

GSK DA98B AC Servo Drive Unit

User Manual



GSK

广州数控设备有限公司
GSK CNC EQUIPMENT CO., LTD.



The operating manual describes all matters concerning the operation of the system in detail as much as possible. However, it is impractical to give particular descriptions of all unnecessary and/or unavailable works on the system due to the length limit of the manual, specific operations of the product and other causes. Therefore, the matters not specified herein may be considered impractical or unavailable.



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Company Profile

GSK CNC EQUIPMENT CO., LTD.(GSK) , CNC Industry Base of South China, is responsible for the National High Technology Research and Development Program of China (863 Program): Moderate CNC Industrialization Key Technology. For ten years, we are exclusively engaged in research, Development, manufacture, sale, training and popularization of Machine Tool CNC system, Servo Motor and driver, and other mechanical products. Today, GSK has already expressed into a large-scale new high-tech enterprise that deals with research, teaching, working and trading. Our products support more than 60 domestic manufacturers of machine tools with after-sales service network through the country. With a yield in the lead in China for four years in succession, GSK series products are in great demand in the domestic demand and have a ready sale in Southeast Asia at high performance-to-price ratio.

Chinese version of all technical documents in Chinese and English languages is regarded as final.

Foreword

The manual describes functions and operation methods of DA98B AC servo Drive Unit to ensure that you can comprehensively understand the servo unit to flexibly and conveniently use it. Else, it also provides the knowledge and notes how to operate the unit.

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

Thank you for using DA98B AC Servo Drive Unit and ***User Manual***. Welcome you to feedback your suggestions about our product and ***User Manual*** by the telephone or fax, Email which has been addressed on the back cover of this manual, or feedback to our headquarter by local outlet.



Please read carefully the following warning marks, if not avoided, could result in injury or in heavy damage to property.

- The following warnings with varying degrees of severity appear in the User Manual.



Danger: Indicate an imminently hazardous situation which, if not avoided, will result in death or serious injury.



Caution: Indicate a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in damage to property.



Indicate a potential situation which, if not avoided, may result in an undesirable result or state.



This symbol appears in the user Manual whenever it is necessary to draw your attention to an important item of information....

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



Forbid performing some operation (absolutely must not perform some operation).



Perform some operation (must perform some operation).



Danger

The switch of over-current protection, over-heat protection, breaker and emergency should be fixed.



Lightning strike, hurt, or fire occurring if the indication not observed

Hand is not permitted to stick into the servo unit.



Scalding or electric shock occurring if the indication not observed

Swiveling shaft is not permitted to be touched in the running of motor.



Hurting occurring if the indication not observed

Motor is not permitted to be used near the corruptible gas, inflammable objects.



Fire occurring if the indication not observed

The cable is not permitted to be put on the trenchant edge and excessive pressure, load, tension is not permitted to exert on it



Electric shock, fault, damage occurring if the indication not observed

Moving, wiring and checking can only be performed after the power is switched off for 10 minutes.



Electric shock occurring if the indication not observed

Servo unit should be well grounded.



Electric shock occurring if the indication not observed

Emergency switch should be fixed.



Electric shock, hurt, fire, fault or mechanical damage occurring if the indication not observed



Caution

The motor must be used with the suited servo unit.



Device damage occurring if the indication not observed

Load test for motor can only be performed after the completion of the dry run test.



Motor damage occurring if the indication not observed

When there is an alarm in the running, it must be eliminated before going on running.



Destructive result occurring if the indication not observed

Don't touch the motor, control device or the brake resistance for the heating in the running.



Scalding occurring if the indication not observed

Over adjustment and over change operations or the operations that may result in instability should be avoided.



Damage occurring if the indication not observed

Drive device is not permitted to be modified, disassembled and overhauled.



Electric shock or damage occurring if the indication not observed

Don't grip the cable or the motor shaft in the transportation of the motor.



Hurt occurring if the indication not observed

Don't approach the equipment for the unexpected starting after the power is switch on again.



Physical hurt occurring if the indication not observed



Notes

Don't inhibit the heat diffusion or put object in the radiator fan.



Electric shock, fire or damage occurring if the indication not observed

Observe the voltage instructions.



Electric shock, fire or damage occurring if the indication not observed

Wiring must be assured.



Electric shock or hurt occurring if the indication not observed

The power supply terminals and motor output terminals must be fastened.



Fire occurring if the indication not observed



Chapter 1 Overview	1
1.1 Introduction	1
1.2 Check after delivery	2
1.3 Outline	4
Chapter 2 Installation	5
2.1 Installing servo unit	5
2.2 Installing motor.....	7
Chapter 3 System configuration and assembly	9
3.1 Servo unit specification	9
3.2 Interior diagram block of servo unit.....	11
3.3 Wiring	11
3.4 I/O Interface fundamentals.....	18
3.5 Standard conection	23
3.5.1 Orientation control	23
3.5.2 Speed control	25
Chapter 4 Parameter	27
4.3 Model code parameters for motors	33
Chapter 5 Display and operation	35
5.1 Keys operation	35
5.3 Parameter setting.....	39
Chapter 6 Trial run	43
6.1 Check before trial run	43
6.2.1 Sequence of power on for servo unit	44
6.2.2 JOG running	45
6.2.3 (Sr-) trial run	46
6.2.4 Speed control run	46
6.2.5 Orientation control run	49
6.3 Application of hold release signal	52
6.4 Parameter adjustment for machining characteristics improvement	54
Chapter 7 Function for protection	57
Chapter 8 Isolated transformer	64
Chapter 9 Order guide	69
9.1 Capacity selection	69
9.2 Electronic gear ratio	72
9.3 Stop characteristic	72
9.4 Servo and orientation controller computation.....	73

Chapter 1 Overview

1.1 Introduction

DA98B AC Servo Drive Unit is the second generation of fully digital AC Servo system of our company which is employed with the new type exclusive chip DSP for motor control, large-scale complex programmable logic device (CPLD) and IPM with big power, which has a good integration, compact, perfect protection and highly reliability. It is characterized with the f orientation control, interior speed control, analog speed control etc. and is widely applied in the automation production line, packing machinery and printing machinery and other automatic field.

Compared to stepper system,

DA98B AC Servo Driver Unit has advantages as follows:

● Avoiding out-of-step

Servomotor is equipped with encoder, its orientation signal feedbacks to servo driver with open loop orientation controller to compose a semi-closed loop control system.

● Speed ratio, constant torque

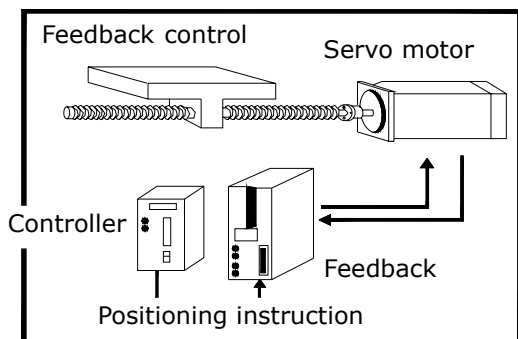
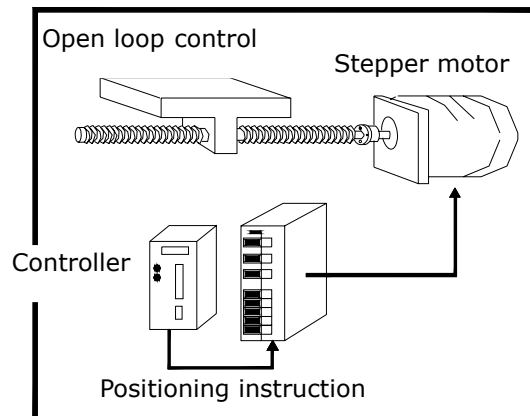
The timing ratio is 1: 5000, with stable torque from low speed to high speed.

● High speed, high precision

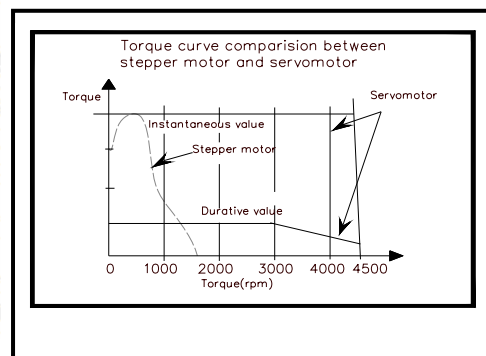
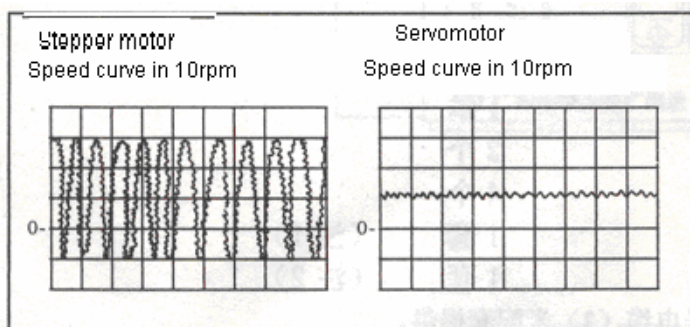
Max. speed can be 3000rpm, and the speed fluctuation rate is less than 2%.

【Note】 There is different rated speed for different motors.

● Simple and flexible control



Parameters can be modified to set properly operating mode, running performance of servo system to meet different requirements.



1.2 Check after delivery

Item

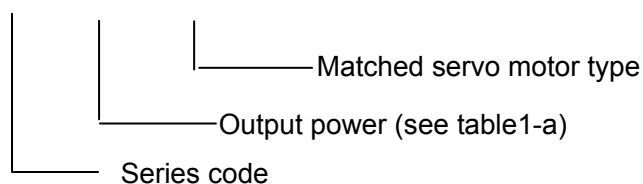
- 1) Whether the packing is good and the goods is damaged.
- 2) Whether the servo unit, servo motor is the ordered one by checking the nameplates of the goods.
- 3) Whether the accessories are complete by checking the packing list.

Note!

- Do not install servo unit which is damaged or lacks of components.
- Servo driver must be matched with servomotor which performance matches the former.
- Please contact with our suppliers or our company if there are any questions after receiving goods.

Model significance

DA98B-04-110SJT-M060D



Mark	Rated output	Mark	Rated output	Mark	Rated output
04	0.4 kW	12	1.2 kW	18	1.8 kW
06	0.6 kW	14	1.4 kW	20	2.0 kW
08	0.8 kW	15	1.5 kW	23	2.3 kW
10	1.0 kW	17	1.7 kW	26	2.6 kW

Table 1—a

(1) Standard accessories for DA98B servo unit:

①	User Manual	1	
②	Installation bracket	2	
③	M4×8 countersink bolt	4	
④	CN1 socket (DB44 female)	1 set	(note 1)
⑤	CN2 plug (DB25 male)	1 set	(note 2)

Accessory list



1: Signal cable (3m) can be provided when it is matched with our servo unit.

2: Feedback cable (3m) available should be used when our servo motor is provided.

(2) Standard accessories of servo motor are provided according to user manual of servo motor.

1.3 Outline

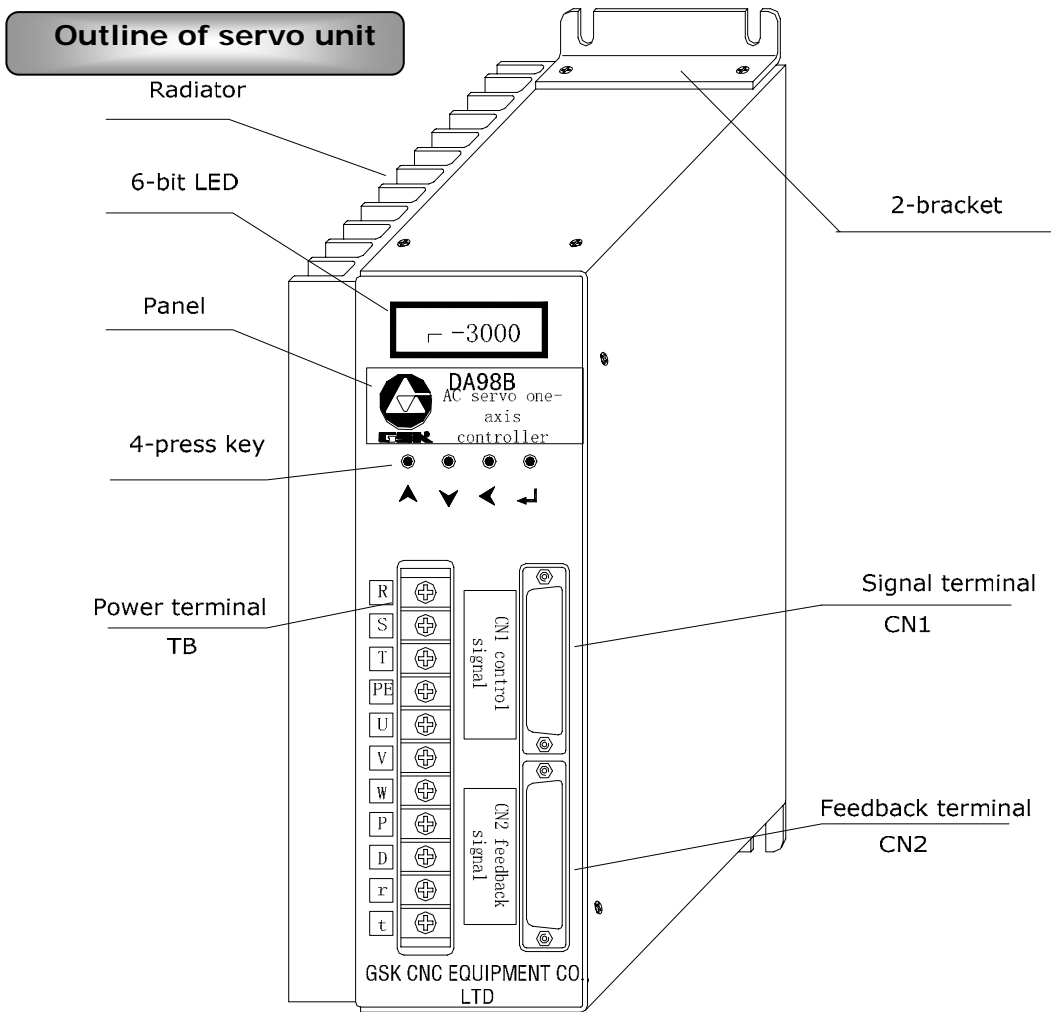


Fig. 1.1 Outline of servo unit

Outline of servo motor

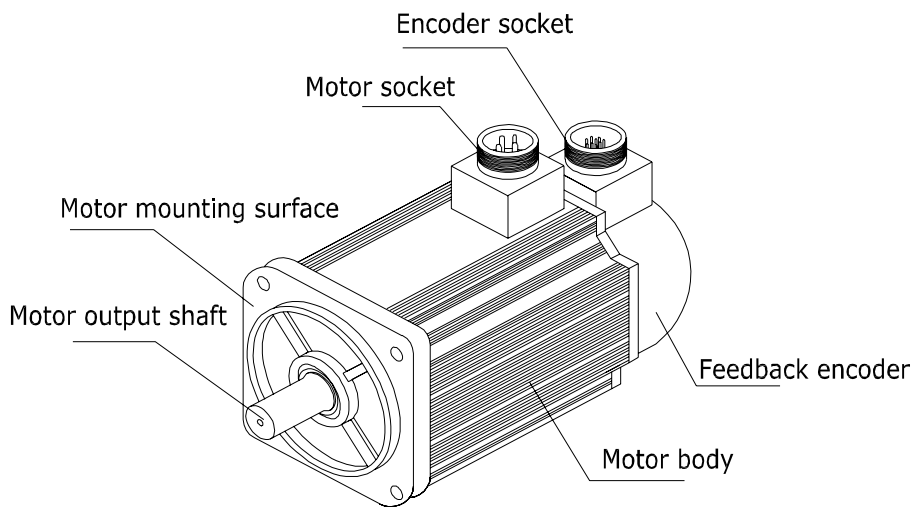


Fig. 1.2 Outline of servo motor

Chapter 2 Installation

Servo unit and servo motor should be correctly installed to avoid the mistaken operation, to protect the machine from being broken or damaged.

2.1 Installing servo unit

Installation environment

- Be careful for the protection against rain and sunlight while the servo unit is being installed.
- Servo unit must be installed in the electric cabinet to prevent dust, corrosive gas, liquid, conductors and inflammable substances from entering it.
- Servo unit should be fixed in the well ventilative, dampproof and dustproof environment.
- Fireproof material should be used in the installation with no permission to fix it on or near the inflammable object.
- Run the servo unit below the temperature of 45°C for reliable long term usage.

Environmental requirements

Item	DA98B servo unit
Operating temperature	0~55°C (no frost) ≤90%RH (no dewing)
Storage/delivery temperature and humidity	-40~80°C ≤90%RH (no dewing)
Atmosphere environment	There should be no corrosive gas, flammable gas, oil fog or dust etc. in the control cabinet.
Altitude	Altitude: below 1,000m
Vibration	≤ 0.5G (4.9m/s ²) 10-60Hz
Atmospheric pressure	86kPa~106kPa
Guard level	IP43

Installation method

The driver is employed with bottom board or panel installation mode in the upright direction of installation plane.

Fig. 2.1 is sketch map for bottom board installation and Fig. 2.2 for panel installation. (Unit below: mm)

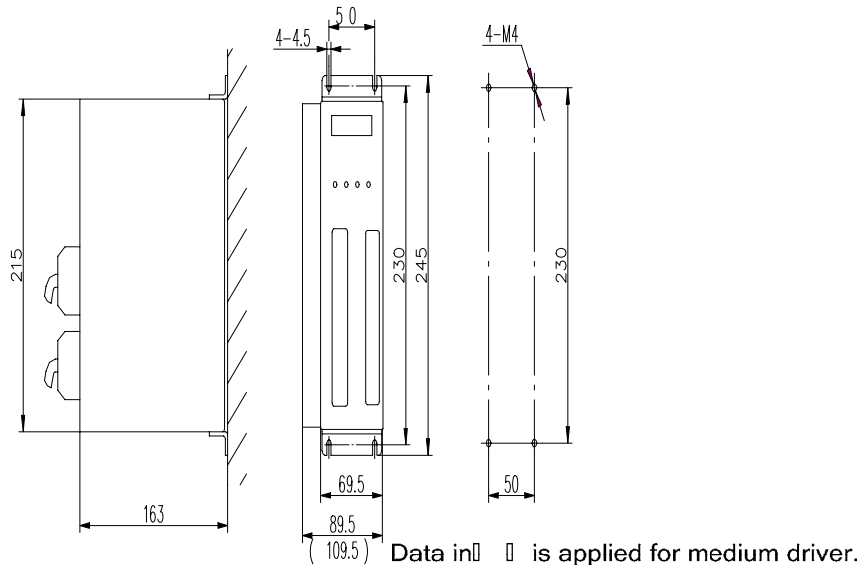


Fig 2.1 Bottom board installation pattern

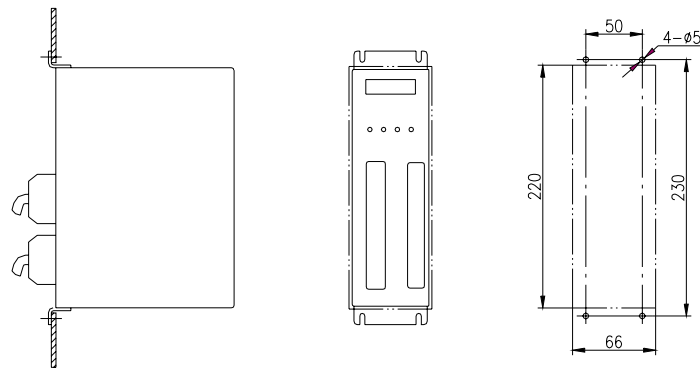


Fig 2.2 Panel installation pattern

Installation interval

Fig. 2.3 is installation interval for one servo unit and Fig. 2.4 is for servo units. The actual interval for installation should be larger as possible as to get a good heat radiation.

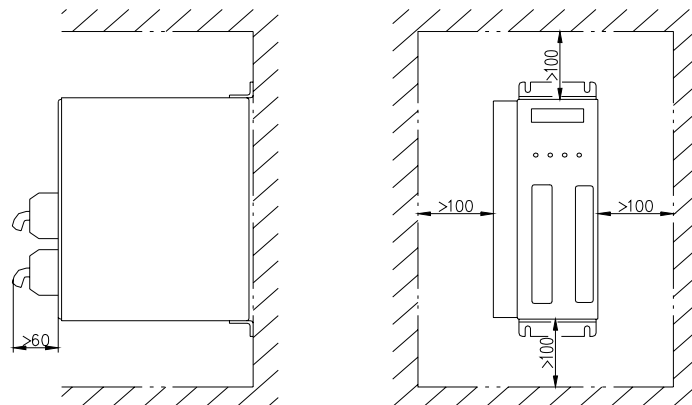


Fig. 2.3 Installation interval for a single servo unit

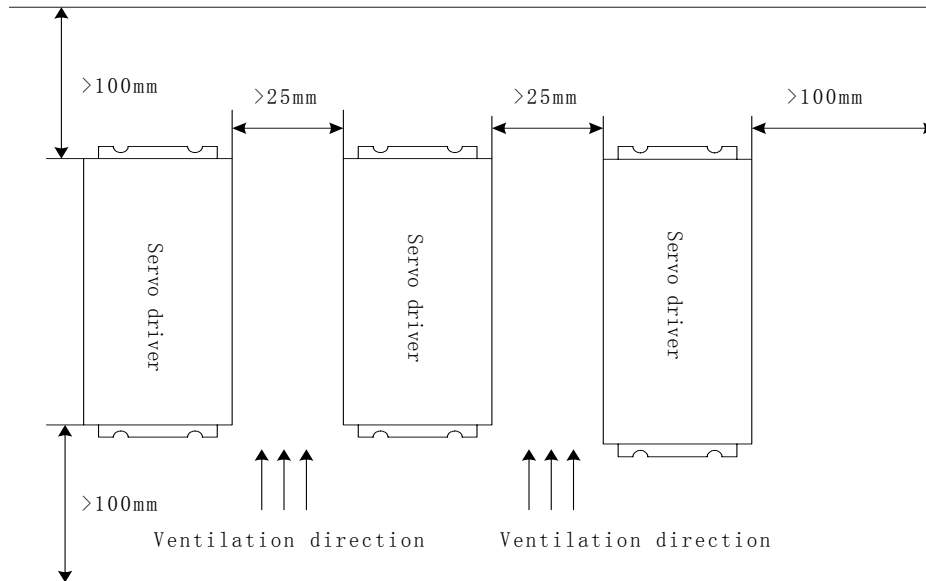


Fig. 2.4 Installation interval for servo units

Heat radiation

There should be convective air to the radiator of the servo unit in electric cabinet to inhibit its environmental temperature from continuously rising.

2.2 Installing motor

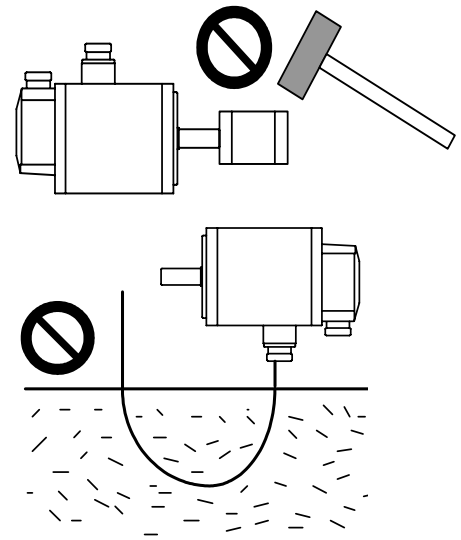
Installation environment

- Be careful for the protection against rain and sunlight.
- The motor must be installed in the electric cabinet to prevent dust, corrosive gas, liquid, conductors and inflammable substances from entering it.
- The motor should be fixed in the well ventilative, dampproof and dustproof environment.
- The motor should be fixed in a place that is convenient for the maintenance, check and cleaning of the motor.

Note!

Installation notes

- Do not hammer the motor or its shaft to protect the encoder from being damaged when removing or assembling belt wheel. Helically pressing or drawing tools should be used for removing and assembling.
- Servo motor cannot support heavy axial, radial load. It should be employed with flexible shaft coupling for load.
- Anti-loose washer should be used to fix the motor against losing.
- Oil and water should be protected from the motor for that the oil or water from the cable which has been dipped in the oil or water can be stuck to the motor, so such possibility should be avoided.



Chapter 3 System configuration and assembly

Chapter 3 System configuration and assembly

3.1 Servo unit specification

Table 3—1 Servo unit specification

Output power (kW)		0.4~0.8	1.0~1.5	1.7~2.6
Motor rated torque (N·m)		2~4	4~10	6~15
Input power supply		Single phase or three-phase AC220V -15~+10% 50/60Hz	three-phase AC220V -15~+10% 50/60Hz	
Environment	Temperature	Working: 0~55℃ Storage: -20℃~80℃		
	Humidity	Less than 90% (no dewing)		
	Vibration	Less than 0.5G (4.9m/s ²), 10~60 Hz(non-continuous running)		
Control method		① Orientation control ② External speed control ③ Internal speed control ④ Trial speed run ⑤ JOG speed ⑥ Encoder zero-adjusting		
Energy brake		Built-in		
Control characteristics	Speed frequency response: 200Hz or more			
	Speed fluctuation rate: <±0.03 (load 0~100%); <±0.02 (power supply -15~+10%) (numerical value corresponding to rated speed)			
	Timing ratio: 1:5000			
	Pulse frequency: ≤500kHz			
Control input		① Servo on ② Alarm cancellation ③ Disable in positive direction ④ Disable in negative direction ⑤ Zero-speed clamping ⑥ Error counter reset/speed choice11 ⑦ Disable instruction pulse/speed choice 2 ⑧ CCW torque limit ⑨ CW torque limit ⑩ Universal I/O port		
Control output		① Servo ready output ② Servo alarm output ③ Orienting completing output/speed in-orientation output ④ Hold release ⑤ Zero speed output ⑥ Universal output ⑦ Pulse feedback output		
Orientation control	Input mode	① Pulse+ direction ② CCU pulse /CW pulse ③ A/B orthogonal phases pulse		
	Electronic gear ratio	Ratio numerator: 1~32767 Ratio denominator: 1~32767		

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	Encoder Feedback	2500 pulse/rev (resolution:10000) incremental encoder
Speed control	4 kinds of internal speed instructions and (+10~-10) external analog voltage instructions	
Monitor function	Speed, current orientation, instruction pulse accumulation, Orientation deviation, motor torque, motor current, linear speed, rotor absolute orientation, instruction pulse frequency, running state, input/output terminal signal and so on	
Protection function	Overspeed, overvoltage/under-voltage of main power supply, overcurrent, overload, brake abnormality, encoder abnormality, control power supply abnormality, orientation oversize	
Display, operation	6-bit LED digital tube, 4 buttons	
Load inertia	Less than quintuple of motor inertia	
	Thin radiating fin	Thick radiating fin
Weight	2.67Kg	3.48Kg
Dimension	244×163×92mm	244×163×112mm

Chapter 3 System configuration and assembly

3.2 Interior diagram block of servo unit

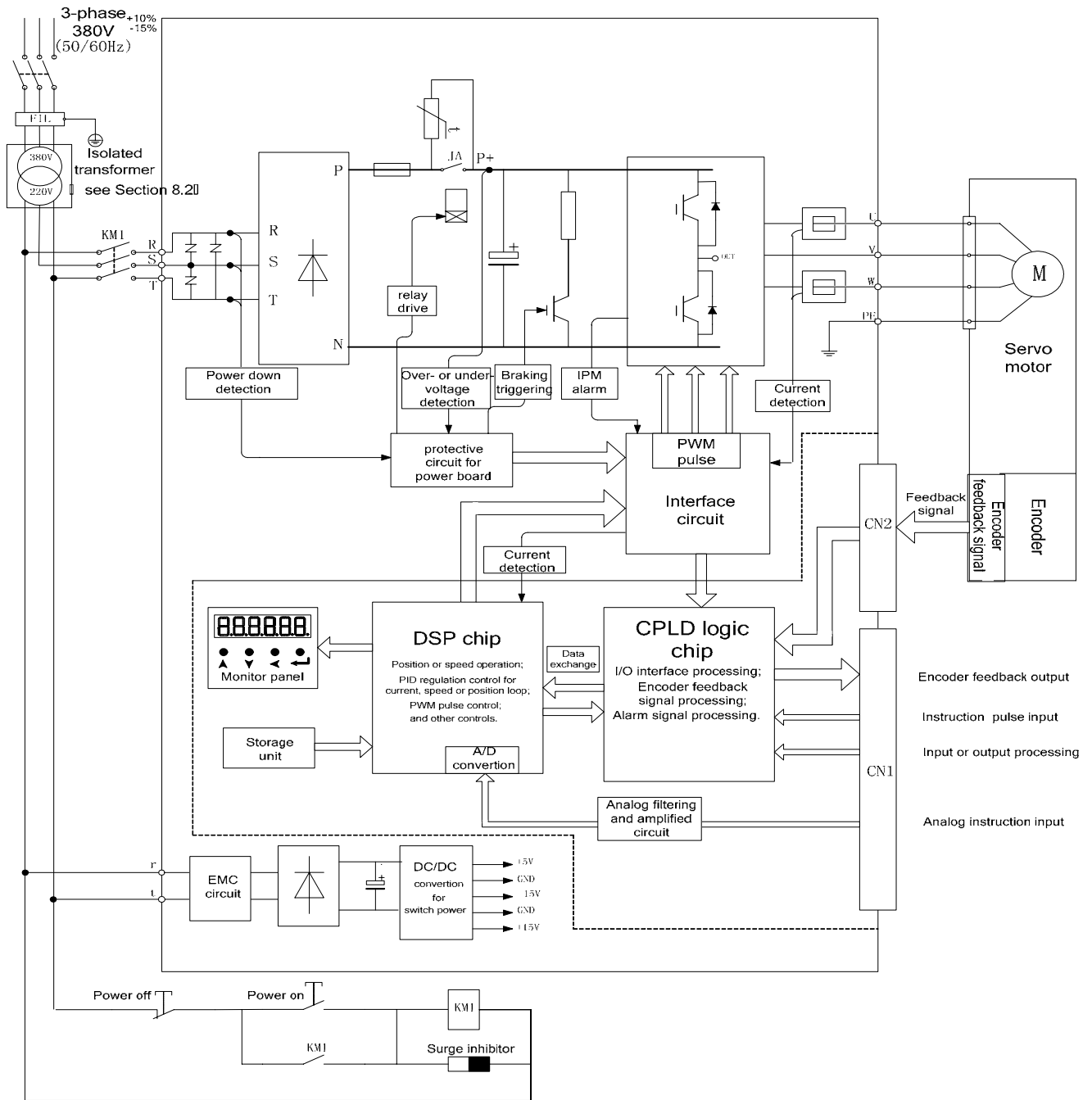


Fig. 3.1 Interior diagram block for DA98B servo unit



Control board diagram block inside the broken line and power supply board diagram block outside the broken line above.

3.3 Wiring

There are several control modes for DA98B: orientation control mode, speed control mode etc. Personnel who take up the wiring and checking should be qualified for

the work, they must do wiring as the terminal voltage and poles by the manual for prevention of the device damage or the injury to personnel.

Main circuit wiring

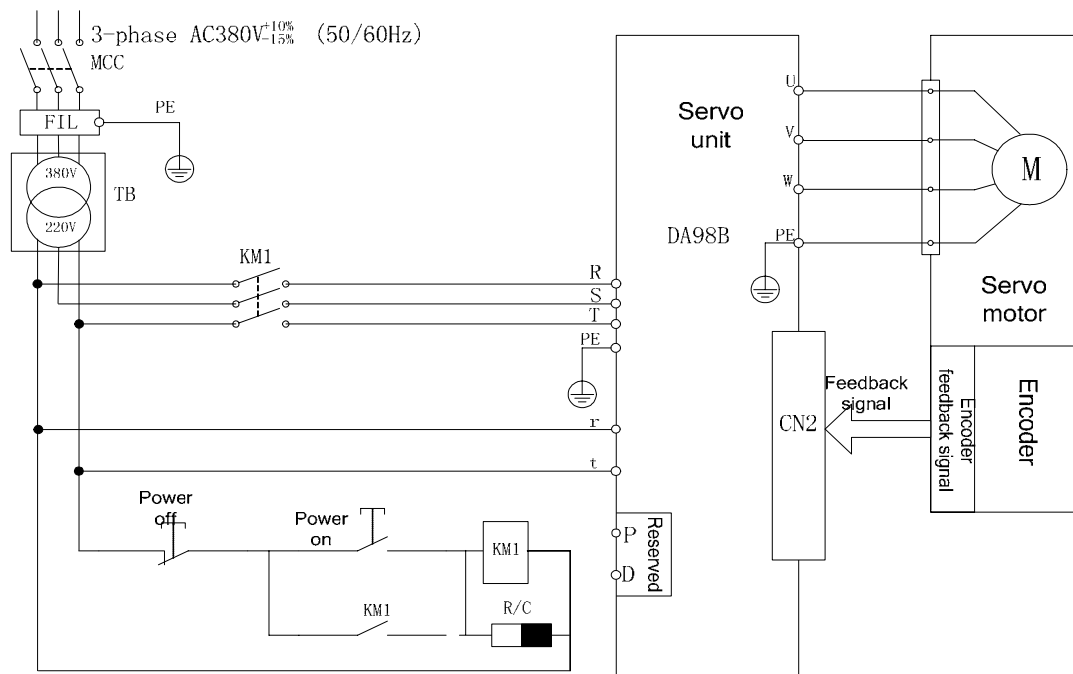


Fig.3.2 Typical wiring for the main circuit

- | | |
|---------------------------|--------------------------|
| MCC : Breaker | FIL : Disturbance filter |
| TB : Isolated transformer | KM1 : AC contactor |
| R/C : Surge inhibitor | P, D : Reserve |

- The breaker should be selected B type short circuit device, the drop-away current is more 1.3 times than servo rated input one, otherwise is less than 1.05 times than the servo rated input current.
- Single phase power supply AC220V(+10%~ -15%) can be employed when the precision is comparative low and the power is less than 0.8KW for servo unit, and its the wiring is as fig.3.2
- While connecting the terminals, peel the insulative surface of the wire and twist the naked copper wires, compress the wiring by the pre-insulation cold pressing terminals to fasten the connection.

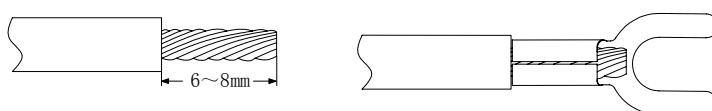


Table 3-2 Wire sections for main circuit (Unit: mm²)

Output power	R	S	T	PE	U	V	W	r	t
Type	Input terminals of the main power supply			Protection earthing	Output terminals of power			Input terminals of the control power	
0.4~0.8 (kW)	1.5	1.5	1.5	≥2.0	1.5	1.5	1.5	1.0	1.0
1.0~1.5 (kW)	2.0	2.0	2.0	≥2.0	2.0	2.0	2.0	1.0	1.0
1.7~2.6 (kW)	2.5	2.5	2.5	≥2.5	2.5	2.5	2.5	1.0	1.0



Caution to main circuit wiring:

① Wires from power supply must not be directly connected with the U, V, W terminals.

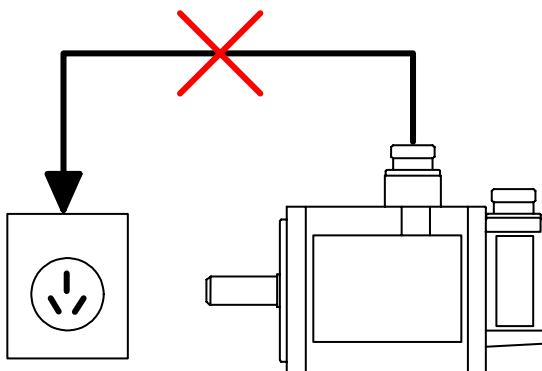
② U, V, W wires should connect with motor terminals correspondingly. Operation of reverse rotation for motor by exchanging the wires of three-phase terminals is not allowed.

③ Due to the high frequency switch current in the motor, the leaking current is relatively larger, the motor grounding terminal must be connected with the servo unit grounding terminal PE and the grounding resistance should be less than 100Ω.

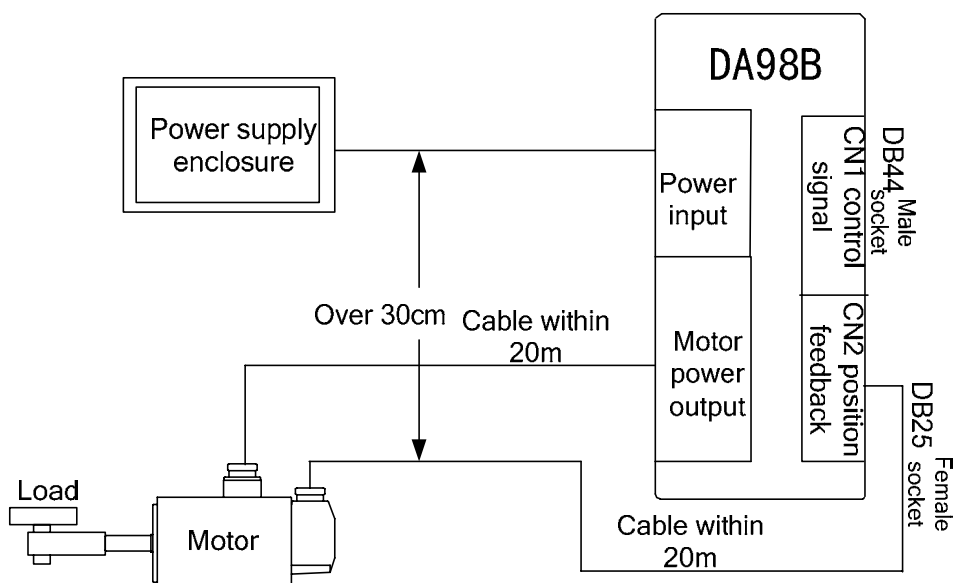
④ Do not touch the servo unit and motor in 5 minutes after the power supply is switched off because there is large electrolytic capacitance keeping high voltage inside the servo unit even if it is switched off.

⑤ Operator should keep a certain distance to the servo unit and motor after the power is switched on.

⑥ Servo motor must not be driven by the industrial power directly connecting to the U, V, W terminals of motor in the absence of servo unit, or the servo motor will be damaged.



CN2 terminal wiring



- ① The cable length between the servo unit and motor should be within 20 meters.
- ② The distance between the feedback cable of encoder and main circuit cable should be over 30cm as well as the both cables should not use the same tube or be bound together.
- ③ Shielded cable with the size $0.15\text{mm}^2 \sim 0.20\text{mm}^2$ (AWG24-26) should be used for feedback signal cable, and the shielded tier should connect with FG terminal.
- ④ The cables and wares should be well fixed as well as not be adjacent to servo unit radiator or motor for their protection of insulation against heating.
- ⑤ The wiring of CN2 in the following sketch map is done by accordance of GSK SJT series motor. If user uses motor from other manufacturers or self-made wires, the wiring below should be followed by. (Leading wires of temperature controller connect to OH, OV terminals for motor with temperature controller.)

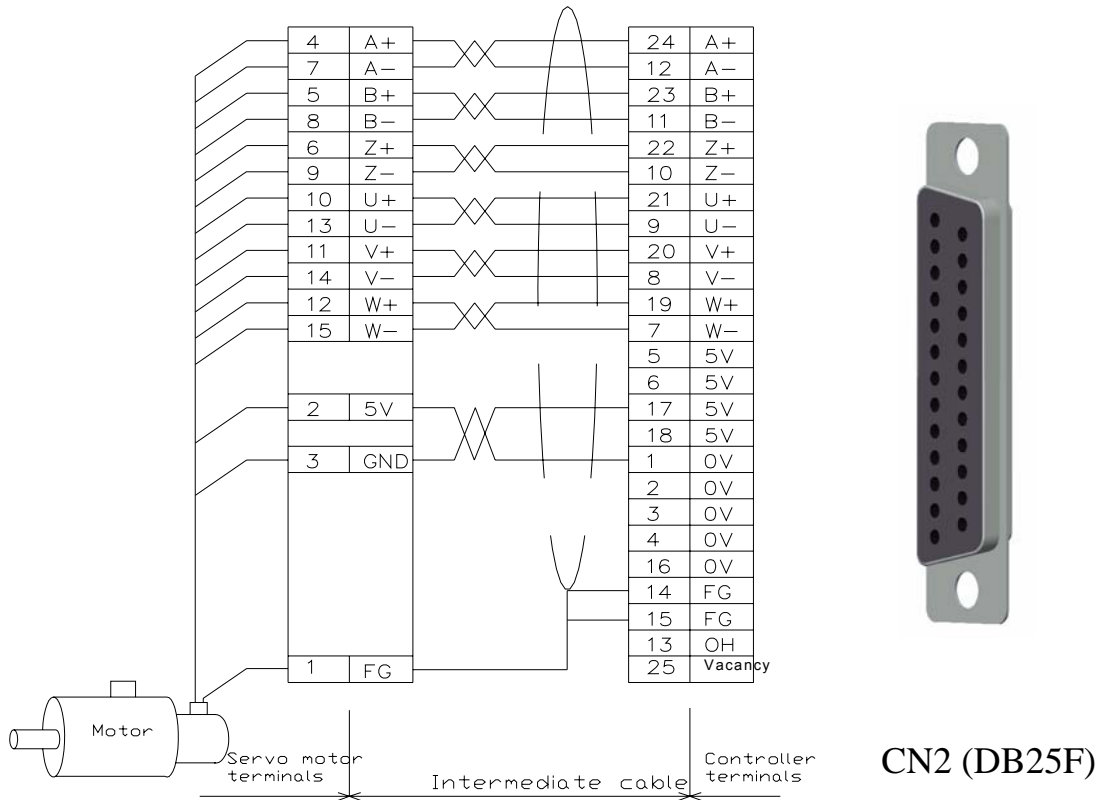
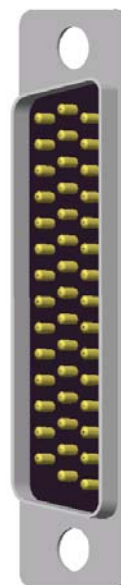
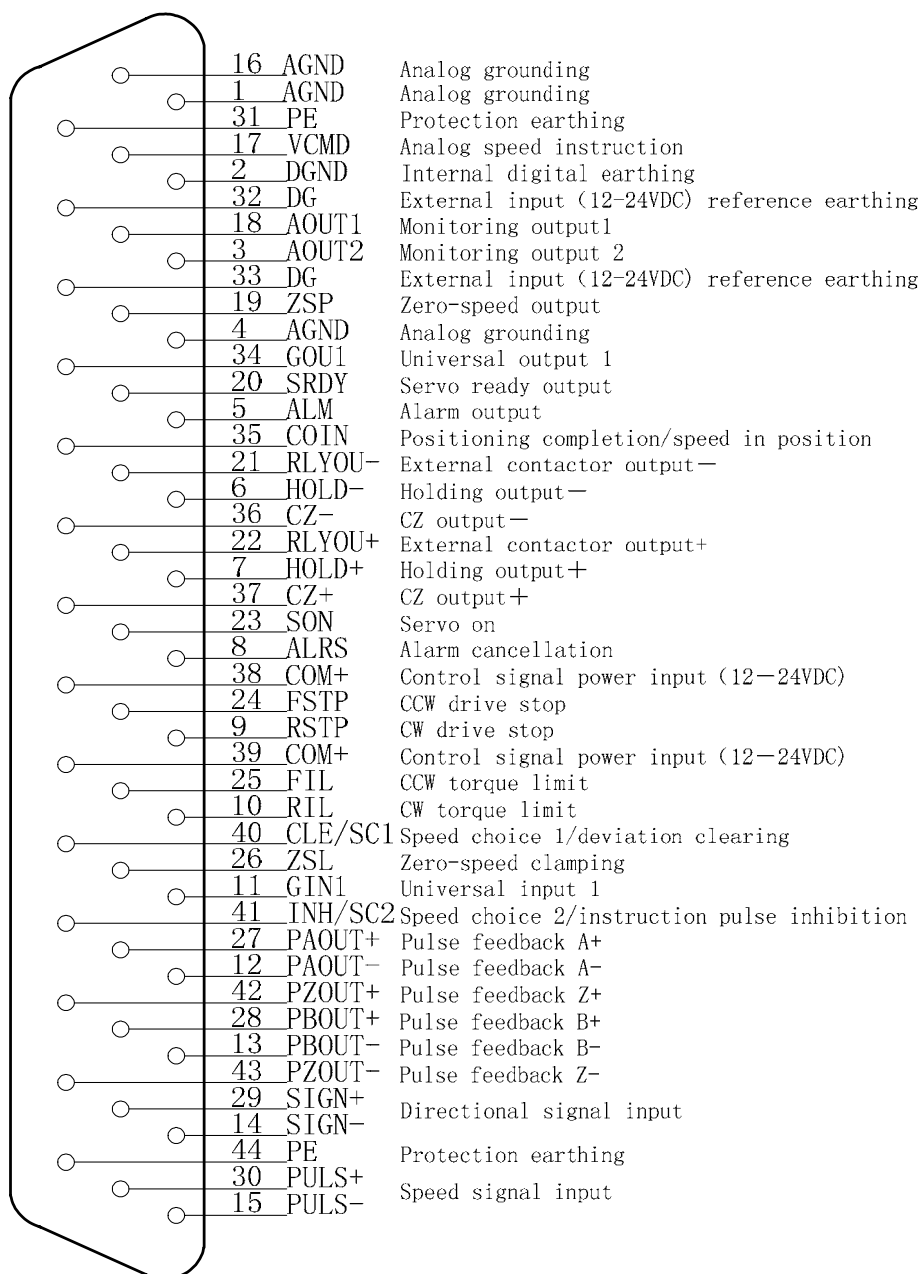


Fig.3.3 Encoder wiring

CN1 terminal wiring

- ① The cable length of the control signal should be within 3m.
- ② The distance to the main circuit cable should be above 30cm as well as the both cables should not use the same tube or be bound together for protection against disturbance.
- ③ The external power supply should be provided by user.
- ④ There are different wirings for CN1 terminal in different control modes, see section 3.5 for details.

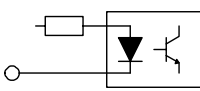
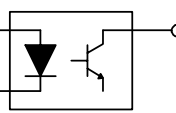
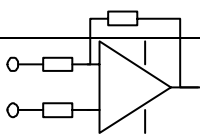
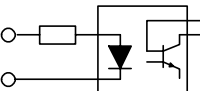
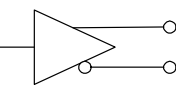


CN1 (DB44M)

Fig.3.4 Terminals and definition of CN1

Input and output interface pattern for CN1

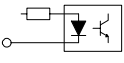


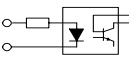
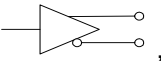
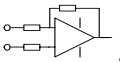
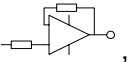
Table 3—3 Terminal signal type

Input terminals			Output terminals			Other terminals	
Pin No.	Sign	Signal type	Pin No.	Sign	Signal type	No.	Sign
23	SON		19	ZSP		2	DGND
8	ALRS		35	COIN/SCMP		4	AGND
9	RSTP		34	GOU1		16	AGND
24	FSTP		5	ALM	31	PE	
40	CLE/SC1		20	SRDY	32	DG	
41	INH/SC2		7	HOLD+	33	DG	
10	RIL		6	HOLD_	38	COM+	
25	FIL		36	CZ+	39	COM+	
26	ZSL	37	CZ-	44	PE		
11	GIN1		22	RLYOU+			
1	AGND		21	RLYOU-			
17	VCMD		27	PAOUT+			
30	PULS+		12	PAOUT-			
15	PULS-		28	PBOUT+			
29	SIGN+		13	PBOUT-			
14	SIGN-		42	PZOUT+			
			43	PZOUT-			

3.4 I/O Interface fundamentals

CN1 interface signal

There are 7 types of CN1 interface signal as following:

- Switching volume input, , A lateral pole is connected to COM+ via 3kΩ resistance in series for one internal photoelectric coupling; K lateral pole is connected to input terminal for one photoelectric coupling.
- Switching volume output, , E lateral pole is connected to DG terminal, C pole to output terminal for two internal photoelectric couplings. The max. current $\leq 15\text{mA}$
- Switching volume output, , E lateral pole is connected to DG terminal, C pole to output terminal for two internal Darlington output photoelectric couplings. The max. current $\leq 50\text{mA}$
- Pulse input interface, , A lateral pole is connected to positive input terminal via a resistance in series and K pole to negative input terminal for one internal high speed photoelectric coupling.
- Differential output, , internally connecting the output terminal of differential output chip 26LS31
- Analog signal input, , interior is the difference-analog amplified circuit input.
- Analog signal output, , internally connecting the output of operational amplified circuit.

Input interface of switching

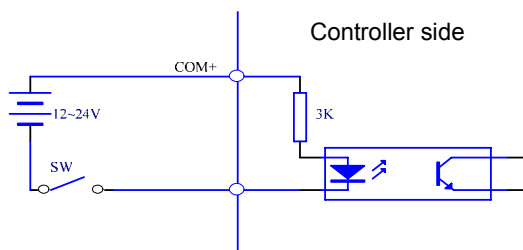


Fig. 3.5 Input interface of switching volume

- (1) Power supply is provided by user, DC12~24V, current $\geq 100\text{mA}$;
- (2) Note: if power polarities are wrongly connected, the servo unit does not work.

Output interface of switching

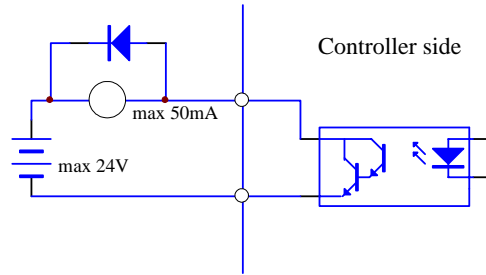


Fig. 3.6 Output interface of switching volume

- (1) External power supply is provided by user, and if its polarities are connected reversely, the servo unit will be damaged;
- (2) Output is electron collector open circuit, max. current is 50mA, and the max. external DC power voltage is 25V. Load of switching volume output signal must meet the requirement. If the load exceeds them or output is connected directly with power supply, the servo unit may be damaged;
- (3) If the load is an inductive one such as relay, terminals of load must be connected with freewheeling diode in parallel. If they are connected reversely, the servo unit will be damaged.

Pulse volume input interface

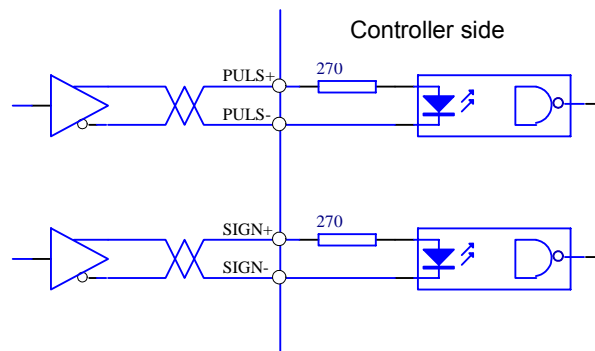


Fig. 3.7 Differential drive mode of pulse volume input interface

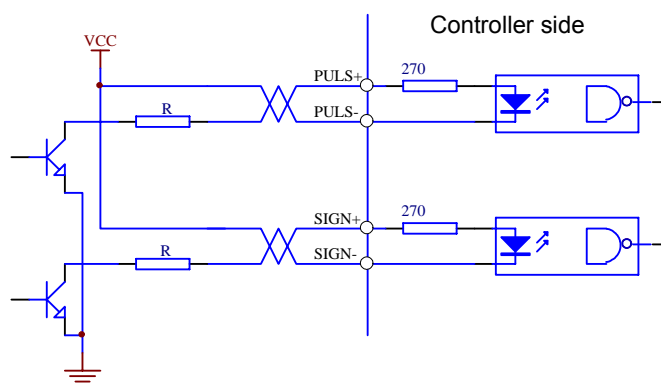

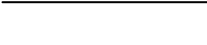

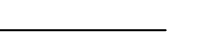

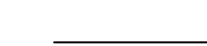

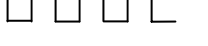
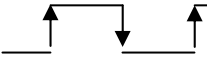

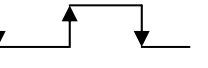



Fig. 3.8 Single terminal drive mode of pulse volume input interface

- (1) It is suggested to apply differential drive mode to correctly transmit pulse volume data;
- (2) AM26LS31, MC3487 or RS422 linear driver are employed in the differential drive mode;
- (3) Action frequency will be reduced in single terminal drive mode. According to pulse volume input circuit, Resistance R is determined by the max. 25V voltage of external power and 10~15mA drive current of the pulse input circuit. Practical data: VCC=24V, R=1.3~2K; VCC=12V, R=510~820Ω; VCC=5V, R=82~120Ω.
- (4) Refer to Table 3—4 about pulse input form, arrowhead indicates counting curb, and Table 3—5 shows pulse input time sequence and parameter. If two-phase input form is employed, 4-fold pulse frequency is less than 500kHz.

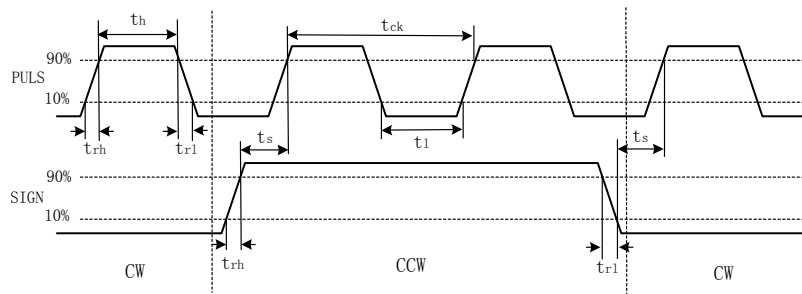
Table 3—4 Pulse input pattern

Pulse instruction form	CCW	CW	Parameter setting value
Pulse string sign	PULS  SIGN 	PULS  SIGN 	0 Instruction pulse +sign
CCW pulse string CW pulse string	PULS  SIGN 	PULS  SIGN 	1 CCW pulse /CCW pulse
A phase pulse string B phase pulse string	PULS  SIGN 	PULS  SIGN 	2 2-phase instruction pulse

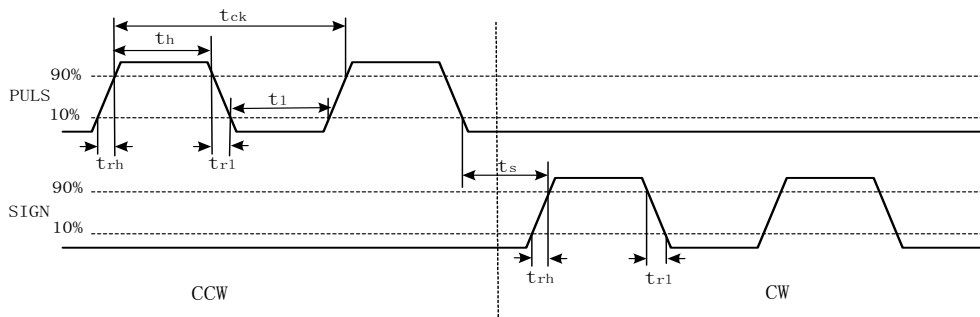
Chapter 3 System configuration and assembly

Table 3—5 Pulse input sequence parameter

Parameter	Differential drive input	Single terminal drive input
t_{ck}	$>2\mu\text{S}$	$>5\mu\text{S}$
t_h	$>1\mu\text{S}$	$>2.5\mu\text{S}$
t_l	$>1\mu\text{S}$	$>2.5\mu\text{S}$
t_{rh}	$<0.2\mu\text{S}$	$<0.3\mu\text{S}$
t_{rl}	$<0.2\mu\text{S}$	$<0.3\mu\text{S}$
t_s	$>1\mu\text{S}$	$>2.5\mu\text{S}$
t_{qck}	$>8\mu\text{S}$	$>10\mu\text{S}$
t_{qh}	$>4\mu\text{S}$	$>5\mu\text{S}$
t_{ql}	$>4\mu\text{S}$	$>5\mu\text{S}$
t_{qrh}	$<0.2\mu\text{S}$	$<0.3\mu\text{S}$
t_{qrl}	$<0.2\mu\text{S}$	$<0.3\mu\text{S}$
t_{qs}	$>1\mu\text{S}$	$>2.5\mu\text{S}$



**Fig. 3.9 Sketch map of pulse +sign input interface time sequence
(max. pulse frequency 500kHz)**



**Fig. 3.10 CCW pulse /CW pulse input interface time sequence (max.
pulse frequency 500kHz)**

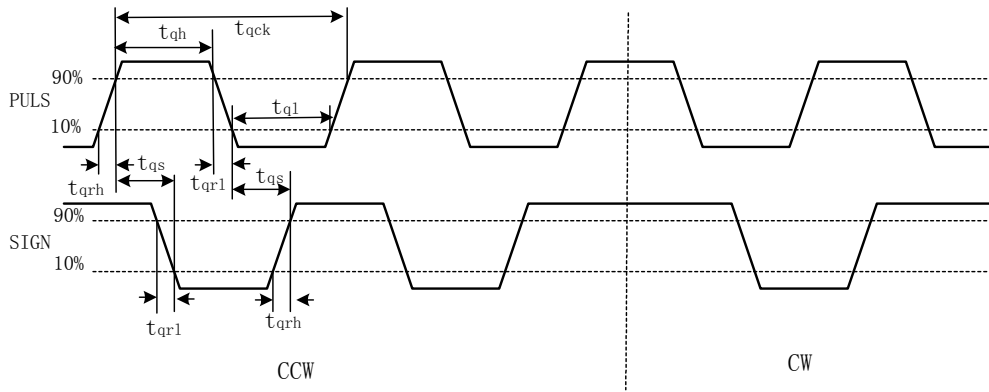


Fig. 3.11 2-phase instruction pulse input interface time sequence
(max. pulse frequency 125kHz)

Input interface of photoelectric encoder

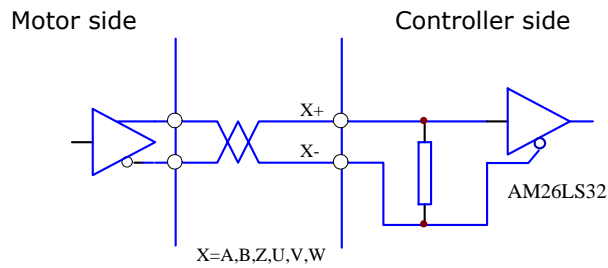
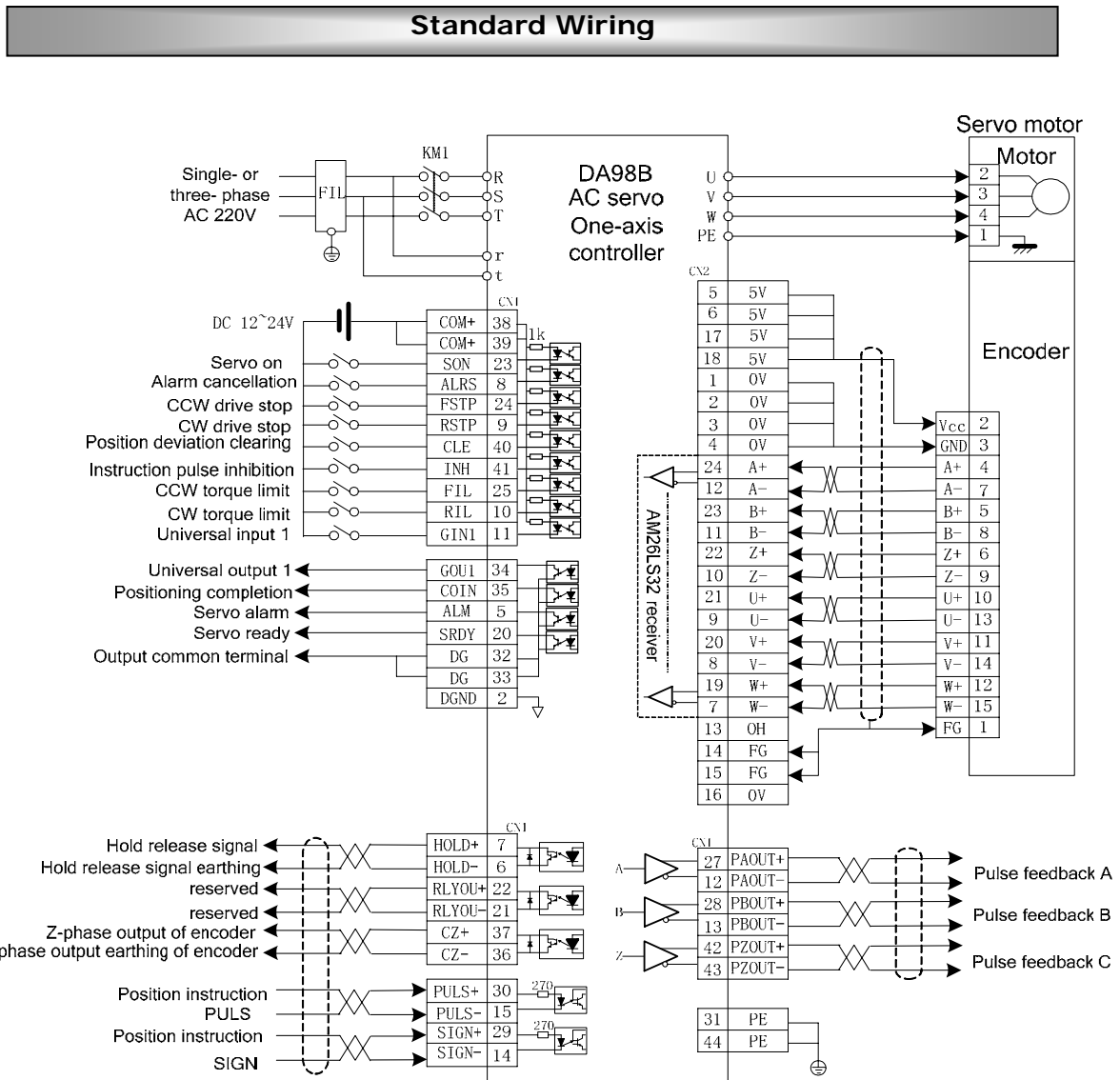


Fig. 3.12 Input interface of servo motor photoelectric encoder

Chapter 3 System configuration and assembly

3.5 Standard connection

3.5.1 Orientation control



Terminal functions of position control mode

Table 3—6 Terminal functions of orientation control mode

Sign	Function	Sign	Function
SON	Servo on input terminal	PAOUT+	Encoder A phase differential positive output
		PAOUT-	Encoder A phase differential negative output
ALRS	Alarming cancellation input	PBOUT+	Encoder B phase differential positive

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	terminal	PBOUT-	output Encoder B phase differential negative output
FSTP	CCW drive stop	PZOUT+ PZOUT-	Encoder Z phase differential positive output Encoder Z phase differential negative output
RSTP	CW drive stop	SRDY	Output terminal ready, identical to the time sequence of HOLD signal, and also used for hold release output (see section 6.3)
PULS+ PULS-	PLUS instruction pulse input	ALM	Alarm output terminal
SIGN+ SIGN-	SIGN instruction pulse input	CZ+ CZ-	Z phase pulse output of photoelectric encoder Common terminal of z phase pulse output terminal
GIN	Universal input terminal	COIN	Orienting completion output
CLE	Orientation deviation reset input	GOU1	General output 1
INH	Instruction pulse disabled input	RLYOU+ RLYOU-	Reserved
FIL	CCW torque limit input	HOLD+ HOLD-	Hold release output of motor Hold release grounding output of motor (see section 6.3)
RIL	CW torque limit input		
COM+	Power supply positive of input terminal, used for driving photoelectric coupling of input terminal DC12~24V, Current≥100mA		
DG	External input(12 ~ 24VDC) reference earthing		
DGND	Internal digital earthing		
PE	Protection earthing		

Chapter 3 System configuration and assembly

3.5.2 Speed control

Standard Wiring

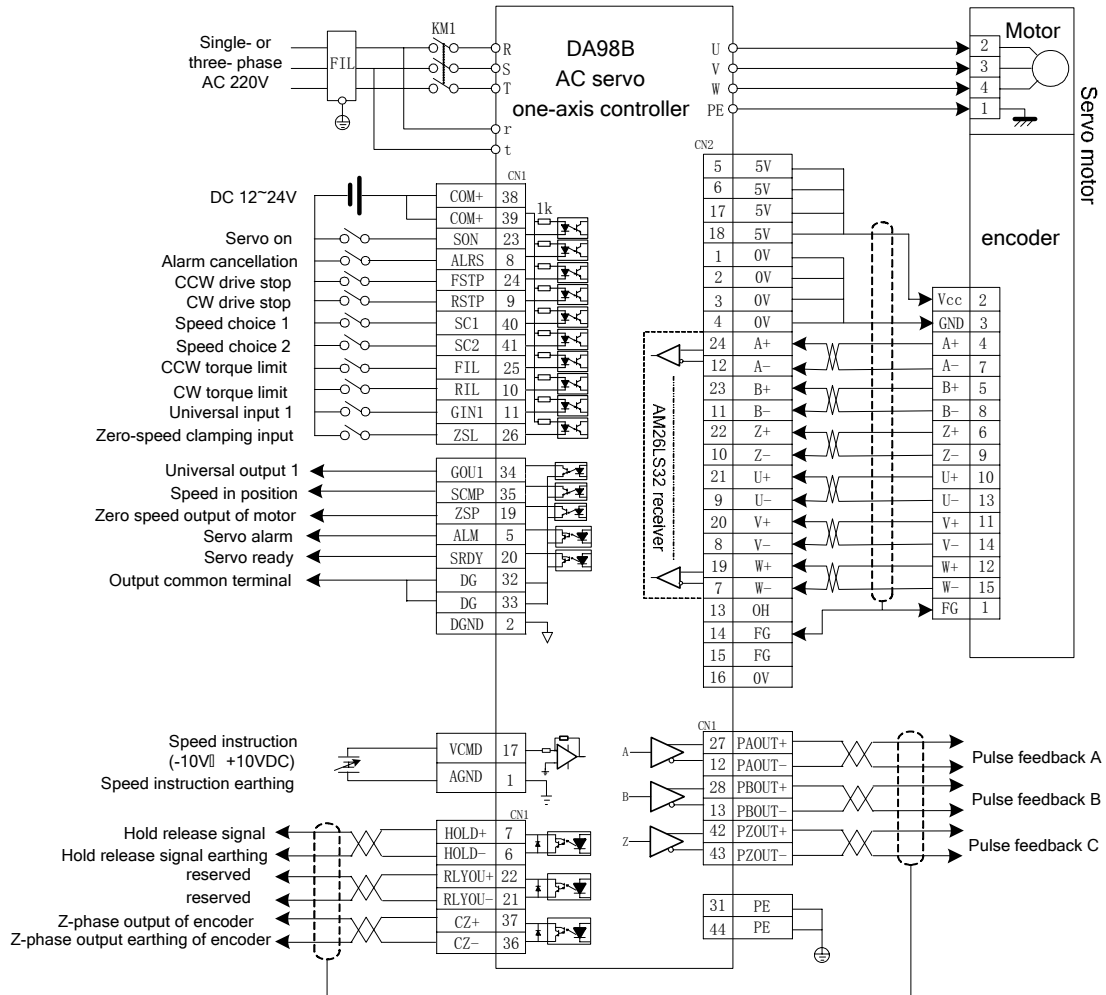


Fig3.14 Standard wiring for speed control mode

Terminal functions for speed control mode

Table 3—7 Terminal functions for speed control mode

Sign	Function	Sign	Function
SON	Servo on input terminal	PAOUT+	Encoder A phase differential positive output
		PAOUT-	Encoder A phase differential negative output
ALRS	Alarming cancellation input terminal	PBOUT+	Encoder B phase differential positive output
		PBOUT-	Encoder B phase differential negative output

SC1	Forward rotation signal input for analog instruction voltage 0~10 V input	PZOUT+ PZOUT-	Encoder Z phase differential positive output Encoder Z phase differential negative output
SC2	Backward rotation signal input for analog instruction voltage 0~10 V input	SRDY	Output terminal ready, identical to the sequence of HOLD signal, and also used for hold release output (see section 6.3)
GIN	General input terminal	ALM	Alarm output terminal
FSTP	CCW drive stop	CZ+ CZ-	Z phase pulse output of photoelectric encoder Common terminal of z phase pulse output terminal
RSTP	CW drive stop	SCMP	Speed in orientation output
FIL	CCW torque limit input	GOU1	General output 1
RIL	CW torque limit input	RLYOU+ RLYOU-	Reserved
VCMD AGND	Speed analog instruction input, the instruction voltage range:-10~+10 VDC Earthing of analog instruction input terminal	HOLD+ HOLD-	Hold release output of motor Hold release grounding output of motor (see section 6.3)
ZSL	Zero speed clipping input terminal	ZSP	Zero speed output of motor
COM+	Power supply positive of input terminal, used for driving photoelectric coupling of input terminal DC12~24V, Current≥100mA		
DG	External input(12 ~ 24VDC) reference earthing		
DGND	Internal digital earthing		
PE	Protection earthing		

Chapter 4 Parameter

There are various parameters in the servo unit to be adjusted and set to the performance, characteristics and so on, which can meet the requirement for the different functions by user. The user should make a complete study of the parameters before searching, setting and adjusting the parameters by the control panel.

4.1 Parameter list

P: orientation S: speed

No.	Name	Applicable mode	Setting range	Factory setting	Unit
PA 00	Password		0~9999	315	
PA 01	Motor type code		0~63	0	
PA 02	Software version (read only)			2.04	
PA 03	Initial display state		0~20	0	
PA 04	Control mode selection		0~5	1	
PA 05	Speed proportional gain	P,S	5~2000	600	
PA 06	Speed integration time constant	P,S	1~1000	15	
PA 07	Torque instruction filter	P,S	1~1500	500	%
PA 08	Speed detecting low pass filter constant	P,S	1~5000	200	
PA 09	Orientation proportional gain	P	1~1000	40	1/S
PA 10	Orientation feedforward gain	P	0~100	0	%
PA 11	Orientation feedforward instruction filter cut-off frequency	P	1~1200	300	Hz
PA 12	Orientation instruction pulse dividing numerator	P	1~32767	1	
PA 13	Orientation instruction pulse dividing denominator	P	1~32767	1	
PA 14	Input and analog instruction selection of orientation instruction pulse	P	0~3	0	
PA 15	Orientation instruction pulse reverse direction	P	0~1	0	
PA 16	Orienting completing range	P	0~30000	20	Pulse
PA 17	Orientation out-of-tolerance detecting range	P	0~30000	400	×100 pulse
PA 18	Orientation out-of-tolerance invalid	P	0~1	0	
PA 19	Reverse analog speed	S	0~1	0	
PA 20	Drive stop input invalid	P,S	0~1		
PA 21	JOG running speed instruction	S	-31000~31000	2000	0.1rpm
PA 22	Analog speed instruction aberrance	S	-500~500	0	0.1rpm
PA 23	Max. speed limit	P,S	0~31000	30000	0.1rpm
PA 24	Internal speed 1	S	-30000~30000	1000	0.1rpm

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PA 25	Internal speed 2	S	-30000~30000	-500	0.1rpm
PA 26	Internal speed 3	S	-30000~30000	2000	0.1rpm
PA 27	Internal speed 4	S	-30000~30000	-3000	0.1rpm
PA 28	Speed in orientation	S	0~30000	5000	0.1rpm
PA 29	Max. speed of analog instruction	S	0~31000	25000	0.1rpm
PA 30	Conversion numerator for linear speed	P,S	1~32767	10	
PA 31	Conversion denominator for linear speed	P,S	1~32767	1	
PA 32	Decimal point for linear speed	P,S	0~5	3	
PA 34	Internal CCW torque limit	P,S	0~300	300	%
PA 35	Internal CW torque limit	P,S	-300~0	-300	%
PA 36	External CCW torque limit	P,S	0~300	300	%
PA 37	External CW torque limit	P,S	-300~0	-300	%
PA 38	JOG torque limit of trial speed	S	0~300	300	%
PA 52	Latency for hold stop	P,S	0-32767	0	ms

4.2 Parameter function

No.	Name	Function	Parameter range												
PA 00	Password	It is used for parameter not to be modified by mistake. Set it for 315 when a parameter is needed to set. After debugging, set it for 0 to ensure it not to be modified by mistake later.	0~9999												
PA 01	Motor type code	The motor models Corresponding to PA01 are as following, refer to Section 4.3 for details. <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>PA01</th> <th>Motor model</th> </tr> </thead> <tbody> <tr> <td>12</td> <td>110SJT-M060D</td> </tr> <tr> <td>17</td> <td>130SJT-M100D</td> </tr> <tr> <td>19</td> <td>130SJT-M150D</td> </tr> <tr> <td>35</td> <td>110ST-M04030H</td> </tr> <tr> <td>46</td> <td>130ST-M06025H</td> </tr> </tbody> </table>	PA01	Motor model	12	110SJT-M060D	17	130SJT-M100D	19	130SJT-M150D	35	110ST-M04030H	46	130ST-M06025H	0~63
PA01	Motor model														
12	110SJT-M060D														
17	130SJT-M100D														
19	130SJT-M150D														
35	110ST-M04030H														
46	130ST-M06025H														
PA 02	Software version	① Software version can be seen but can not be modified.	Ver 2.04												
PA 03	Initial display state (Display state selection after servo unit power is switched on)	0: Motor speed display; 1: Low 5-bit digit display of current orientation; 2: High 5-bit digit display of current orientation; 3: Low 5-bit digit display of orientation instruction(instruction pulse accumulation); 4: High 5-bit digit display of orientation instruction(instruction pulse accumulation); 5: Low 5-bit digit display of orientation deviation; 6: High 5-bit digit display of orientation deviation;	0~20												

		<p>7: Motor torque display; 8: Motor current display; 9: Linear speed display; 10: Control mode display; 11: Orientation instruction pulse frequency display; 12: Speed instruction 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: Reserved.</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <th colspan="4">Display format of input terminals state</th> <th colspan="3">Display format of output terminals state</th> </tr> <tr> <td>RIL</td> <td>FIL</td> <td>SC2</td> <td>SC1</td> <td>RSTP</td> <td>FSTP</td> <td>ARLS</td> <td>SON</td> <td>ZSP</td> <td>HOLD</td> <td>COIN</td> <td>ALM</td> <td>SRDY</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>DIG4</td> <td></td> <td>DIG3</td> <td></td> <td>DIG2</td> <td></td> <td>ZSL</td> <td>GINT</td> <td>DIG3</td> <td>DIG2</td> <td>DIG1</td> <td></td> <td></td> </tr> </table>	Display format of input terminals state				Display format of output terminals state			RIL	FIL	SC2	SC1	RSTP	FSTP	ARLS	SON	ZSP	HOLD	COIN	ALM	SRDY														DIG4		DIG3		DIG2		ZSL	GINT	DIG3	DIG2	DIG1			
Display format of input terminals state				Display format of output terminals state																																													
RIL	FIL	SC2	SC1	RSTP	FSTP	ARLS	SON	ZSP	HOLD	COIN	ALM	SRDY																																					
DIG4		DIG3		DIG2		ZSL	GINT	DIG3	DIG2	DIG1																																							
PA 04	Control mode selection	<p>Set control mode of the servo unit by the parameter:</p> <p>0: Orientation control mode, orientation instruction input by pulse input port</p> <p>1: Speed control mode, speed instruction input by VCMDIN, VCMDINC analog input terminals</p> <p>2: Internal speed control mode</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>SC2</th> <th>SC1</th> <th>Internal speed</th> </tr> </thead> <tbody> <tr> <td>OFF</td> <td>OFF</td> <td>1</td> </tr> <tr> <td>OFF</td> <td>ON</td> <td>2</td> </tr> <tr> <td>ON</td> <td>OFF</td> <td>3</td> </tr> <tr> <td>ON</td> <td>ON</td> <td>4</td> </tr> </tbody> </table> <p>3: Manual mode 4: JOG mode 5: Encoder zero-adjusting mode</p>	SC2	SC1	Internal speed	OFF	OFF	1	OFF	ON	2	ON	OFF	3	ON	ON	4	0~5																															
SC2	SC1	Internal speed																																															
OFF	OFF	1																																															
OFF	ON	2																																															
ON	OFF	3																																															
ON	ON	4																																															
PA 05	Speed proportional gain	<p>① Proportional gain set of speed loop regulator</p> <p>② The 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 bigger the setting value is.</p> <p>③ Set the bigger value if there is no vibration for system.</p>	5~2000Hz																																														
PA 06	Speed integral time	<p>① Integral gain set of speed loop regulator</p>	1~1000ms																																														

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	constant	<p>② The bigger the setting value is, the higher the integral speed 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.</p> <p>③ Set the bigger value if there is no vibration for system.</p>	
PA 07	Torque instruction filter	<p>① Set cut-off frequency of low pass filter of torque instruction.</p> <p>② It is used for limiting the frequency band of current instruction to get the stable current response against the impact and vibration of the current.</p> <p>③ Set the bigger value if there is no vibration for system.</p>	1~1500%
PA 08	Speed detecting low pass filter constant	<p>① Low pass filter cut-off frequency set for speed detection</p> <p>② The smaller the setting value is and the lower the cut-off frequency is, the lower the noise from motor is. If the load inertia is very large, reduce the setting value properly. If the value is too small, vibration may be caused by slow response.</p> <p>③ The 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 can be increased appropriately.</p>	1~5000
PA 09	Orientation proportional gain	<p>①Proportional gain set of orientation loop regulator</p> <p>②The bigger the setting value is, the higher the gain is and the bigger the rigidity is, the smaller the orientation lag is. But if the value is too big, the vibration and overshoot may occur.</p> <p>③The value is decided by special servo unit model and load.</p>	1~1000/S
PA 10	Orientation feedforward gain	<p>① Feedforward gain set of orientation loop</p> <p>② When it is set for 4096, it means that orientation lag is 0 in any instruction pulse frequency.</p> <p>③ If the feedforward gain of orientation loop increases and the high response of the control system is raised, overshoot may occur for the instability of the system orientation loop caused.</p> <p>④Unless the high response is needed, the feedforward gain of orientation loop is usually 0.</p>	0~100%
PA 11	Orientation feedforward instruction filter coefficient	<p>①Cut-off frequency determination of orientation loop feedforward low pass filter.</p> <p>②The low pass filter is used for increasing the stability of complex orientation control.</p> <p>③The bigger the parameter value is and the higher the cut-off frequency is, the more liable the noise and overshoot are to occur in running.</p>	1~1200
PA 12	Orientation instruction pulse dividing numerator	Refer to Section 6.2.5.	1~32767
PA 13	Orientation instruction pulse dividing	Refer to Section 6.2.5.	1~32767

Chapter 4 Parameter

	denominator		
PA 14	Input and analog instruction selection of orientation instruction pulse	<p>① there are 4 modes to be selected: 0 pulse+sign; analog voltage(-10~+10) valid in analog instruction mode</p> <p>1 CCW pulse/CW pulse</p> <p>2 two-phase orthogonal pulse input</p> <p>3 analog voltage(0~+10) instruction valid in analog instruction mode (SC2, SC1 for forward and reverse rotation selection)</p> <p>② CCW rotation is defined as the forward direction when viewed from the axial direction.</p> <p>③ CW rotation is defined as the reverse direction when viewed from the axial direction.</p>	0~3
PA 15	Orientation instruction pulse reverse direction	<p>① Reverse direction of orientation instruction pulse, set for</p> <p>0: normal;</p> <p>1: reverse direction of orientation instruction pulse.</p>	0~1
PA 16	Orienting completing range	<p>① Pulse range set for orienting completion in orientation control mode.</p> <p>② The parameter provides factors the servo unit judges whether the orienting is completed in orientation control. When remainder pulses in orientation deviation counter are less than or equal to the setting value of the parameter, the servo unit defaults that the orienting is completed and the signal for it is COIN ON, otherwise it is COIN OFF.</p> <p>③ Orienting completing output signal is COIN in orientation control mode, and speed in-orientation output signal is SCMP in other control mode.</p>	0~30000 pulse
PA 17	Orientation out-of-tolerance detecting range	<p>① Alarm detection range set of orientation out-of-tolerance.</p> <p>② In orientation control mode, servo unit makes alarm of orientation out-of-tolerance when the counting of orientation deviation counter exceeds the parameter setting.</p>	0~30000×100 pulse
PA 18	Orientation out-of-tolerance invalid	<p>① Orientation out-of-tolerance enabling parameter, set for</p> <p>0: The alarm is valid.</p> <p>1: The alarm is invalid.</p>	0~1
PA 19	Reverse analog speed	<p>Reverse of analog speed instruction, set for</p> <p>0: Normal.</p> <p>1: Reverse of analog speed instruction.</p>	0~1
PA 20	Drive stop invalid input	<p>Drive stop invalid input setting, set for</p> <p>0: Allowable input of drive stop signal</p> <p>1: Not allowable input of drive stop signal.</p>	0~1
PA 21	JOG running speed instruction	The running speed set in JOG mode.	-31000~31000 0.1r/min
PA 22	Analog speed instruction	Analog speed instruction aberrance set	-500~500 0.1r/min

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	aberrance		
PA 23	Max. speed limit	<ul style="list-style-type: none"> ① Max. speed limit set of servomotor. ② It is irrelevant to rotary direction. ③ If the setting exceeds the rated speed, the actual max. speed limit is the rated speed. 	0~31000 0.1r/min
PA 24	Internal speed 1	<ul style="list-style-type: none"> ① Internal speed 1 set. See PA04. 	-30000 ~ 30000 0.1r/min
PA 25	Internal speed 2	<ul style="list-style-type: none"> ① Internal speed 2 set. ② See PA04. 	-30000 ~ 30000 0.1r/min
PA 26	Internal speed 3	<ul style="list-style-type: none"> ① Internal speed 3 set. ② See PA04. 	-30000 ~ 30000 0.1r/min
PA 27	Internal speed 4	<ul style="list-style-type: none"> ① Internal speed 4 set. ② See PA04. 	-30000 ~ 30000 0.1r/min
PA 28	Speed in orientation	<ul style="list-style-type: none"> ① Speed in orientation set ② Not available in orientation control mode ③ Irrelative to rotation direction 	0~30000 0.1r/min
PA 29	Max. speed of analog instruction	Instruction value of max. speed corresponding to max. analog voltage output	0~31000 0.1r/min
PA 30	Conversion numerator for linear speed	<ul style="list-style-type: none"> ① Used for linear speed ② Linear speed = motor speed (r/min) × $\frac{\text{conversion numerator for linear speed}}{\text{conversion denominator for linear speed}}$ ③ The orientation of linear speed decimal point is determined by parameter PA32. And 0 stands for no point, 2 for 2-bit and so on. ④ 【Example】 If servo motor drives 10mm ball screw, then set the conversion numerator for linear speed for 10, conversion denominator for linear speed for 1, the decimal point orientation of linear speed is 3. linear speed can be displayed in monitor with the unit m/min. When the speed of motor is 500r/min, linear speed 5.000m/min will be displayed. 	1~32767
PA 31	Conversion denominator for linear speed	See parameter No.30.	1~32767
PA 32	Decimal point for linear speed	See parameter PA30.	0~5
PA 34	Internal CCW torque limit	<ul style="list-style-type: none"> ① Internal torque limit set in CCW direction of servo motor. ② The setting is the percent of rated torque. e.g. if the setting is the double of rated torque, the setting is 200. 	0~300%

Chapter 4 Parameter

		<ul style="list-style-type: none"> ③ The limit is valid under any conditions. ④ If the setting exceeds max. overload allowable, the actual torque limit is the max. loading. 	
PA 35	Internal CW torque limit	<ul style="list-style-type: none"> ① Internal torque limit set in CW direction of servo motor. ② The setting is the percent of rated torque. e.g. if the setting is the double of rated torque, the setting is 200. ③ The limit is valid under any conditions. ④ If the setting exceeds max. overload allowable, the actual torque limit is the max. loading. 	-300~0%
PA 36	External CCW torque limit	<ul style="list-style-type: none"> ① External torque limit set in CCW direction of servo motor. ② The setting is the percent of rated torque. e.g. if the setting is the rated torque, the setting is 100. ③ The limit is valid only when the CCW torque limit input terminal (FIL) is ON. ④ If the limit is valid, the actual torque limit is the minimum of the absolute values among the max. overload allowable, internal or external torque limit. 	0~300%
PA 37	External CW torque limit	<ul style="list-style-type: none"> ① External torque limit set in CW direction of servo motor. ② The setting is the percent of rated torque. e.g. if the setting is the rated torque, the setting is 100. ③ The limit is valid only when the CW torque limit input terminal (RIL) is ON. ④ If the limit is valid, the actual torque limit is the minimum of the absolute values among the max. overload allowable, internal or external torque limit.. 	-300~0%
PA 38	JOG torque limit of trial speed	<ul style="list-style-type: none"> ① The setting is the percent of rated torque. e.g. if the setting is the rated torque, the setting is 100. ② Internal or external torque limit is valid in any conditions. 	0~300%
PA 52	Latency for hold stop	<ul style="list-style-type: none"> ① As for the motor with brake, if the servo on signal is cancelled, the motor will be activated for working for some time by servo unit. ② Latency=setting value×4ms (Refer to Section 6.3.) 	ms

4.3 Model code parameters for motors

PA01 parameters for STZ series servo motor

PA01 parameter	Model and technological parameters of servo motor	Remark
10	110SJT-M020E, 0.6kW,220V, 3000rpm,3A,0.34×10 ⁻³ kg.m ²	
11	110SJT-M040D, 1.0kW,220V, 2500rpm,4.5A,0.68×10 ⁻³ kg.m ²	
12	110SJT-M060D, 1.5kW,220V, 2500rpm,7A,0.95×10 ⁻³ kg.m ²	
13	130SJT-M040D, 1.0kW,220V, 2000rpm,4A,1.19×10 ⁻³ kg.m ²	

GSK CNC Equipment Co., Ltd.

14	130SJT-M050D, 1.3kW,220V, 2000rpm,5A,1.19×10 ⁻³ kg.m ²	
15	130SJT-M060D, 1.5kW,220V, 2000rpm,6A,1.95×10 ⁻³ kg.m ²	
16	130SJT-M075D, 1.88kW,220V, 2000rpm,7.5A,1.95×10 ⁻³ kg.m ²	
17	130SJT-M100D, 2.5kW,220V, 2500rpm,10A,2.42×10 ⁻³ kg.m ²	※
18	130SJT-M100B, 1.5kW,220V, 1500rpm,6A,2.42×10 ⁻³ kg.m ²	
19	130SJT-M150B, 2.3kW,220V, 1500rpm,8.5A,3.1×10 ⁻³ kg.m ²	※
20	130SJT-M150D, 3.9kW,220V, 2500rpm,14.5A,3.6×10 ⁻³ kg.m ²	※
34	110ST-M02030H, 0.6kW,220V, 3000rpm,4A,0.33×10 ⁻³ kg.m ²	
35	110ST-M04030H, 1.2kW,220V, 3000rpm,5A,0.65×10 ⁻³ kg.m ²	
36	110ST-M05030H, 1.5kW,220V, 3000rpm,6A,0.82×10 ⁻³ kg.m ²	
37	110ST-M06020H, 1.2kW,220V, 2000rpm,6A,1.00×10 ⁻³ kg.m ²	
39	130ST-M04025H, 1.0kW,220V,2500rpm,4A,0.85×10 ⁻³ kg.m ²	
45	130ST-M05025H, 1.3kW,220V, 2500rpm,5A,1.06×10 ⁻³ kg.m ²	
46	130ST-M06025H, 1.5kW,220V, 2500rpm,6A,1.26×10 ⁻³ kg.m ²	
47	130ST-M07720H, 1.6kW,220V, 2000rpm,6A,1.58×10 ⁻³ kg.m ²	
49	130ST-M10015H, 1.5kW,220V, 1500rpm,6A,2.14×10 ⁻³ kg.m ²	
50	130ST-M10025H, 2.6kW,220V, 2500rpm,10A,2.14×10 ⁻³ kg.m ²	※
51	130ST-M15015H, 2.3kW, 220V, 1500rpm,9.5A,3.24×10 ⁻³ kg.m ²	※
60	150ST-M27020H, 5.5kW,220V, 2000rpm,20.5A	

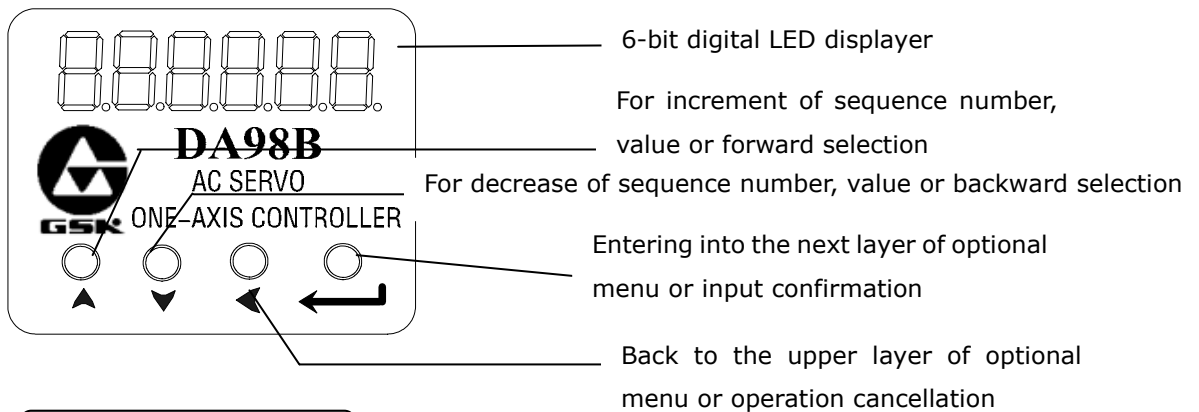


For the motor above with the "※" mark, thickened radiator should be applied for the suited servo unit.

Chapter 5 Display and operation

5.1 Keys operation

The DA98B servo unit is very easy to operate that the functions required can be set by only 4 keys. The outline of its panel is as following:



Operation procedure

- 1) In the speed monitoring mode, after switching on the power supply of the servo unit, the default display is: \longrightarrow r 0.0 ;
- 2) The operation is performed according to multi-layer menus. The first layer is the main menu that consists of 9 kinds of operation modes, the second layer is the function menus in various operation modes. The fig.5.1 shows the diagram block of the main menu:
- 3) According to the diagram block above, pressing ' \triangleleft ' key or holding ' \triangleleft ' can enter into the main menu, then press ' \triangleup ' or ' \triangledown ' key to select any mode in the 9 modes. After selecting a mode, press \longleftarrow key to enter the next menu of the mode. Press ' \triangleleft ' key to return if backing to upper menu is required.



Holding ' \triangleup ' or ' \triangledown ' key on, the operation will be repeated. The more the holding time is, the faster the speed repeated is.

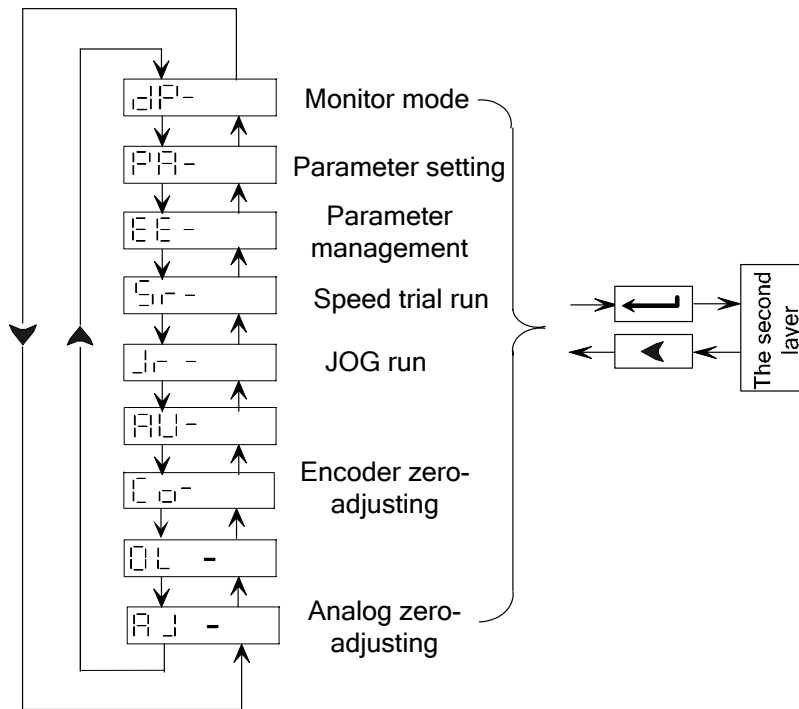


Fig. 5.1 Diagram block of main menu

5.2 Monitoring mode

- ① Select "dP-" in the main menu and press '←' key to enter into monitoring mode.
- ② There're 21 display modes in monitoring mode. Select the desired display mode by '▲、▼' keys, then press '←', to enter into monitoring mode.

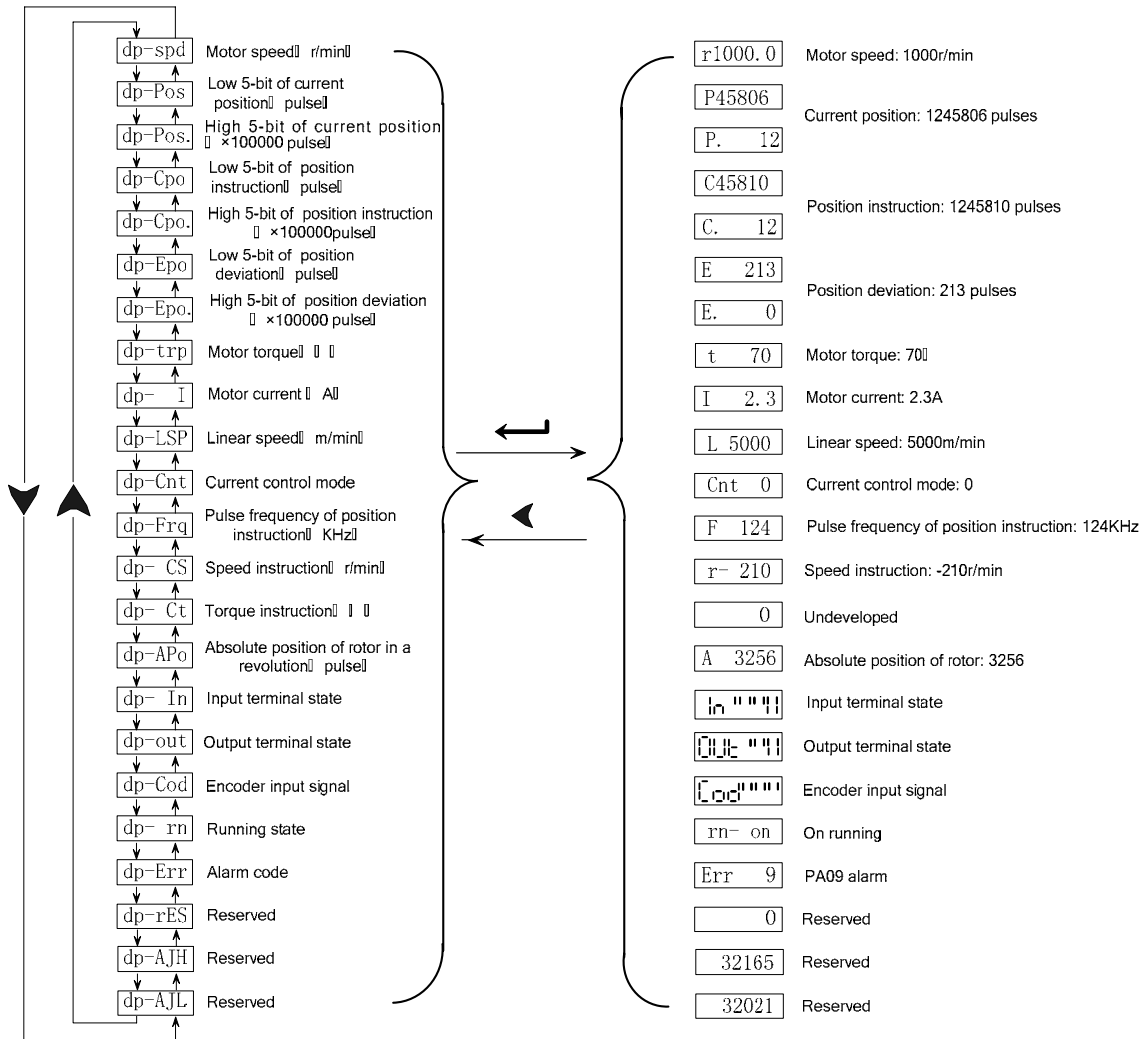


Fig. 5.2 Diagram block of monitoring mode

Explanation

1. r 1000.0 or - 1000.0

r: Speed code for motor. It displays '—' if the motor runs reversely in that speed.

1000.0: Speed value for motor Unit: rev/min

2. The pulse number unit in this servo unit is 10000 pulse/rev, and orientation pulse number is comprised by two parts of high 4-bit and low 5-bit. e.g.

$$\text{P. 12} \times 10000 + \text{P45806} = 1245806 \text{ pulses}$$

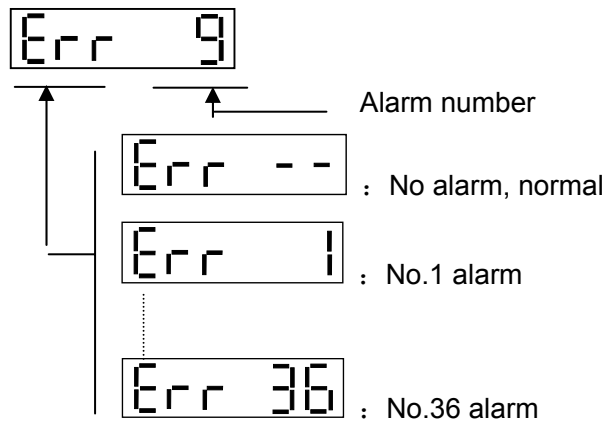
i.d. orientation instruction pulse number is also comprised by two parts, e.g.:

$$\text{C. 12} \times 100000 + \text{C45810} = 1245810 \text{ pulses}$$

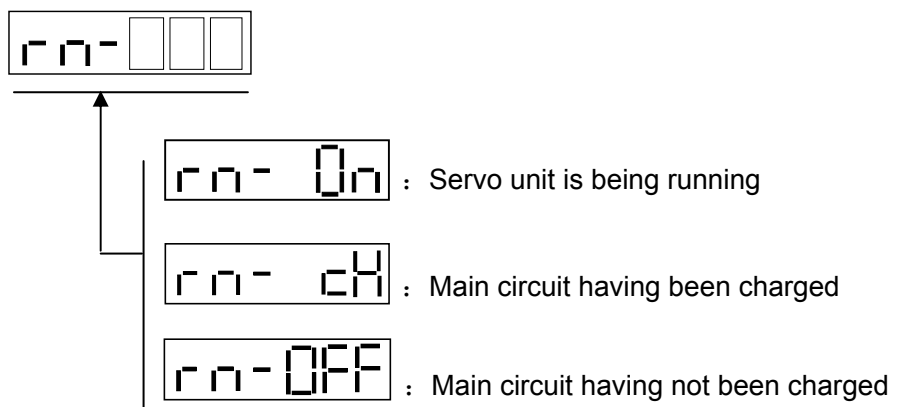
Therefore, the formula for orientation deviation is:

$$\begin{aligned} \boxed{E. \quad 0} &= \boxed{C. \quad 12} - \boxed{P. \quad 12} \\ \boxed{E \quad 4} &= \boxed{C45810} - \boxed{P45806} \end{aligned}$$

3. Alarm display:



4. Running display



- Instruction pulse values in orientation mode are the magnified ones through electronic gear.
- Pulse frequency of orientation instruction is the actual one before inputting it to the electronic gear with positive number for positive direction and negative number for negative direction and its min. unit is 0.1kHz.
- The formula for effective value of phase current of motor is as follows:

$$I = \sqrt{\frac{1}{3}(I_U^2 + I_V^2 + I_W^2)}$$

- The absolute orientation of rotor in a revolution means the relative orientation of rotor to stator, where a revolution for a period with the range 0~9999.
- The orientations of input terminals, output terminals and encoder signal are

shown as follows, and their definitions are shown in Fig.5.3, Fig.5.4, Fig. 5.5.

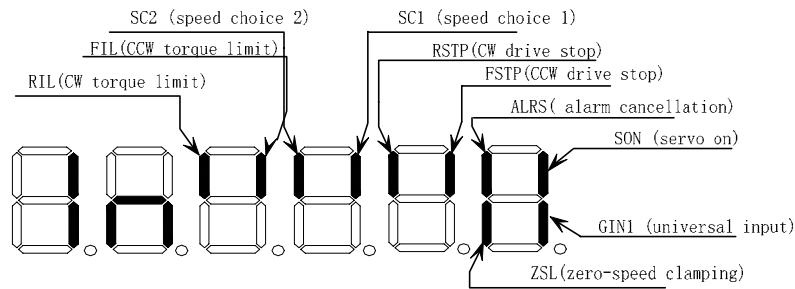


Fig. 5.3 Input terminal display (bright light is ON and dark light is OFF)

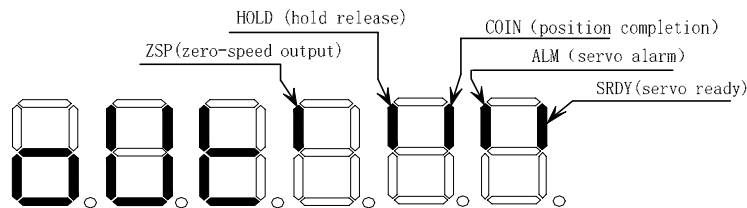


Fig. 5.4 Output terminal display (bright light is ON and dark light is OFF)

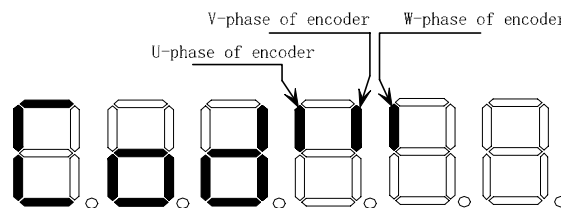


Fig. 5.5 Encoder signal display (bright light is ON and dark light is OFF)

5.3 Parameter setting

Prior to parameter setting, modify the parameter by the user password according to the PA00 parameter in the parameter list. After the setting, press the '←' key for confirming the setting. Attention should be paid for the parameter setting range against accident.

Select "PA-" in the first layer and press '←' to enter into parameter setting mode. Select parameter number by '▲', '▼', then press '←' to display the value of the parameter, modify the value by '▲', '▼'. Press '▲' or '▼' key for once to increase or decrease 1 for the parameter value, press and hold on '▲' or '▼' to continuously increase or decrease value for the parameter. When the parameter value is modified, the decimal point of rightmost LED digital tube is lighted, press '←' to confirm the modification, and then the decimal point of rightmost LED digital tube is put out. And the modified value will

immediately be reflected in the control process, press '▲' or '▼' to go on modify parameters till the completion of modification, then press '◀' to back to parameter selection mode. Do not press '←' to confirm if the parameters modified are not proper, press '◀' to cancel it to make the parameter recover to its original value and back to the parameter selection mode.

The following is the parameter setting procedure for **GSK 110SJT-M040D** servo motor:

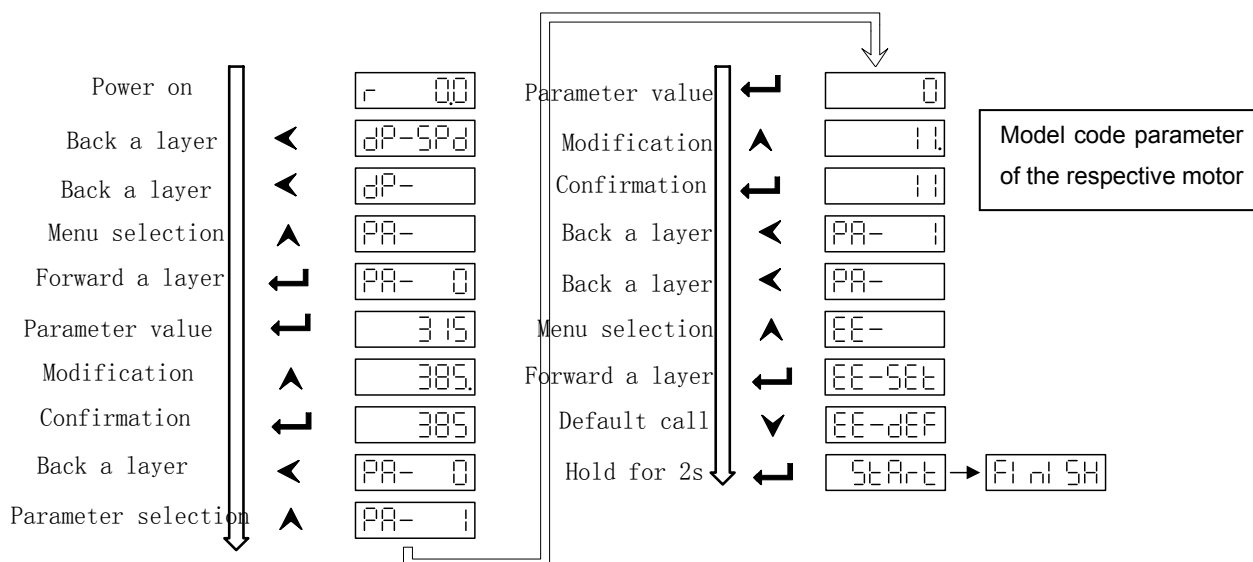


Fig. 5.5 Diagram block of parameter setting

5.4 Parameter management

The parameter management is mainly used for memory and EEPROM operation. Select "EE-" in the first layer and press '←' to enter into parameter management mode. 5 operation modes can be selected by '▲、▼' keys. For example, for "parameter writing", select "EE-Set", then press '←' and hold it on for over 1 second, the monitor displays "StArt" that means the parameter is being written into EEPROM. After 1~2 seconds, the monitor displays "FI nI SH" if the writing is successful, otherwise "ErrOr" is displayed. Press '◀' again to return 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 data in EEPROM parameter area into the memory to recover the original parameters in the state of power on.
- **EE—bA:** Parameter backup. (Reserved)
- **EE—rs:** Restoring backup. (Reserved)
- **EE—dEF:** Restoring default value. It means to read all default values (factory setting) of parameters into the memory and write them into EEPROM parameter area that they will be used when power is on again. Perform the above operation to restore all parameters to their factory setting if the parameters are disordered by user that cause the system to run abnormally. Because the 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.

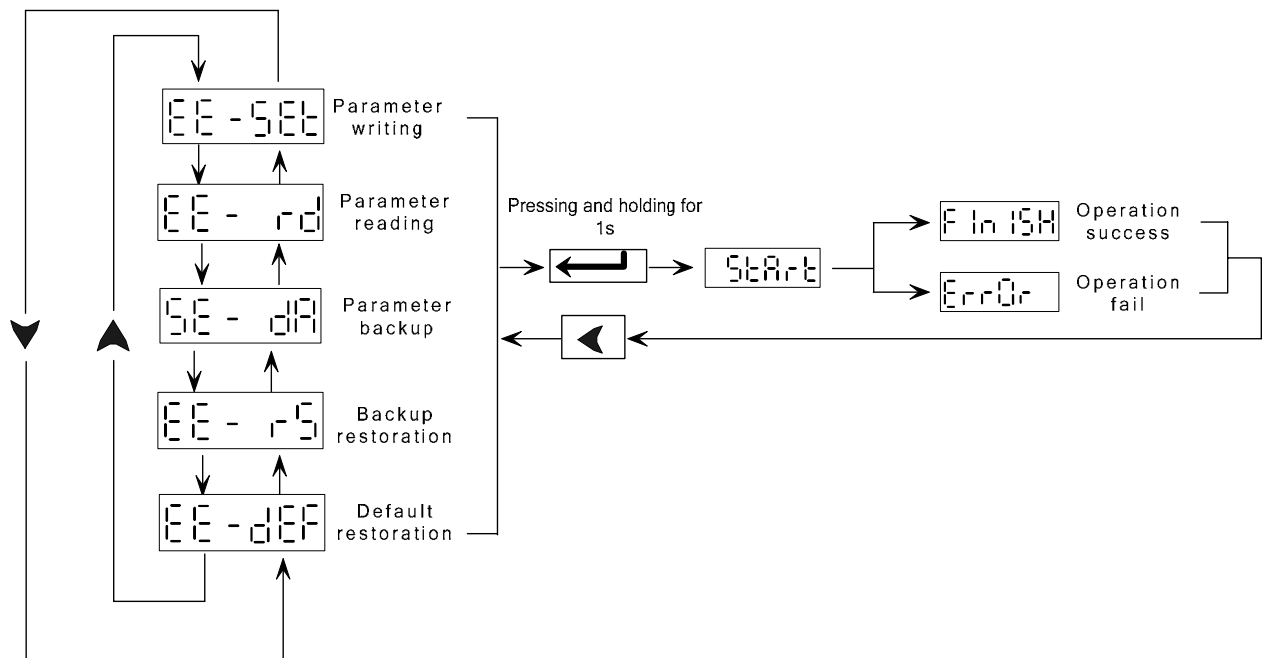


Fig. 5.6 Diagram block of parameter management

	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



The parameter setting will not be saved after the power is down and the modification is invalid if the writing has not been executed for the modified parameter.

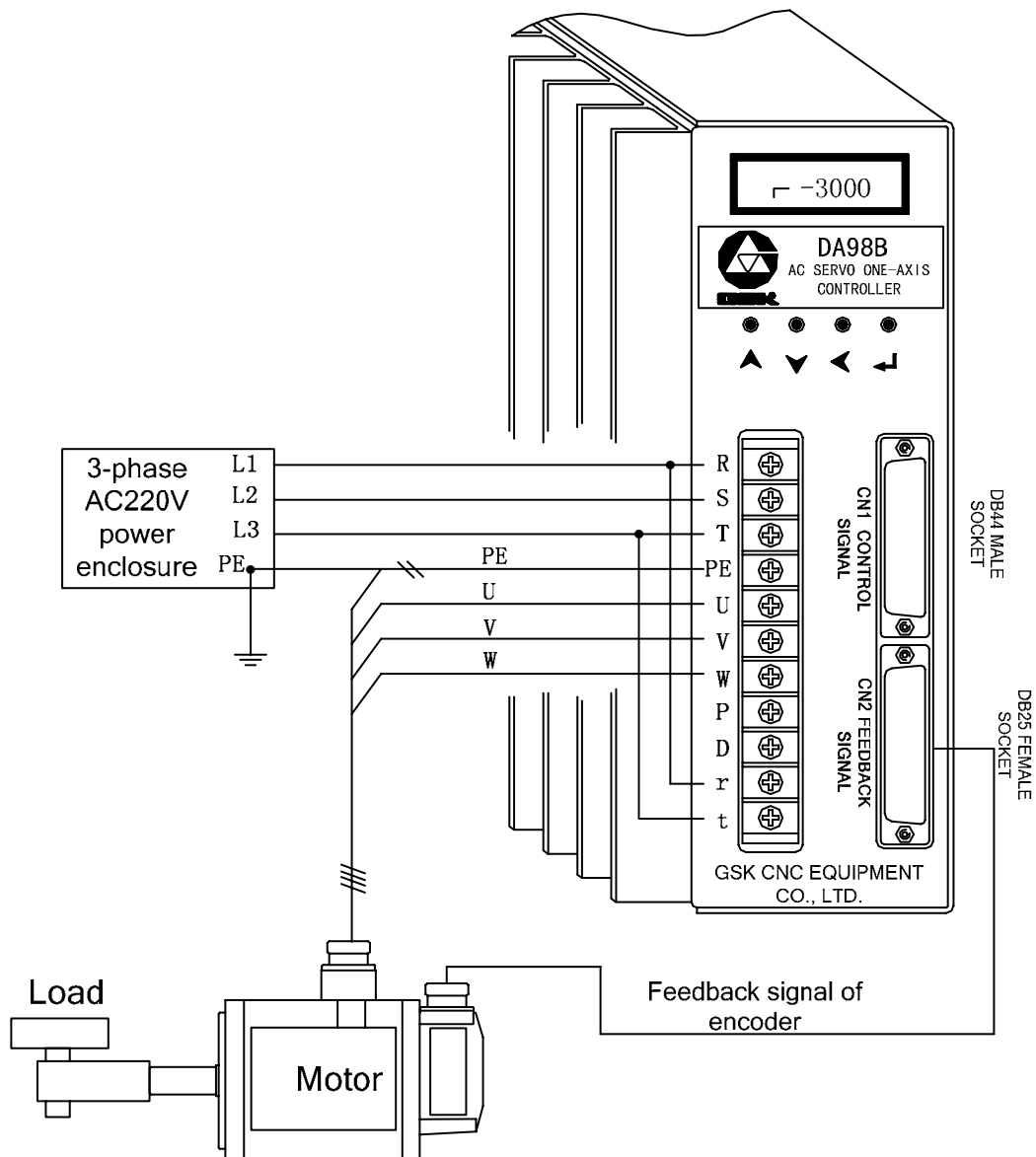
5.5 Additional information

The function of automatic gain adjustment being developed at present is not available.
The encoder zero-adjusting function unallowable to be used by user is provided for motor manufacturer.

Chapter 6 Trial run

6.1 Check before trial run

- ① Check wiring:
 - Ensure the wiring, especially the connections of the power supply wiring and motor wiring of servo unit.
 - Ensure the earthing connection.
- ② Check power supply to ensure the normal voltage.
- ③ Fix the servo motor securely against overturning or bumping.
- ④ Perform the dry run operation in trial run to make sure the normal running prior to loading running.



6.2.1 Sequence of power on for servo unit

The connection of power supply is shown as Fig.6.1, switch on the power by following steps:

- 1) Put the power supply to the power input terminals of main circuit (3-phase to R, S, T respectively, single phase to R,S) by electromagnetic contactor (NFB、MC) .
- 2) The r, t terminals of control circuit should be switched on prior to the main circuit power (or with it simultaneously without MC), then switch on the main circuit manually. The cut-off function of main power for alarm is attached to the circuit.

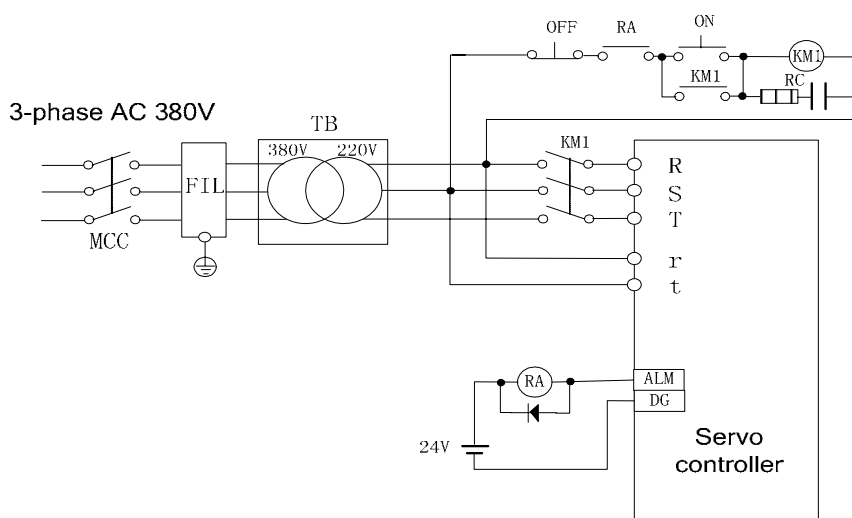
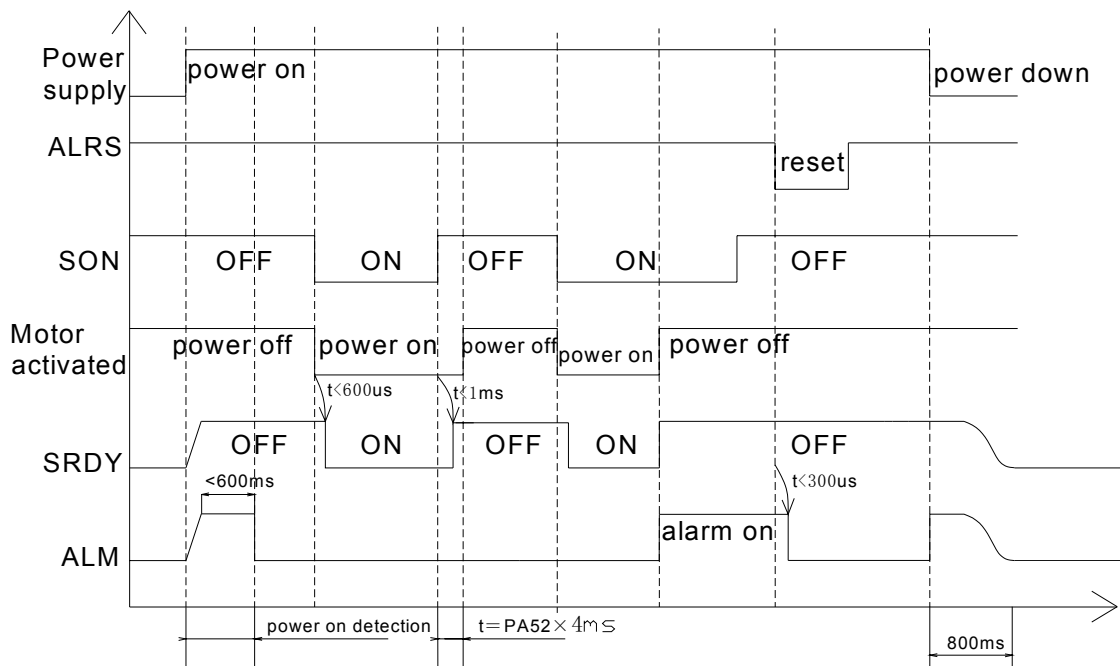


Fig.6.1 Power supply wiring

- 3) If servo on (SON) is ON after the connection of the control power with the main circuit power, the motor is activated and the system is on running. If servo on signal is switched off or alarming occurs, the base electrode circuit closes and the motor is in a free state.
 - a) If servo on (SON) is switched on with power supply, the motor is activated in about 100 ms.
 - b) Frequent switching on or off the power supply may damage the soft start circuit and energy hold circuit. The frequency limit for switching on or off should be 5 times per hour or 30 times per day. If the servo unit or motor is overheated, only by cooling of 30 minutes after the fault is exterminated, can the power supply be switched on again.
- 4) Sequence for power switch on



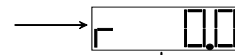
6.2.2 JOG running

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

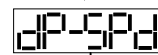
Steps:

- (1) Connect CN1 for the control signal : OFF for servo enabling, ON for CCW drive stop(FSTP), ON for CW drive stop(RSTP).

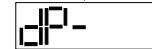
- (2) Power on for servo unit and the initial display is:



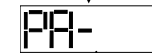
- (3) Press '←' key, it displays:



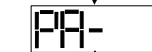
- (4) Repress '←' key to back to the first layer menu, it displays



- (5) Press '▲' or '▼' key to find the parameter setting menu



- (6) Press '←' key, it displays



- (7) Press '▲' or '▼' key to find the No.4 parameter



- (8) Press '▲' or '▼' key to set No.4 parameter to 4, it displays



(9) Press '←' key to confirm the setting of the No.4 parameter, it displays

4

(10) i.b., set the PA21 parameter to the motor speed required, i.e. the JOG speed

(11) Press '↶' key to back to the first main menu layer to find the JOG mode

Jr-

(12) Press '←' key, it displays

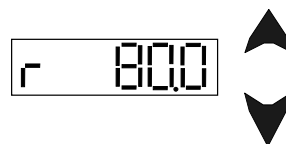
J- 00

(13) Set ON for the enabling, press '▲' key and hold it on, the motor runs by the setting speed, release the key, the motor running stops; press '▼' key and hold it on, the motor runs reversely by the setting speed, release the key, the motor running stops with zero speed.

6.2.3 (Sr-) trial run

Change the value in PA-4 by 3 according to the JOG running steps above; select "Sr-" in the first layer, press '←' key to enter into trial run mode. The prompt for speed trial run is "r", and its unit is 0.1r/min. The system is in a speed control mode and the instructions of speed are provided by keys operation. C, the motor runs by the speed instructions changed by '▲', '▼' key. Pressing '▲' key increases the speed, and pressing '▼' key decreases the speed. While the speed displayed is positive number, the motor runs forward; and negative number for backward.

r 800



6.2.4 Speed control run

There're two kinds of running control for speed. One is the analog speed instruction input, the other is internal speed instruction. Details are as follows:

Analog speed instruction input

- 1) Input the control signal by the Fig.6.2 wiring diagram block: OFF for servo on (SON), ON for CCW drive stop (FSTP), ON for CW drive stop (RSTP).
- 2) Set the analog voltage instruction for 0 V, ON for servo on (SON), the motor is activated

with zero speed. If the motor runs in low speed, adjust the parameter PA22 to make the motor to be in zero speed state.

3) Slowly adjust the analog voltage, the motor speed will vary by the voltage variation. The highest motor speed in $\pm 10V$ input voltage can be adjusted by modifying parameter PA29. Be attentive that the highest running speed is limited by PA23.

4) Modify parameter PA19 if the rotation direction is required to be changed.

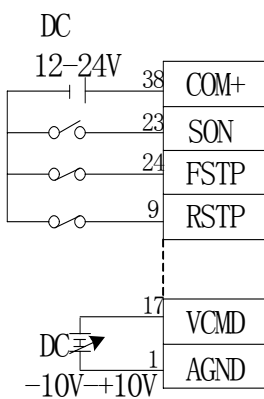
When PA19=0, motor runs forward (CCW) for positive voltage, backward(CW) for negative voltage;

When PA19=1, motor runs backward (CW) for positive voltage, forward(CCW) for negative voltage;

5) If vibration occurs in the CNC closed loop running, adjust parameter PA08 for feedback filtering.

Wiring diagram block:

parameter list



Sequence number	Name	Setting range	Factory setting
PA04	Control mode selection	0~6	1
PA08	Low pass filter for speed detecting	1~5000	200
PA19	Reverse of analog speed	0~1	0
PA22	Instruction deviation of analog speed	-500~500	0
PA23	Highest speed setting for motor	-30000~30000	25000
PA29	Highest speed of analog instruction	-30000~30000	25000

Fig.6.2 Wiring for analog instruction control

Wirings for two types of CNC system for milling machines made by us.

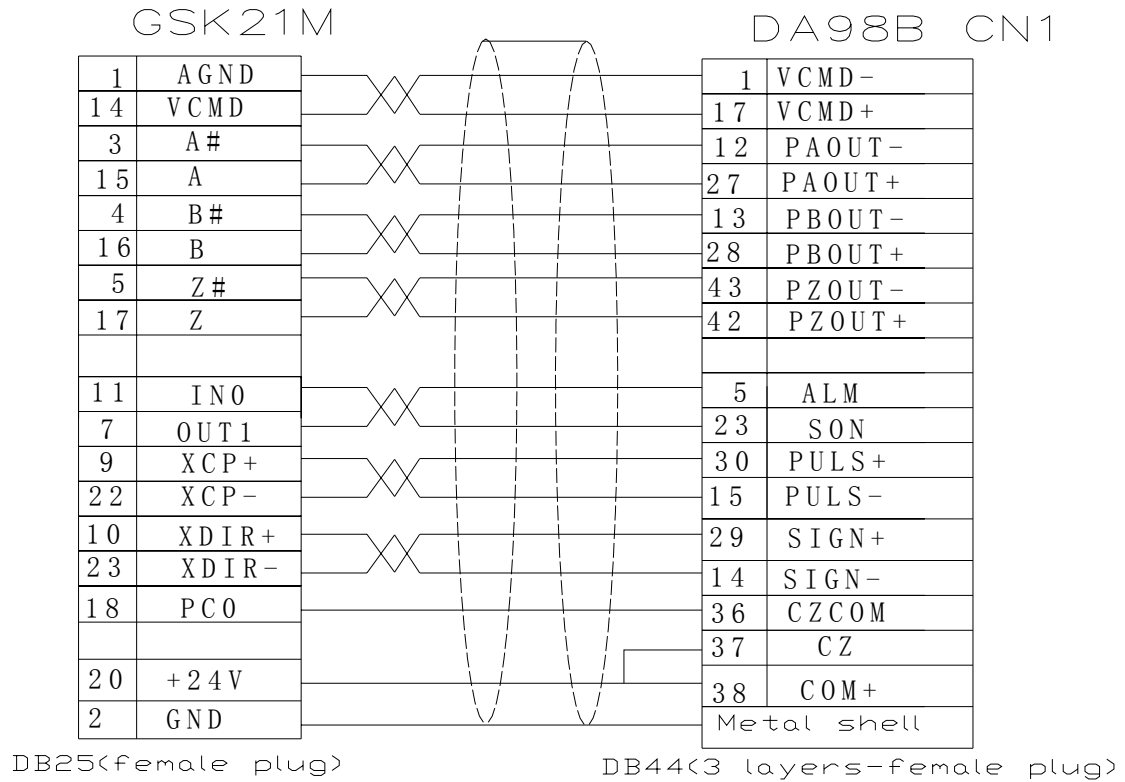
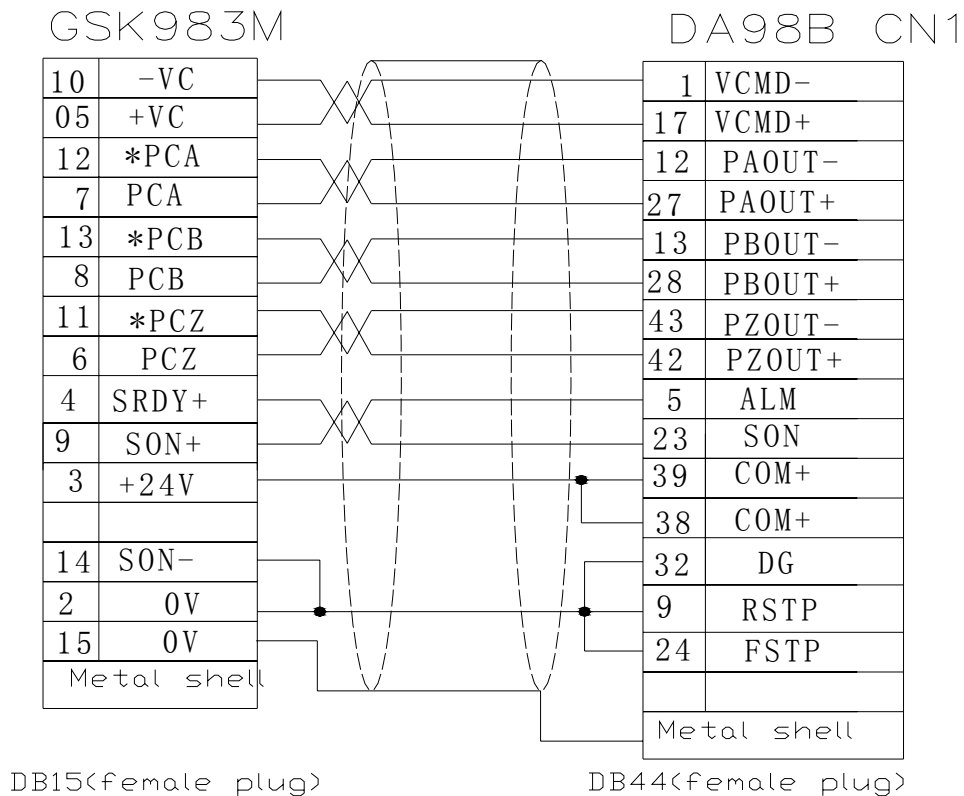


Fig. 6.3 (a) Valid for analog and pulse instructions



(b) Valid for analog instruction

Internal speed instruction

- 1) Input the control signal by connecting CN1: OFF for servo on(SON), OFF for speed choose1 (SC1), speed choose2 (SC2), ON for CCW drive stop (FSTP), ON for CW drive stop (RSTP).
- 2) Switch on the power supply of the control circuit, the servo unit displayer will light. Check connection if alarming occurs.
- 3) Set the control mode selection(parameter PA04) for speed running mode(set for 2), set the speed parameters PA24~PA27 as required.
- 4) Set servo on(SON) for ON, the motor will be activated for internal speed running state.
- 5) Change the states of input signal SC1, SC2 for different combinations of internal speed, which is shown as following table:

S	C	1	Internal speed	Parameter	Setting range	Unit
S	C	2				
0		1		PA24	-30000~+30000	0.1rpm
0						
0		2		PA25	-30000~+30000	0.1rpm
1						
1		3		PA26	-30000~+30000	0.1rpm
0						
1		4		PA27	-30000~+30000	0.1rpm
1						

6.2.5 Orientation control run

- 1) Input the control signal by the Fig.6.4 wiring diagram block: OFF for servo on(SON), ON for CCW drive stop (FSTP), ON for CW drive stop (RSTP).
- 2) Switch on the power and adjust the parameters, set appropriate electronic gear ratio (PA12, PA13).

The so-called 'electronic gear function' is a function that compared to the mechanical gear, the motor moving that is equivalent to the input instruction pulse can be set for any value by the adjustment of servo parameters without considering the mechanical reduction ratio and encoder pulses in controlling. By the setting of PA12, PA13 parameters, it is easy for user to match with various pulse resources to get the desirable control resolution (i.e. angle/pulse).

The formula for electronic gear ratio is as follows:

$$P \times G = N \times C \times 4$$

P: pulse amount of input instruction;

G: electronic gear ratio;

G=dividing numerator / dividing denominator

Recommended range of G is: $\frac{1}{50} \leq G \leq 50$

N: motor rotating circles;

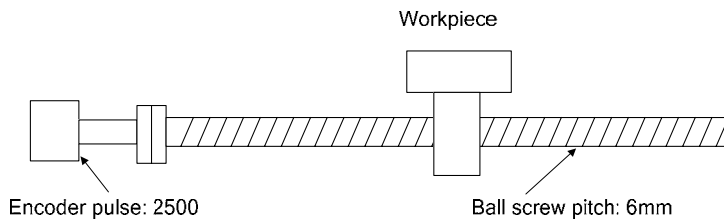
C: photoelectric encoder lines/rev, in this system C=2500

【Example 1】 When input instruction pulse is 6000, and servo motor rotation is 1:

$$G = \frac{N \times C \times 4}{P} = \frac{1 \times 2500 \times 4}{6000} = \frac{5}{3}$$

so parameter PA12 is set for 5 and PA 13 is set for 3.

【Example 2】



If the workpiece is required to move 10mm

Electronic gear ratio not used

For a 6mm moving in a revolution, it needs $10 \div 6 = 1.6666$ revolution; as for 2500×4 pulses for a revolution, the instruction pulse input is $1.6666 \times 2500 \times 4 = 16666$ pulses. And the operation must be executed in the upper device.

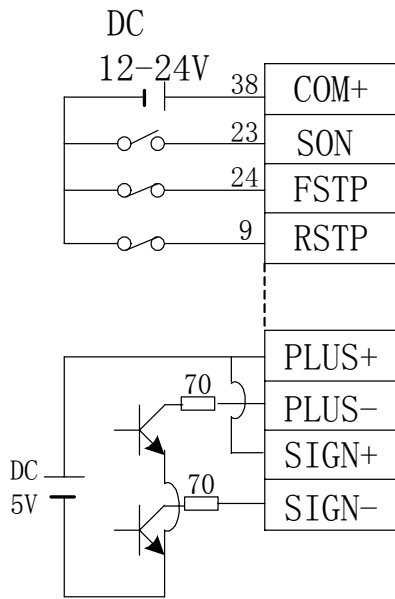
Electronic gear ratio used

The mechanical condition and instruction unit must be defined in advance by electronic gear ratio. If the instruction unit is set for 1 μm , 10mm moving needs $10\text{mm} \div 1\mu\text{m} = 10000$ pulses.

- 3) Set servo on(SON) for ON on condition that no alarming and abnormality occurs. The motor will be actuated for zero speed.
- 4) Input low frequency pulse to make the motor run in a low speed, and check whether the motor speed is the setting one. Stop inputting low frequency pulse to see whether the motor stops. Adjust the parameter if the motor runs in a low speed.

Wiring diagram block

Parameter list



Sequence number	Name	Setting	Factory setting
PA04	Control mode selection	0	1
PA14	Pulse input mode	0	0
PA12	Orientation instruction dividing numerator	See Section 6.2.5.	1
PA13	Orientation instruction dividing denominator		1
PA05	Speed gain	Adjust it by requirement. See parameter adjustment in Section 6.4.	
PA06	Time constant for speed integral		
PA09	Orientation control gain		40
PA10	Orientation feedforward gain		0
PA11	Cut-off frequency of orientation feedforward instruction filter		300

Fig.6.4 Wring of orientation instruction control

Wiring sketch map for CNC system of GSK980TD turning machine

GSK980TD(X or Z axis)
XS30 or XS31

DA98B CN1

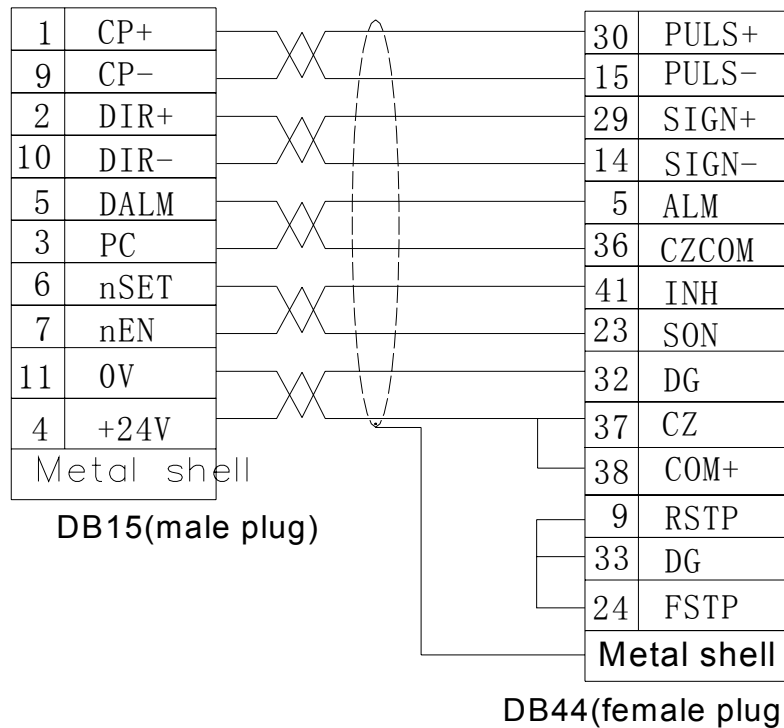


Fig.6.5 Valid pulse instruction

6.3 Application of hold release signal

In order to lock the vertical or tilted work table linked with the motor against falling down by the servo power off, servo motor with hold brake is usually employed. The hold releasing signal (HOLD±) is provided for the effective control of the motor with hold in the servo unit.



The hold brake is only for work table hold and is not allowed to be used for reduction and stop of machine.

Fig.6.6 shows the wiring applied for the control of motor by the hold release signal. The 24V power supply in the map is provided by user. The polarities of power should be noticed when switching on the hold release signal (HOLD±). The time sequence of SRDY and HOLD± are identical and they both can be used for the hold release signal for special purpose. The wiring is as following.

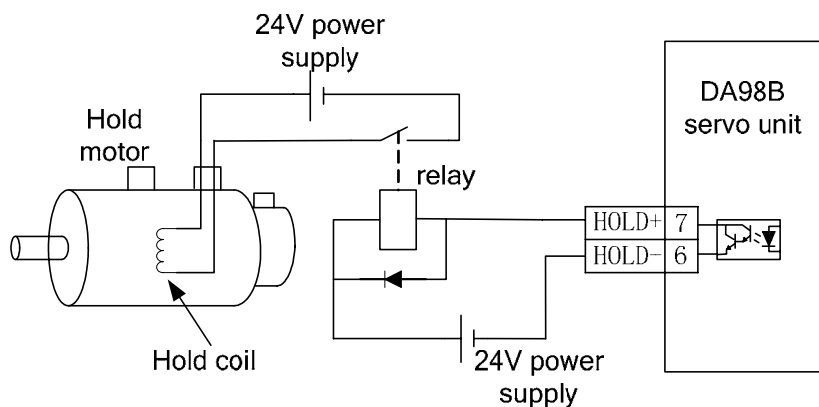


Fig. 6.6 (a) Typical instance of the HOLD± hold release signal

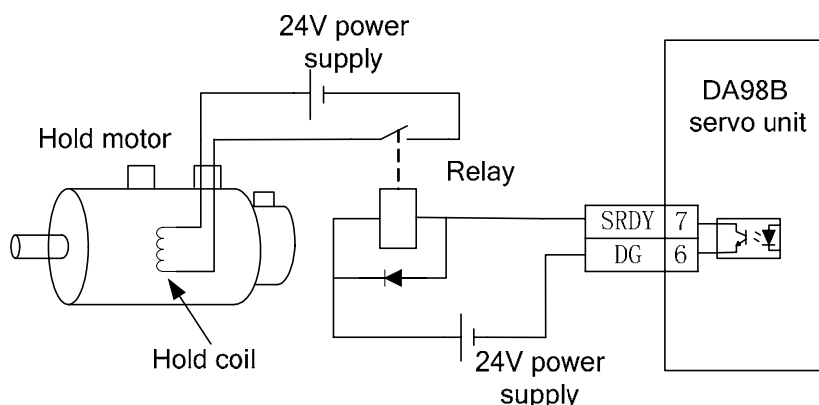
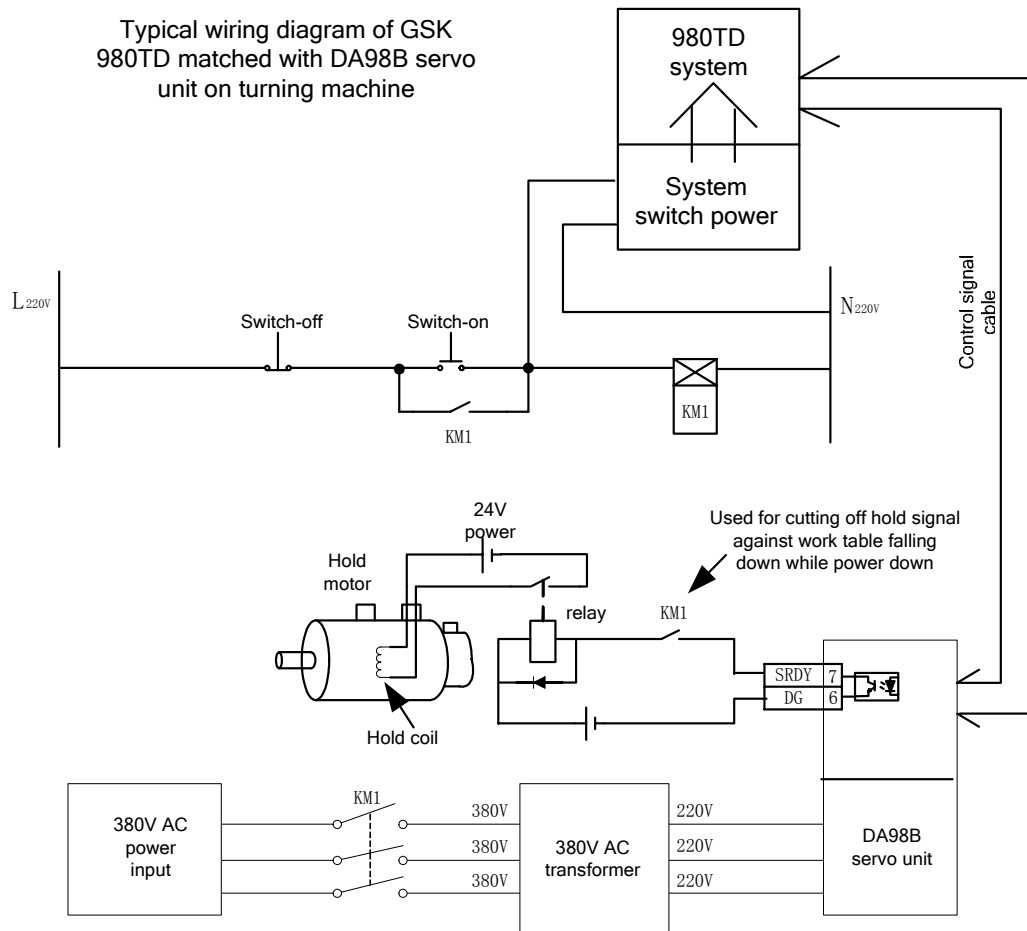


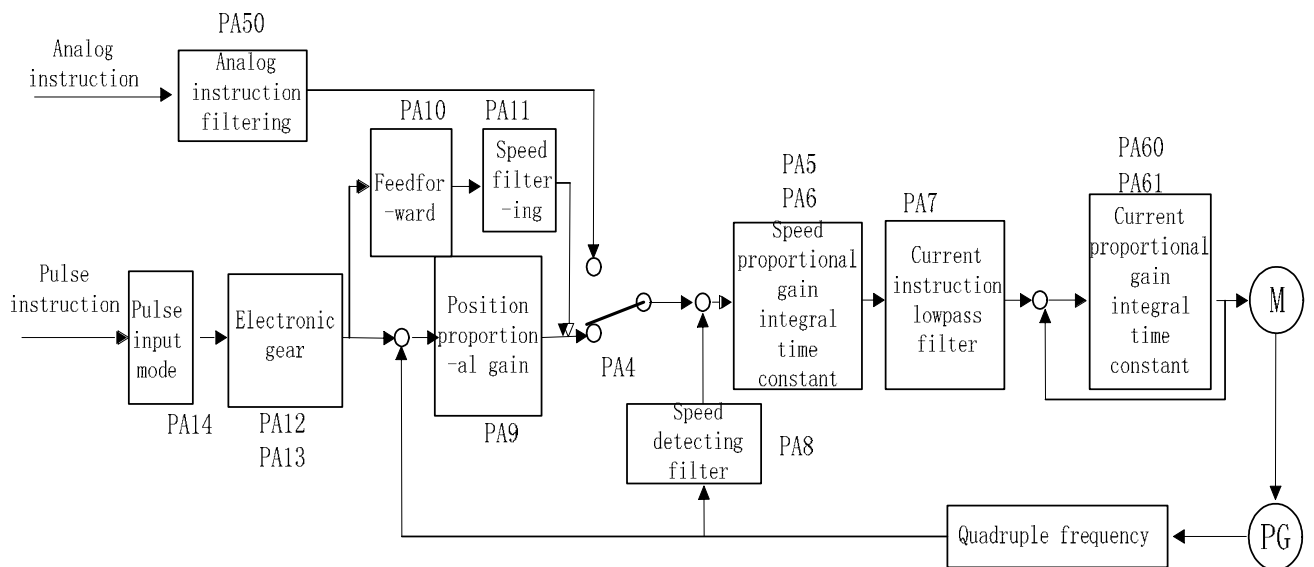
Fig. 6.6 (b) Typical instance of the SRDY hold release signal

The Fig.6.7 shows the time sequence sketch map of normal hold release signal. When the servo on (SON) is switched off, the motor's actuation is cut off in suspense. Cut off the motor's actuation if the motor shaft is completely clamped after the power off of hold coil. The latency is defined by parameter PA52.



6.4 Parameter adjustment for machining characteristics improvement

DA98B basic parameter adjustment diagram



Parameter adjustment for speed loop regulator

PA05 Proportional gain of speed loop range (150-900)

PA05 is the speed loop proportional gain KP, if its value increases, the action of the servo will be more agile and faster. If the value is a bit larger, the motor screams with hardened rigidity. The speed fluctuation of motor increases (inferior surface finish). If the value is too large, the motor becomes unstable, if the value is too small the crawling of motor occurs for the motor's softening as well as the action of servo adjustment lowered. And overshooting of speed occurs in the transmission and loading alternation. The smaller the value is, the larger the overshooting is. Extreme overshooting will result in the low frequency oscillation. KP increasing may lower the error of the stable in the steady system and increase the controlling precision, but the error can't be exterminated. If the PA05 value is lower than 100, normal cutting is unavailable for over-cutting occurred. If the value is higher than 900, severe screaming occurs. In the absence of oscillation, set a larger value as far as possible. Usually, the bigger the load inertia is, the smaller the PA05 value set is.

PA06 Speed loop integral gain range (1-15)

PA06 is speed loop integral gain. In practice the parameter can be set in a range of 1~15, the error of the stable will be lowered if it is properly set and speed fluctuation lowered. If the value is set for too large, shaking occurs and running speed fluctuation increases. It is usually set for 2 or 3.

PA07 Filter coefficient of torque instruction range (300-1200)

Used for the cut-off frequency setting of low pass filter of torque instruction.

It is used for limiting the instruction frequency band of current to make the current respond steadily against current shock and vibration.

If the value is too small, the motor shakes. Set a large value as far as possible if no oscillation occurs. It is usually set for 600.

PA08 Low pass filter filtering coefficient of speed detection range (40-1000)

The smaller the setting is, the better the filtering effect is. If the setting is too small, the speed fluctuation increases that results in severe shaking in running.

If the setting is too large, the speed fluctuation increases with the motor screaming. It is usually set for 80.

PA50 Filtering coefficient of external analog instruction range (20~4096)

If the setting is too small, overshooting occurs in transmission with enhancing

fluctuation. If the setting is decreased, the filtering for analog instruction will be enhanced. The error of the stable increases (error followed increasing) and running characteristic lags severely if the setting is too small. If the setting is too large, the speed fluctuation and instruction disturbance enhance that may result in shaking.

Parameter adjustment for position loop

Set proper speed proportional gain PA05 and speed integral gain PA06 according to the methods introduced above.

PA09 Orientation loop proportional gain range (10-70)

PA09 is the orientation loop proportional gain. Set a larger value as far as possible in a stable range. For a large orientation proportional gain, on one side, it can make the servo to act swiftly and the tracking trait of orientation instruction with smaller lagging error much better; on the other hand, too large setting may result in shaking trend of motor and too large setting may cause the motor to run unsteadily. If the setting is above 140, there is predominantly accidented surface in the sphere machining. Also oscillation is liable to occur in the stop orienting. If the orientation loop proportional gain is set too small, the action of the system is slow and the machining precision is bad. Over-cutting occurs if the value is below 10.

PA10 Orientation feedforward gain is set for 0%.

PA11 Cut-off frequency of orientation feedforward instruction filter range (1-1200)

While the orientation feedforward gain is required to increase without leading to the voice in the process of acceleration and deceleration of motor, properly reduce the cut-off frequency of orientation feedforward instruction filter. The larger the PA11 setting is and the higher the cut-off frequency of orientation loop feedward instruction filter is, the more liable the noise is to occur in the acceleration and deceleration of the motor. Also the orientation overshooting is liable to occur.



- ① If position proportional gain setting value is set for a small one, the system is stable, but the position tracking trait is getting bad and the lag error is getting larger.
- ② Refer to [position proportional gain] setting values as following table:

Rigidity	Position proportional gain
Low rigidity	10~20/s
Middle rigidity	30~50/s
High rigidity	50~70/s

Chapter 7 Function for protection

There are many protection functions such as overheat protection, overcurrent protection, over-voltage protection for this DA98B AC servo device. While alarming occurs, the motor stops. In the meantime, alarm code is being displayed on the LED display panel. Only is the fault exterminated by operator according to the alarm code displayed, can the device be put into use. The servo unit and motor can be touched only after they are powered off at least 5 minutes for avoiding electric shocking and burning. The servo on signal (SON) must be confirmed invalid to avoid the unexpected starting of the motor before resetting alarm.

7.1 Alarm list

Alarm code	Alarm name	Content
--	Normal	
1	Overspeed	The servo motor speed exceeding its setting
2	Main circuit over-voltage	Power voltage of main circuit too high.
3	Main circuit under-voltage	Power voltage of main circuit too low.
4	Orientation oversize	Value of orientation deviation counter exceeding its setting
5	The motor overheated	Motor temperature too high.
6	Saturation fault of speed amplifier	Long saturation of speed regulator
7	Abnormity of drive stop	CCW, CW drive stop OFF
8	The orientation deviation counter overflowing	Absolute value of orientation deviation counter exceeding 2^{30}
9	Encoder fault	Encoder signal error
10	The control power supply down-voltage	Control power supply $\pm 15V$ lower
11	IPM module fault	IPM intelligent module fault
12	Over- current	Motor current overlarge
13	Overload	The servo driver and motor overloaded (instantaneous overheating).
14	Brake fault	Brake circuit fault
15	Encoder counting fault	Abnormity of encoder counting
16	Motor overheating	Value of motor heating exceeding setting(I^2t detection)

20	Data and detecting alarm of EEPROM	EEPROM chip damaged
22	Zero-adjusting error of encoder	Zero-adjusting fail of encoder
23	Current sampling fault	Current sampling circuit fault
32	Encoder UVW signals code invalid	Complete high or low level of UVW signals

7.2 Alarm troubleshootings

Alarm code	Alarm name	Running state	Cause	Remedy
Err-1	Overspeed	Occurring in switching on control power supply	① Control circuit board fault ② Encoder fault	① Change servo driver ② Change servo motor
		Occurring in motor running	① The frequency of instruction pulse input is overhigh.	① Set correctly the input instruction pulse.
			① Acceleration/deceleration time constant is too small to cause the speed overshooting too large.	① Increase acceleration/deceleration time constant.
			① The electronic gear ratio input is too large.	① Set it correctly.
			① Encoder fault	① Change the servo motor.
			① Encoder cable is inferior.	① Change the encoder cable.
			① Servo system is not stable to cause the overshooting.	① Set the related gain again. ② If the gain can not be set to a proper value, reduce rotation inertia ratio of load.
		Occurring in the starting of the motor	① The load inertia is too large.	① Reduce load inertia. ② Change driver and motor with larger power ones.
			① Encoder zero fault	① Change servo motor. ② Re-adjust encoder zero by manufacturer.

Chapter 7 Function for protection

			<ul style="list-style-type: none"> ① The U, V, W lead wires of the motor are not connected correctly. ② Cable lead wires of encoder are not connected correctly. 	<ul style="list-style-type: none"> ① Connect the wires correctly.
Err-2	Main circuit over-voltage	Occurring in switching on control power supply	<ul style="list-style-type: none"> ① The circuit board fault 	<ul style="list-style-type: none"> ① Change servo driver.
		Occurring in switching on main power supply	<ul style="list-style-type: none"> ① Power supply voltage is too high. ② Wave form of power supply voltage is abnormal. 	<ul style="list-style-type: none"> ① Check power supply.
		Occurring in motor running	<ul style="list-style-type: none"> ①The brake resistance connection breaks off. 	<ul style="list-style-type: none"> ① Connect it again.
			<ul style="list-style-type: none"> ① Brake transistor is damaged. ② Internal brake resistance is damaged. 	<ul style="list-style-type: none"> ① Change servo driver.
			<ul style="list-style-type: none"> ① The capacity of brake loop is not enough. 	<ul style="list-style-type: none"> ① Reduce start-stop frequency ② Increase acceleration/ deceleration time constant. ③ Reduce torque limit. ④ Reduce load inertia. ⑤ Change the driver and motor with larger ones.
Err-3	Main circuit under-voltage	Occurring in switching on main power supply	<ul style="list-style-type: none"> ① Circuit board is at fault. ② Fuse of power supply is damaged. ③ Soft start circuit fault ④ Rectifier is damaged. 	<ul style="list-style-type: none"> ① Change servo driver
			<ul style="list-style-type: none"> ① Power supply voltage is low. ② Temporary power cut-off is more than 20ms. 	<ul style="list-style-type: none"> ① Check power supply.
		Occurring in motor running	<ul style="list-style-type: none"> ① Power capacity is not enough. ② Instantaneous power down 	<ul style="list-style-type: none"> ① Check power supply.
			<ul style="list-style-type: none"> ①The Radiator is overheated. 	<ul style="list-style-type: none"> ① Check load.
Err-4	Orientation oversize.	Occurring in switching on control power supply	<ul style="list-style-type: none"> ① Circuit board is at fault. 	<ul style="list-style-type: none"> ①Change the servo driver.

		the motor doesn't rotate after switching on the main power supply and the control wires and inputting instruction pulse	<ul style="list-style-type: none"> ① U, V, W lead wires of motor are not connected correctly. ② Lead wires of encoder cable are not connected correctly. 	<ul style="list-style-type: none"> ① Connect them correctly.
			① Encoder fault	① Change the servo motor.
			① The orientation oversize detecting setting range is too small.	① Increase the setting range.
			① The orientation proportional gain is too small.	① Increase the gain.
			① Torque is not enough..	<ul style="list-style-type: none"> ① Check the torque limit value. ② Reduce the load capacity.. ③ Change the driver and motor with larger power ones.
			① Instruction pulse frequency is too high.	① Reduce the frequency.
Err-5	Motor overheated	Occurring in switching on control power supply	<ul style="list-style-type: none"> ① Circuit board is at fault. ① Cable is broken. ② Internal temperature relay of motor is damaged. 	<ul style="list-style-type: none"> ① Change the servo driver. ① Check the cable. ② Check the motor.
		Occurring in motor running	<ul style="list-style-type: none"> ① Motor is overloaded. 	<ul style="list-style-type: none"> ① Reduce the load. ② Reduce the start-stop frequency. ③ Reduce the torque limit value. ④ Reduce the related gain. ⑤ Change the driver and motor with larger power ones.
			① Motor interior is at fault.	① Change the servo motor.
	Err-6	Speed error too big or too long saturation time fault of speed amplifier	Occurring in motor running	The motor is chucked mechanically.
The load is too big.				<ul style="list-style-type: none"> ① Reduce the load. ② Change the driver and motor with larger power ones.

Chapter 7 Function for protection

Err-7	Abnormity of drive stop		The input terminals of CCW, CW drive stop are both broken off.	① Check the connection and power supply of input terminals.
Err-9	Photoelectric encoder signal fault		① Encoder connection is wrong.	① Check the connection.
			① Encoder is damaged.	① Change the motor.
			① Encoder cable is inferior.	① Change the cable.
			① Encoder cable is so long that the encoder voltage is too low.	① Shorten the cable. ② Employ with multi-core parallel power-up.
Err-10	Control power supply undervoltage		① Control power supply voltage input is too low.	① Check the control power supply.
			① Internal connector assembly of driver is inferior. ② Switch power supply is abnormal. ③ Chip is damaged.	① Change the driver. ② Check the connector assembly. ③ Check the switch power supply.
Err-11	IPM module fault	Occurring in switching on control power supply	① Circuit board is at fault	① Change the servo driver.
		Occurring in motor running	① Power-up voltage is low. ② Overheated.	① Check the driver. ② Power on again. ③ Change the driver.
			① Driver U, V, W terminals are short circuit.	① Check the connection.
			① Earthing is not well done.	① Be grounded correctly.
			① Motor insulation is damaged.	① Change the motor.
			① It is interfered with.	① Add the circuit filter. ② Be far away from the interference source.
Err-12	Over-current		Driver U, V, W terminals are short circuit.	Check the connection.
			Earthing is not well done.	Be grounded correctly.
			Motor insulation is damaged.	Change the motor.
			Driver is damaged.	Change the driver.

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Err-13	Overload	Occurring in switching on control power supply	① Circuit board is at fault.	① Change the servo driver.
		Occurring in motor running	① The motor runs exceeding rated torque.	① Check the load. ② Reduce the start-stop frequency. ③ Reduce the torque limit value. ④ Change the driver and motor with the larger power ones.
			① Hold brake is not on.	① Check the hold brake.
			① Motor vibrates unsteadily.	① Adjust the gain. ② Increase the acceleration/ deceleration time. ③ Reduce the load inertia.
			① One of U, V, W phases is broken off. ② The connection of encoder is mistaken.	① Check the connection.
Err-14	Brake circuit fault	Occurring in switching on control power supply	① Circuit board is at fault.	① Change the servo driver.
		Occurring in motor running	① Brake resistance connection is broken off.	① Connect the wire again.
			① Brake transistor is damaged. ② Internal brake resistance is ③ damaged.	① Change the servo driver.
			① Brake loop capacity is not enough.	① Reduce the start-off frequency. ② Increase the acceleration/ deceleration time constant. ③ Reduce the torque limit value. ④ Reduce the load inertia. ⑤ Change the driver and motor with larger power ones.

Chapter 7 Function for protection

			① Main circuit power supply voltage is too high.	① Check the main power supply.
Err-15	Encoder counting fault		Encoder is damaged.	Change the motor.
			Encoder connection is wrong.	Check the connection.
			Earthing is not well done.	Be grounded correctly.
Err-16	Motor overheating	Occurring in switching on control power supply	Circuit board is at fault.	Change the servo driver.
			Parameter setting is wrong.	Set the parameter correctly.
		Occurring in motor running	Motor runs exceeding rated torque for a long time.	① Check the load. ② Check the start-stop frequency. ③ Reduce the torque limit value. ④ Change the driver and motor with the larger power ones.
			Mechanical transmission is not good.	Check the mechanical part.
Err-20	Data and detecting alarm of EEPROM	EEPROM chip damaged	① Chip or circuit board is damaged.	① Change the servo driver. ② Driver model (parameter PA01) must be set again after repairing, then restore the defaults.
Err-22	Zero-adjusting error of encoder		Chip or circuit board is damaged.	Change the servo driver.
			Parameter setting is wrong.	Set the parameter correctly.
Err-23	Current sampling fault		① Chip or circuit board is damaged. Circuit sensor is damaged.	① Change the servo driver.
Err-32	Encoder UVW signals code invalid		① UVW signals of encoder are damaged. ② Cable is inferior. ③ Cable shielding is not good. ④ Shielding ground wire is not well done. ⑤ Encoder interface circuit is at fault.	① Change the encoder ② Check the interface circuit of encoder.

Chapter 8 Isolated transformer

The isolated transformer should be employed to driver to reduce the liability of electric shock or interference from power supply and electromagnetic field. The servo motor of 0.8KW or less can be employed with single phase type, and the one of more must be employed with three-phase type. The following isolated transformer models provided by us have good quality, high cost-performance ratio, and good-looking figure, and user can choose according to your servo motor power and actual load.

Table 8.1 Isolated transformer specification

Type	Capacity (KVA)	Phase	Input voltage(V)	Output voltage (V)
BS--120	1.2	Three-phase	380	220
BS--200	2.0			
BS--300	3.0			
BD--80	0.8	Single-phase		
BD--120	1.2			

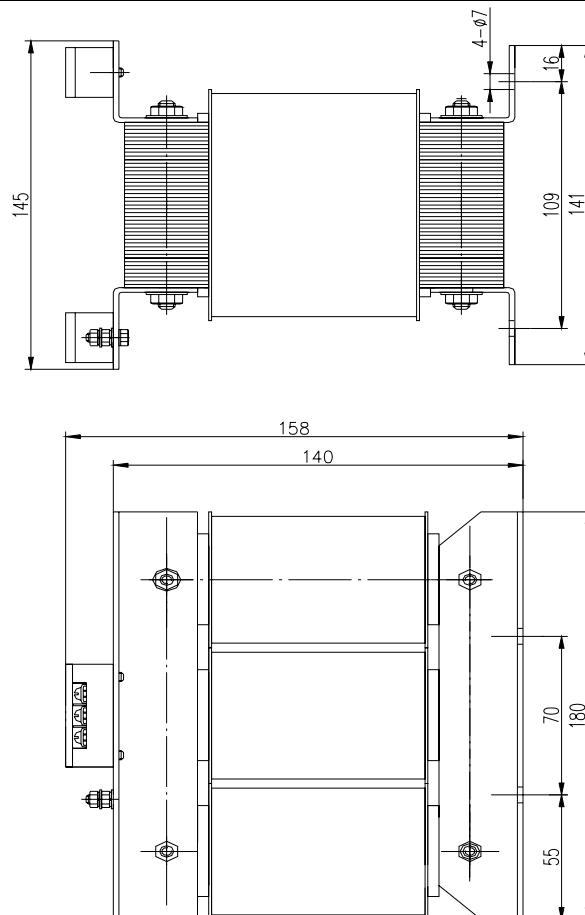


Fig.8.1 Outline and installation dimension for BS-120 model

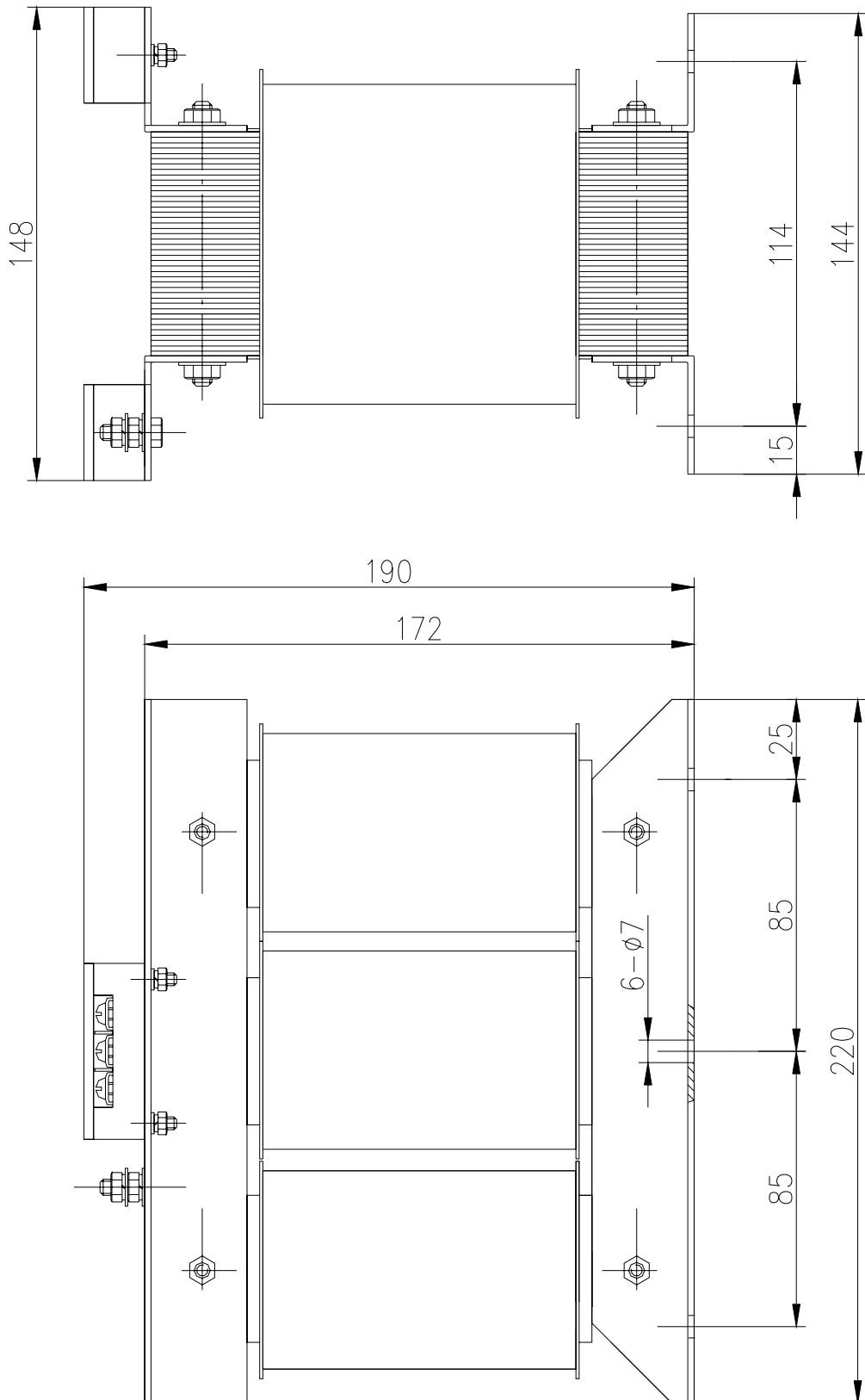


Fig.8.2 Outline and installation dimensions for BS-200 model

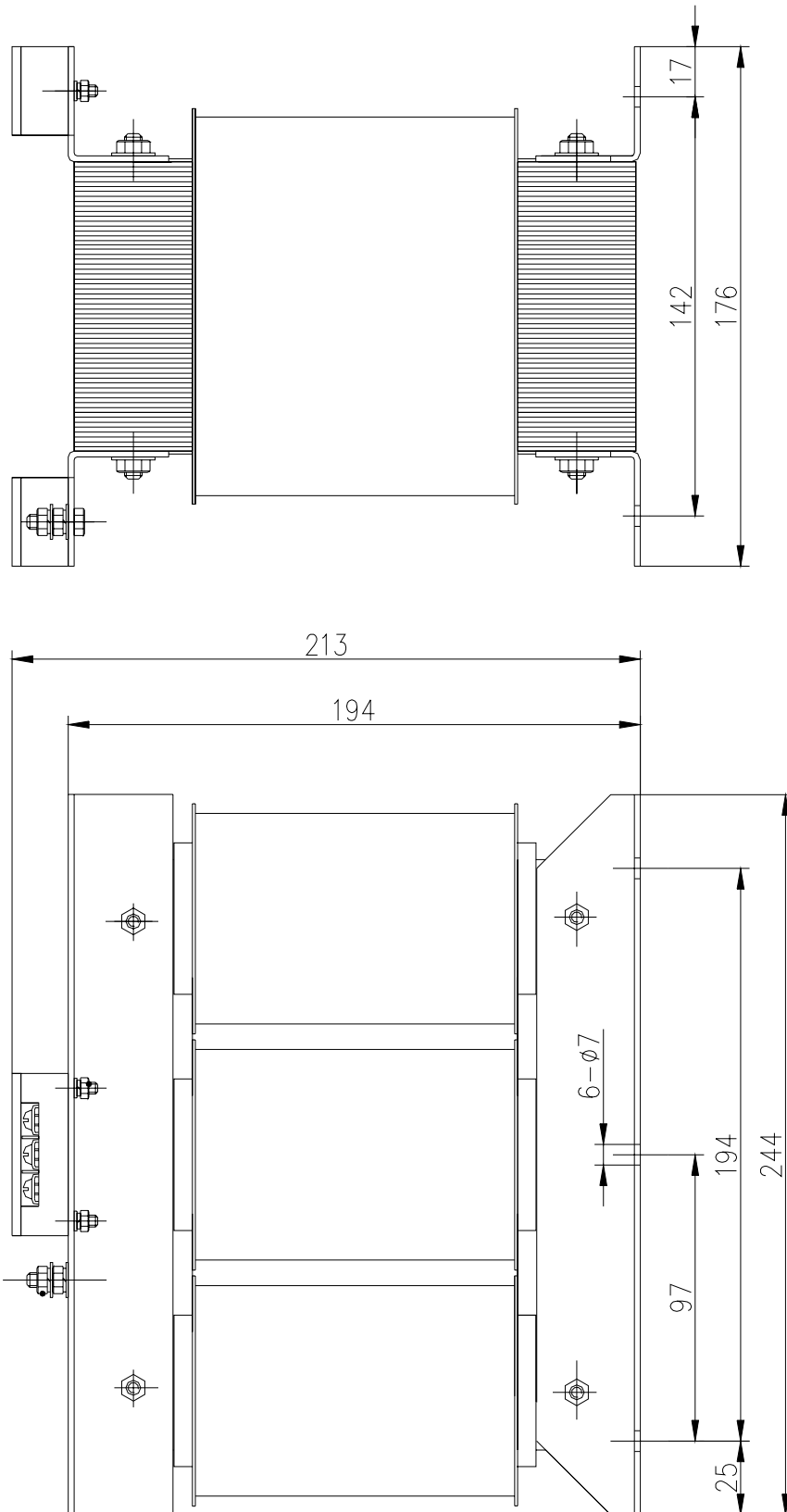


Fig.8.3 Outline and installation dimensions for BS-300 model

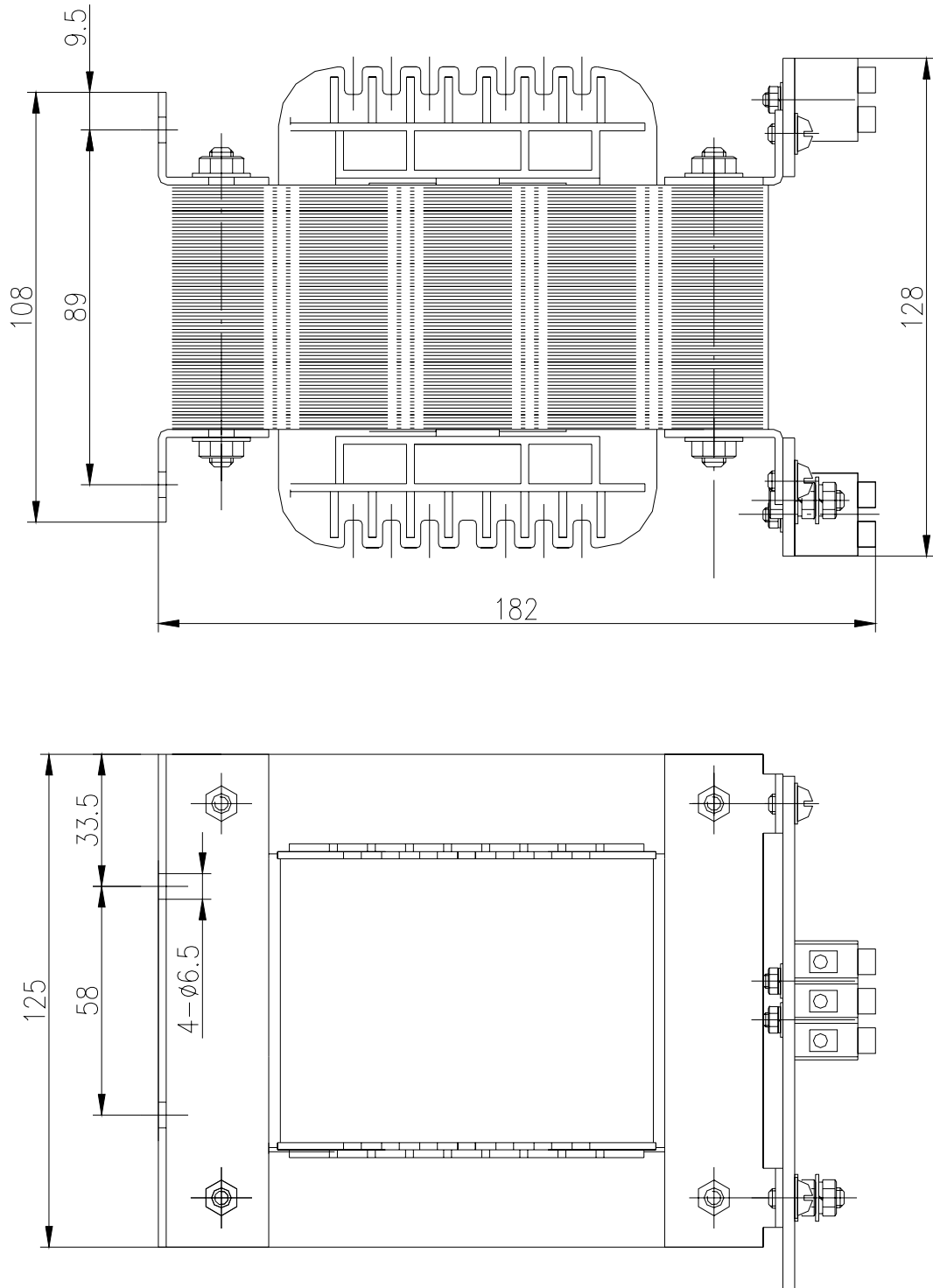


Fig.8.4 Outline and installation dimensions for BD-80 model

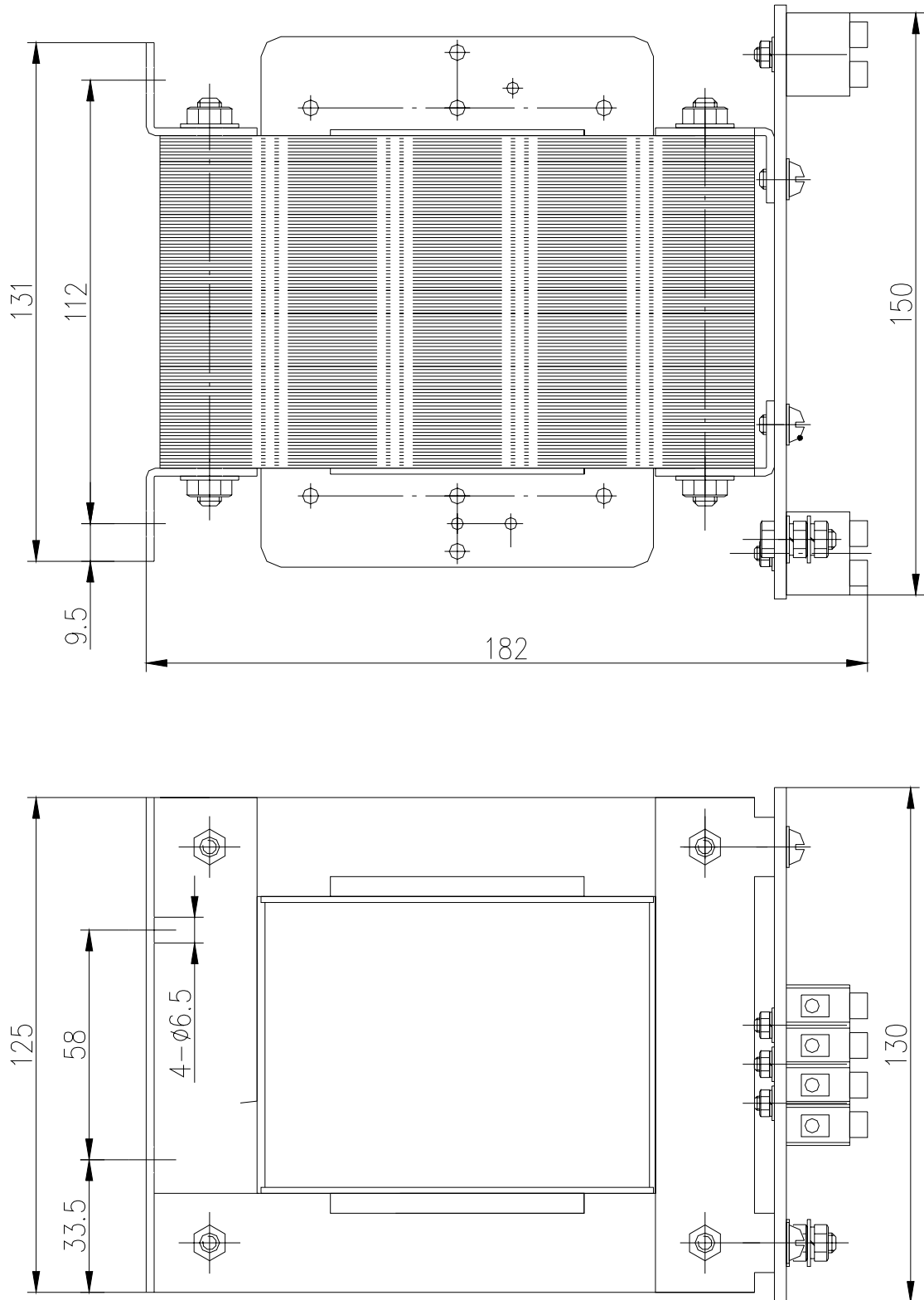


Fig.8.5 Outline and installation dimensions for BD-120 model

Chapter 9 Order guide

9.1 Capacity selection

Servo capacity is relative to the load inertia, the load torque, the orienting precision and max. speed required which are taken into account by the following steps:

1) Calculation of inertia and torque of load, torque of acceleration and deceleration

① Calculation of torque

The load torque is caused by the friction and cutting force of the driver.

$$2\pi M = FL$$

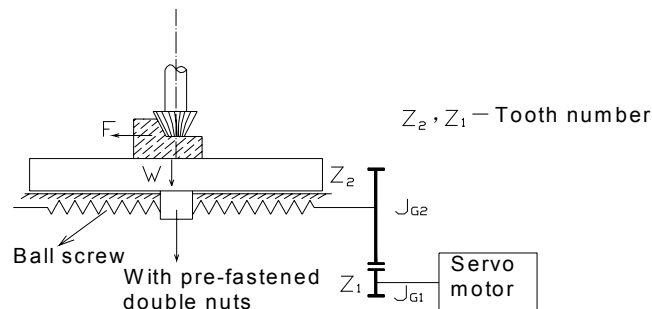
M — Torque of motor shaft

F — Force required for moving the mechanical parts in linear direction

L — Distance of moving mechanically for a revolution (2 π rad) of motor

2πM is the work done by the motor torque M in a revolution, while FL is the work done by force F moving an object for L distance.

Practically, due to the factors of transmission efficiency and friction coefficient, the torque required by ball screw overcoming the external load force P for uniform velocity movement is shown as following diagram:



An example for servo feeding drive system

Calculate it by the following equation:

$$M_1 = \left(K \frac{F_{a0} h_{sp}}{2\pi} + \frac{P h_{sp}}{2\pi\eta_1} + M_B \right) \frac{Z_1}{Z_2}$$

M₁ — Drive torque for uniform velocity movement

$K \frac{F_{a0} h_{sp}}{2\pi}$ — Pre-fastened torque of double nuts ball screw (N•mm)

F_{a0} — Pre-fastened force, it generally amounts to one third of the

max. axial working load, i.e. $F_{a0} = 1/3F_{maz}$. If F_{maz} is hard to get, $F_{a0} = (0.1\sim 0.12) C_a$ (N) is suggested for use.

C_a ——The rated load of ball screw that can be looked up in the sample

h_{sp} —— Ball screw lead (mm)

K ——Pre-fastened torque coefficient of ball screw, 0.1—0.2

P ——axial external load of ball screw (N) , $P=F+\mu W$

F ——Axial cutting force of ball screw (N)

W ——Load in normal direction (N), $W=W_1+P_1$

W_1 ——Gravity of moving parts (N) , including max. loading gravity

P_1 ——Clamping force of splinting (etc. headstock)

μ —— Slideway frictional coefficient, for slideway clung with CIC₄ board, $\mu=0.09$; for lubrication, $\mu=0.03-0.05$; for linear rolling slideway, $\mu=0.003-0.004$

η_1 —— Efficiency of ball screw, 0.90—0.95

M_B —— Frictional torque of supporting bearing, namely, start torque (N•m) , which can be looked up in the sample of bearing for ball screw

z_1 —— Tooth number of gear 1

z_2 —— Tooth number of gear 2

Select a servo motor which satisfies the following inequation:

$$M_1 \leq M_s$$

M_s is the rated torque of the servo motor.

② Calculation for inertia matched

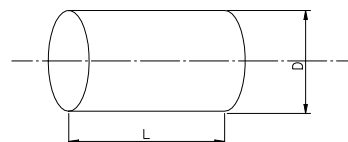
The following inequation is generally recommended for use among motor inertia J_M , load inertia J_L (converted to motor shaft), general inertia J_r :

$$\frac{1}{4} \leq \frac{J_L}{J_M} \leq 1 \quad , \quad 0.5 \leq \frac{J_M}{J_r} \leq 0.8 \quad \text{or} \quad 0.2 \leq \frac{J_L}{J_r} \leq 0.5$$

The motor rotor inertia J_M can be looked up in the sample manual. The calculation for load inertia is as follows:

1. The inertia of rotary object Ball screw, coupling, gear, tooth form belt etc. are all rotary objects.

$$J = \frac{\pi \gamma}{32 \times g} D^4 L (\text{kg} \cdot \text{m}^2)$$



Chapter 9 Order guide

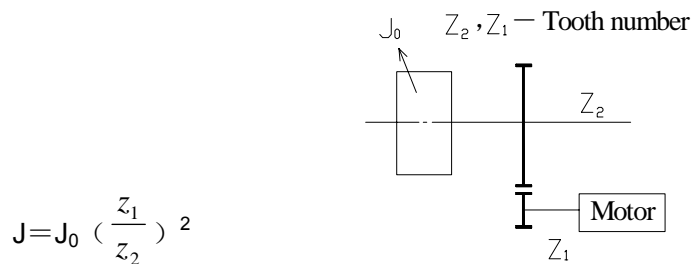
- γ — Material density of rotational object(kg*m²)
- D — Diameter of rotational object (cm)
- L — Length of rotational object (cm)
- g — Gravity acceleration, g=980cm/s²

2. The inertia of linear movement object

$$J = \frac{W}{g} \left(\frac{L}{2\pi} \right)^2 \quad (\text{kg} \cdot \text{m}^2)$$

- W — Gravity of linear movement object (N)
- L — The object moving distance for one revolution of motor; if the motor is directly connected to the lead screw, L=lead screw lead h_{sp}.

3. The inertia converted to the motor shaft in deceleration and the deceleration of gears, gear-form belt drive



Refer to the sketch map above, the load inertia J_L converted to the motor shaft is:

$$J_L = J_{G1} + \left(\frac{z_1}{z_2} \right)^2 [(J_{G2} + J_S) + \frac{W}{g} \left(\frac{L}{2\pi} \right)^2] (\text{kg} \cdot \text{m}^2)$$

- J_{G1} — Inertia of gear 1 (kg*m²)
- J_{G2} — Inertia of gear 2 (kg*m²)
- J_S — Inertia of ball screw (kg*m²).

③ Calculation of the max. torque in orienting acceleration

$$M = \frac{2\pi n_m}{60 t_a} (J_M + J_L) + M_L$$

- n_m — Speed of fast moving motor (r/min) (r/min)
- t_a — Acceleration or deceleration time (s), taking 150-200ms by $t_a \approx 3 / K_S$;

K_S — Open loop gain of the system, usually $8s^{-1}$ - $25s^{-1}$; for MC $K_S = 20s^{-1}$;

M_L — Load torque (N·m) .

If M is less than the max. torque M_{max} of servo motor, the motor speed can be increased or decreased by the time constant used.

2) Preliminary confirmation of mechanical gear ratio

Calculate the max. mechanical reduction ratio by the highest speed and highest speed of motor required and collate it to the min. orientation unit with the min. revolution unit and the reduction ratio. If the requirement of the orientation precision is very high, increase the mechanical reduction ratio (the actual highest speed is lowered) or choose a faster motor.

3) Check of inertia and torque

Convert the inertia and torque of load to the motor shaft by mechanical reduction ratio, and the inertia converted should be less than quintuple of the motor rotor inertia. And the load torque converted and the effective torque should be less than the rated torque of motor. If the requirement above can't be met, increment of mechanical reduction ratio (the actual highest speed is lowered) or a higher capacity motor may be employed.

9.2 Electronic gear ratio

Refer to chapter 4 (Section 4.2 Parameter function), chapter 6 (Section 6.2.5 Orientation control run) for the significance and adjustment of electronic gear ratio.

In the orientation control mode, the actual speed of load is:

Instruction pulse speed $\times G \times$ mechanical reduction ratio.

In the orientation control mode, the actual min. displacement of load is:

Min. instruction pulse stroke $\times G \times$ mechanical reduction ratio



If the electronic gear ratio G is not 1, there may be a remainder when executing the division for gear ratio, which may lead to position deviation and the max. deviation is the min. revolution amount of the motor (min. resolution).

9.3 Stop characteristic

Lag pulse is defined to the difference between the instruction pulse and feedback pulse when the servo motor is controlled by pulse strings in orientation control mode. The difference is accumulated in the orientation deviation counter, and its relationship with the instruction pulse frequency, the electronic gear ratio and the orientation proportional gain

is as follows:

$$\varepsilon = \frac{f^* \times G}{K_p}$$

ε : Lag pulse (Puls);

f : Instruction pulse frequency (Hz);

K_p : Orientation proportional gain (1/S);

G : Electronic gear ratio.



The equation is obtained when [position feedback gain] is 0% and the lag pulse will be less than the computation counted by the above equation if [position feedback gain] is more than 0%.

9.4 Servo and orientation controller computation

1. Instruction displacement and actual displacement:

$$S = \frac{I}{\delta} \cdot \frac{CR}{CD} \cdot \frac{DR}{DD} \cdot \frac{1}{ST} \cdot \frac{ZD}{ZM} \cdot L$$

S : Actual displacement mm;

I : Instruction displacement mm;

δ : Min. unit of CNC mm;

CR : Instruction dividing frequency numerator;

CD : Instruction dividing frequency denominator;

DR : Servo dividing frequency numerator;

DD : Servo dividing frequency denominator;

ST : Servo motor scale of per rev;

ZD : Side gear tooth numbers of motor;

ZM : Side gear tooth numbers of lead screw;

L : Lead screw pitch mm;

Generally $S=I$, the instruction value is equal to the actual one.

$$\frac{F}{60 \times \delta} \cdot \frac{CR}{CD} \leq f_{\max}$$

2. Max. instruction speed of CNC:

F : Instruction speed mm/min;

f_{\max} : Max. output frequency of CNC Hz.

$$V_{\max} = n_{\max} \times \frac{DR}{DD} \times L$$

3. Max. speed of servo:

V_{\max} : Max. speed of worktable allowed by servo, mm/min;

n_{\max} : Max. speed allowed by servo motor, r/min;

The practical max. speed of machine is limited by max. speed of CNC and servo.

$$\alpha = INT \left[INT \left(N \cdot \frac{CR}{CD} \right) \cdot \frac{DR}{DD} \right]_{\min} \cdot \frac{1}{ST} \cdot \frac{ZD}{ZM} \cdot \frac{L}{\delta}$$

4. Min. movement of machine tool:

α : Min. movement of machine tool, mm;

N: Natural number;

INT (): Integer rounding;

INT[]_{min}: Min. integer.

广州数控设备有限公司
GSK CNC EQUIPMENT CO., LTD.

Add: No.52, 1st . Street, Luochong North Road, Luochongwei, Guangzhou, 510165, China

Website: <http://www.gsk.com.cn>

E-mail: gsk@gsk.com.cn

Tel: 86-20-81796410/81797922

Fax: 86-20-81993683

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