE－dEF: Default Restoration It means all default values (factory setting) of parameters are read into the memory and be written into EEPROM parameter area that they will be used when power is on again. Perform the operations above to restore all parameters to their factory settings if the parameters are disordered by user that cause the system to run abnormally. Because different servo motor corresponds to different parameter default value of the servo unit, the model code of the servo motor must be ensured (parameter PA01) when restoring default parameters.

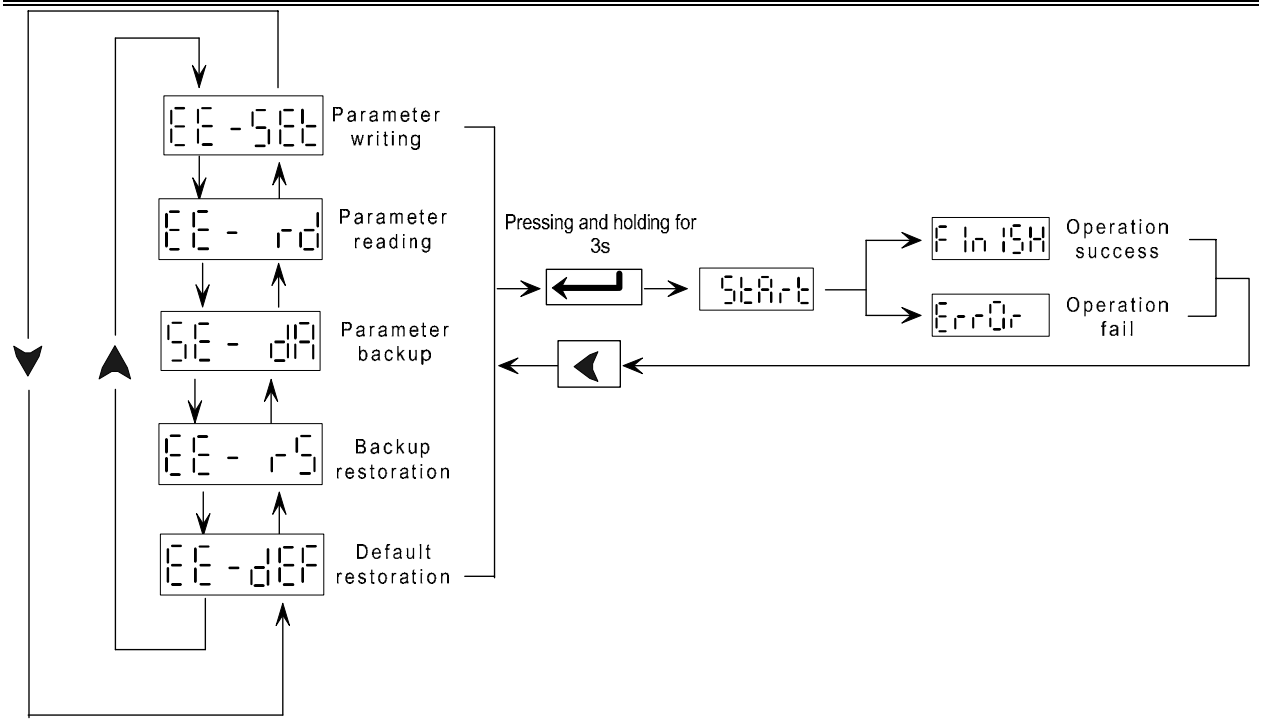


Fig.4.5 Parameter management block diagram

Power on : EEPROM parameter area ⇨ memory

EE-SEt	Parameter writing: memory	⇨ EEPROM parameter area
EE- rd	Parameter reading: EEPROM parameter area	⇨ memory
EE- bA	Parameter backup: memory	⇨ EEPROM backup area
EE- rS	Backup restoration: EEPROM backup area	⇨ memory
EE-dEF	Default value restoration: default value	⇨ memory, EEPROM parameter area

If the parameter writing is not executed, the parameter modified will not be saved after power is down, and the modification of this parameter is invalid.

CHAPTER 5 RUNNING

Caution **The R,S,T inlets of power must not be connected with the U,V,W output terminals of the servo unit, otherwise the servo unit will be damaged.**

Note **If the drive unit is used for the first time, please call out the motor current monitor mode after the initial power on and use this mode to monitor the motor current in real time as the motor enable signal is given. If the motor current is too large, it means the motor connection is wrong or the spindle servo parameters are not properly set. Please cut off the enable if this happens, or else the motor may be damaged.**

5.1 Check Before Running

Please make the following check before initial power on by referring to Section 3.3.1:

- **Check the power supply input terminals （R、S、T、PE）connection and the fastness of the terminal screws.**
- **Check the connection of the output terminals（U、V、W）for spindle servo unit with the spindle motor power input terminals（U、V、W）.**
- **Check whether the correct external brake resistance is connected.**
- **Check whether the feedback signal cables of the motor encoder (feedback signal cables of the spindle encoder) and the control signal cables are securely connected.**
- **Make sure the spindle motor shaft has been completely detached from the loading prior to running.**
- **Switch on 380V AC power.**

5.2 Trial Run by Power-On

5.2.1 Power-on time sequence of servo unit

The wiring of power is shown as Fig.5.1, switch on the power by following steps:

1） Connect the power supply with the power input terminals of main circuit (R, S, T) by AC contactor KM1.

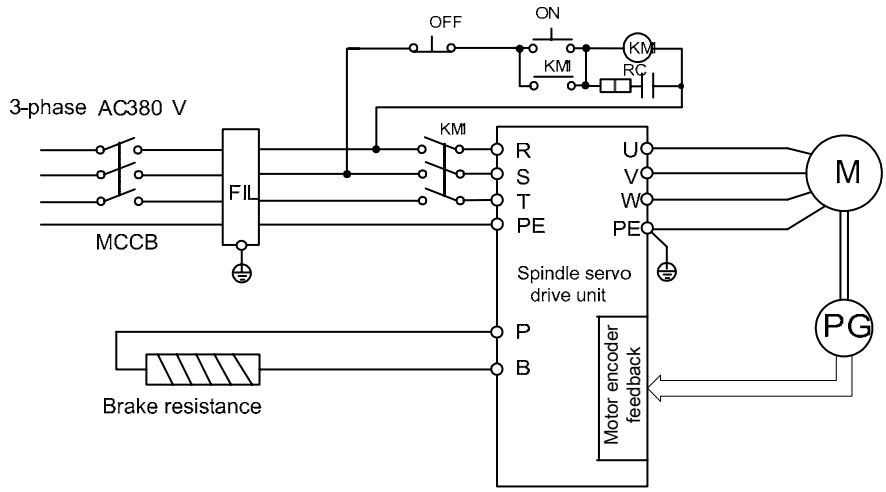


Fig.5.1 Power wiring block diagram

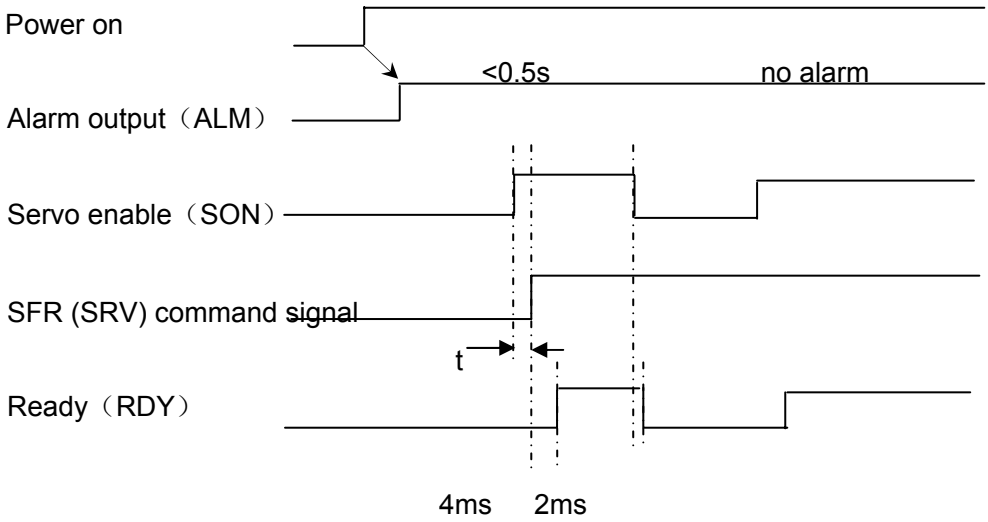
2） If servo enable (SON) is ON after the connection of the control power with the main circuit power, the motor is not active and the system is in a free state. If servo enable signal is cut off or alarming occurs, the motor is in a free stat.

3） If servo enable (SON) is on together with SFR (SRV)signal, the motor is excited in about 100 ms.

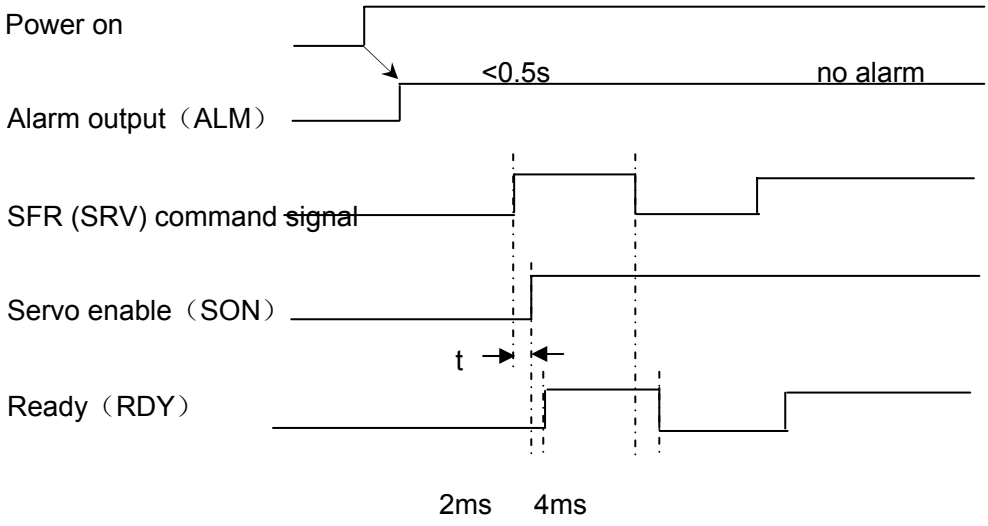
Note

Frequent switching on or off the power may damage the soft start circuit and energy consumption brake circuit. The frequency limit for switching on or off should be limited for once per 10 minutes. If the servo unit or motor is overheated, only by 30 minutes cooling after the fault is exterminated, can the power be switched on again.

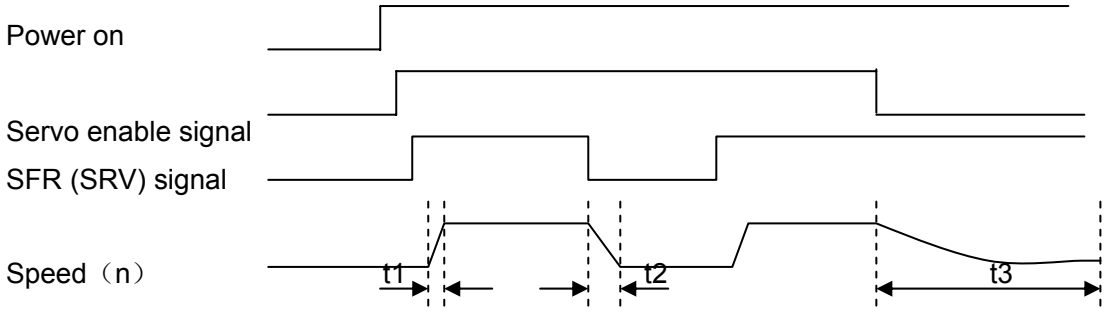
4) Time sequence diagram for power on



"t" can either be more or less than 0, namely, it has the same effect if the servo enable（SON）signal is commanded before SFR(SRV) signal or SFR(SRV) signal before servo enable（SON）signal.

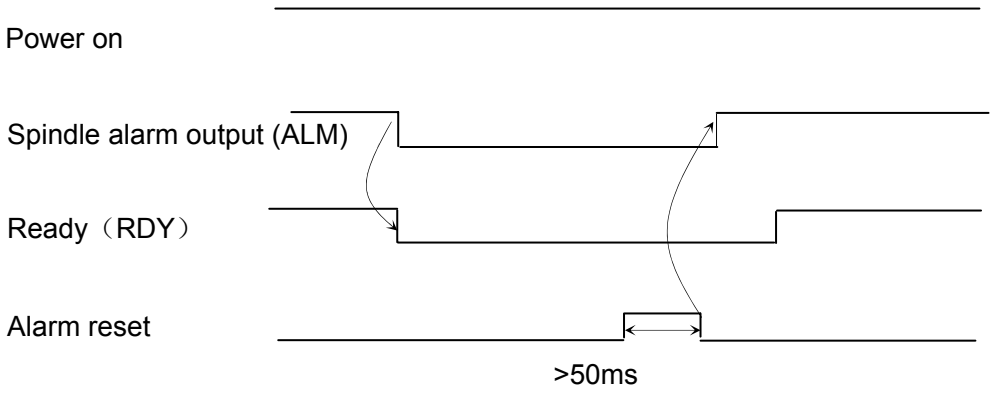


5） Servo enable and speed time sequence



t1, t2 are the acceleration and deceleration time which can be modified by parameter PA39, PA40; t3 is the motor free halt time after Enable is off. Attention should be paid that t2 and t3 are different because t2 is for motor braking halt, while the motor is excited and it is in free state after it stops; and t3 is for free halt, while the motor is at free if enable signal is off, which is as parameter PA74=0; while PA74=1, the servo enable is off, the motor brakes to stop and stays at free. In this situation the significances of t3 and t2 are identical.

6) Time sequence of spindle alarm and reset



5.2.2 JOG running

Do switch off load prior to JOG running. If the JOG running is well done, it means that the connection between the spindle motor and the servo drive unit is correct.

Steps:

First call out the default parameters for the suited motor with CN1 not connected

↓

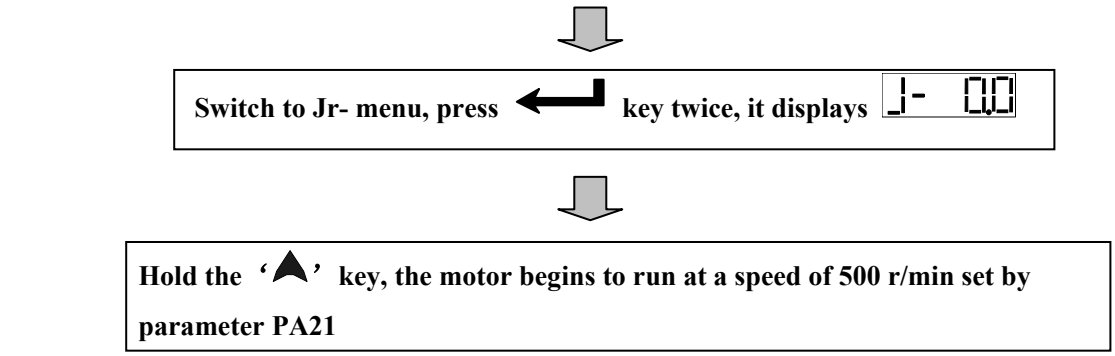
Set parameter PA4=3 for JOG mode

↓

Set parameter PA21＝500 for a 500 r/min JOG speed

↓

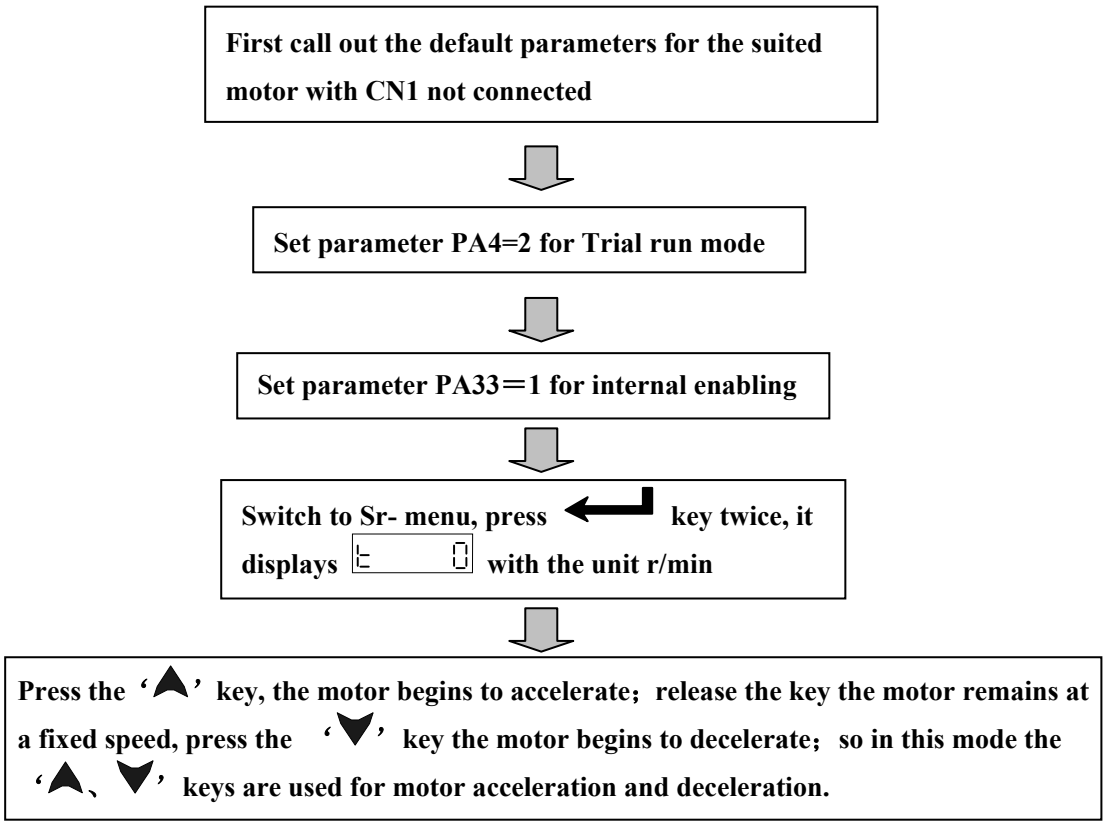
Set parameter PA33＝1 for internal enabling



Hold the ‘▲’ key, the motor runs at a speed set by parameter PA21; hold the ‘▼’ key for running reversely; release the key, the motor stops and stays at zero-speed.

5.2.3 (Sr-) Trial run

Similar to JOG run, the Trial run steps are as follows:



5.2.4 External speed control run

Connect CN1 by the right figure, power on and call out the default parameters for the suited motor

Set parameter A4=1 for Speed control mode

Set parameter PA22＝1 for external analog command input

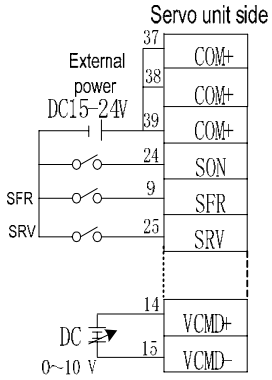
If analog command is 0～10V, set PA46=1，PA45=1;

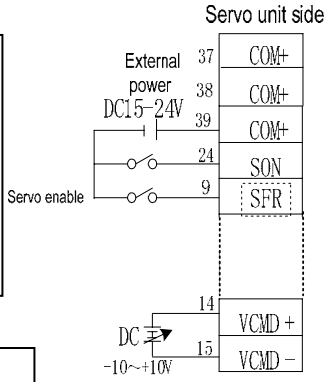
If analog command is -10V～10V, set PA46=0;

Make analog command for 0V, SON, SFR or SRV for ON, adjust the value of PA44 to make the motor for zero-speed if it runs at a low speed.

Make analog command for 0V, SON, SFR for ON, adjust the value of PA44 to make the motor for zero-speed if it runs at a low speed.

Change the analog command voltage to make the speed to vary proportionally with this voltage. The corresponding maximum speed can be obtained by modifying PA42 as the command voltage is 10V. It should be noted that the motor maximum speed is restrained by PA23.





In this manual the input point ON indicates the external switch is closed, or low level signal is input. Actually the internal photoelectric coupler of this input point is on.

In this mode, the motor is not excited by a SON signal; if 0～10V command（PA46＝1）is selected, the motor can be excited by another SFR or SRV signal. And the motor runs if PA45 is set for 1, not if set for 0;

When －10V～10V command （PA46＝0）is selected, another SFR signal should be given for motor excitation, where SFR acts as servo enable signal; the current motor running direction can be altered by setting parameter PA45 for 0 or 1.

5.2.5 Internal speed control run

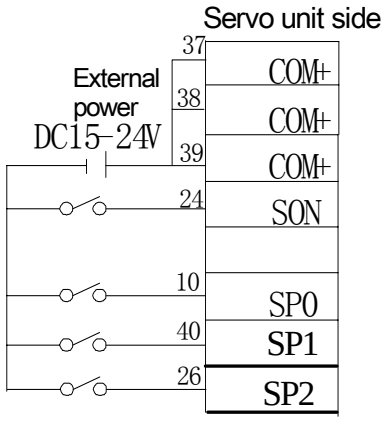
Connect CN1 by the right figure, power on and call out the default parameters for the suited motor

Set parameter A4=1 for Speed control mode

Set parameter PA22＝0 for internal speed command input

Set appropriate value for parameter PA24~PA30 as required

Set SON for ON, the motor is excited for zero-speed, different motor speed values can be obtained by inputting the speed selection command according to the combinations of SP0, SP1, SP2 in Table 5.1.



In internal speed modes, SP0, SP1, SP2 are defined as input point combinations for multiple level speeds selection: speed selection 0（SP0）, speed selection 1（SP1）, speed selection 2（SP2）. As following table shows these three terminals is combined for 8 level speeds that are set in parameters PA24～PA30 respectively.

Table 5-1

SP2	SP1	SP0	Speed corresponding to combination	Parameters for speeds
OFF	OFF	OFF	0r/min	—
OFF	OFF	ON	Internal speed 1	PA24
OFF	ON	OFF	Internal speed 2	PA25
OFF	ON	ON	Internal speed 3	PA26
ON	OFF	OFF	Internal speed 4	PA27
ON	OFF	ON	Internal speed 5	PA28
ON	ON	OFF	Internal speed 6	PA29
ON	ON	ON	Internal speed 7	PA30

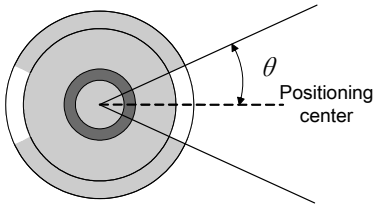
The positioning function is also available in internal speed mode. Though the input point combinations above are defined for speed selection, the positioning can only be done by a position set by parameter PA58.

5.3 Positioning Function

Spindle positioning: As for tool change or measurement requirement, the rapid and accurate positioning, which is done by the feedback pulses from the spindle servo motor encoder or the encoder directly connected with the spindle, and spindle preliminary dwell position (i.e. position of servo motor) holding function is called spindle positioning. It also involves single point positioning and multiple point continuous positioning.

Spindle positioning precision: It is expressed by a minimum angle θ of spindle accurate positioning as following equation:

Formula 1——
$$\theta = \frac{360^{o}}{4L} = \frac{90^{o}}{L}$$



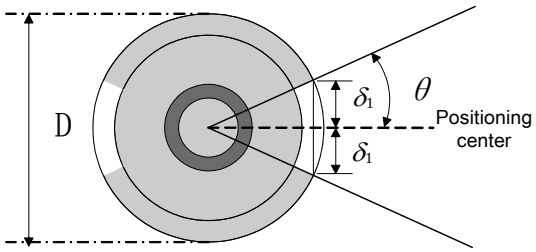
L： Positioning encoder pulses

4L： Positioning encoder pulses by 4 frequency

There is a θ angular error for spindle positioning center in actual positioning, so the minimum positioning precision of this DAP01 drive unit can reach 2 θ .

The positioning precision can also be expressed by the minimum arc of the positioning circle connected with the spindle or the chord of the minimum arc in practice. e.g. positioning drill on the outer circle of the round part in a lathe; the tool setting of machine center and spindle in a milling machine. So the positioning precision is related not only with the motor (spindle) encoder pulses, but also with the positioning circle diameter, as is shown in following equation:

Formula 2——
$$\delta_1 = \frac{D}{2}\sin\frac{90^{\circ}}{L}$$

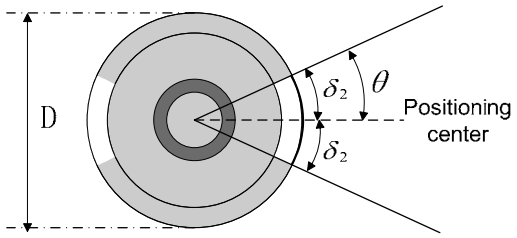


D： positioning circle diameter

δ_1： spindle positioning precision by the chord in positioning circle

It also can be calculated by following expression:

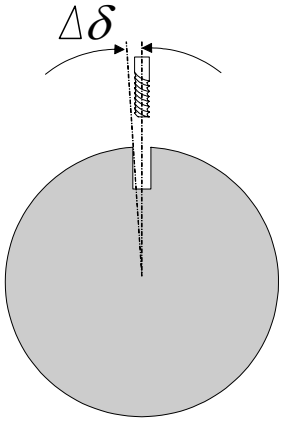
Formula 3—— $\delta_2 = \frac{\pi D}{4\,\mathrm{L}}$



Δ_2： spindle positioning precision by the arc in positioning circle

As known from the above two expressions, the minimum positioning precision for this DAP01 drive unit can reach $2\delta_1$, or $2\delta_2$.

For example, to drill at a fixed position on the outer circle of the round part with a diameter 200mm in the right figure, the requirement of drilling position error is not more than 50μm，how many pulses for the encoder should be chosen to meet the requirement?



For the arc length, to meet the requirement not more than 50μm, Δδ ≤25μm should be ensured by this DAP01 drive unit. By formula 3,

$$\Delta\delta \geqslant \frac{\pi D}{4\,\mathrm{L}} \quad \Longrightarrow \quad \mathrm{L} \geqslant \frac{\pi D}{4\Delta\delta}$$

then： L ≥ 6280

To ensure the drilling position error not more than 50μm, the pulses of the encoder selected should be equal to or more than 6280.

A single point positioning for DAP01 drive unit can be achieved by position values setting of parameter PA58 in internal speed control mode; In external speed control mode, the 3 SP0, SP1, SP2 input points are defined for combination input terminals of multiple point positioning selection: positioning selection 0（SP0），positioning selection 1（SP1），positioning selection 2（SP2）. As

following table shows, 8 positioning angles can be obtained by the combinations of these 3 terminals.

Table 5-2

SP2	SP1	SP0	Positioning locations corresponding to combinations	Parameters for positioning locations
OFF	OFF	OFF	positioning location 1	PA58
OFF	OFF	ON	positioning location 2	PA59
OFF	ON	OFF	positioning location 3	PA60
OFF	ON	ON	positioning location 4	PA61
ON	OFF	OFF	positioning location 5	PA62
ON	OFF	ON	positioning location 6	PA63
ON	ON	OFF	positioning location 7	PA64
ON	ON	ON	positioning location 8	PA65

Either internal speed or external speed control mode, the positioning operations are identical, and the operating procedures by taking motor encoder as positioning encoder are as following:

1. Invoke the menu DP－APO, press ↵ key to display E xxxx, the sign 'E' indicates that the motor rotor is in a false position, whose value can't be taken as a reference.
2. Make the motor rotor to run at least for a rotation, DAP01 drive unit will automatically search the correct position of the motor encoder. When this position is found, "DP－APO" turns into |- xxxx, it indicates the current correct encoder position is xxxx.

There are 2 ways to make the motor to run for a revolution:

A) Power the drive unit without giving enable signal to make the motor to stay in a free state, manually rotate the motor rotor or spindle connected to the motor rotor for at least a revolution;

B) Run the motor for at least a revolution in JOG mode. (see Section 5.2.2 for JOG run)

3. Slowly adjust the motor rotor or spindle connected to the positioning point, then note its DP－APO position and write it into parameter PA58 and save, then this parameter value is the positioning location 1.
4. User can continuously adjust 8 positioning point and note their locations, and write them to PA58～PA65 sequently（as Table 5－2）, so multiple point positioning can be performed in external speed control mode.

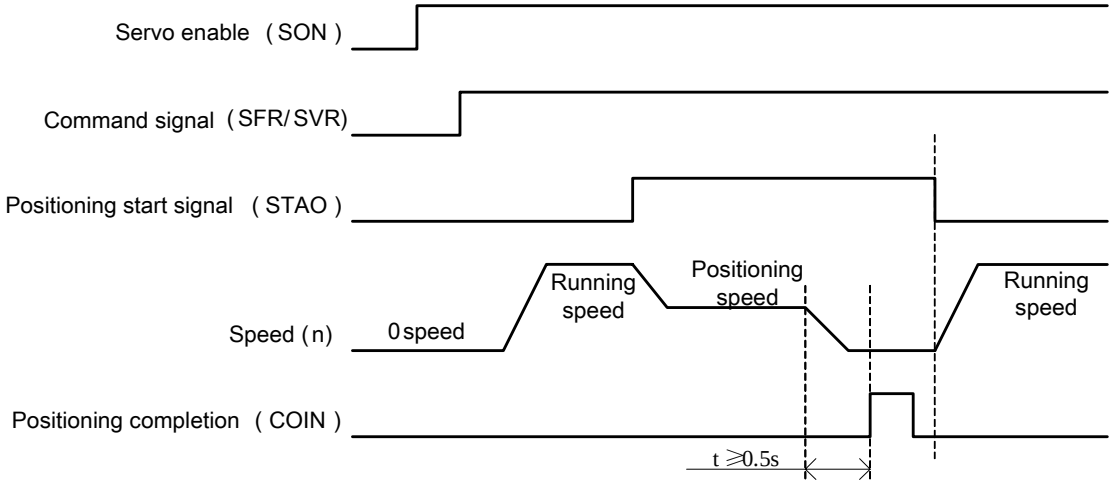
5. Enable drive unit(input SON signal, and SFR signal together in external speed control mode), whether or not servo motor is running, input positioning start signal（STAO）and keep low level effective, servo motor begins to run at a speed set by parameter PA55, after it finds the position point, it remains at this point and output the positioning completion signal(COIN).
6. The upper machine executes the tool setting after it receives the COIN signal, and the positioning start signal（STAO）is effective during tool changing. After the operation, the positioning start signal must be cancelled for other operations.

The operation procedures by taking spindle encoder as positioning encoder is similar to the operations above, except the first 3 steps, the rest steps are the same. The first 3 steps are as follows:

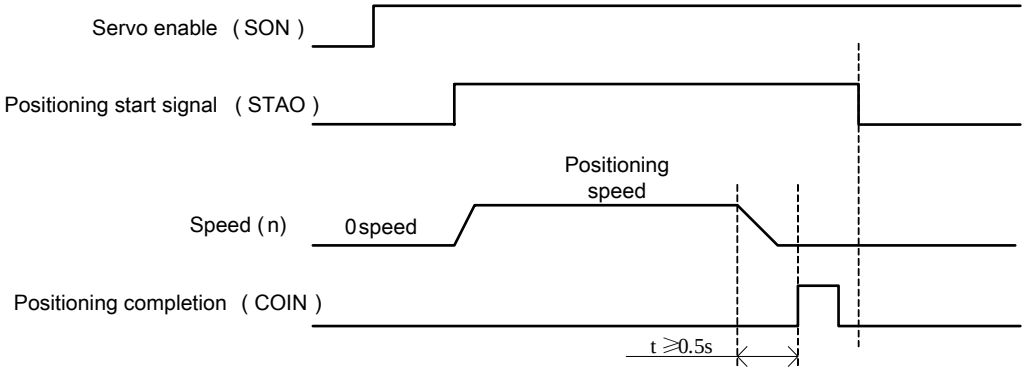
1. Invoke the menu DP－SPO, press ↵ key, it displays E xxxx, the sign 'E' indicates that the spindle is in a false positioning location, whose value can't be taken as a reference.
2. Make the spindle to run at least a rotation, DAP01 drive unit will automatically search the correct location of the spindle encoder. When this location is found, "DP－APO" turns into ⊢ xxxx, it means the current correct encoder position is xxxx.
3. Slowly adjust the spindle to the positioning point, then note its DP－SPO location and write it into parameter PA58 and save, then this parameter value will be the **positioning location 1**.

The time sequence diagram for the complete positioning is as following:

- Spindle positioning time sequence A (motor in running)

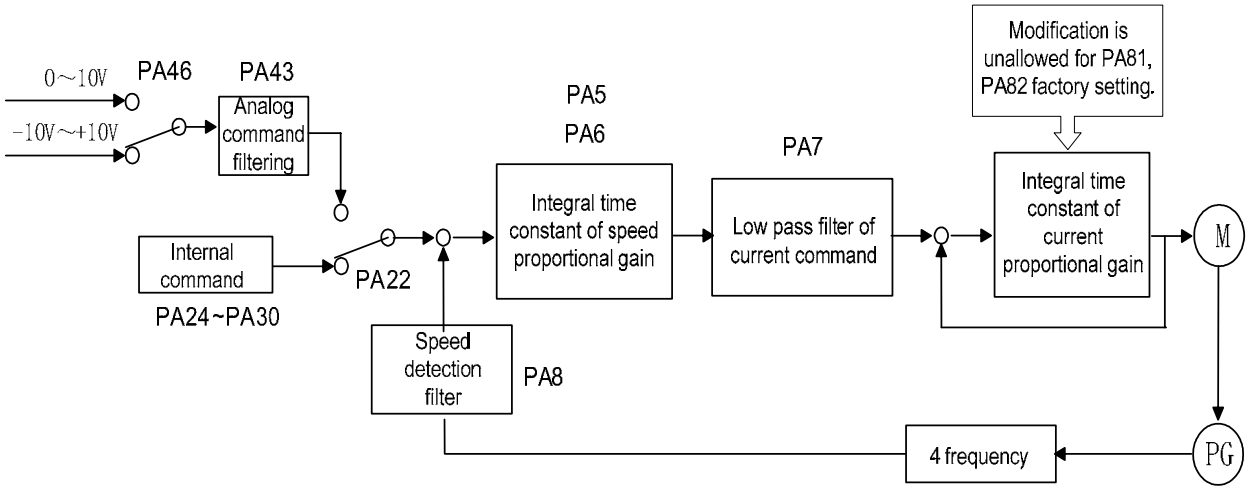


■ Spindle positioning time sequence B (motor at free or zero-speed)



5.4 Debugging and Parameter Adjustment

The relevant parameters adjustment is as following figure:



Relevant parameters adjustment

PA5 ： Proportional gain of speed loop Steady range（150-900）

① It is used to set the proportional gain of speed loop adjustor.

② The bigger the setting value is and the higher the gain is, the larger the rigidity is. The value is determined by the specific servo unit model and the loading. Generally, the bigger the load inertia is, the smaller the setting value is.

③ On the condition that no oscillation occurs in the system, set a larger value.

PA6 ： Speed loop integral gain Steady range（1～30）

① It is used to set the integral gain of speed loop adjustor.

② The bigger the setting value is and the faster the integration is, the larger the rigidity is. The value is determined by the specific servo unit model and the loading. Generally, the bigger the load inertia is, the smaller the setting value is.

③ Set a larger value on the condition that there is no oscillation in the system.

PA7 ： Low pass filtering coefficient of current command (reserved)

PA8 ： Low pass filtering coefficient of speed detection Steady range（40-1000）

① The smaller the setting is and the lower the cutoff frequency is, the better the filtering effect is and the lower the noise by motor is. If the setting is too small, the lower response and larger speed fluctuation may result in oscillation and severe motor shaking.

② The bigger the setting is and the higher the cutoff frequency is, the faster the speed feedback response is. Properly increase the setting value if a higher speed response is required.

③ Properly decrease the setting value if the loading inertia is too big.

PA43 ： External analog command filtering coefficient Steady range（20-4096）

① It is used to smoothly filter the speed command received.

② If this value is decreased, the filtering to the analog command will be increased. The lower the cut-off frequency is, the better the filtering effect is and the lower the speed command response is.

③ If this value is too large, the command disturbance and speed fluctuation rise and the motor shake occurs.

CHAPTER 6 PARAMETERS

This servo drive unit has various parameters that can be adjusted and set to meet the different function requirement for performance, characteristics and so on by user. The user should make a complete study of the parameters before searching, setting and adjusting them by the operator panel.

6.1 Parameter List

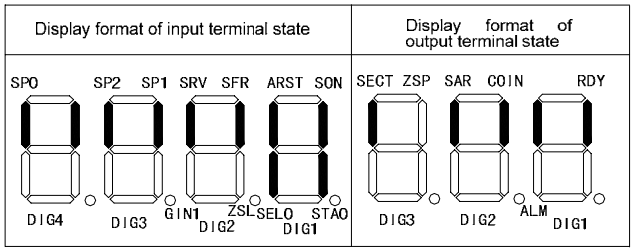
No.	Name	Setting range	Factory setting	Unit
PA0	Password	0~9999	315	
PA1	Motor model code	0~20	0	
PA2	Software version (read only)		223	
PA3	Initial display	0~24	0	
PA4	Control mode selection	1~3	1	
PA5	Speed proportional gain	1~3000	500	Hz
PA6	Speed integral time constant	0~1000	10	
PA7	Reserved			
PA8	Speed detecting low pass filter	10~1000	100	
PA9	Position proportional gain	1~1000	40	1/s
PA10～PA20	Reserved			
PA21	JOG running speed	-6000~6000	300	r/min
PA22	Internal and external speed selection	0~1	1	
PA23	Max. speed limit	0~20000	6000	r/min
PA24	Internal speed 1	-6000~6000	1000	r/min
PA25	Internal speed 2	-6000~6000	-500	r/min
PA26	Internal speed 3	-6000~6000	2000	r/min
PA27	Internal speed 4	-6000~6000	-3000	r/min

PA28	Internal speed 5	-6000~6000	5000	r/min
PA29	Internal speed 6	-6000~6000	3000	r/min
PA30	Internal speed 7	-6000~6000	10	r/min
PA31	Arrival speed	0~100	10	%
PA32	Zero-speed output threshold value	0~100	10	r/min
PA33	Internal forcefully enable	0~1	0	
PA34	Overload folds of motor current	10~300	200	%
PA35～PA38	Reserved			
PA39	Acceleration time constant	0~10000	1000	ms
PA40	Deceleration time constant	0~10000	1000	ms
PA41	Reserved			
PA42	Motor max. speed of analog 10V	0~20000	6000	r/min
PA43	Analog command filter coefficient	1~600	100	
PA44	Analog command zero-drift compensation	-3000~3000	0	
PA45	Analog command reversing	0~1	0	
PA46	Analog input mode selection	0~1	0	
PA47	SFR or SRV signal reversing	0~1	0	
PA48	Motor type	0~1	1	
PA49	Motor encoder pulses	128~8000	1024	
PA50	Motor pole pairs	1~8	2	Pole pair
PA51	Motor rated speed	1~6000	1500	r/min
PA52	Asynchronous motor time constant	1~1000	160	
PA53	Asynchronous motor exciting current	0~300	50	0.1A
PA54	Exciting current at 1.5 fold rated speed	0~300	25	0.1A
PA55	Positioning speed	1~1000	100	r/min
PA56	Position window in locating	0~100	2	pulse
PA57	Positioning direction selection	0~2	0	
PA58	Positioning location 1	0~30000	0	pulse

PA59	Positioning location 2	0~30000	0	pulse
PA60	Positioning location 3	0~30000	0	pulse
PA61	Positioning location 4	0~30000	0	pulse
PA62	Positioning location 5	0~30000	0	pulse
PA63	Positioning location 6	0~30000	0	pulse
PA64	Positioning location 7	0~30000	0	pulse
PA65	Positioning location 8	0~30000	0	pulse
PA66	Positioning encoder selection	0~1	0	
PA67	Spindle encoder pulses	128~8000	1024	
PA68	Reversing spindle encoder signal input direction	0~1	0	
PA69	Encoder output selection	0~1	0	
PA70	Reversing encoder output	0~1	0	
PA71	4 frequency selection of encoder output	0~1	0	
PA72	Reversing alarm output	0~1	0	
PA73	Shielding of motor overheat alarm	0~1	0	
PA74	Enable signal selection	0~1	0	
PA75	Window of zero-speed analog command	0~1000	0	r/min
PA76	Reserved			
PA77	Reserved			
PA78	Reserved			
PA79	Reserved			
PA80	Reserved			

6.2 Parameter Function Description

No.	Name	Relevant parameter	Function and meaning	Parameter setting range
PA 0	Password		① Set this parameter for user password 315 when a parameter is to be modified. ② For modification of motor model, the motor model parameter can only be modified after this parameter PA0 is set for model password 385. ③ The password restores to 315 if the unit is repowed after power down.	0~9999
PA 1	Motor model code		① It corresponds to the different power drive unit and motor of the same series. ② Because different motor model code corresponds to different parameter default value, the correctness of this parameter must be ensured while using default parameter recovering function. ③ When EEPROM alarm (20#) occurs, this parameter must be set again and recovering its default value, or else the drive unit may run abnormally or be damaged.	0~20
PA 2	Software version (read only)		Software version can be looked up but can not be modified.	223

PA 3	Initial display (display selection when the servo unit is powered)		0: Motor speed display; 7: Motor torque display; 8: Motor current display; 10: Control mode display; 12: Speed command display; 13 : Torque command display; 15: Input terminal state display; 16: Output terminal state display; 17: Encoder input signal display; 18: Running state display; 19: Alarm code display; 20: DC bus voltage display; 21: Software version display; 22: Hardware version display; 24: Reserved.  Annotation: SON: servo enable ARST: alarm reset signal SFR: SFR/stop signal SRV: SRV/stop signal SP0, SP1, SP2: internal speed/positioning selection duplex signal STAO: positioning start signal SELO: positioning direction selection ZSL: 0-speed clamping signal GIN: universal input signal RDY: ready signal COIN: positioning completion signal SAR: speed arrival signal ZSP: 0-speed output signal SECT: motor excitation(used) ALM: driver alarm signal	0~24

PA 4	Control mode selection	PA22: internal and external speed selection	Set the servo unit control mode by this parameter: 1：Speed control mode, speed command input by VCMD+, VCMD- analog volume input terminals	1~3
		PA45: analog command reversing		
		PA46: Analog input mode selection		
		PA47 ： SFR and SRV signal reversing		
			2：JOG mode (trial speed run)	
		PA21: JOG run speed	3：JOG mode (JOG run)	
PA 5	Speed proportional gain	PA6:speed integral time constant	①Proportional gain set of speed loop adjustor ②The bigger the setting value is, the higher the gain is and the bigger the rigidity is. Parameter value is determined by specific servo unit model and load. Generally, the bigger the load inertia， the smaller the setting value is. ③Set a bigger value if there is no oscillation in the system.	10~3000Hz

PA 6	Speed integral time constant	PA5: speed proportional gain	① Integral gain set of speed loop adjustor The bigger the setting value is, the higher the integral speed is and the bigger the rigidity is. ② Parameter value is determined by specific servo unit model and load. Generally, the bigger the load inertia， the smaller the setting value is. ③ Set the bigger value if there is no oscillation in the system.	0~3000
PA 8	Speed detection low pass filter		①The smaller the setting value is and the lower the cut-off frequency is, the more effective the filtering is, the lower the motor noise is. If the value is too small, oscillation may be caused by increased speed fluctuation and slow response and motor shakes acutely. ②The bigger the setting value is and the higher the cut-off frequency is, the quicker the speed feedback response. If higher speed response is needed, the setting value may be increased appropriately. ③Properly reduce the setting value if load inertia is too large.	20~1000

<table>
<tr>
<td>PA 9</td>
<td>Position proportional gain</td>
<td></td>
<td>①Proportional gain set of position loop adjustor
②The bigger the setting value is, the higher the gain is and the bigger the rigidity is, the smaller the position lag is. But if the value is too big, the oscillation or overshooting may occur.
③Under the same condition, the larger the setting value is, the faster the positioning is, but motor shake or positioning failure may occur in positioning if the value is too large. The value is defined by special servo unit model and loading.</td>
<td>1~1000 1/s</td>
</tr>
<tr>
<td>PA 21</td>
<td>JOG running speed</td>
<td></td>
<td>Running speed set in JOG mode</td>
<td>-6000~6000 r/min</td>
</tr>
<tr>
<td>PA 22</td>
<td>Internal and external speed selection</td>
<td>PA4：control mode selection the parameter should be set for 1 in this status</td>
<td>①If it is set for 1, the speed command is from external analog input
②If it is set for 1, the speed command is from internal speed.
There are 8 combinations for the SP0, SP1, SP2 inputs. If all the inputs are off, the motor is in zero excitation. And the other 7 internal speeds can be set by parameters, which is shown in PA24～PA30.
<table>
<tr><td>SP2</td><td>SP1</td><td>SP0</td><td>Internal speed</td></tr>
<tr><td>OFF</td><td>OFF</td><td>OFF</td><td>0r/min</td></tr>
<tr><td>OFF</td><td>OFF</td><td>ON</td><td>Internal speed 1</td></tr>
<tr><td>OFF</td><td>ON</td><td>OFF</td><td>Internal speed 2</td></tr>
<tr><td>OFF</td><td>ON</td><td>ON</td><td>Internal speed 3</td></tr>
<tr><td>ON</td><td>OFF</td><td>OFF</td><td>Internal speed 4</td></tr>
<tr><td>ON</td><td>OFF</td><td>ON</td><td>Internal speed 5</td></tr>
<tr><td>ON</td><td>ON</td><td>OFF</td><td>Internal speed 6</td></tr>
<tr><td>ON</td><td>ON</td><td>ON</td><td>Internal speed 7</td></tr>
</table>
</td>
<td>0~1</td>
</tr>
</table>

PA 23	Max. speed limit	PA42： Max. motor speed corresponding to analog 10V generally，PA42≤PA23	① For max. speed set of spindle motor ② It is irrelevant to rotation direction and applicable to both internal and external speed. ③ If PA42≥PA23, the motor max. speed is PA23. ④ If PA42≤PA23, the motor max. speed is PA42.	0~20000 r/min
PA 24	Internal speed 1		①Internal speed 1 set ②See PA22 for details.	-6000～6000 r/min
PA 25	Internal speed 2		①Internal speed 2 set ②See PA22 for details.	-6000～6000 r/min
PA 26	Internal speed 3		①Internal speed 3 set ②See PA22 for details.	-6000～6000 r/min
PA 27	Internal speed 4		①Internal speed 4 set ②See PA22 for details.	-6000～6000 r/min
PA 28	Internal speed 5		①Internal speed 5 set ②See PA22 for details.	-6000～6000 r/min
PA 29	Internal speed 6		①Internal speed 6 set ②See PA22 for details.	-6000～6000 r/min
PA 30	Internal speed 7		①Internal speed 7 set ②See PA22 for details.	-6000～6000 r/min

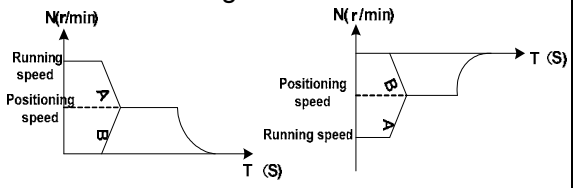
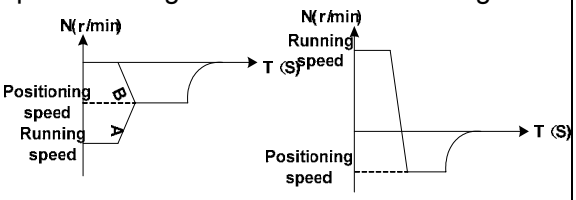
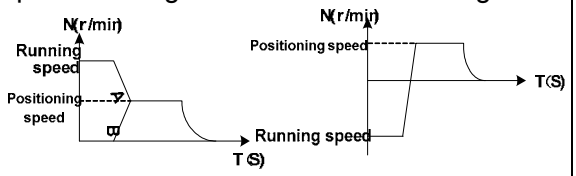
PA 31	Arrival speed		①Arrival speed set. ②In speed mode, when the actual speed of the spindle motor gets the setting range of the command speed, speed arrival signal is output. The setting is adjustable in the 0%～100％ range of the command speed. e.g. if it is set for 10％, then the setting value is 10. When the speed command is 1000r/min, the speed arrival (SAR)signal is output for the actual speed 900r/min～1100r/min. ③It is irrelevant with the spindle motor rotation direction.	0～100%
PA 32	Zero-speed output threshold value		If the actual speed is less than or equal to zero-speed output threshold value, zero-speed output (ZSP) signal is valid.	0～100 r/min
PA 33	Internal forcefully enable		①If it is set for 0, the internal enable is invalid. ②If it is set for 1, the signal is forcefully enabled, the motor is excited if PA4＝2 or 3,SFR OR SRV signal is needed to be added for excitation with no need of external enable signal input if PA4=1.	0～1
PA 34	Overload folds of motor curren		①For the motor overload coefficient setting. The setting value is the percentage of the rated current. E.g. If it is set for the double rated current, the value is 200. Unit:% ②This parameter value determines the maximum torque output by the motor.	10~300
PA 39	Acceleration time constant		①For linear acceleration time setting in Speed control mode ②Its value is equal to the time the motor accelerates from 0 to the rated speed.	0～10000

PA 40	Deceleration time constant		①For linear deceleration time setting in Speed control mode ②Its value is equal to the time the motor decelerates from 0 to the rated speed.	0～10000
PA 42	Motor max. speed of analog 10V	PA23：maximum speed limit	①It is used to set the maximum speed under a 10V analog voltage, and it is irrelevant to the rotation direction. ②If the speed command exceeds the maximum speed, the actual speed is the maximum speed.	0～20000 r/min
PA 43	Analog command filter coefficient		①For smoothly filtering the speed command received ②If the value is reduced, the analog command filtering will be increased, the lower the cut-off frequency is, the higher the filtering effect is, and the speed command response becomes slower. ③If the value is too large, the disturbance and speed fluctuation increase, and it will cause motor shaking.	1～600
PA 44	Analog command zero-drift compensation		For user analog command error compensation	-3000～3000

PA 45	Reversing analog command	PA4：control mode selection PA22：internal and external speed selection PA46：analog input mode selection PA47：reversing SFR and SRV signal	①If set for 1, for PA46=1: when PA47=0, the motor runs forward for the SFR signal, reversely for SRV signal; when PA47=1, the motor runs reversely for the SFR signal, forward for SRV signal; ②If set for 1, when PA46=0, the motor runs forward for the positive analog command, and reversely for the negative; ③If set for 0, when PA46=1, the motor doesn't run whether for forward signal or reverse signal; ④If set for 0, when PA46=0, the motor runs reversely for the positive analog command, and forward for the negative.	0～1
PA 46	Analog input mode selection	PA4：control mode selection PA22：internal and external speed selection PA45：reversing analog command PA47：reversing SFR and SRV signal	①If set for 1, the external analog input voltage is 0~+10VDC; ②If set for 0, the external analog input command voltage is -10VDC ~+10VDC	0～1

PA 47	Reversing SFR or SRV signal	PA4：control mode selection PA22：internal and external speed selection PA45：reversing analog command PA46：analog input mode selection	①Valid when PA46＝1, for SFR and SRV signal exchange; ②When PA47 ＝ 0, motor forward for enabling SFR signal, reversely for enabling SRV signal; ③ When PA47 ＝ 1, motor reversely for enabling SFR signal, forward for enabling SRV signal.	0～1
PA48	Motor type		① If set for 0, the control object is synchronous motor, 0 setting is unallowable; ②If set for 1, the control object is spindle motor, it's a default setting.	0～1
PA49	Motor encoder pulses		This parameter must be set correctly.	128～8000
PA50	Motor pole pairs		Motor pole pair, 1 pole pair =2 poles pole number=2×pole pairs, the unit is pole pair. Note the conversion for the pole number marked on motor nameplate.	1～8

PA 51	Motor rated speed		It is from motor nameplate.	1～6000
PA 52	Asynchronous motor time constant		Asynchronous motor time constant	1～1000
PA 53	Asynchronous motor exciting current		Asynchronous motor excitation current	1～300
PA 54	Exciting current at 1.5 fold rated speed		Excitation current at 1.5 fold rated speed	1～300
PA 55	Positioning speed		For searching fixed position (parameter settable) by positioning speed in positioning Refer to parameter PA57.	1～1000
PA 56	Positioning window in positioning		①In positioning, the spindle searches Z pulse by positioning speed, then searches the position to be located, positioning completion（COIN）signal is given while the error of the position to be searched is within the positioning window. ②The bigger the setting value is, the larger the error is; the smaller the setting value is, the more unsteady the positioning completion（COIN）signal is.	0～100

PA 57	Positioning direction selection		① Set for 0, for random positioning. i.e. positive positioning speed is used for motor forward, negative for reverse. The figure is shown as following:  **Note: Curve A means that if the running speed is larger than the positioning speed, motor decreases to positioning speed, after the positioning position is found, the motor decelerates till the positioning is completed. So curve B means that the running speed is less than the positioning speed, the motor accelerates to the positioning speed, and then complete the positioning.** ② Set for 1, for negative positioning. i.e. regardless the motor running direction, the motor locates by the negative positioning speed. The figure is shown as following:  ③ Set for 2, for positive positioning. i.e. regardless the motor running direction, the motor locates by the positive positioning speed. The figure is shown as following:  	10～300

PA 58			There are 3 input interfaces which provide 8 combinations to support 8 point positioning, and the positioning locations are defined by PA58～PA65. It is shown as following:				
			SP2	SP1	SP0	Positioning location	
	Positioning location 1		OFF	OFF	OFF	Positioning location 1	0～30000
PA 59	Positioning location 2		OFF	OFF	ON	Positioning location 2	0～30000
PA 60	Positioning location 3		OFF	ON	OFF	Positioning location 3	0～30000
PA 61	Positioning location 4		OFF	ON	ON	Positioning location 4	0～30000
PA 62	Positioning location 5		ON	OFF	OFF	Positioning location 5	0～30000
PA 63	Positioning location 6		ON	OFF	ON	Positioning location 6	0～30000
PA 64	Positioning location 7		ON	ON	OFF	Positioning location 7	0～30000
PA 65	Positioning location 8		ON	ON	ON	Positioning location 8	0～30000

6.3 Motor Model Code Parameter Correspondence Table

PA1 parameter correspondence table for spindle motors

PA1 parameter	Spindle motor model and technical parameters	Remarks
0	GM7101-4SB6□，3.7KW, 6000r/min，0.02kg.m^2	
1	GM7103-4SB6□，5.5KW, 6000r/min, 0.02kg.m^2	
2	GM7105-4SB6□，7.5KW, 6000r/min, 0.032kg.m^2	
3	GM7131-4SB6□，11KW, 6000r/min, 0.076kg.m^2	
4	GM7103-4SC6□，7.5KW, 9000r/min, 0.02kg.m^2	**Basic speed 2000r/min**
5		
6		
7		
8		
9		
10	YPNC-50-3.7-B, 3.7kw,380V, 6000r/min, 8.0A, 24.0N.m	
11	YPNC-50-5.5-B, 5.5kw,380V, 6000r/min, 11.8A, 36.0N.m	
12	YPNC-50-7.5-B, 7.5kw,380V, 6000r/min, 16.0A, 49.0N.m	
13	YPNC-50-11-B, 11kw, 380V, 6000r/min, 21.3A, 72.0N.m	
14		
15		
16		
17		
18		
19		
20		
21		
22		

Note

① □ stands for motor installation type, which may be 1,3,6. See section 8.1.

② The motor models are not fully listed in above table, see special explanations for other motor models suited.

CHAPTER 7 PROTECTION FUNCTIONS

There are many protection functions such as overheat protection, overcurrent protection, over-voltage protection for this DAP01 AC spindle servo drive unit. While alarming occurs, the motor stops. In the meantime, alarm code is being displayed on the LED display panel. Only the fault is exterminated by operator according to the alarm code displayed, can the device be put into use. It is at least 10 minutes for the servo drive unit and spindle motor to be touched after they are powered off to prevent from electric shock and burning.

7.1 Alarm List

Alarm code	Alarm name	Content
Er--	Normal	
Er--1	Motor overspeed	The spindle motor speed exceeding its setting value
Er--2	Main circuit over-voltage	Main power voltage too high
Er--3	Main circuit under-voltage	Main power voltage too low
Er--5	Motor overheated	Motor temperature too high
Er--7	Abnormity of SFR and SRV signal I/O	SFR and SRV signal ON simultaneously
Er--9	Motor encoder fault	Motor encoder signal error
Er--11	IPM module fault	IPM intelligent module fault
Er--13	Over- loading	Motor overloaded
Er--14	Brake fault	Brake circuit fault
Er--16	Motor overheating	Spindle servo drive unit and motor overloaded (instant overheating)
Er--17	Braking time too long	It occurring if discharge time too long
Er--18	Braking circuit fault 1	There is raking signal, but no braking feedback
Er--19	Braking circuit fault 2	There is no braking signal, but braking feedback

Er--20	EEPROM error	EEPROM error
Er--23	Current error too large	Current feedback zero drift too large
Er--24	Spindle encoder fault	Spindle encoder signal error
Er--25	Positioning fail	Positioning location can not be found
Er--26	Radiator overheating	Radiator fan temperature too high
Er--27	U, V, W connection error	U, V, W phase sequence incorrect
Er--28	Software upgrade parameter error	Parameters not adjusted and saved after software upgrade
Er--29	Power on parameter detection error	Parameter detected as power is supplied but not within setting range

7.2 Alarm Troubleshootings

Alarm code	Alarm name	Running state	Cause	Remedy
Er-1	Motor overspeed	Occurring in switching on control power supply	①Control circuit board fault ②Encoder fault	①Change servo drive unit. ②Change spindle motor.
		Occurring in motor running	Motor overload	Decrease load.
			① Acceleration/deceleration time constant is too small which will cause too large speed overshooting. ② The gain adjustment parameter is not appropriate.	①Increase acceleration/ deceleration time constant ②Readjust the gain for the overshooting.
			Encoder fault	Change the encoder.
			Encoder cable is inferior or connection is wrong.	Change the encoder cable or connect correctly by the wiring diagram.

Er-2	Main circuit over-voltage	Occurring in switching on power supply	①Power supply voltage is too high. ②Power supply voltage wave is abnormal.	Check power supply.
		Occurring in motor running	The brake resistance is not connected that cause the pumping voltage too high.	Connect it again.
			①Brake components are damaged. ②Brake resistance is damaged.	①Change the components damaged. ②Change the brake resistance.
			The brake resistance value is not suitable.	①Reduce the on-off frequency. ②Increase deceleration time constant. ③Reduce torque limit. ④Reduce load inertia. ⑤Change for the power suited brake resistance.
Er-3	Main circuit under-voltage	Occurring in switching on main power supply	① Soft start circuit fault ② Rectifier is damaged.	Change the servo drive unit.
			① Power supply voltage is low. ② Instantaneous power-off occurs. ③ The input power voltage fluctuation is too large.	Check power supply.
		Occurring in motor running	① Power capacity is not enough. ② Instantaneous power down ③The input power terminals are loosen or input power lacks phases.	Check power supply.

Er-5	Motor overheated	Occurring in switching on control power supply	There's no thermal protection switch inside the motor body.	Set PA73 for 1 to shield the alarm.
			① Cable is broken off. ② Internal thermal switch of motor is damaged.	① Check the cables. ② Check the spindle motor.
		Occurring in motor running	Motor is overloaded.	①Reduce the load. ②Reduce the on-off frequency. ③Increase the acceleration/deceleration time. ④Increase the drive unit and motor capacity. ⑤Reduce the ambient temperature.
			Motor interior is at fault.	Change the spindle motor.
Er-7	Abnormity of SFR and SRV signal I/O		SFR and SRV signal are both ON.	SFR and SRV signal can't be input simultaneously.
Er-9	Motor encoder fault		Motor encoder connection is broke off.	Check the connection.
			Motor encoder is damaged.	Change the motor encoder.
			Motor encoder cable is inferior.	Change the cable.
			Motor encoder cables are so long that the encoder voltage is too low.	① Shorten the cables. ② Employ with multi-core parallel power supply.

Er-11	IPM module fault	Occurring in switching on control power supply	Circuit board is at fault.	Change the servo drive unit.
		Occurring in motor running	①Control power voltage is low. ②IPM module is overheated. ③IPM module is overcurrent.	① Check the servo drive unit. ② Check whether the cooling fan is at normal. ③Correct the loading.
			Drive unit U, V, W terminals are short circuit.	Check the connection.
			Earthing is not well done.	Be grounded correctly.
			Motor insulation is damaged.	Change the spindle motor.
			It is interfered with.	①Add the circuit filter. ②Be far away from the interference source.
Er-13	Overloading	Occurring in motor running	Drive unit U, V, W terminals are short circuit.	Check the connection.
			Earthing is not well done.	Be grounded correctly.
			Loading is increased abruptly.	Reduce the loading.
			Motor oscillation or abnormal noise occurs due to improper gain setting.	Readjust gain.

Er-14	Brake fault	Occurring in motor running	The main power voltage is too high.	Check the main power.
			Brake resistance connection is broken off.	Connect it again.
			① Brake transistor is damaged. ②Internal brake resistance is damaged.	Change the servo drive unit.
			Brake loop capacity is not enough.	①Reduce the on-off frequency. ②Increase the deceleration time constant. ③Reduce the load inertia. ④Replace the drive unit and motor with larger power ones.
Er-16	Motor overheating	Occurring in motor running	①Running exceeding rated torque ②Long time motor overloading	①Reduce the load. ②Reduce the on-off frequency. ③Increase the overheating time. ④Replace the driver and motor with the larger power ones.
			Motor oscillates unsteadily.	① Adjust gain. ② Increase acceleration/ deceleration time constant. ③ Reduce load inertia.

Er-17	Pumping time too long	In braking	DC bus voltage exceeding pumping voltage too long	① Brake resistance is not connected. ② Increase brake resistance capacity. ③ External input voltage is too high.
Er-18	Braking circuit fault 1		There being brake signal，but no brake feedback	Refer to Er-14.
Er-19	Braking circuit fault 2		There being brake feedback， but no brake signal	Refer to Er-14.
Er-20	EEPROM error	Occurring in switching on control power supply	①Chip or circuit board fault ②Not initialized ③EEPROM reading data damaged as power is supplied	① Change the servo drive unit. ② After reparation, the drive unit model must be re-specified (by parameter PA-1), then restore the default parameters.
Er-23	Current error too large		Chip or circuit board is damaged.	Change the servo drive unit.
			Current sensor is damaged.	Change the current sensor.
			①Current feedback drift is too large. ②The voltage of the control power for detecting chips not within a valid range	①Make zero adjustment. ②Adjust parameters. ③Check the control power voltage.

Er-24	Spindle encoder fault		Spindle encoder connection is wrong.	Check connection.
			Spindle encoder is damaged.	Change the spindle encoder.
			Parameter setting is wrong.	PA66=1, without spindle encoder positioning.
			Spindle encoder cables are too long that cause the encoder supply voltage low	① Shorten the cables. ② Employ with multi-core parallel cables for power supply.
Er-25	Positioning fail	In positioning	①Positioning location can't be found. ② Parameter setting not correct as positioning by spindle encoder	① Check Z pulse of the encoder feedback signal or cables. ② Check the consistency of feedback encoder and positioning encoder selected by parameter.
Er-26	Radiator overheating		① The temperature of radiator fins exceeding the setting value, which causes the thermal switch broken off. ② Temperature switch damaged ③ It is interfered with	①Reduce the load or cut off the power to cool the module. ②Change the thermal switch. ③Be far away from interference source.
Er--27	U, V, W connection error	Occurring in switching on control power supply	Phase sequence not correct	①Connect them correctly. ②Exchange any two phases. ③Refer to the wiring table in section 3.3.2.

Er--28	Software upgrade parameter error	Occurring in switching on control power supply	Parameter not adjusted and saved after software upgrade.	Readjust and save parameters.
Er--29	Power on parameter detection error	Occurring in switching on control power supply	Parameter value detected as power is supplied not within the setting range	Check the parameter range.

7.3 Maintenance and Reparation

The spindle servo drive unit is mainly comprised by semiconductor components. Their performance varies with the ambient temperature, humidity, dust, dirt and shake, therefore proper daily maintenance and reparation are necessarily needed.

Make check as following:

1) Check abnormal shaking, noise, and smell of the running motor.
2) Check the running, abnormal shaking, noise, or the parts fastness of the cooling fan.
3) Check the surrounding environment change, especially whether the vent hole is blocked by dirt.
4) Check the screws and bolts fastness and the terminal blocks due to the temperature variation and the shake.
5) Check the insulation resistances between the terminals or the terminal-to-earth according to a relevant standard.

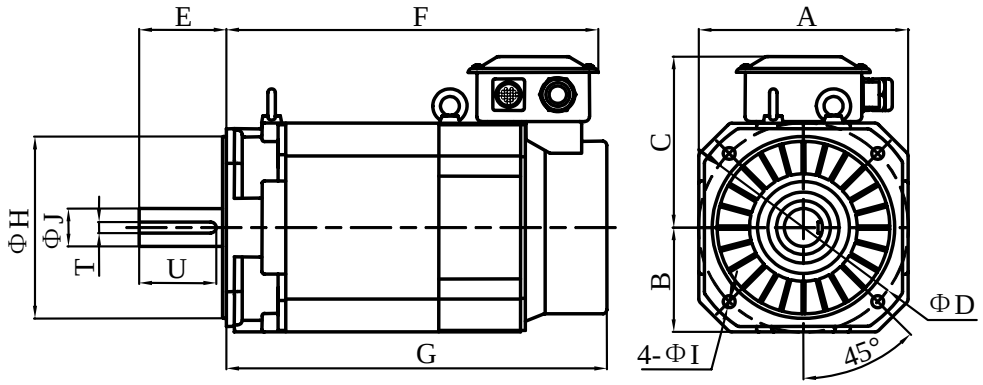
CHAPTER 8 SUITED SPINDLE SERVO MOTOR

8.1 GSK Spindle Servo Motor

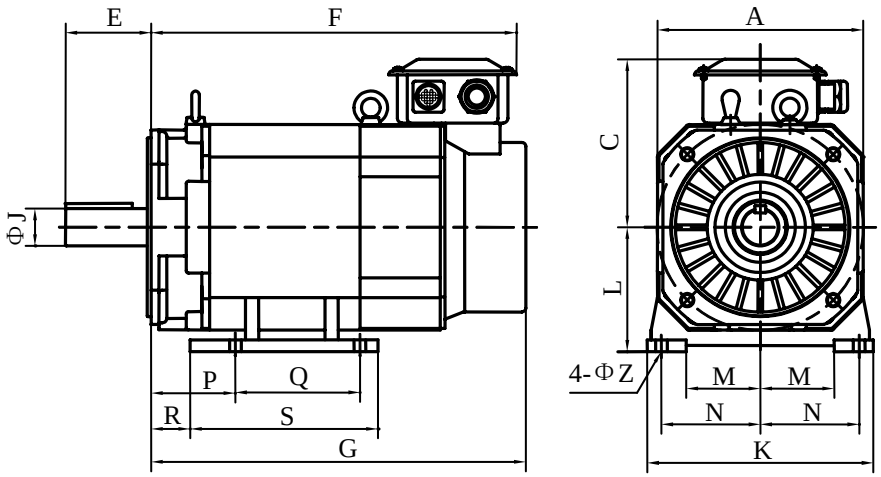
The main technical parameters and outline dimensions of the motors are shown in the following table:

Specification / Items	ZJY132-2.2	ZJY132-3.7	ZJY132-5.5	ZJY132-7.5	ZJY160-7.5	ZJY160-11	ZJY160-15
Rated power（kW）	2.2	3.7	5.5	7.5	7.5	11	15
Rated voltage（V）	3-phase AC 340				3-phase AC 330		
Rated current（A）	5.7	8.9	13.2	17.3	18	26	35
Rated frequency（Hz）	50	50	50	50	50	50	50
Rated torque（N·m）	14	24	35	48	49	72	98
30 min power（kW）	3.7	5.5	7.5	11	11	15	18.5
30 min current（A）	9.4	13	17.1	25	26	34	42
30 min torque（N·m）	24	35	48	70	74	100	123
Rated speed（r/min）	1500	1500	1500	1500	1500	1500	1500
Constant power range（r/min）	1500～8000				1500～6000		
Maximum speed（r/min）	10000	10000	10000	8000	7000	7000	7000
Rotation inertia（kg·m2）	0.0103	0.0168	0.0238	0.0309	0.0413	0.0744	0.0826

Specification / Items		ZJY132-2.2	ZJY132-3.7	ZJY132-5.5	ZJY132-7.5	ZJY160-7.5	ZJY160-11	ZJY160-15
Weight（kg）		49	51	66	77	89	107.2	125
Installation type		IM B5 or B35	IM B5			IM B5 or B35 （GB/T 997—2003）		
Protection degree		IP54（GB/T 4942.1—2001）						
Insulation degree		F （GB 1094.3—2003）						
Vibration degree		R （GB 10068—2000）						
Internal encoder		Incremental 1024～5000 p/r/						
Air conditioner power（V）		3-phase AC 380						
Outline dimensions	A	208	208	208	208	264	264	264
	B	104	104	104	104	132	132	132
	C	188	188	188	188	216	216	216
	D	215	215	215	215	265	265	265
	E	60	60	80	110	110	110	110
	F	351	401	456	511	425	470	515
	G	363	413	468	523	436	481	526
	H	180	180	180	180	230	230	230
	I	15	15	15	15	15	15	15
	J	28	28	32	38	48	48	48
	K	220	——	——	——	290	290	290
	L	132	——	——	——	160	160	160
	M	72	——	——	——	95	95	95
	N	95	——	——	——	127	127	127
	P	70	——	——	——	108	108	108
	Q	114	——	——	——	160	160	178
	R	35	——	——	——	50	50	50
	S	184	——	——	——	241	241	259
	T	——	——	——	——	14	14	14
	U	——	——	——	——	97	97	97
	Z	12	——	——	——	15	15	15



Flange installation pattern（B5）



Flange basement installation pattern（B35）

An example: ZJY132-7.5B5

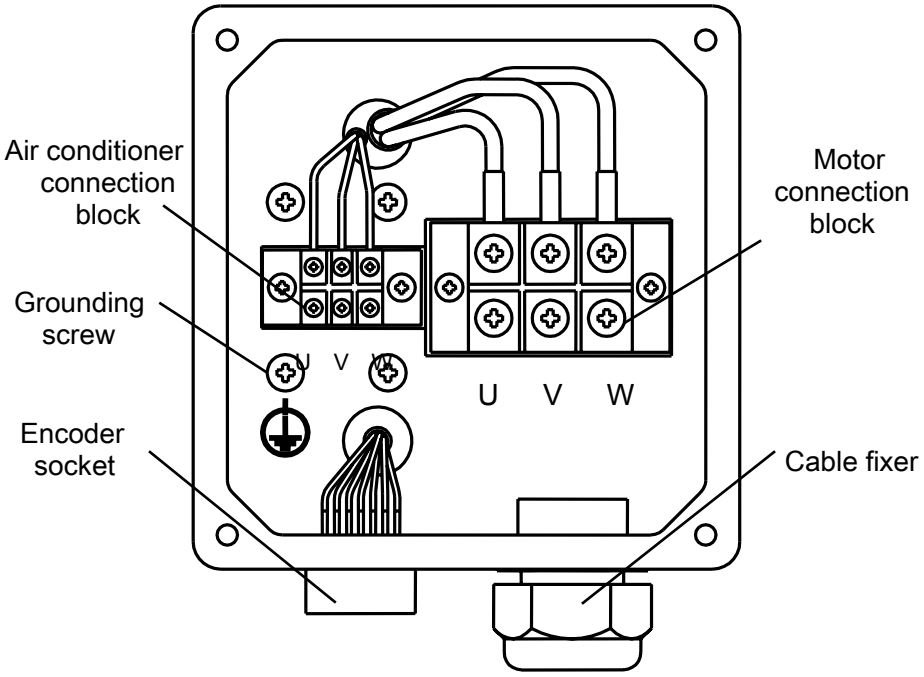
ZJY 132 - 7.5 B5

- B5 Installation formation type：（B5 or B35）
- 7.5 Rated power（unit kW）；
- 132 Foundation No.；
- ZJY Spindle servo motor (spindle AC asynchronous servo motor)

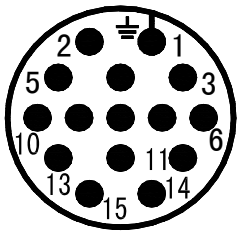
B5 ——— flange installation，no foundation
B35 ——— flange, foundation type

The motor 3 phase U, V, W windings and the shell (grounded) are led out by the cable fixation ends, and their locations in the connection box are shown in the following figure. In the figure the 3

phase U, V, W windings and the shell (grounded) are connected to the U, V, W, PE terminals of the unit main circuit correspondingly. The wind from the air conditioner is blown from the shaft to the other end.



Encoder lead-out	Shell （grounded）	V_{CC}	GND	A	$\overline{A}$	B	$\overline{B}$	Z	$\overline{Z}$
Socket No.	1	2	3	4	7	5	8	6	9



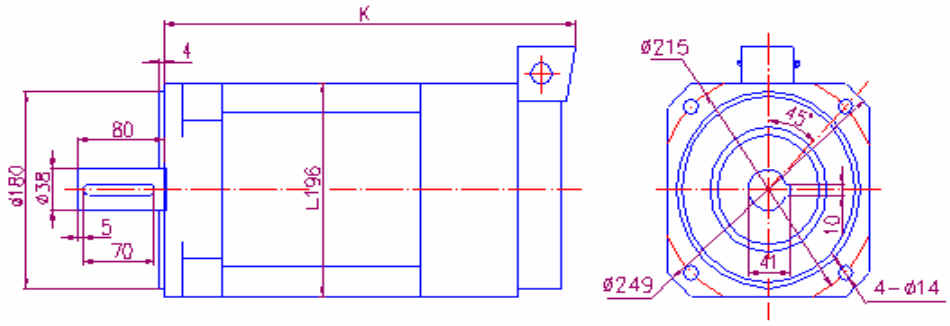
Plug schematic diagram
（welding side)

8.2 GOLDEN AGE Spindle Motor

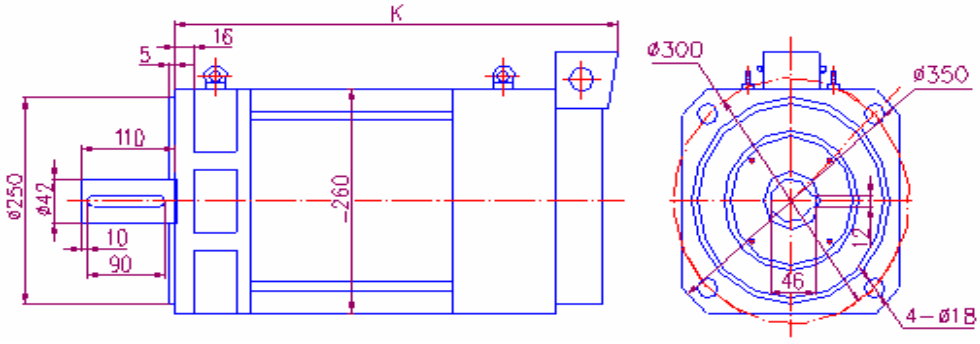
Motor technical data

Model	Rated power kW	Rated torque Nm	Rated current A	Rated speed r/min	Maximum speed r/min	Rotation inertia kgm^2	Weight kg
GM7101-4SB61	3.7	23.6	10	1500	6000/9000	0.02	35
GM7103-4SB61	5.5	35	13	1500	6000/9000	0.02	55
GM7105-4SB61	7.5	47.8	18.8	1500	6000/8000	0.032	93
GM7131-4SB61	11	70	24	1500	6000/8000	0.076	93

Motor installation outline and dimensions Unit (mm)



Model	K
GM7101	405
GM7103	405
GM7105	500
GM7107	500
GM7109	540

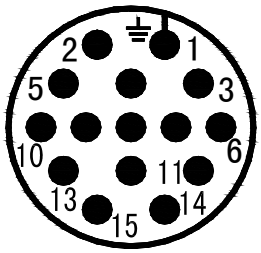


Model	K
GM7130	430
GM7131	510
GM7132	430
GM7133	510
GM7135	595

The pin-out of the photoelectric encoder is led out by a 15-core connector whose correspondence is shown as following table. The pin-out should be connected to the plug of the servo unit feedback signal CN2.

Encoder connection table

Encoder pin-out	**Shell(grounded)**	**V_{CC}**	**GND**	**A+**	**A-**	**B+**	**B-**	**Z+**
Socket No.	1	12	13	2	3	4	5	16
Encoder pin-out	**Z-**	**OH1**	**OH2**					
Socket No.	17	14	15					



Plug schematic diagram
(welding side)

No.14, 15 pins are the output terminals of the motor internal thermal protection switch. While there is no such switch inside the motor, No.5 overheating alarm occurs after power-on. Please set parameter PA73 for 1 to shield the alarm, then save the setting and re-power the unit.

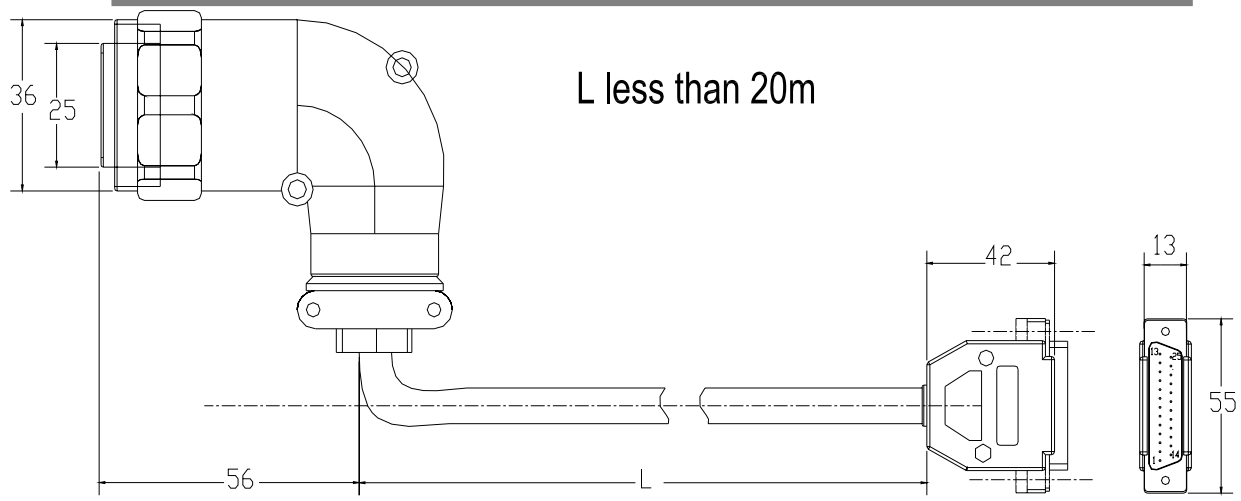


Fig.8.1 Encoder signal cable dimension Unit: mm

Model significance of GOLDEN AGE GM7 series frequency conversion (spindle) motor:

GM7 10 1 — 4 S B 6 1 — O Y

- GM7: GM7 series AC servo frequency conversion (spindle) motor
- 10: Central height (integer part of the height divided by10）
- 1 — 4: Motor poles, 4 means 4 poles
- S: Motor specification code

Code	Cooling type
S	Forced cooling

- B:

Code	Rated speed
B	1500

- 6:

Code	Power voltage
6	3-phase AC380V power

- 1:

Code	Installation type
1	1M B5
3	1M B3
6	1M B35

- O:

Code	Feedback component
O	1024p/r (square wave encoder)

- Y:

Code	Shaft extension
None	standard
Y	special

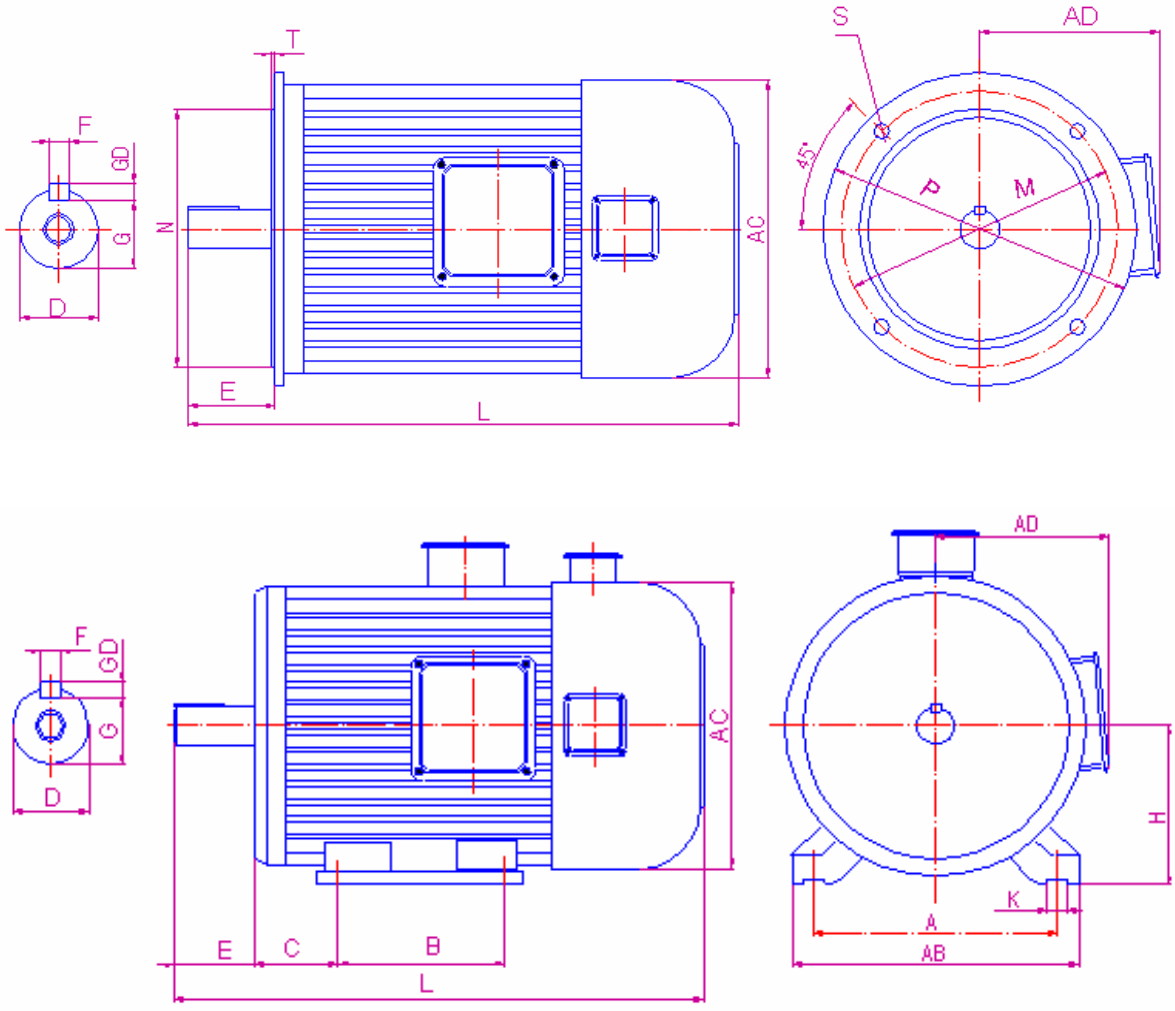
8.3 CEMA Spindle Servo Motor

Motor technical data

Motor specification	Motor output power		Rated speed r/min	Maximum speed r/min	Rated torque N.m	Current at 380V (A)	
	100%	150%				100%	150%
YPNC-50-3.7-B	3.7	5.5	1500	6000	24.0	8.0	12.5
YPNC-50-5.5-B	5.5	7.5	1500	6000	36.0	11.8	15.5
YPNC-50-7.5-B	7.5	11.0	1500	6000	49.0	16.0	23.0
YPNC-50-11-B	11.0	15.0	1500	6000	72.0	21.3	30.5

Motor installation dimensions

Motor installation outline: unit (mm)

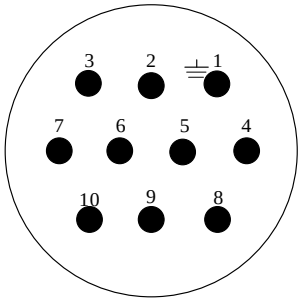


Motor installation dimensions form

		YPNC-50-3.7-B	YPNC-50-5.5-B	YPNC-50-7.5-B	YPNC-50-11-B
Vertical dimensions（B5）	M	215	265	265	300
	N	180	230	230	250
	P	250	300	300	350
	T	4	4	4	5
	S	4-φ15	4-φ15	4-φ15	4-φ19
Horizontal dimensions（B3）	A	190	216	216	254
	B	140	140	178	210
	C	70	89	89	108
	K	12	12	12	15
	H	112	132	132	160
Outline dimensions（no more than）	AB	245	280	280	330
	AD	190	210	210	265
	AC	240	275	275	335
	L	459	528	568	715
Shaft extension dimensions	F×GD	8×7	10×8	10×8	12×8
	DH	M10×20	M12×24	M12×24	M16×32
	D	28	38	38	42
	G	24	33	33	37
	E	60	80	80	110

Connection table for CEMA spindle motor encoder

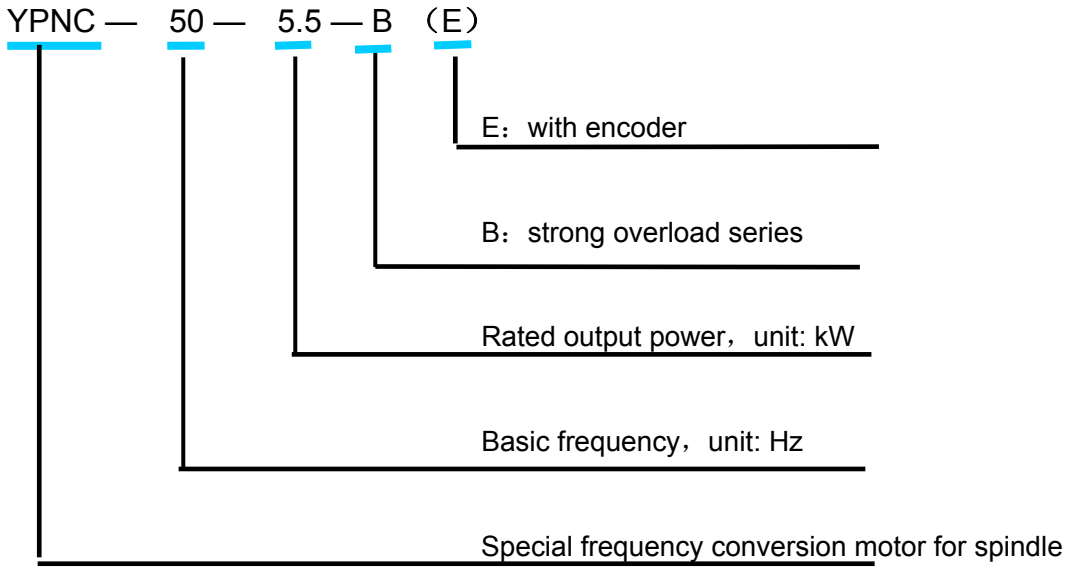
Pin-out	1	2	3	4	7	5	8	6	9
Mark	PE	Vcc	GND	A+	A-	B+	B-	Z+	Z-



Plug schematic map

（welding side）

Model significance of Shanghai CEMA YPNC series motor:



Connections of several model motor encoders are listed above, more are unlisted. If user want to use other model spindle motor, pay attention to the connections of power jack and encoder socket as well as the motor use criterion and requirement.