

GSK DA98A
Full Digital AC Servo System

User Manual



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

Foreword

Thank you for purchasing DA98A AC Servo System. For optimum performance and safety instruction, please read this manual carefully.

Caution: Improper operation leads to accidents. Before operating the system, please read the manual completely.

- All specification and designs are subject to change without notice.
- We do not undertake any responsibility and product warranty sheet is cancelled if user changes our product.

Pay attention to the following signs when reading the user manual:



If operation is incorrect, a dangerous situation may occur, resulting in death or serious injuries.



If operation is incorrect, a dangerous situation may occur, resulting in minor to medium injuries or damage to equipment.



If operation is incorrect, damage to system or machine may occur.

Safety regulation



Warning

- Design and manufacturing of the product are not used for the mechanism and system which can cause danger to people.
- Precautions in design and making should be taken to avoid accidents resulted by malpractice or malfunction of the product when matching with this product.

Acceptance



Caution

- Products that were damaged or broken-down cannot be put into use.

Delivery



Caution

- Products should be stored and delivered by proper storage and delivery environment.
- Do not put many packing boxes in piles to avoid falling down.
- Appropriate package should be done for delivery.
- Do not drage its wires, spindle or encoder when moving the servomotor.
- Protect the servo driver and the servomotor from external force and crash.

Installation



Caution

Servo driver and servomotor:

- Do not install it on or near flammable objects.
- Avoid vibration and protect it from impact.
- No assembly for product that was damaged or lack of components.

Servo driver:

- It should be fixed in a control coffer with a high protection level.
- Enough clearance should be set aside with other equipments.
- A good heat radiation condition should be provided.
- Protect dust, corrosive gas, conductive objects, liquids and flammable or explosible material from entering it.

Servomotor:

- Fastness must be assured to avoid looseness owing to shaking.
- Protect liquids from entering motor and encoder.
- Forbid hammering motor and its spindle to avoid damaging encoder.
- Load cannot exceed the maximum of motor spindle.

Connection

Warning

- Only qualified persons can do or check the connection.
- Connection and checking cannot be performed in 5 minutes after the power supply is switched off.
- The servo driver and servomotor must be grounded.
- Explosion or operation incident caused by mistakenn voltage or polarity of power supply may occur.
- Connection is permitted after stable installation of servo driver and servomotor.
- Insulate and Protect from squeezing wires to avoid electric shock.

Caution

- Correctness and fastness of connection must be assured, otherwise the motor will run in a mistakenn direction and the equipment may be damaged by loosen connection.
- U, V, W terminals must not be connected reversely and connected with AC power supply.
- Servomotor must be directly connected with servo driver without connecting of capacitance, inductance or filter.
- Protect conductive fastener and end of wire from entering servo driver.
- Wires and non-thermal protective objects are not permitted to approach to servo driver radiator and servomotor.
- Freewheeling diode in parallel on output signal of DC relay must not be connected reversely.

Debugging

Caution

- Stable assembly and fixation of servo driver and servomotor, correctness of power voltage and cable connection must be assured before the power supply is switched on.
- Servomotor should run in dry run mode while debugging. Load debugging should be performed after the parameters are rightly set to avoid damage of machine and equipment caused by maloperation.

Usage

Caution

- Emergency circuit should be connected to make the machine stop running immediately with power cut off when an incident occurs.
- The running signal must be off before resetting an alarm or it will restart suddently.
- The servo driver must be matched with the specified servomotor.
- Do not frequently switch on/off the power supply of servomotor to avoid damaging servomotor.
- Do not touch the driver radiator and the servomotor in running and power off to avoid

scalding .

- Must not refit the servo system.

Troubleshooting

Warning

- Do not touch the terminals in 5minutes after power is off because of the high voltage of servo driver.
- Only qualified persons can dismount or maintain it.

Caution

- Resolve malfunction after alarming, and reset alarming signal before restarting.
- Keep away from machine while power is on after instantaneous power off because machine might start suddently.(No danger occurrence in restarting should be assured in design.)

Option

Note

- Rated torque of servomotor should be higher than that of effective continuous load.
- Inertia ratio between the load and the servomotor should be less than that of recommendation.
- The servo driver should be matched with the servomotor.

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Overview

1.1 Introduction

AC servo technology has been advanced and improved since the early of 90th last century and applied to NC machine, printing packing machinery, textile machinery, automatic production line and other automatic fields.

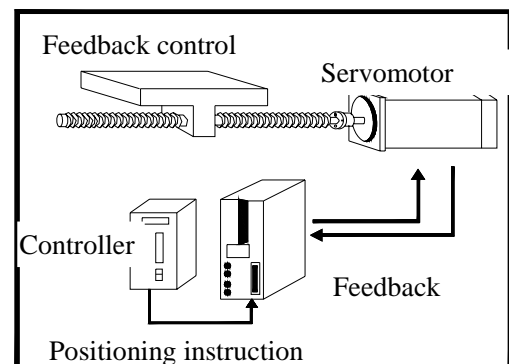
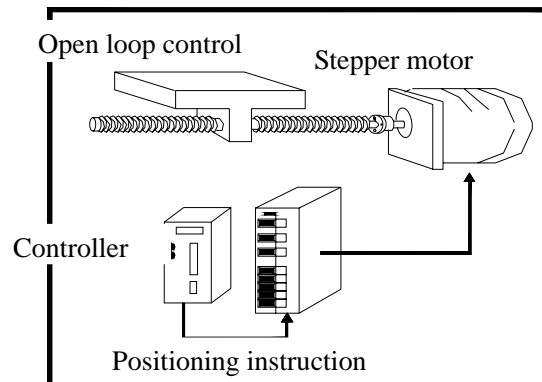
With high integration, compact, excellent reliability, DA98A AC servo system is the first full digital one in China, employed with the advanced digital signal processor DSP(TMS320f2407A) from America TI company, large-scale complex programmable logic device and MITSUBISHI intellegent power module, and with PID operation to execute PWM control. Its performance has reached the same overseas level.

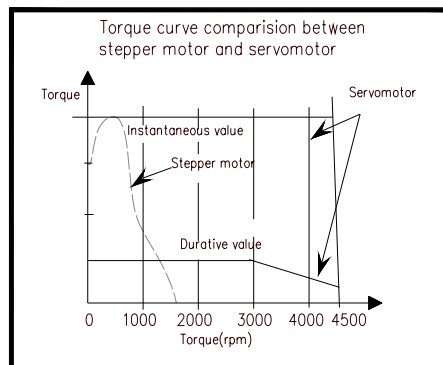
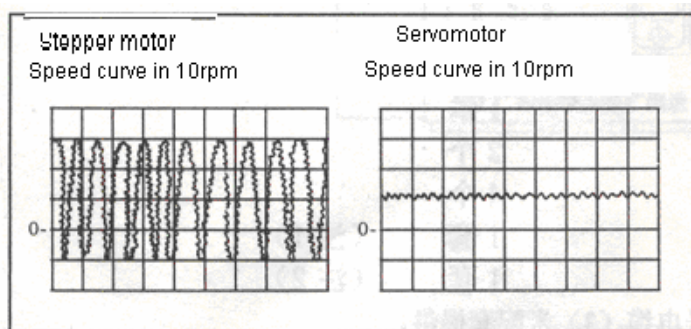
DA98A AC servo system has advantages compared to stepper system as follows:

- **Avoiding out-of-step**
Servomotor is employed with encode, its position signal feedbacks to servo driver with open loop position 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, position precision of turning is 1/10000r.

Note: There is different max. speed for different types.

- **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

1) Check after delivery:

- (1) Whether packing box is good and goods is damaged.
- (2) Whether the servo driver, servo driver nameplate is the ordered ones.
- (3) Whether accessories are the requirements.

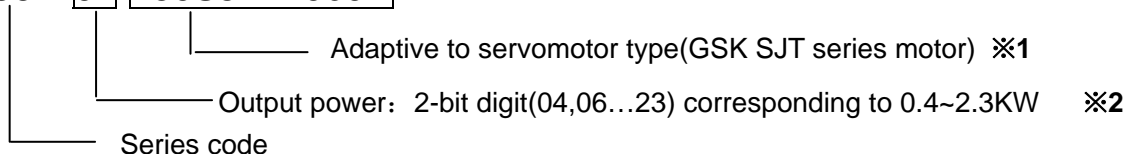
⚠ Note

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

2) Type signification:

- (1) Type for servo driver

DA98A-04-130SJT-M060D



※ 1: It can be matched with other homemade or imported servomotor which is needed to order. The driver which is short of parameters can be only adaptive to SJT, STZ, Star series servomotor.

※ 2: Small power (less than 1.5KW) is the standard configuration, and middle power ($<1.5 \leq 26$ KW) is employed with thicker radiator.

Note: Product type has been filled in before delivery and check the product with its nameplate.

- (2) Servomotor type.

DA98A (2.0 Version) AC servo driver can be matched with many domestic and abroad types of servomotor which can be selected by user. Servomotor information of GSK SJT

series and STZ, Star series from Huazhong University of Science and Technology are provided in Chapter 8, and other servomotor information are provided with delivery.

3) Accessories

(1) DA98A servo driver standard accessories:

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

Note 1: Signal cable (standard 3m) can be provided when it is matched with our position controller.

Note 2: User can select feedback cable (standard 3m) when our servomotor is provided.

(2) Standard accessories of servomotor are provided according to servomotor user manual

1.3 Outline

1) Outline of servo driver

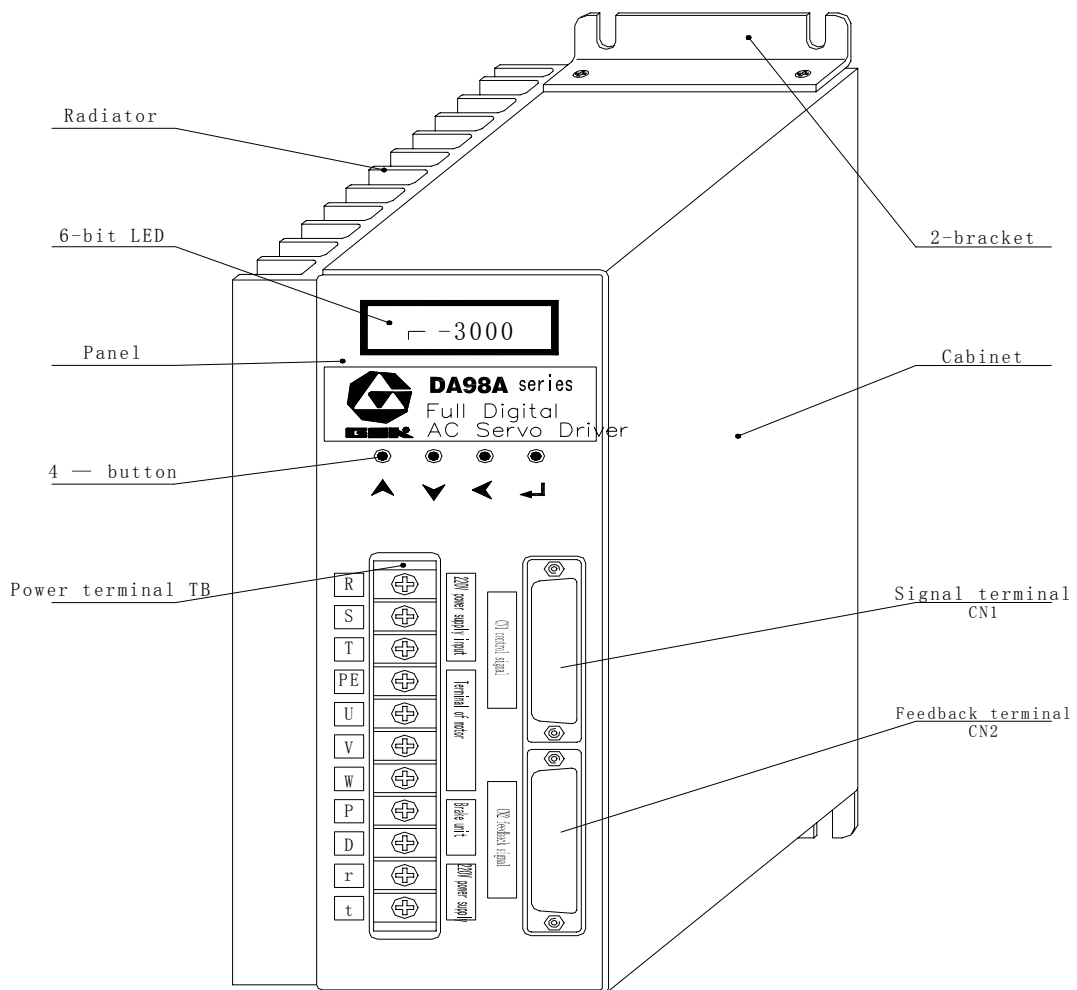


Fig. 1-1 Outline of driver

2) Outline of servomotor

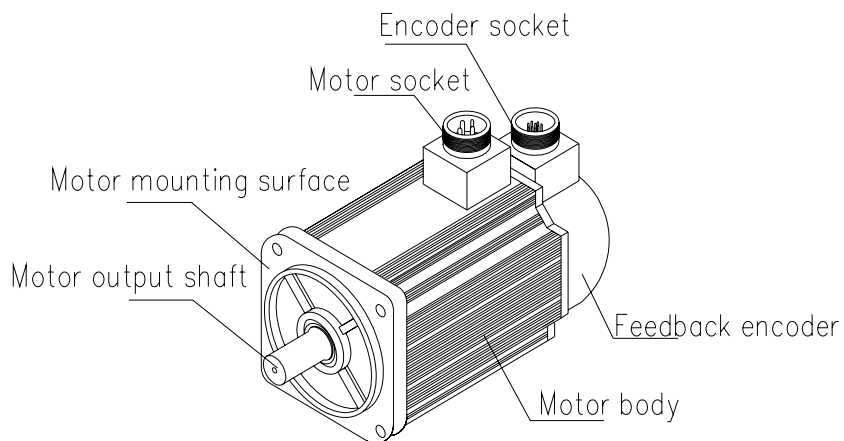


Fig. 1-2 Outline of SJT series servomotor

Installation

 **Note**

- Storage and installation must be a proper environmental condition.
- Do not put many packing boxes in piles to protect from being damaged and fallen
- Products are employed with original packing boxes in delivery.
- Products which are damaged or lacks some components must not be installed.
- Products are installed with fireproofing and must not be installed on or near flammable to avoid fire accident.
- Servo driver must be installed in electricity box to prevent dust, corrosive air, liquid, conductors and inflammable substances from entering it.
- Protect the servo driver and servomotor from being vibrated and shocked.
- Protect motor wire, motor spindle and encoder from be dragged.

2.1 Environmental condition

Item	DA98A servo driver	GSK SJT series servomotor
Operating temperature	0~55℃ (no freezing) below 90%RH (no dewing)	-25~40℃ (Star) no freezing, below 90%RH (no dewing)
Storage/delivery temperature/humidity	-20~80℃ 90%RH (no dewing)	-25~70℃ below 80%RH (no dewing)
Atmosphere environment	No corrosive gas, flammable gas, oil fog or dust in control cabinet	No corrosive gas, flammable gas, oil fog or dust in storehouse(no insolation)
Altitude	Altitude: below 1000m	Altitude: below 2500m
Vibration	Less than 0.5G (4.9m/s ²) 10-60HZ (non-continuous run)	
Guard level	IP00 (no guard)	IP65

2.2 Installation of servo driver

 **Note**

- It must be installed in a protective electric cabinet.
- It must be installed in the specified direction and interval to get good heat sink.
- It must not be installed on or near flammable objects to avoid fire.

1) Installation environment

(1) Guard

The servo driver without guard must be installed in the protective electric cabinet to prevent dust, corrosive gas, liquid, electricity-conduct or inflammable substances from entering it.

(2) Temperature and humidity

Environmental temperature is 0-50°C, and long-term safe operating temperature is below 45°C to get good heat sinking.

(3) Vibration and impact

The servo driver must be protected from vibration which is below 0.5(4.9m/S²) and driver cannot receive weight and impact.

2) Installation method

(1) Installation mode

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

Fig 21. is sketch map for bottom board installation and Fig.2.2 is one for panel installation.

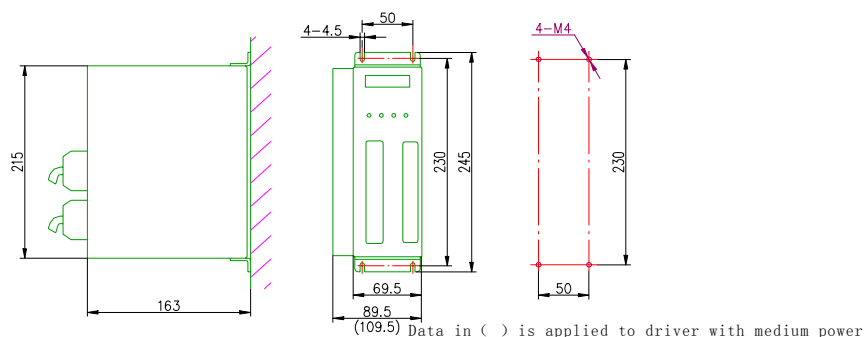


Fig. 2.1 bottom board installation mode

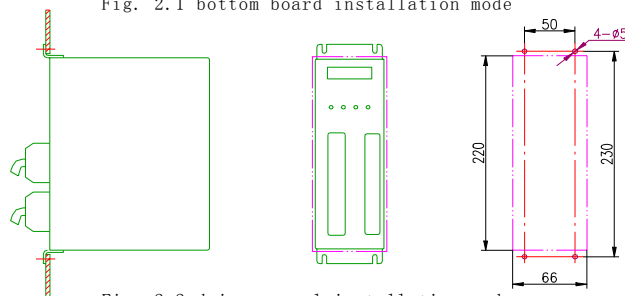


Fig. 2.2 driver panel installation mode

(2) Installation interval

Fig. 2.3 is installation interval for one driver and Fig. 2.4 is for drivers. The interval for actual installation should be more as possible to get good heat radiation.

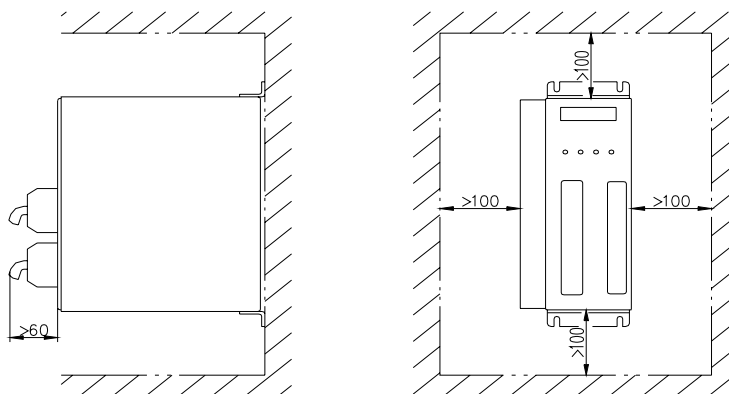


Fig. 2.3 Installation interval for one driver

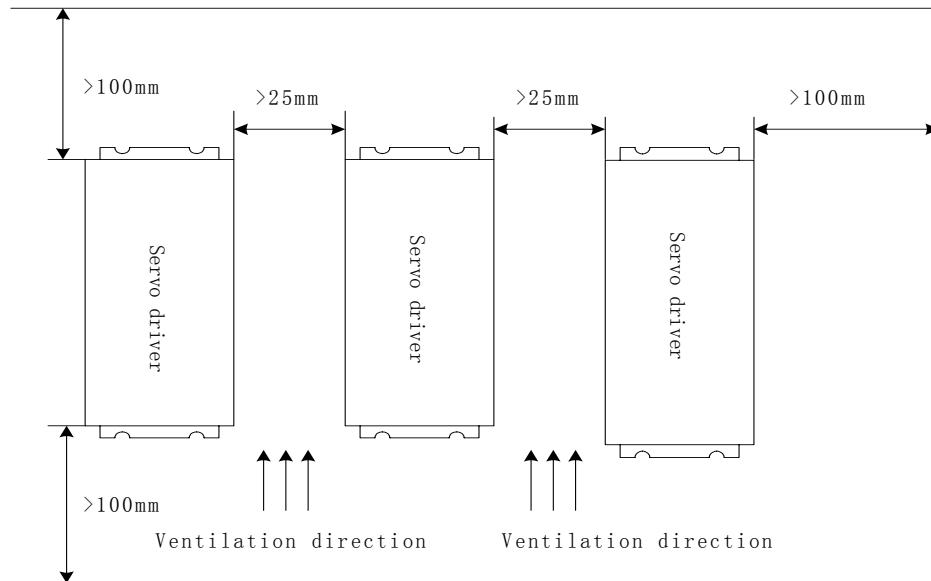


Fig. 2.4 Installation interval for drivers

(3) **Heat radiation**

There should be convective wind blown to the radiator in electric cabinet to protect its environmental temperature from continuous rising.

2.3 Installing servomotor



Note

- Protect motor shaft or encoder from pounding to avoid vibration or impact.
- Do not drag the motor shaft, outgoing line or encoder.
- Motor shaft cannot be over loaded, otherwise which may damage motor.
- Motor must be installed firmly and there should be measures against loose.

1) Installation environment

(1) Guard

GSK SJT series, Star series servomotors from Huazhong University of Science and Technology are not employed with waterproof device. So, protect liquid from splashing on motor and grease from motor internal by its lead wire and shaft.

Note: Please remark in order if you need servomotor with waterproof.

(2) Temperature and humidity

Environmental temperature should be $-25\sim 40^{\circ}\text{C}$ (no freezing). Measures of heat radiation must be done when the motor's temperature rises owing to long-term run, if there is small surrounding space or there is heating equipment nearby.

(3) Vibration

Servomotor should not be installed in vibrational environment and its vibration should be less than 0.5G (4.9m/s²).

2) Installtion method

(1) Installtion mode

SJT, Star series motors are employed with flange installation mode in every direction.

(2) Cautions:

- Do not hammer motor or its shaft to protect it from damaging encoder when removing belt wheel. Helical instruments are employed to removing it.
- SJT, Star series motor cannot be weighted with heavy axial, radial load. It should be employed with flexible shaft coupling to load.
- Anti-loose washer is employed to fix motor to protect it from loose.

Wiring



Warning

- Only qualified persons can connect the system or check the connection
- Wiring and check cannot be done in 5 minutes after the power supply is switched off to avoid electric shock.



Caution

- Connect with voltage and polarity of terminal to avoid damaging equipment and injuring people.
- Driver and servomotor must be grounded.

3.1 Standard wiring

External connection of driver is relative to control mode.

1) Position control mode:

Fig. 3.1 is standard wiring of position control mode.

2) Wiring

(1) Power supply terminal TB

- Wire size: wire size of R, S, T, PE, U, V, W $\geq 1.5\text{mm}^2$ (AWG14-16), wire size of r, t $\geq 1.0\text{mm}^2$ (AWG16-18).
- Grounding: the grounding wire should be thick, PE terminals of driver and servomotor should be earthed and their resistance is less than $100\ \Omega$.
- The terminal is employed with SVM2-4 pre-insulation coldpress to be connected firmly.
- It should suggest that it is employed with three-phase isolation transformer to power on to avoid electric shock to person.
- It should be suggested that power supply is connected by noise filter to improve anti-interference ability.
- Install non-fusing breaker to cut off external power supply timely when the driver is fault.

(2) Control signal CN1, feedback signal CN2

- Wire diameter: it is employed with shield cable, wire diameter $\geq 0.12\text{mm}^2$ (AWG24-26) and shield layer must be connected with FG terminal.
- Length: the cable length should be as possible as short, one to control CN1 should be less than 3m, and another to control feedback signal CN2 should be less than 20m.
- Wiring: be far away from power circuit to wiring to anti-interference.
- Inductive components (coil) should be installed with surge absorbing element: DC coil parallels reversely with freewheeling diode and AC coil parallels with RC absorption circuit.

⚠ Note

- U, V, W should be connected with motor winding one by one.
- Cable and lead wire must be fixed to avoid to approach radiator of driver and motor, which will ensure the insulation.
- Do not touch driver and motor in 5 minutes after the power supply is switched off because there is large electrolytic capacitance to keep high pressure even if they are switched off.

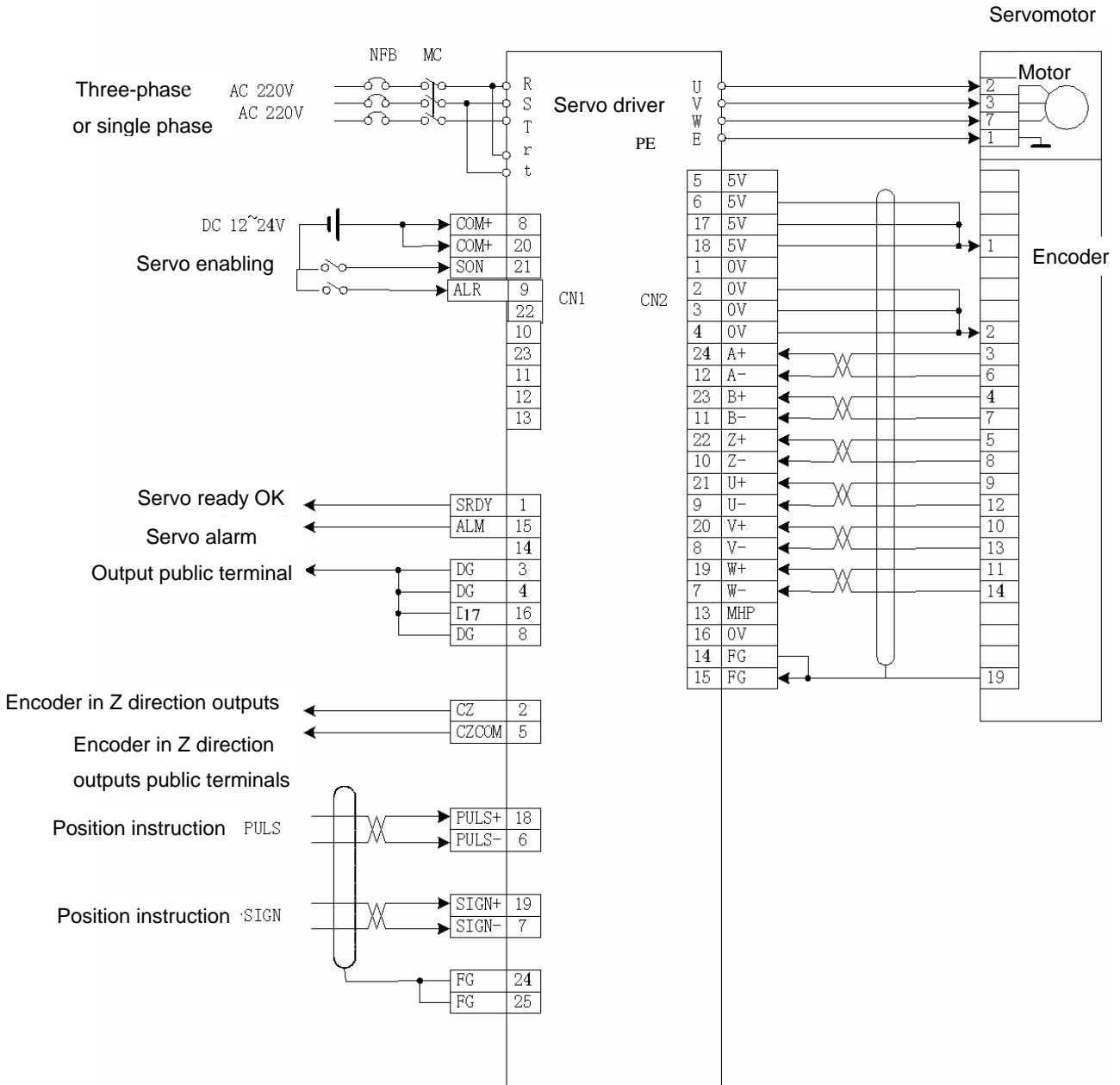


Fig. 3.1 Standard wiring of position control mode

3.2 Terminal function

1) Terminal configuration

Fig. 3.2 is for interface terminal configuration of servo driver. TB is terminal block; CN1 is DB25 connector assembly, socket is male and plug is female; CN2 is DB25 connector assembly, socket is female and plug is male.

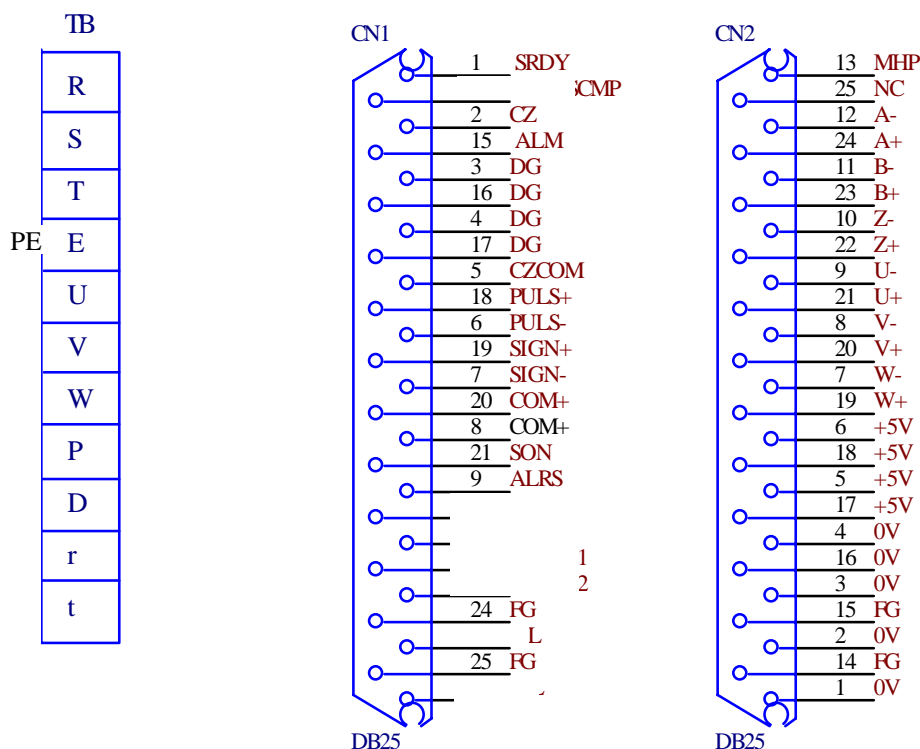


Fig. 3.2 Interface terminal configuration of servo driver`

2) Power supply terminal TB

Table3.1 power supply terminal

Terminal No.	Terminal sign	Signal name	Function
TB-1	R	Main loop power supply: single phase or three-pahse	Power supply input terminal of main loop ~220V 50Hz Note: do not connect with motor output terminal U, V, W.
TB-2	S		
TB-3	T		
TB-4	PE	System be grounded	Ground terminal Ground resistance < 100 Ω Common terminal of servomotor input and power Supply input must be grounded
TB-5	U	Servomotor output	Output terminal of servomotor must be connected correspondingly with U, V, W
TB-6	V		
TB-7	W		
TB-8	P	standby	
TB-9	D	standby	
TB-10	r	Control power supply:	Power supply input terminal of control loop

TB-11	t	single phase	~220V 50Hz
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3) Control terminal CN1

Table 3.2 Input/output terminal CN1 of control signal

Terminal No.	Signal name	Sign	I/O	Mode	Function	
CN1-8 CN1-20	Power supply positive of input terminal	COM+	Type1		Power supply positive of input terminal Photoelectric coupling used for driving input terminal DC12~24V, Current \geq 100mA	
CN1-21	Servo enabling	SON	Type1		Input terminal of servo enabling SON ON: enabling driver operating SON OFF: close driver not to operate, and motor is in free state. Note 1: The motor must be stationary before it is switched from SON OFF to SON ON; Note 2: Waits for 50ms before inputting command after it is SON ON.	
CN1-9	Alarm clearance	ALRS	Type1		NC	
CN1-1	Servo ready output	SRDY	Type2		Servo ready output terminal SRDY ON: the control power supply and the main power supply are normal, the driver does not alarm and the Servo Ready OK outputs ON. SRDY OFF: the main power supply is switched off or the driver alarms and the Servo Ready OK outputs OFF.	
CN1-15	Servo alarm output	ALM	Type2		Servo alarm output terminal ALM ON: the servo driver does not alarm and the servo alarm outputs ON. ALM OFF: the servo driver alarms and the servo alarm outputs OFF.	
CN1-3 CN1-4 CN1-16 CN1-17	Common of output terminal	DG			Control the public terminal of ground wire of signal output terminal(except for CZ)	
CN1-2	Encoder(Z phase) output	CZ	Type2		Output terminal of encoder(Z) Photoelectric encoder pulse(Z) of servomotor output CZ ON: signal (Z) appears	
CN1-5	Public terminal of encoder (Z phase)	CZCOM			Public terminal of encoder (Z) output terminal	
CN1-18 CN1-6 CN1-19 CN1-7	Instruction pulse PLUS input Instruction pulse SIGN input	PULS+ PULS- SIGN+ SIGN-	Type3 Type3	P P	External instruction pulse input terminal	
CN1-24	Shield ground	FG				Terminal of shield ground wire

CN1-25	wire				
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4) Feedback signal terminal CN2

Table 3.3 Signal input/output terminal CN2 of encoder

Terminal No.	Signal name	Terminal sign			Color	Function
		Sign	I/O	Mode		
CN2-5 CN2-6 CN2-17 CN2-18	Power supply output(+)	+5V				The servomotor photoelectric encoder connects with +5V power supply; multi-core wire in parallel are used when the length of cable is too long.
CN2-1 CN2-2 CN2-3 CN2-4 CN2-16	Power supply output(-)	OV				
CN2-24	Encoder(A+) input	A+	Type4			Connect with servomotor photoelectric encoder (A+)
CN2-12	Encoder(A-) input	A-				Connect with servomotor photoelectric encoder (A-)
CN2-23	Encoder(B+)input	B+	Type4			Connect with servomotor photoelectric encoder (B+)
CN2-11	Encoder(B-) input	B-				Connect with servomotor photoelectric encoder (B-)
CN2-22	Encoder(Z+)input	Z+	Type4			Connect with servomotor photoelectric encoder (Z+)
CN2-10	Encoder (Z-)input	Z-				Connect with servomotor photoelectric encoder (Z-)
CN2-21	Encoder(U+)input	U+	Type4			Connect with servomotor photoelectric encoder (U+)
CN2-9	Encoder(U-) input	U-				Connect with servomotor photoelectric encoder (U-)
CN2-20	Encoder(V+)input	V+	Type4			Connect with servomotor photoelectric encoder (V+)
CN2-8	Encoder (V-) input	V-				Connect with servomotor photoelectric encoder (V-)

3.3 I/O Interface method

1) Input interface of switching value

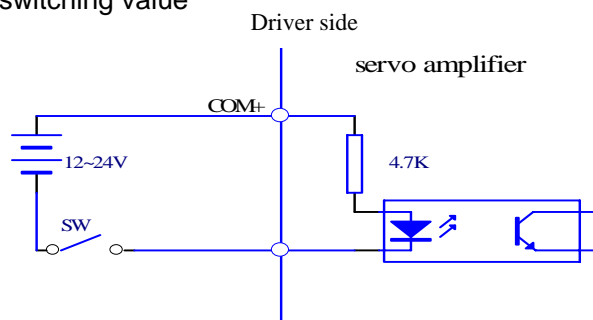


Fig. 3.3 Type1 Input interface of switching value

- (1) Power supply is provided by user, DC12~24V, current $\geq 100\text{mA}$;
- (2) Note: if current polarity is connected wrongly, the servo driver will not run.

2) Output interface of switch value

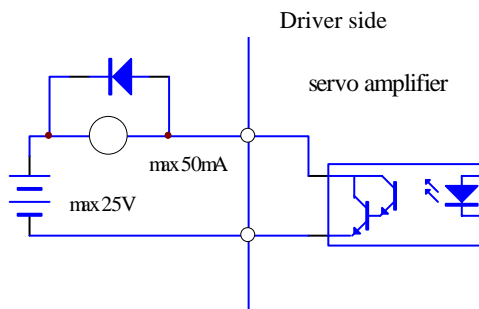


Fig. 3.4 Type2 Output interface of switching value

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

3) Pulse value input interface

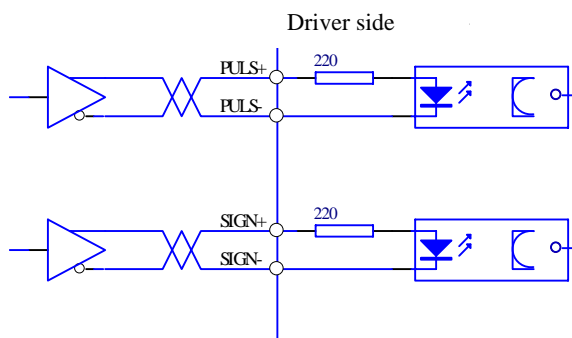


Fig. 3.5 Type3 differential drive mode of pulse value input interface

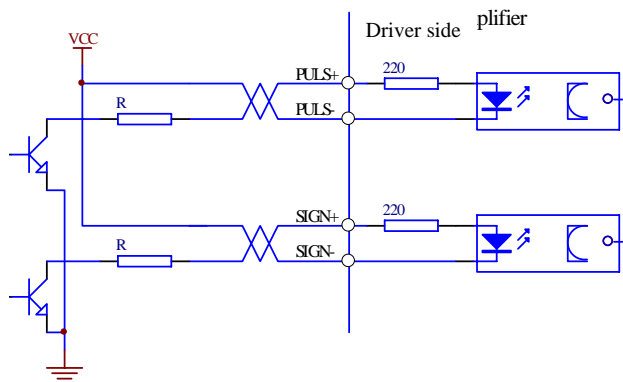


Fig. 3.6 Type3 single terminal drive mode of pulse value input interface

- (1) It is better to adopt with differential drive mode to transmit correctly pulse value data;
- (2) AM26LS31, MC3487 or RS422 driver are employed in the differential drive mode;
- (3) Operating frequency will be reduced in single terminal drive mode. Define the resistance R value according to pulse value input circuit, the drive current 10~15mA and max. voltage 25V of the limited external current. Practical data: VCC=24V, R=1.3~2K; VCC=12V, R=510~820 Ω; VCC=5V, R=82~120 Ω.
- (4) In single terminal drive mode, the external power supply is provided by user. and if its polarity is connected reversely, the servo driver may be damaged.
- (5) Refer to Table 3.4 about pulse input form, arrowhead is represented to counting drift, and Table 3.5 is represented to pulse input time sequence and parameter. If 2-phase input form is employed, 4 folds pulse frequency is less than 500kHz.

Table 3.4 pulse input form

Pulse instruction form	CCW	CW	Parameter setting value
Pulse array symbol	0		
	Command pulse +symbol		

Table 3.5 pulse input time sequence parameter

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

t_{qrh}	$<0.2 \mu S$	$<0.3 \mu S$
t_{qrl}	$<0.2 \mu S$	$<0.3 \mu S$
t_{qs}	$>1 \mu S$	$>2.5 \mu S$

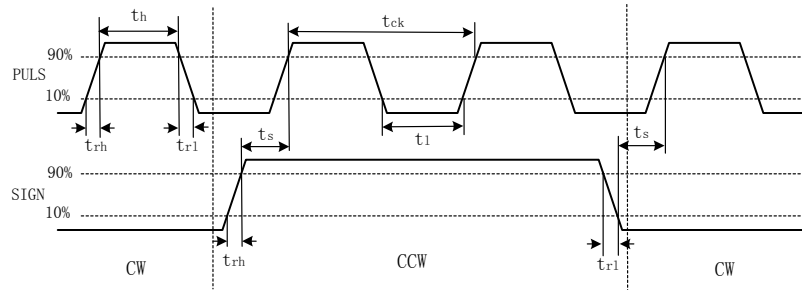


Fig. 3.7 Pulse +symbol input interface time sequence (max. pulse frequency 500kHz)

3) • Servomotor photoelectric encoder input interface •

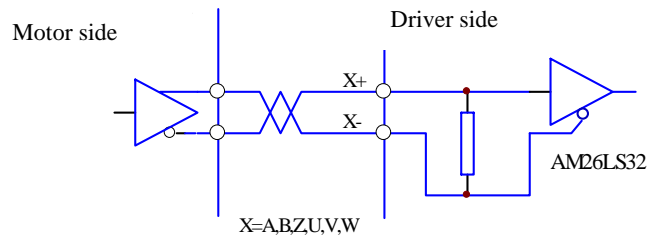


Fig. 3.8 Servomotor photoelectric encoder input interface

Parameter



Note

- Operator to set parameters must understand parameter meanings and mistakenn setting may cause to damage the equipment and injure people.
- Adjust parameter when the servomotor runs in no load mode.
- Motor parameter defaults servomotors of GSK SJT series, STZ, Star series from Huazhong University of Science and Technology, and the corresponding parameters must be adjusted if other servomotor is used, otherwise, the motor may run abnormally.

4.1 Parameter list

- User password (315): it can be modified(except for the type of driver);
- Value set by factory in Table 4.1 is for driver of motor 130ST-M04025H, and it is different for other types with "*" parameters.

Table 4.1 parameter list

No.	Name	Modifying password	Range	Value set by factory	Unit
0	Password	*	0~9999	315	
1	Driver type	385	0~52	39*	
2	Software version (only read)	*	*	*	
3	Initial display state	315	0~19	0	
4	Control mode selection	510	0~5	0	
5	Speed proportional gain	315	5~300	35*	Hz
6	Speed integration time constant	315	50~3000	300*	
7	Speed regulator input limiting		1~300	50*	
8	Speed detecting lowpass filter constant	315	20~200	100	
9	Position proportional gain	315	1~1000	128	1/S
10	Magnetic pole position zero deviation		0~1024	0	
11	Speed instruction lowpass filter constant	315	0~1200	16	
12	Position instruction pulse division frequency numerator	315	1~9999	1	
13	Position instruction pulse division frequency denominator	315	1~9999	1	
14	NC(standby)				
15	Position instruction pulse reverse direction	315	0~1	0	
16	Positioning completing range	315	0~9999	8	Pulse
17	Position out-of-toleration detection range	315	0~9999	200	× 100 pulse
18	Invalid position out-of-toleration error	315	0~2	0	
19	NC(standby)				
20	NC(standby)				
21	JOG running speed	315	-3000~3000	200	r/min
22	Current integral time constant		0~9999	280*	mS

23	Max. speed limit	315	0~4000	2550*	r/min
24	Motor speed testing set	315	-3000~3000	100	r/min
25	NC (standby)				
26	NC (standby)				
27	NC(standby)				
28	NC(standby)				
29	Current proportional gain		1~9999	4096*	
30	NC (standby)				
31	NC (standby)				
32	NC (standby)				
33	Overload limit		0~500	140*	
34	Internal torque limit		0~300	134*	%
35	Actual load capacity		-300~0	-134*	%
36	Current instruction lowpass filter cutoff frequency		1~200	110	HZ

*: Values set by factory of servo driver system with different power level are different.

4.2 Parameter function

Table 4.2 Parameter function

NO.	Name	Function	Parameter range
0	Password	<p>① It is used for avoiding parameter to be modified by mistaken. Set it to the required password and then set it when a parameter is needed to set. After adjusting, set it to 0 to ensure it not to be modified by mistaken later.</p> <p>② The password is divided into many levels to correspond to user parameter, internal parameter.</p> <p>③ Use the driver type password without other password to modify driver type parameter (No.1)</p> <p>④ The user password is 315.</p> <p>⑤ The driver type password is 385.</p> <p>⑥ Operating mode selection password is 510.</p>	0~9999
1	Driver type	<p>① It corresponds to the same series driver and motor with different power level.</p> <p>② Different driver types correspond to different parameter default. Ensure the parameter is right when recovering default parameter function.</p> <p>③ Refer to Table 4.3 for parameters significance.</p>	0~70
2	Software version	① Software version can be seen but cannot be modified.	*
3	Initial display state	② Select display state after the driver is switched on. 0: Display motor speed;	0~19

		<p>1: Display current position low order 4-bit; 2: Display current position high order 4-bit; 3: Display position instruction(instruction pulse accumulation) low order 4-bit; 4: Display position instruction high order 4-bit; 5: Display position deviation low order 4-bit; 6: Display position deviation high order 4-bit; 7: Display motor torque; 8: Display motor current; 9: Display linear speed; 10: Display control mode; 11: Display position instruction pulse frequency; 12: Display speed instruction; 13: Display torque instruction; 14: Display absolute position of rotor in one rev; 15: Display input terminal state; 16: Display output terminal state; 17: Display encoder input signal; 18: Display running state; 19: Display alarm code; 20: Reservation.</p>	
4	Control mode selection	<p>Set control mode of driver by the parameter: 0: Position control mode; 2: Trial run control mode; 3: JOG control mode; 4: Motor zero adjusting mode; 5: Motor testing mode</p>	0~5
5	Speed proportional gain	<p>① Set proportional gain of speed regulator. ② The bigger the setting value is, the higher the gain is and the bigger the rigidity is. Parameter value is defined by specific servo driver system type and load. Generally, the bigger the load inertia, the bigger the setting value is. ③ Set the bigger value if there is no vibration for system.</p>	5~300HZ
6	Speed integration time constant	<p>① Set integraltion time constant of speed loop controller. ④ The bigger the setting value is, the faster the speed integration is and the bigger the rigidity is. Parameter value is defined by specific servo driver system type and load. Generally, the bigger the load inertia, the smaller the setting value is. ② Set the bigger value if there is no vibration for system.</p>	50~3000
7	Speed regulator input limiting	The smaller the setting value is, the smoother the timing is.	1~300
8	Speed detecting	<p>① Set speed detecting lowpass filter characteristics. ② The smaller the setting value is, the lower the cutoff frequency</p>	20~200%

	lowpass filter	<p>and the smaller the noise is. Properly reduce setting value if the load inertia is large. If the setting value is too small, the response will be slow as to cause surging.</p> <p>③ The bigger the value is, the higher the cutoff frequency is and the quicker the response is. Increase properly setting value if quick response is needed.</p>	
9	Position proportional gain	<p>① Set proportional gain of position loop regulator.</p> <p>② The bigger the setting value is, the higher the gain is, the bigger the rigidity is and the smaller the position lag is in the same frequency instruction pulse. If the numerical value is too big, the surging or overshoot may occur</p> <p>③ Parameter numerical value is set according to specific servo driver and load.</p>	1~1000
10	Magnetic pole position zero deviation		0~1024
11	Speed instruction lowpass filter constant	<p>① Set the cutoff frequency of lowpass filter of position loop feedforward value.</p> <p>The filter is used for increasing the stability of complex position control.</p>	1~1200Hz
12	Position instruction pulse division frequency numerator	<p>① Set division frequency/ double frequency(electronic gear) of position instruction pulse.</p> <p>② In position control mode, set parameter No.12, No.13 to conveniently match with pulse resource to get the control resolution(i.e. angle/pulse) required by user.</p> <p>③ $P \times G = N \times C \times 4$ P: pulse amount of input instruction; G: electronic gear ratio; G=division frequency numerator / division frequency denominator N: motor rotating circles; C: photoelectric encoder lines/rev, the system C=2500</p> <p>④ 【 Example 】 when input instruction pulse is 6000, when servomotor rotation is 1: $G = \frac{N \times C \times 4}{P} = \frac{1 \times 2500 \times 4}{6000} = \frac{5}{3}$ then parameter No.12 is set to 5 and No. 13 is set to 3.</p> <p>⑤ Recommended range of electronic gear is: $\frac{1}{50} \leq G \leq 50$</p>	1~9999
13	Position instruction pulse division frequency denominator	<p>① Refer to parameter No.12</p>	1~9999

15	Position instruction pulse reverse direction	<p>① Set:</p> <p>0: normal;</p> <p>1: reverse direction of position instruction pulse.</p>	0~1
16	Positioning completed range	<p>① Set positioning complete pulse range in position control mode.</p> <p>② The parameter provides factors the driver judges whether the positioning is completed in position control. When remainder pulses in position deviation counter is less than or equal to setting value by the parameter, the driver defaults that the positioning is completed and the signal for it is COIN ON, otherwise, it is COIN OFF.</p> <p>③ Output positioning completing signal COIN in position control mode, and output speed in-position signal SCMP in other control mode.</p>	0~9999 pulse
17	Position out-of-tolerant detection range	<p>① Set the alarm range of position out-of-tolerant detection.</p> <p>② In position control mode, servo driver alarms position out-of-tolerant when the counting value of position deviation counter exceeds the parameter value.</p>	0~9999 × 100 pulse
18	Position error invalid	<p>① Set:</p> <p>0: The alarm of position out-of-tolerant detection is valid.</p> <p>1: The alarm of position out-of-tolerant detection is invalid, and stop the detection of position out-of-tolerant error.</p> <p>2: Stop the detection of all alarm errors.</p>	0~2
21	JOG running speed	Set the running speed in JOG mode.	-3000~3000 r/min
22	Current integration time constant	<p>① Set the integration time constant of current loop regulator.</p> <p>② The bigger the setting value is, the faster the integration speed is and the smaller the error of current track is. If the integration time is too long, noise or vibration may occur.</p> <p>③ It is related to the servo driver and motor and is not related to the load. Generally, the bigger the electromagnetism time constant is, the smaller the integration time constant.</p> <p>④ Set the bigger load inertia if there is no vibration for system.</p>	0~9999
23	Max. speed limit	<p>① Set max. limit speed of servomotor.</p> <p>② It is irrelevant to rotatory direction.</p> <p>③ If the setting value exceeds the rated speed, the actual max. limit speed is the rated speed.</p>	0~4000 r/min
24	Motor testing speed set	① Set motor running speed in test mode.	-3000~3000
29	Current proportional gain	<p>① Set proportional gain of current loop regulator.</p> <p>② The bigger the setting value is, the higher the gain is and the smaller the error of current track is. If the gain is too high, there is noise or vibration.</p>	0~9999

		<p>③ It is related to the servo driver and motor and is not related to the load.</p> <p>④ Set the bigger load inertia if there is no vibration for system.</p>	
33	Overload limit	<p>① Set torque initial detecting point of motor heat overloading.</p> <p>② Setting value is percent of rated torque.</p> <p>③ When the motor torque is lower than the initial detecting point, the electronic relay in the system cannot work, namely, it does not detect the motor heat overloading; when the motor torque is higher than the initial detecting point, the electronic relay starts to work, and when it exceeds its threshold, the motor heat overloading alarming will occur. The bigger the motor overloading multiple is, the shorter the alarm occurring time is. The threshold is defined by the motor electrothermal characteristics. The motor heat overloading alarm indicates the motor is overheated.</p> <p>It is set by the manufacturer and cannot be modified.</p>	0~500
34	Max. load limit	<p>① Set limit value of max. load of servomotor.</p> <p>② Setting value is the limit constant value of max. load.</p> <p>③ The limit value is valid anytime</p>	0~300%
35	Actual load capacity	<p>① Set limit value of servomotor internal torque.</p> <p>② Setting value is the rated torque constant.</p> <p>③ The limit value is valid anytime.</p> <p>If the setting value exceeds the permissive max. load capacity of the system, the actual torque limit is permissive max. load capacity of the system.</p>	-300~0%
36	Current instruction lowpass filter cutoff frequency	<p>① Set cutoff frequency of current instruction lowpass filter</p> <p>② It is used for limiting current instruction frequency band to avoid current impact and vibration and to keep current response smooth.</p>	1~1500

4.3 Type code parameter and motor

No 1 parameter	Servomotor type	Driver type	Remark
2	110STZ4-1	DA98A-08-110STZ4-1	
8	130STZ10-1	DA98A-14-130STZ5-1	
9	130STZ5-1	DA98A-10-130STZ5-1	
19	130STZ6-1	DA98A-12-130STZ6-1	
30	110ST-M02030H	DA98A-06-110ST-M02030H	
35	110ST-M04030H	DA98A-12-110ST-M04030H	

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36	110ST-M05030H	DA98A-15-110ST-M05030H	
37	110ST-M06020H	DA98A-12-110ST-M06020H	
39	130ST-M04025H	DA98A-10-130ST-M04025H	
45	130ST-M05025H	DA98A-13-130ST-M05025H	
46	130ST-M06025H	DA98A-15-130ST-M06025H	
47	130ST-M07720H	DA98A-16-130ST-M07720H	
49	130ST-M10015H	DA98A-15-130ST-M10015H	
50	130ST-M10025H	DA98A-26-130ST-M10025H	
51	130ST-M15015H	DA98A-23-130ST-M15015H	
52	130SJT-M060C	DA98A- 12-130SJT-M060C	
	130SJT-M075C	DA98A-15-130SJT-M075C	
53	4127N1824E200	DA98A-4127N1824E200	
61	130SJT-M050C	DA98A-10-130SJT-M050C	
	130SJT-M040C	DA98A-10-130SJT-M040C	
75	110SNMA2IE	DA98A-04-110SNMA2IE	
76	110SNMA4IE	DA98A-08-110SNMA4IE	
81	130SNMA4 II E	DA98A-08-130SNMA4 II E	
82	130SNMA5IE	DA98A-10-130SNMA5IE	
84	130SNMA6 II E	DA98A-12-130SNMA6 II E	
85	130SNMA7.5IE	DA98A-15-130SNMA7.5IE	
86	130SNMA10IE	DA98A-15-130SNMA10IE	
87	130SNMA15IE	DA98A-23-130SNMA15IE	

Alarm and troubleshooting

 **Note**

- Only qualified persons can execute check and maintenance.
- Do not touch the driver and motor in 5 minutes after they are switched off to avoid electric shock and burn.
- Firstly remove of malfunction according to alarm code after the driver alarms and then use it.
- Confirm SON(the servo is valid)signal is invalid to avoid the unexpected accident owing to start suddently the motor before resetting alarm.

5.1 Alarm list

Table 5.1 Alarm list

Alarm code	Alarm name	Content
--	Normal	
1	Overspeed	The servomotor speed exceeds its setting value.
2	Main circuit is overvoltage.	Power voltage of main circuit is too high.
3	Main circuit is undervoltage.	Power voltage of main circuit is too low.
4	Position is out-of-toleration.	Numerical value of position deviation counter exceeds its setting value.
5	The motor is overheated.	Motor temperature is too high.
8	The position deviation counter overflows.	Absolute value of position deviation counter exceeds 2^{30}
9	Encoder fault	Encoder signal error
10	The control power supply is undervoltage.	Control power supply $\pm 15V$ is too low
11	IPM module fault	IPM intellegent module fault
13	Overload	The servo driver and motor are overloaded (instantaneous overheating).
14	Brake fault.	Brake circuit fault
21	IC2(EPLD core) error	IC2(EPLD core) error
24	The current collection circuit fault	
31	Encoder pulse in Z direction is lost.	Encoder pulse in Z dirction is error.

5.2 Alarm troubleshootings

Table 5.2 Alarm troubleshootings

Alarm code	Alarm name	Running state	Cause	Troubleshooting
1	Overspeed	Connect with control power supply	<ul style="list-style-type: none"> ① Control circuit board fault ② Encoder fault 	<ul style="list-style-type: none"> ① Change servo driver ② Change servomotor
		Motor is running	① The input instruction pulse frequency is overhigh	① Set correctly the input instruction pulse.
			① Acceleration/deceleration time constant is too small to cause the overshoot is too big.	① Increase acceleration, deceleration time constant.
			① The input electronic gear ratio is too big.	① Set correctly.
			① Encoder fault	① Change the servo driver.
			① Encoder cable is inferior.	① Change the encoder cable.
			① Servo system is not stable to cause the overshooting.	<ul style="list-style-type: none"> ① Set the related gain again. ② If the gain can not be set to proper value, reduce inertia ratio of load rotation.
		Motor is started	① The load inertia is too big.	<ul style="list-style-type: none"> ① Reduce load inertia. ② Change driver and motor with big power.
			① Encode zero fault	<ul style="list-style-type: none"> ① Change servomotor. ② Adjust encoder zero by the manufacturer.
			<ul style="list-style-type: none"> ① Motor lead wire U, V, W is not connected correctly. ② Cable lead wire of encoder is not connected correctly. 	① Connect wire correctly.
2	Main circuit is excess voltage	Connect with control power supply	① The circuit board fault	① Change servo driver.
		Connect with main power supply	<ul style="list-style-type: none"> ① Power voltage is too high. ② Waveform of power voltage is normal. 	① Check power supply

		Motor is running	① Brake resistance connection is switched off.	① Connect it again.
			① Brake transistor is damaged. ② Internal brake resistance is damaged.	① Change servo driver.
			① Capacity of brake loop is not enough.	① Reduce on-off frequency. ② Increase acceleration/ deceleration time constant. ③ Reduce torque limit value. ④ Reduce load inertia. ⑤ Change it with driver and motor with big power.
3	Main circuit is short of voltage	Connect with main power supply	① Circuit board fault ② Fuse of power supply is damaged. ③ Soft starting circuit fault ④ Rectifier is damaged.	① Change servo driver
			① Power voltage is low. ② Temporary power cut is more than 20mS.	① Check power supply.
		Motor is running	① Power capacity is not enough. ② Instantaneous power down	① Check power supply.
			① Radiator is overheated.	① Check loading.
4	Position is out-of-tolerance.	Connect with control power supply	① Circuit board fault	① Change the servo driver.
		Connecting with main power supply and control circuit, inputting instruction pulse and the motor doesn't rotate	① Motor lead wire U, V, W is not connected correctly. ② Cable lead wire of encoder is not connected correctly.	① Connect the wire correctly.
			① Encoder fault	① Change the servo driver.
		Motor is running	① The position out-of-tolerance detecting setting range is too small.	① Increase the detecting range.
			① The position proportional gain is too small.	① Increase the gain.
① Torque is not enough..	① Check the torque limit value. ② Reduce the load capacity.. ③ Change it with driver and motor with big power.			
		① Instruction pulse frequency is too high.	① Reduce the frequency.	
5	Motor is	Connect with	① Circuit board fault	① Change the servo driver.

	overheated	control power supply	<ul style="list-style-type: none"> ① Cable is broken. ② Internal temperature relay of motor is damaged. 	<ul style="list-style-type: none"> ① Check the cable. ② Check the motor.
		Motor is running	<ul style="list-style-type: none"> ① Motor is overloaded. 	<ul style="list-style-type: none"> ① Reduce the load. ② Reduce the on-off frequency. ③ Reduce the torque limit value. ④ Reduce the related gain. ⑤ Change it with driver and motor with bigger power.
			<ul style="list-style-type: none"> ① Motor internal fault 	<ul style="list-style-type: none"> ① Change the servo motor.
			<ul style="list-style-type: none"> ① Load is too big. 	<ul style="list-style-type: none"> ① Reduce the load. ② Change it with a driver and motor with bigger power.
8	Position Out-of-toleration counter overflow		<ul style="list-style-type: none"> ① Motor is blocked to stop by machine. ② Input instruction pulse is abnormal. 	<ul style="list-style-type: none"> ① Check the load of machine. ② Check the instruction pulse. ③ Check whether the motor rotates according to instruction pulse.
9	Encoder is fault		<ul style="list-style-type: none"> ① Encoder connection is wrong. 	<ul style="list-style-type: none"> ① Check the connection.
			<ul style="list-style-type: none"> ① Encoder is damaged. 	<ul style="list-style-type: none"> ① Change the motor.
			<ul style="list-style-type: none"> ① Encoder cable is inferior effect. 	<ul style="list-style-type: none"> ① Change the cable.
			<ul style="list-style-type: none"> ① Encoder cable is too long to cause the encoder voltage is too low. 	<ul style="list-style-type: none"> ① Shorten the cable. ② Employ with multi-core parallel power-up.
10	Control power supply is undervoltage		<ul style="list-style-type: none"> ① Input control power supply is low. 	<ul style="list-style-type: none"> ① Check the control power supply.
			<ul style="list-style-type: none"> ① Internal connector assembly of driver is inferior. ② Switch power supply is abnormal. ③ Core is damaged. 	<ul style="list-style-type: none"> ① Change the driver. ② Check the connector assembly. ③ Check the switch power supply.
11	IPM module is fault	Connect with control power supply	<ul style="list-style-type: none"> ① Circuit board is fault 	<ul style="list-style-type: none"> ① Change the servo driver.

		Motor is running	① Power-up voltage is too low. ② Overheated.	① Check the driver. ② Power on again. ③ Change the driver.
			① Driver U, V, W are short circuit.	① Check the connection.
			① Ground is inferior.	① Be grounded correctly.
			① Motor insulation is damaged.	① Change the motor.
			① It is interfered.	① Increase the circuit filter. ② Be far away from the interference source.
13	Overload	Connect with control power supply	① Circuit board is fault.	① Change the servo driver.
		Motor is running	① Running exceeds rated torque to run.	① Check the load. ② Reduce the on-off frequency. ③ Reduce the torque limit value. Change with a driver and motor with bigger power.
			① Hold brake is not switched on.	① Check the hold brake.
			① Motor vibrates unstably.	① Regulate the gain. Increase the acceleration/ deceleration time. ② Reduce the load inertia.
			① One of U, V, W is switched off. ② The connection of encoder is mistaken.	① Check the connection.
14	Brake fault	Connect with control power supply	① Circuit board is fault.	① Change the servo driver.
		Motor is running	① Brake resistance connection is switched off.	① Connect the wire again.
			① Brake transistor is damaged. ② Internal brake resistance is damaged.	① Change the driver.

			① Brake loop capacity is not enough.	① Reduce the on-off frequency. ② Increase the acceleration/ deceleration time constant. ③ Reduce the torque limit value. ④ Reduce the load inertia. Change with a driver and a motor with bigger power.
			① Main circuit power supply is too high.	① Check the main power supply.
			① Parameter setting is wrong.	① Set correctly the related parameter.
		Motor is running	① Long-term rated torque runs.	① Check the load. ② Reduce the on-off frequency. ③ Reduce the torque limit value. ④ Change with a driver and a motor with bigger power.
			① Machine transmission is inferior.	① Check the mechanical device .
21	IC2(EPLD core) error		① Core or circuit board is damaged.	① Change the servo driver.
24	Current collection circuit is fault		① Core or circuit board is damaged.	① Change the servo driver.
31	Z-axis pulse of encoder is lost		① There is no pulse in Z direction and the encoder is damaged. ② Cable is inferior. ③ Cable shield is inferior. ④ Shield ground wire is not connected well. ⑤ Encoder interface circuit is fault.	① Change the encoder ② Check the interface circuit of encoder.

Display and operation

6.1 Keyboard operation

- The driver panel consists of 6 LED digital display and 4 keys \uparrow , \downarrow , \leftarrow , Enter , used for displaying various system status and setting parameters etc. And the functions for keys are as followings:

\uparrow : sequence number, numerical number increment or forwarding selection

\downarrow : sequence number, numerical number decrease or backward selection

\leftarrow : back to upper operation menu or cancellation of operation

Enter : enter into next operation menu or confirmation of operation

Note: holding press \uparrow , \downarrow at the same time, the operation is executed repetitively, the longer the holding time is, and the faster the repetitive operation speed is.

- The 6-bit digital LED can display various status and data of system, flashing of all digital tubes or the decimal point of rightmost digital tube means alarm.
- Performance is executed by multilayer operating menus. The first layer is main menu that includes 8 operating modes and the second is the functional menu of each operating mode. Fig.6.1 is operating frame of main menu:

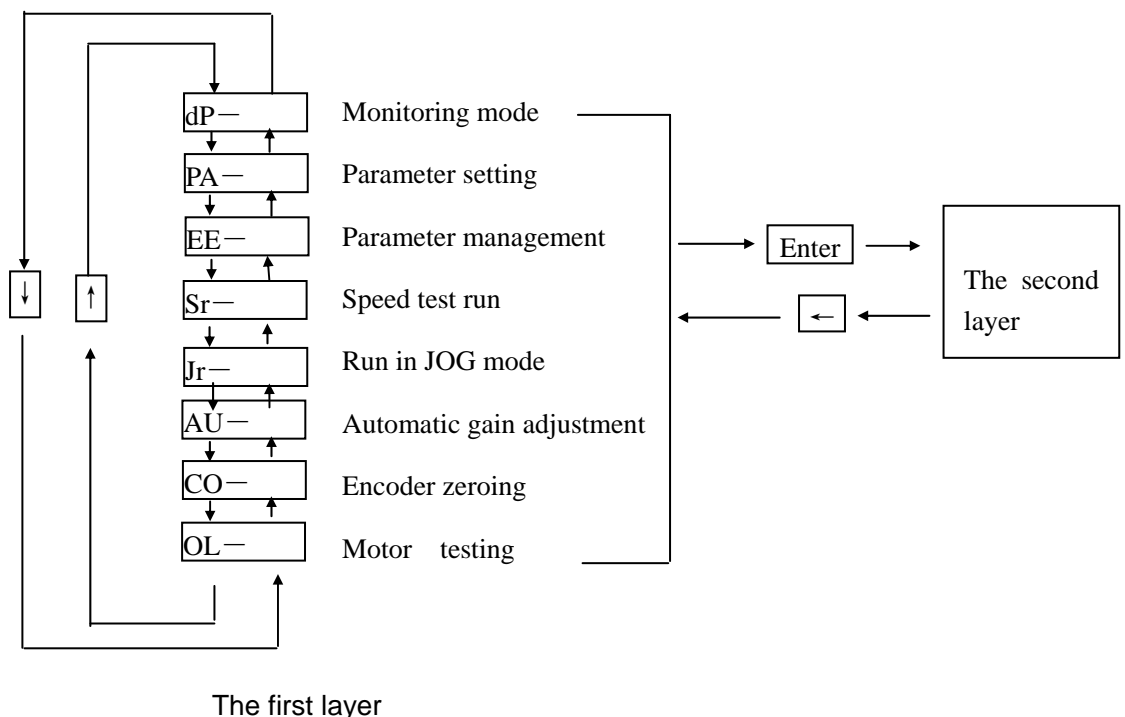


Fig. 6.1 Operating frame of mode selection

6.2. Monitoring mode

Select “dP-” in the first layer and press Enter to enter into monitoring mode which includes 21 display modes. Select the desired display mode by \uparrow , \downarrow keys, then press Enter to enter into specific

display mode.



Fig. 6.2 Operating frame of monitoring mode

Note 1: Position pulse and instruction pulse value are the magnified ones after inputting the electronic gear.

Note 2: Pulse unit is the internal pulse one that is 10,000 pulse/rev in this system. The magnitude for pulse is described by high 4-bit plus low 4-bit and the calculation method is as follows:

$$\text{Pulse} = \text{high 4-bit numerical value} \times 10,000 + \text{low 4-bit numerical value}$$

Note 3: Control mode: 0-position control; 1-speed control; 2-speed trial run; 3- run in JOG mode; 4-encoder zeroing; 5-motor testing.

Note 4: Pulse frequency of position instruction is the actual one before inputting the electronic gear and its min. unit is 0.1 kHz, with positive number for positive direction and negative number for negative direction.

Note 5: Calculation method of motor current I is as follows:

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

Note 6: The absolute position of rotor in a rev means the relative one opposite to stator, one rev is one loop, and its range is 0~9999.

Note 7: Input terminals is as Fig.6.3, output terminals is as Fig.6.4, encoder signal displaying is as Fig.6.5.

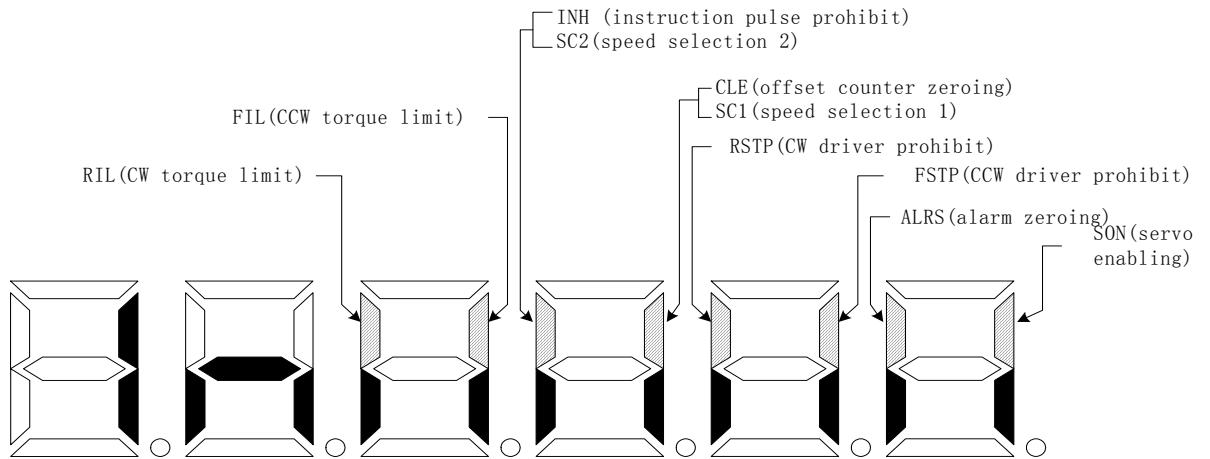


Fig. 6.3 Input terminal display (light is ON and poor light is OFF)

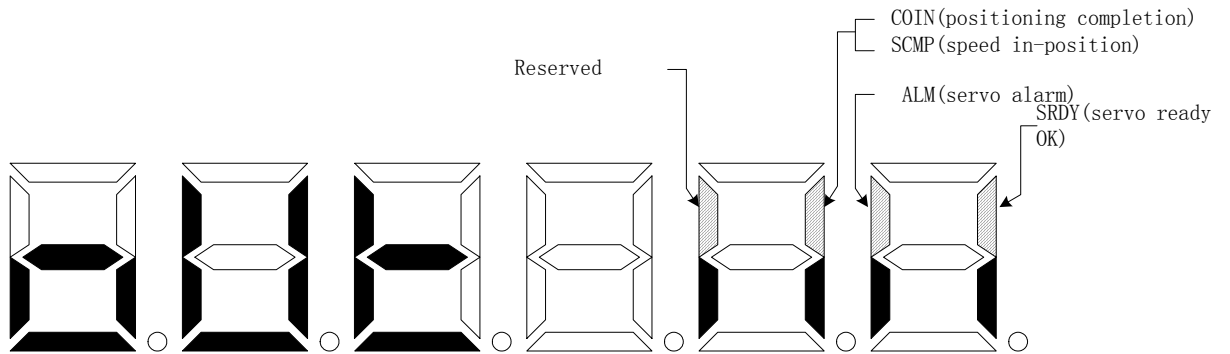
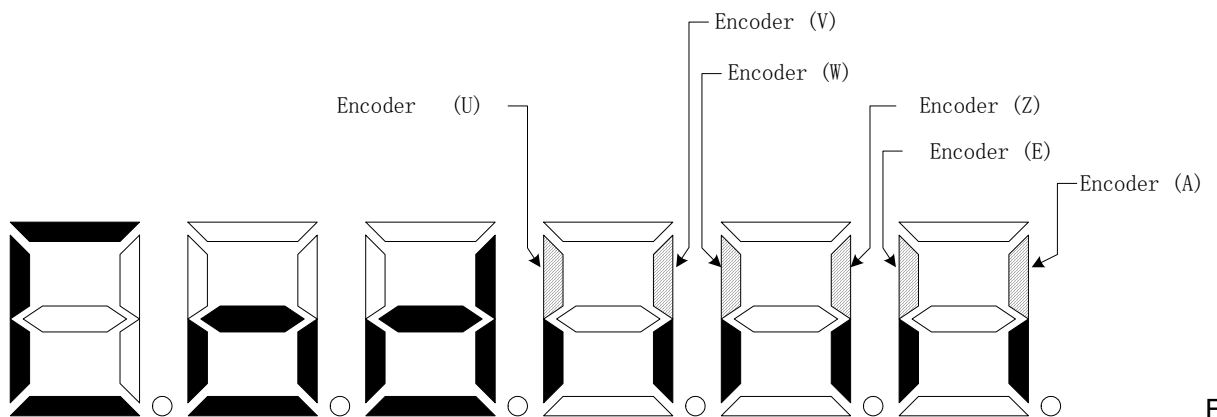


Fig. 6.4 Output terminal display (light is ON and poor light is OFF)



ig. 6.5 Encoder signal displaying (light is ON and poor light is OFF)

Note 1: Runnig state:

“cn- oFF”: the main circuit has not charged and the servo system does not run;

“cn- CH”: the main circuit has been charged and the servo system does not run(the servo has no enabling and an alarm occurs);

“cn- on”: the main circuit has been charged and the servo system runs anormally;

Note 2: “Err --” for alarm means the system is normal and no alarm occurs.

6.3 Parameter setting

Note

- Other parameters can be modified after parameter 0 is set to its corresponding numerical value.
- Setting of parameters effects immediately and false setting may result in false run to occur accidents.

Select “PA-” in the first layer and press **Enter** to enter into parameter setting mode. Select parameter number by **↑**, **↓**, then press **Enter** to display the value of that parameter , modify the value by **↑**, **↓**. Press **↑** or **↓** key for once to increase or decrease 1 for the parameter value, press and hold on **↑**, **↓** 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 **Enter** to confirm the modification, and then the decimal point of rightmost LED digital tube is put out. And the modified value will immediately respond to the control process, press **↑**, **↓** to go on modify parameters till the completion of modification, then press **←** to back to parameter selection. Do not press **Enter** to confirm if the parameters modified are not proper, press **←** to cancel it to make the parameters recover to their previous value and back to the parameter selection.

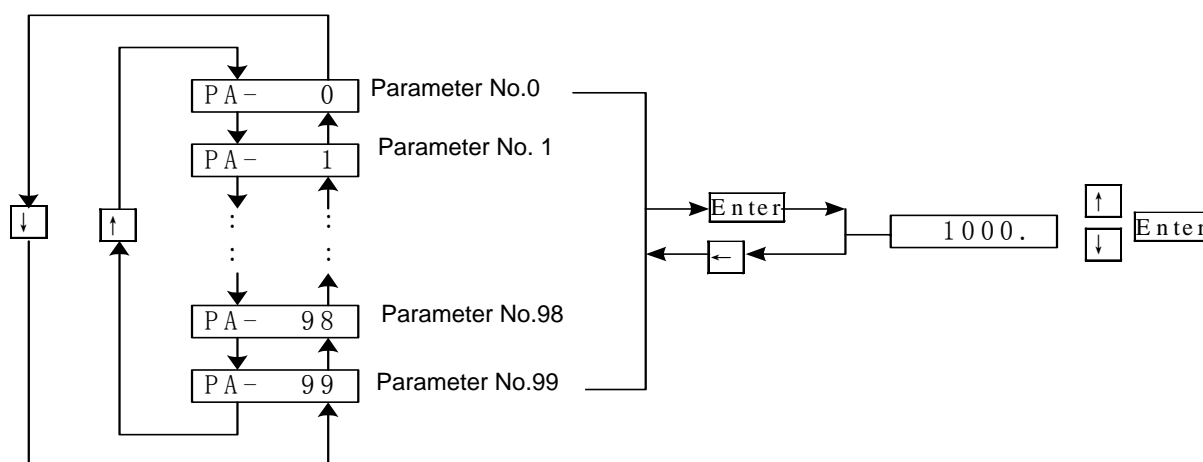


Fig. 6.6 Operating frame of parameter setting

6.4 Parameter management



Modified parameters which are not executed the read operation are not saved and valid after power off.

The parameters management mainly processes memory and EEPROM option. Select “EE-” in the first layer and press **Enter** to enter into parameter management mode. Firstly select the selection mode that has 5 modes by **↑**, **↓**. For example, for “ parameter access ”, select “EE-Set”, then press **Enter** and hold it on for over 3 seconds, the CRT displays “StArt” that means the parameters are being reading into EEPROM. After 1~2 seconds, the CRT displays “FlNISH” if the reading is succeeded, otherwise “Error” is displayed. Press **←** again to return to selection mode.

- **EE—Set:** parameter writing. It means to write the parameters in the memory into EEPROM parameter zone. The parameters modified by user only change the parameter values in the memory that they will recover to their previous values after power on again. If the parameter values are changed permanently, parameter writing operation is executed, and the parameters in the memory are written into the EEPROM parameter zone so the modified parameter values are valid after power on again.
- **EE—rd:** parameter reading. It means to read the data in EEPROM parameter zone into the memory. The process will be executed automatically when power on. At the beginning, the parameters in the memory are the same as that of EEPROM parameter zone. If the parameters are modified by user, the parameter values in the memory will change. If the user is not satisfied with the modified parameter values or the parameters are disordered, the parameter reading operation is executed to read data in EEPROM parameter zone into the memory to recover the previous parameters which are in the state of power on.
- **EE—bA:** parameters backup. It means to write the parameter in the memory into EEPROM backup zone. The whole EEPROM zone consists of parameter zone and backup zone that can store two sets of parameter. EEPROM parameter zone is used for power on, parameter writing and reading, and EEPROM backup zone for parameter backup and backup recovering. If user is satisfied with one set of parameters with further modification, he can save the memory parameters into the EEPROM backup zone by executing the parameter backup operation in advance, then modify the parameters. If the result is not satisfied, recover the backup to read the parameters which are saved in EEPROM backup zone last time into the memory for further modification or completion. Besides, after the user set parameters, execute the reading and backup to ensure data in EEPROM parameter and backup zero are the same to avoid parameter to be modified by mistaken, and also use the recovering backup operation to read the data in EEPROM backup zone into the memory and write operations by parameters, and write parameter in the memory into EEPROM parameter zone.
- **EE—rS:** recovering copy. It means to read the data in EEPROM backup zone into the memory,

which does not execute the parameter writing and reading the data in EEPROM parameter zone into the memory when power on again. If the user permanently uses parameter in EEPROM backup zone, execute the parameter writing operation again.

- **EE-dEF**: recovering default value. It means to read all default values of parameters into memory and write them into EEPROM parameter zone that it will be used when power on again. Execute the above operation to recover all parameter to their original before delivery if the user adjusts parameter by mistaken to cause the system cannot run normally. Because the different driver type corresponds to different parameter default value, ensure the driver type is right (parameter No.1) when using the recovering default parameters.

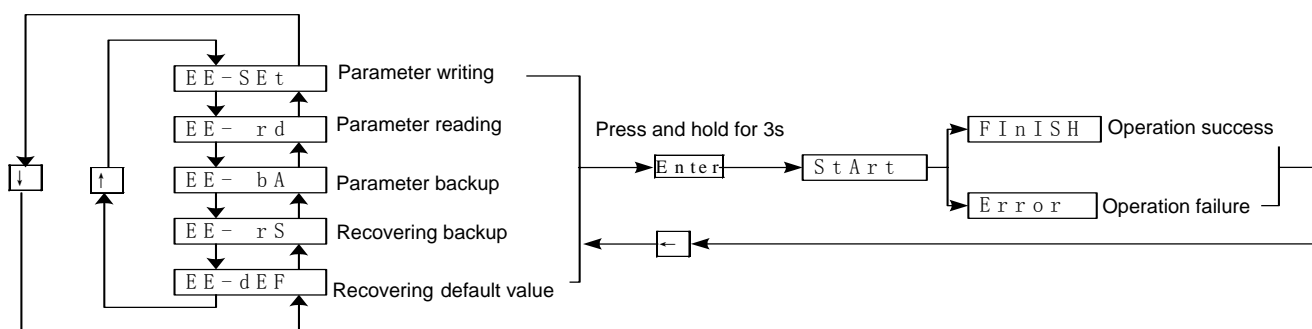


Fig. 6.7 Operating frame of parameter management

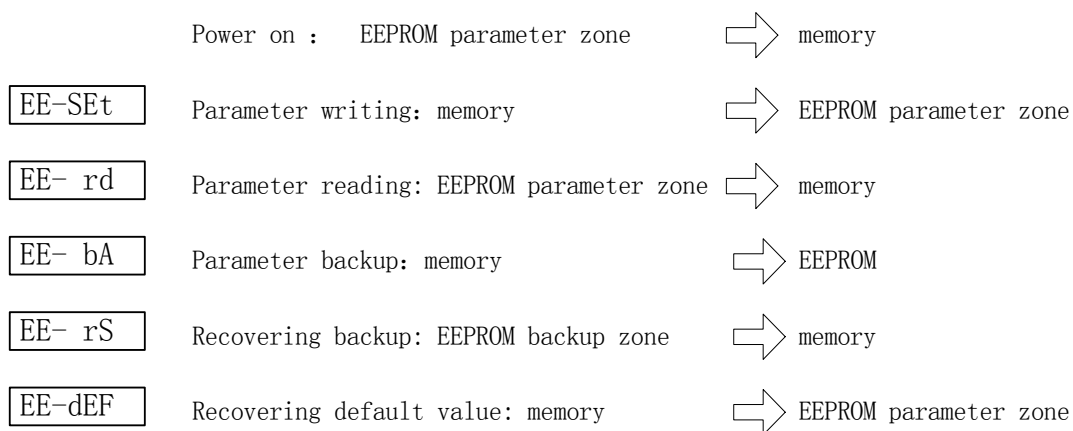


Fig. 6.8 Operating meaning of parameter management

⚠ Note

- Execute the speed trial run or run in JOG mode when there is no load for motor to avoid the unexpected accident.
- The driver SON(servo enabling) must be valid in trial run.

6.5 Speed trial run

Select "Sr-" in the first layer and press to enter into the trial run mode. The prompt identifier "J" and the unit is r/min. The system is in speed control mode and speed instructions are changed by , , and the motor runs as the specified speed. Press to increase speed and press to decrease speed. The motor rotates clockwise when the display speed is positive, and vice versa.

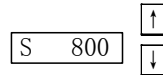


Fig. 6.9 Operating frame of speed trial run

6.6 JOG run

Select "Jr-" in the first layer and press Enter key to enter into JOG run. The prompt identifier "J" and the unit is r/min. The system is in speed control mode and its speed instructions are changed by keys. After entering into JOG mode, press and hold to make motor run in JOG mode, release the key to make motor stop with 0; press and hold it to make motor run counterclockwise in JOG mode, and release the key to make motor stop with the speed of 0. The speed in JOG mode is set by No.21.

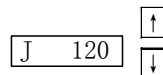


Fig. 6.10 Operating frame in JOG mode

6.7 Motor testing

Select "oL-" in the first layer and press Enter to enter into motor testing mode. The prompt identifier "J" and the unit is r/min. The system is in speed control mode with position limit value 268,435,456 pulses and its speed is set by No.24. After entering into motor testing mode, press Enter and hold it for 2s to make motor run in testing mode, Press and hold it for 2s to make motor stop with the speed of 0. Press to switch off servo enabling to exit motor testing mode.

6.8 Miscellaneous

It is not available for the automatic gain adjustment which is being developed.

The encoder zeroing is executed when the motor runs without load, otherwise it will affect the zero precision.

Run

Note

- The driver and the motor must be grounded, and PE terminal of driver must be connected with the terminal of grounding device.
- The power supply of driver is provided through isolation transformer and power supply filter to get better safety and anti-interference ability.
- The power supply is switched on after wiring is correctly completed.
- Connect with an emergent stop circuit to make the power supply stop immediately when there is fault. (Refer to Fig. 7.1).
- After the driver alarms, it should be insured that the fault has been resolved and SON signal is invalid before startup again.
- Cannot touch them in at least 5 minutes to avoid electric shock after the driver and motor are cut off.
- Prevent from being burned because the temperature will rise after the driver and motor run for a period of time.

7.1 Power supply connection

Refer to Fig. 7.1 about power supply connection as follows:

- 1) Connect the power supply with input terminal (three-phase power supply connects with R, S, T and single phase connects with R,S) of main circuit power supply by electromagnetism contactor.
- 2) Power supply r, t of control circuit and main circuit power supply are switched on simultaneously or the former is prior to the latter. If only power supply of control circuit is switched on, the servo ready signal (SRDY) is OFF.
- 3) The main circuit power supply is switched on and delays 1.5s, and the servo ready signal (SRDY) is ON, the servo can receive the servo enabling signal (SON) and detect it to be valid, the driver output is valid and the motor runs. When the servo enabling is invalid or alarms, the base electrode circuit is switched off and the motor is in free state.
- 4) The base electrode circuit is switched on after 1.5s when the servo enabling and the power supply are switched on together.
- 5) If the power supply is switched off or on frequently, the soft start circuit and the energy consumption brake circuit is damaged. Frequency of on-off should be less than 5 times in one hour and 30 times less each day. Owing to the overheating of the driver and the motor, the power supply is switched on only after the fault is resolved and waiting for 30 minutes to cool it down.

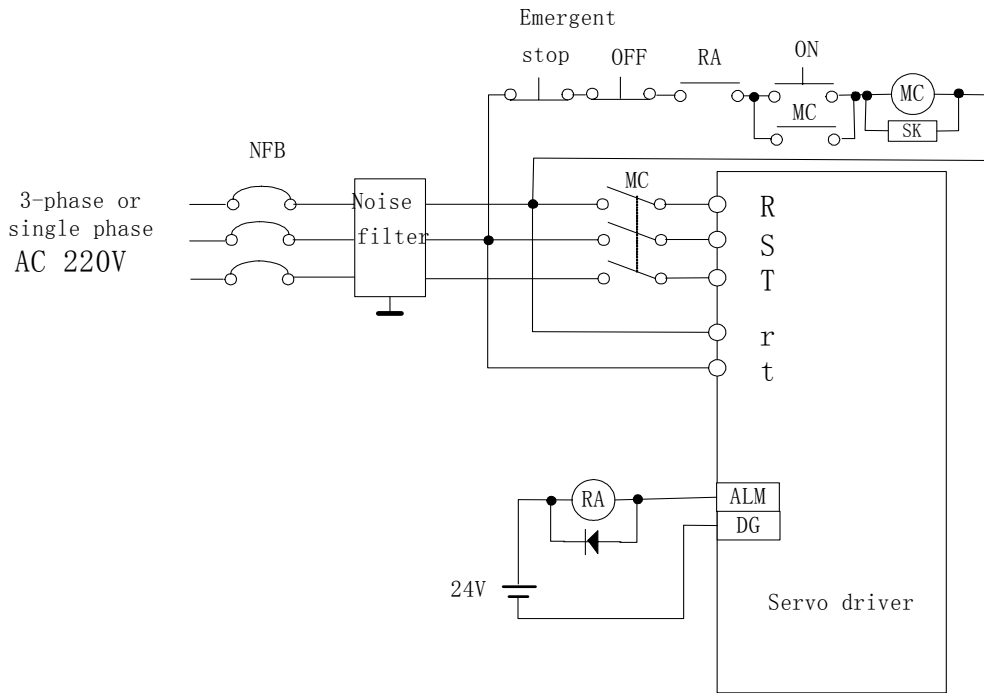


Fig. 7.1 Power supply connection diagram

Time sequence of power supply switching on and alarming:

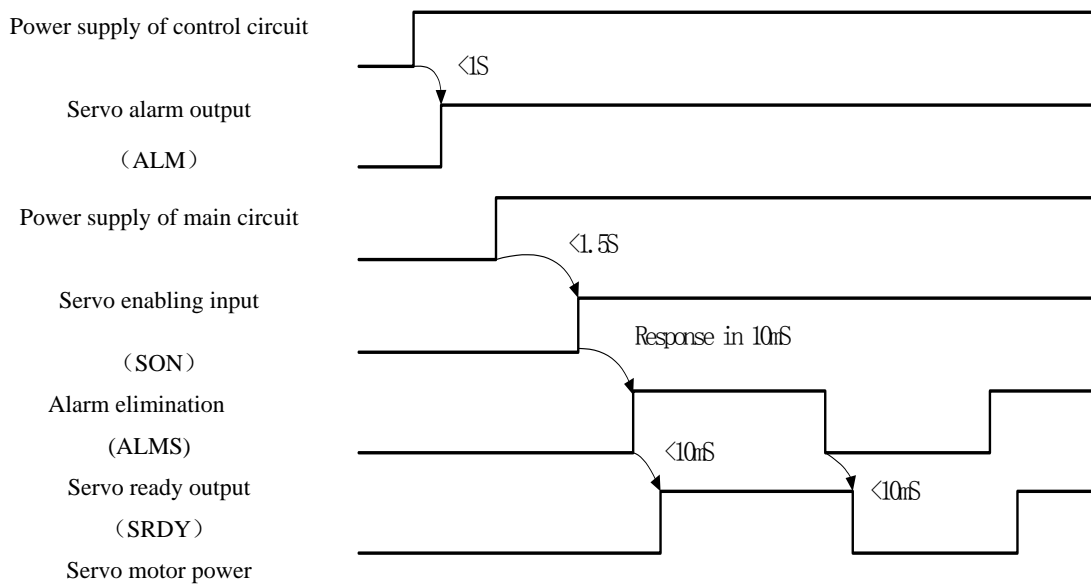


Fig. 7.2 Time sequence of power supply connection

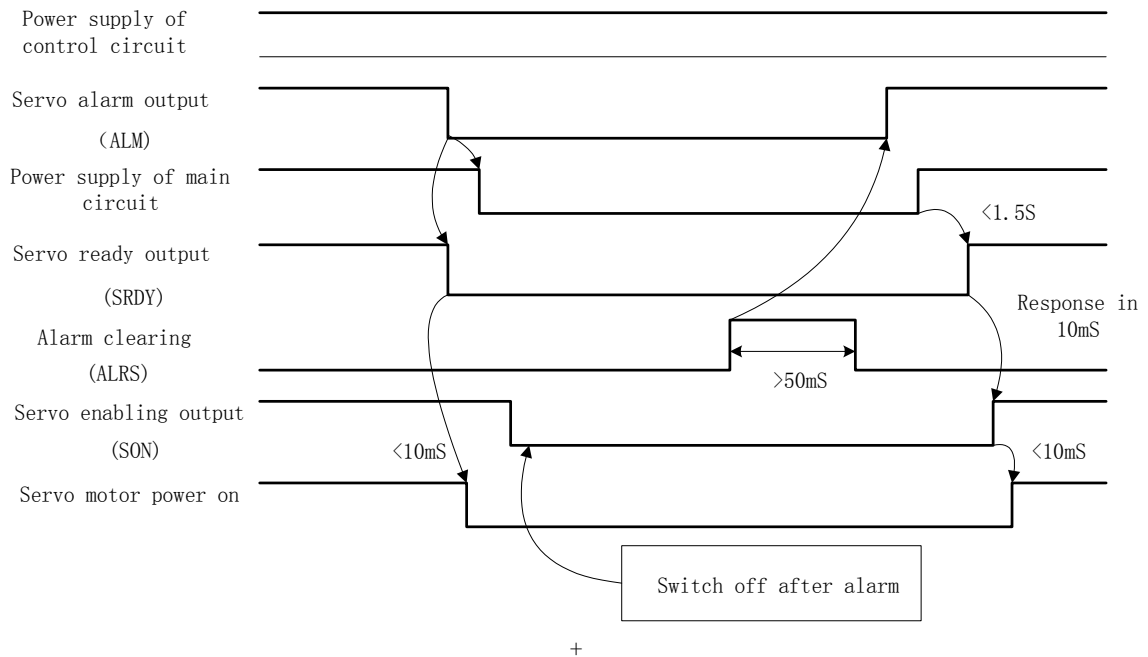


Fig. 7.3 Time sequence of alarm

7.2 Trial run

1) Check before running

After installation and wiring, check the following items before power on:

- Ensure the TB connection of power supply and the reliable input voltage is correct.
- Whether the power line and the motor line are short circuit or grounded.
- Ensure the connection of encoder cable is correct.
- Ensure the connection of control signal terminal, the power supply polarity, and its voltage and current are correct.
- Ensure the driver and motor are fixed.
- Whether the motor shaft is loaded.

2) Trial run after power on

A: Trial run

- (1) Connect with CN1 to input controlling signals: when the servo enabling (SON) is OFF, connect with the power supply of control circuit (no connection for master circuit), the display of driver is ON, and check the connection if the alarm occurs.
- (2) Set the control mode selection (parameter No.4) to the speed trial run (set to 2).
- (3) Connect with the power supply of main circuit.
- (4) When the alarm does not occur and there is no abnormality, ensure the servo enabling (SON) is ON, at the moment, the motor is powered with the speed of 0.
- (5) Enter into the speed trial run by pressing key, the prompt identifier is "S", and the unit is r/min. When the system is in the speed control mode, the speed instructions is changed by pressing \uparrow \downarrow keys, and the motor runs as the specified speed.

B: JOG run

- (1) Connect with CN1 to input controlling signal: the servo enabling (SON) is OFF.
- (2) Connect with the power supply of control circuit(no connection for master circuit), the display of driver is ON, and check the connection if the alarm occurs.
- (3) Set the control mode selection (parameter No.4) to JOG run (set to 3).
- (4) Connect with the power supply of main circuit.
- (5) When the alarm does not occur and there is no abnormality, ensure the servo enabling (SON) is ON, at the moment, the motor is powered with the speed of 0.
- (6) Enter into JOG mode by pressing key. The prompt identifier is "S" and the unit is r/min. When the system is in the speed control mode, the speed and the direction are defined by No.21. The motor runs as the speed and the direction specified by No.21 by pressing ↑ and runs counterclockwise as the specified speed and direction by pressing ↓ .

C: Position mode run

- (1) Connect with CN1 to input controlling signal: the servo enabling (SON) is OFF.
- (2) Connect with the power supply of control circuit (no connection for master circuit), the display of driver is ON, and check the connection if the alarm occurs.
- (3) Set the control mode (parameter No.4) to the position run (set to 0). According to output signal mode of controller, set parameter No.14 and proper electronic gear ratio (No.12, No.13) .
- (4) Connect the power supply of main circuit.
- (5) When the alarm does not occur and there is no abnormality, ensure the servo enabling (SON) is ON, at the moment, the motor is powered with the speed of 0.
- (6) Output signal of the position controller to CN1-6, 18, 7, 19 of the driver to run the motor as requirements of instructions.

7.3 Adjustment

Note

- Ensure parameters are correct before starting to avoid equipment damaged and unexpected accident caused by mistaken parameter setting.
- Adjust the system in dry run mode before the loading adjustment.

1) Basic gain adjustment

- (1) [Speed proportional gain] (parameter No.5) setting value should be big as far as possible without vibration. Generally, the bigger the load inertia is, the bigger the setting value< speed proportional gain> is.
- (2) [Speed integration time constant] (parameter No.6) setting value should be set big as far as possible. If it is too big, the responding speed will be quick but the vibration will occur. The setting value should be set as far as possible without vibration. If it is set too big, the speed will be great changed when the load is changed. Generally, the bigger the load inertia is, the smaller the setting value is.
- (3) [Position propotion gain] (parameter No.9) setting value should be big as far as possible in a stable range. If it is too big, the track characteristic of position instruction is good and the lag error is small, but there will be vibration when stopping positioning.

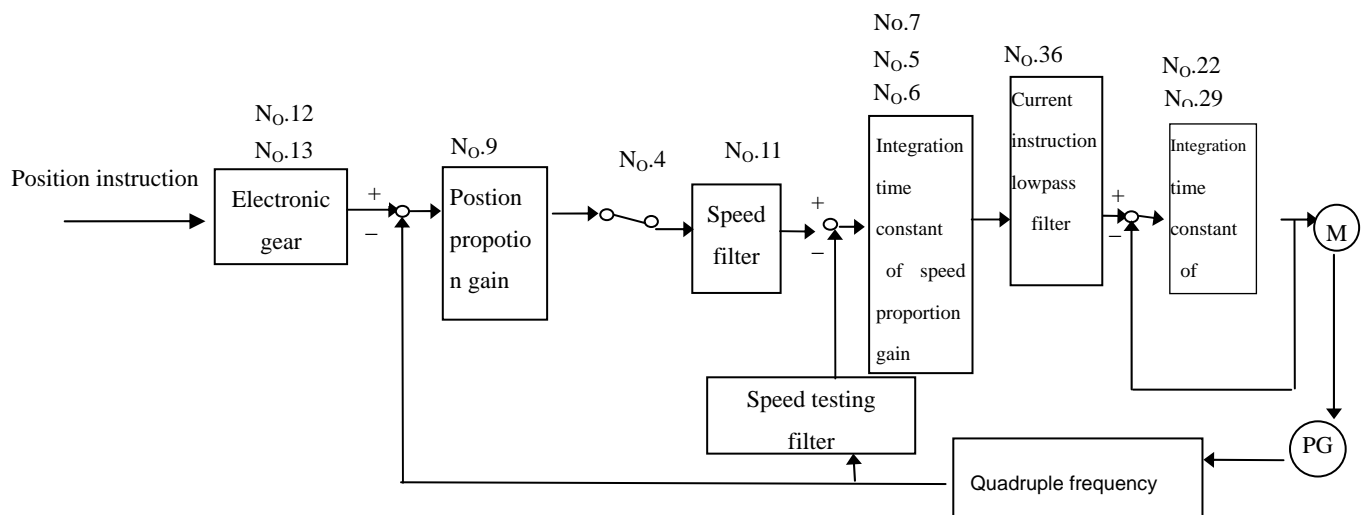
(4) If the high characteristics of position track are required, increase the setting value <position feedforward gain>. But it is too big, it causes the overshoot.

Note1: when [position proportion gain] setting value is small, the system is stable, but characteristic of position track is bad and the lag error is big. To use the high setting value [position proportion gain], reduce the setting value [speed instruction filter time constant](parameter No.11) to avoid the overshoot.

Note 2: Refer to [position proportional gain] setting values as follows:

Rigidity	[position proportion gain]
Low rigidity	58~118
Middle rigidity	118~138
High rigidity	138~198

(2) Adjustment frame of basic parameters



No.8
Fig. 7.4 Adjustment frame of basic parameters

2) Setting of position resolution and electronic gear

The position resolution (one pulse travel Δl) defines the travel ΔS of the servomotor per rev and feedback pulse P_t of encoder per rev and their relation is as follows:

$$\Delta l = \frac{\Delta S}{P_t}$$

Δl : travel per pulse (mm);

ΔS : travel of servomotor per rev (mm/rev);

P_t : feedback pluses of encoder per rev (pulse/rev) .

Because there is quadruple circuit in the system, $P_t=4 \times C$ and C is lines of encoder per rev. In the system, $C=2500$ lines/rev and $P_t=10000$ pulse/rev.

The instruction pulse multiplying the electronic gear ratio G equals the position control pulse , so one instruction pulse travel Δl^* is represented as follows:

$$\Delta I^* = \frac{\Delta S}{Pt} \times G$$

G=instruction pulse frequency division numerator/ instruction pulse frequency division dominator.

Specification



Note

The servo driver must be properly matched with servomotor. The described servomotor in the manual is from GSK SJT series, STAR series of Huazhong University of Science and Technology. Please remark in your order if you choose others.

8.1 Driver specification

Table 8.1 Servo driver specification

Output power (KW)	0.4~0.8		1.0~1.5	1.7~2.3
Motor rated torque (Nm)	2~4		4~10	6~15
Input power supply	Singel phase or three-pahse AC220V -15~+10% 50/60Hz		three-pahse 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 Position control ③ speed trial run ④ run in JOG mode ⑤ motor testing			
Regenerative brake	Built-in			
Control characteristics	Speed frequency response: 200Hz or more			
	Speed fluctuation rate: $\lt; \pm 0.03$ (load 0~100%); $\lt; \pm 0.02$ (power supply -15~+10%) (numerical value corresponding to rated speed)			
	Timing ratio: 1:5000			
	Pulse frequency: $\leq 500\text{kHz}$			
Control input	Servo enabling			
Control output	① Servo ready output ② servo alarm output ③ positioning completing output/speed in-position output			
Position control	Input mode	① pulse+ symbol ② CCU pulse /CW pulse		
	Electronic gear ratio	1~9999/1~9999		
	Feedback pulse	10000 pulse/rev		
Speed control	4 kinds of internal speed			
Acceleration function	Parameter setting acceleration time 1~10000mS (0r/min ↔ 1000r/min)			
Monitor function	Speed, current position, instruction pulse accumulation, position deviation, motor torque, motor current, linear speed, rotor absolute position, instruction pulse frequency, running state, input/output terminal signal and so on			
Protection function	Overspeed, overvoltage/undervoltage of main power supply, overcurrent, overload, brake abnormality, encoder abnormality, control power supply abnormality, position out-of-toleration			
Display, operation	6-bit LED numerical indicator tube, 4 keys			

Load inertia	Less than 5 times of motor inertia	
Weight	2.67Kg	3.48Kg
Dimension	244×163×92mm (Refer to outline)	244×163×112mm

8.2 Servomotor specification

- 1) Introduction
- 2) Characteristics of GSK SJT three-phase AC permanent magnetism synchronous servomotor series are as follows:
 - ✓ Latest model rare earth material, big output power.
 - ✓ Perfect low speed , timing ratio>1:10000.
 - ✓ High dielectric strength and insulation resistance to ensure safety.
 - ✓ Strong overload ability, instantaneous torque reaching 8 times of rated one.

3) Terminal

(1) SJT series motor wind

Motor U, V, W and chassis earth are led out by 4-core connector assembly, and their corresponding relation is as Table 1. U, V, W and chassis earth respectively connects with U, V, W, PE of driver main circuit.

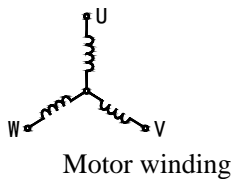
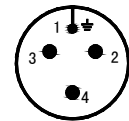


Table 8.2 motor connection

Motor lead wire	U	V	W	Chassis earth
Socket serial number	2	3	4	1



Plug (welding)
Sketch map

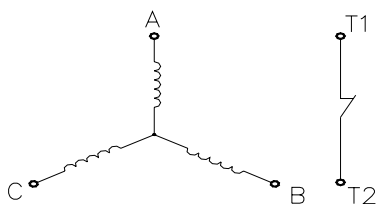
photoelectric encoder lead wire is led out by one 15-core connector assembly shown in Table 2. The lead wire is connected to the plug of driver feedback signal CN2 as requirement of driver.

Table 8.3 Encoder connection

Encoder lead wire	Chassis earth	V _{CC}	GND	A	A'	B	B'	Z
Socket serial number	1	2	3	4	7	5	8	6
Encoder lead wire	Z	U	U	V	V	W	W	
Socket serial number	9	10	13	11	14	12	15	

(2) STZ series motor wind

Motor wind method is as follows:



Encoder terminal

A, B, C are lead terminals of wind: T1, T2 are ones (normally-closed contact of temperature protector). Lead method: P type 7-core socket.

Table 8.4 motor connection

Pin	1	2	3	7	5	6
Sign	PE	A	B	C	T1	T2

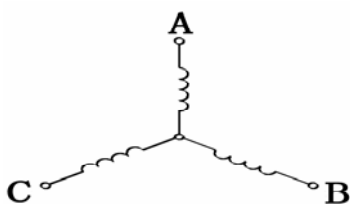
Lead method of photoelectric encoder: P type 19-core socket.

Table 8.5 Encoder connection

Pin	1	2	3	6	4	7	5	8	9	12	10	13	11	14	19
Sign	V _{cc}	GND	A	\bar{A}	B	\bar{B}	Z	\bar{Z}	U	\bar{U}	V	\bar{V}	W	\bar{W}	PE

(3) Star series motor wind

Motor wind method is as follows:



A, B, C are outlet terminal of wind.

Its method: 4-core socket.

Table 8.6 Motor connection

Socket serial number	2	3	4
Motor wind	A	B	C
Remark	1-pin ground (chassis)		

Photoelectric encoder lead method: 15-core socket.

Table 8.7 Encoder connection

Sign	2	3	4	7	5	8	6	9	10	13	11	14	12	15
Pin	V _{cc}	GND	A	\bar{A}	B	\bar{B}	Z	\bar{Z}	U	\bar{U}	V	\bar{V}	W	\bar{W}
Remark	GND is the grounding of encoder power supply V _{cc} . 1-pin grounding(chassis).													

3) Specification

Table 8.8 SJT series motor specification

Specification Item	130SJT—M050C	130SJT—M060C	130SJT—M075C
Polarity	4	4	4
Driver input voltage	three-pahse 220 V	three-pahse 220 V	three-pahse 220 V
Rated current (I _N)	4.7 A	5.6 A	6.8 A
Rted torque (T _N)	5 N · m	6 N · m	7.5 N · m
Max. torque (T _{MAX})	12.5 N · m	18 N · m	20 N · m
Ratd speed (n _N)	2000 rpm	2000 rpm	2000 rpm
Max. speed (n _{MAX})	2500 rpm	2500 rpm	2500 rpm
Rotation inertia (J)	1.41 × 10 ⁻³ kg · m ²	1.62 × 10 ⁻³ kg · m ²	1.95 × 10 ⁻³ kg · m ²
Acceleration time constant (T _m) (rated torque)	60 ms	56 ms	53 ms
Specification Item	110SJT—M020C	110SJT—M040C	110SJT—M060C
Polarity	4	4	4
Driver input voltage	three-pahse 220 V	three-pahse 220 V	three-pahse 220 V
Rated current (I _N)	2.5 A	4.5 A	5A
Rated torque (T _N)	2 N · m	4 N · m	6 N · m
Max. torque (T _{MAX})	6 N · m	12 N · m	12N · m
Rated speed (n _N)	2000 rpm	2000 rpm	2000 rpm

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Max. speed (n_{MAX})	2500 rpm	2500 rpm	2500 rpm
Rotation inertia (J)	$0.34 \times 10^{-3} \text{ kg} \cdot \text{m}^2$	$0.68 \times 10^{-3} \text{ kg} \cdot \text{m}^2$	$0.95 \times 10^{-3} \text{ kg} \cdot \text{m}^2$
Acceleration time constant (T_m) (rated torque)	45 ms	45 ms	33 ms

Table 8.9 STZ series motor specification

Type	Power (Kw)	Zero speed torque (Nm)	Rated speed (rpm)	Rated current (A)	Rotor inertia (Kgm ²)	Mechanical time constant (ms)	Working voltage (VDC)	Weight (Kg)
110STZ2-1-HM	0.4	2	2000	3.0	5.4×10^{-4}	12.6	220(300)	11
110STZ2-2-HM	0.6	2	3000	4	5.4×10^{-4}	12.6	220(300)	11
110STZ4-1-HM	0.8	4	2000	5(3)	9.1×10^{-4}	5.9	220(300)	14
110STZ4-2-HM	1.2	4	3000	7.5(5)	9.1×10^{-4}	5.9	220(300)	14
110STZ5-1-HM	1.0	5	2000	6.5(4.5)	1.1×10^{-3}	6.0	220(300)	15
110STZ5-2-HM	1.5	5	3000	9.5(5.5)	1.1×10^{-3}	6.0	220(300)	15
110STZ6-1-HM	1.2	6	2000	7.5(4.5)	1.29×10^{-3}	6.6	220(300)	17
110STZ6-2-HM	1.7	6	3000	11(7)	1.29×10^{-3}	6.6	220(300)	17
130STZ4-1-HM	0.8	4	2000	6.5(4)	1.6×10^{-3}	12.5	220(300)	13
130STZ4-2-HM	1.2	4	3000	9.5(5.5)	1.6×10^{-3}	12.5	220(300)	13
130STZ5-1-HM	1.0	5	2000	6.5(4.5)	2.0×10^{-3}	10.0	220(300)	15
130STZ5-2-HM	1.5	5	3000	9.5(6)	2.0×10^{-3}	10.0	220(300)	15
130STZ6-1-HM	1.2	6	2000	6.5(4.5)	2.4×10^{-3}	8.5	220(300)	16
130STZ6-2-HM	1.8	6	3000	9.5(6.5)	2.4×10^{-3}	8.5	220(300)	16
130STZ7.5-1-HM	1.4	7.5	2000	9.5(5.5)	2.8×10^{-3}	6.0	220(300)	18
130STZ7.5-2-HM	2.0	7.5	3000	14(9.5)	2.8×10^{-3}	6.0	220(300)	18
130STZ10-1-HM	1.4	10	1500	9.5(5.5)	3.6×10^{-3}	5.0	220(300)	20
130STZ10-2-HM	2.3	10	2500	16(10)	3.6×10^{-3}	5.0	220(300)	20
130STZ15-1-HM	2.1	15	1500	13.5(8.5)	5.2×10^{-3}	3.9	220(300)	26

Note 1: Value in the above-mentioned bracket in rated current is a rated current when it is high voltage.

Note 2: Please remark in your order if you need a power-down brake motor.

Table 8.10 Starseries motor specification

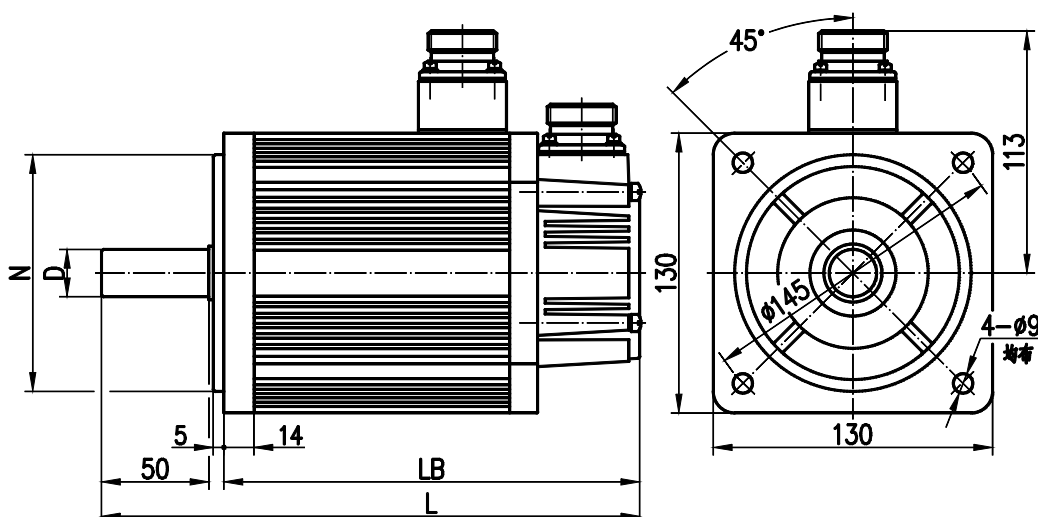
Type	Power (Kw)	Zero speed torque (Nm)	Rated speed (rpm)	Rated current (A)	Rotor inertia (Kgm ²)	Mechanical time constant (ms)	Working voltage (VDC)	Weight (Kg)
110ST-M02030H	0.6	2	3000	4.0	0.33×10^{-3}	3.64	220(300)	4.2
110ST-M04030H	1.2	4	3000	7.5(5.0)	0.65×10^{-3}	2.32	220(300)	5.2
110ST-M05030H	1.5	5	3000	9.5(6.0)	0.82×10^{-3}	2.03	220(300)	5.8
110ST-M06020H	1.2	6	2000	8.0(6.0)	1.00×10^{-3}	1.82	220(300)	6.4
110ST-M06030H	1.8	6	3000	11.0(8.0)	1.00×10^{-3}	1.82	220(300)	6.4
130ST-M04025H	1.0	4	2500	6.5(4.0)	0.85×10^{-3}	3.75	220(300)	7.4
130ST-M05025H	1.3	5	2500	6.5(5.0)	1.06×10^{-3}	3.07	220(300)	7.9
130ST-M06025H	1.5	6	2500	8.0(6.0)	1.26×10^{-3}	2.83	220(300)	8.6
130ST-M07720H	1.6	7.7	2000	9.0(6.0)	1.58×10^{-3}	2.44	220(300)	9.5
130ST-M10015H	1.5	10	1500	9.0(6.0)	2.14×10^{-3}	2.11	220(300)	11.1
130ST-M10025H	2.6	10	2500	14.5(10.0)	2.14×10^{-3}	2.11	220(300)	11.1
130ST-M15015H	2.3	15	1500	13.5(9.5)	3.24×10^{-3}	1.88	220(300)	14.3

Note 1: Value in the above-mentioned bracket in rated current is a rated current when it is high voltage.

Note 2: Please remark in your order if you need a power-down brake motor.

5) Contour

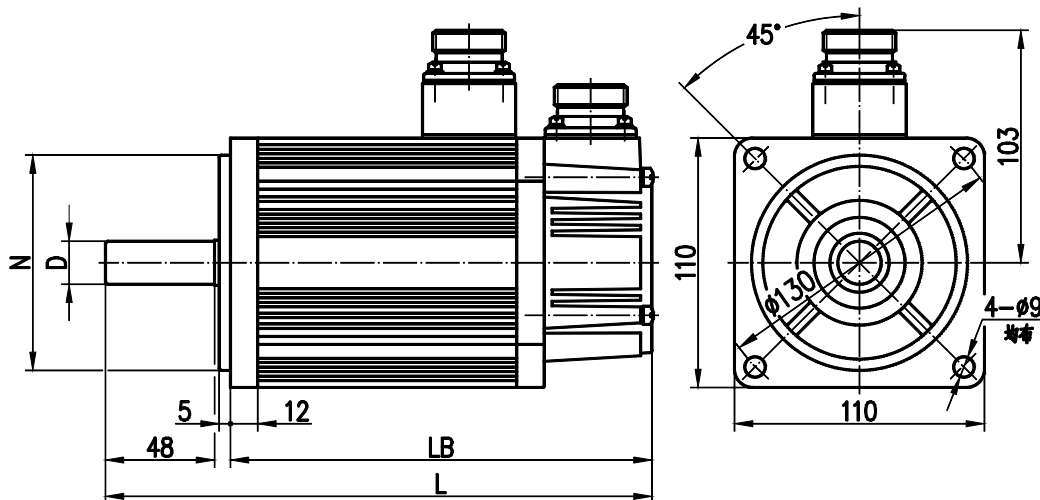
(1) SJT series 130 chassis AC servomotor contour



Specification	D(mm)	N(mm)	LB(mm)	L(mm)
130SJT-M040C	$\phi 22^{0}_{-0.013}$	$\phi 110^{0}_{-0.035}$	170	225
130SJT-M050C	$\phi 22^{0}_{-0.013}$	$\phi 110^{0}_{-0.035}$	179	236

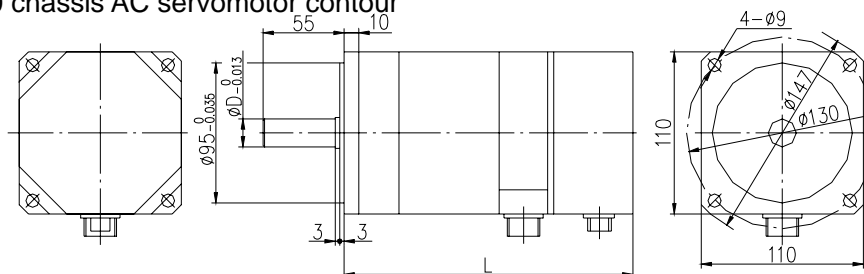
130SJT-M060C	$\phi 22^{0}_{-0.013}$	$\phi 110^{0}_{-0.035}$	185	242
130SJT-M075C	$\phi 22^{0}_{-0.013}$	$\phi 110^{0}_{-0.035}$	196	253
130SJT-M100B	$\phi 22^{0}_{-0.013}$	$\phi 110^{0}_{-0.035}$	223	280
130SJT-M150B	$\phi 22^{0}_{-0.013}$	$\phi 110^{0}_{-0.035}$	268	325

(2) SJT series 110 chassis AC servomotor contour



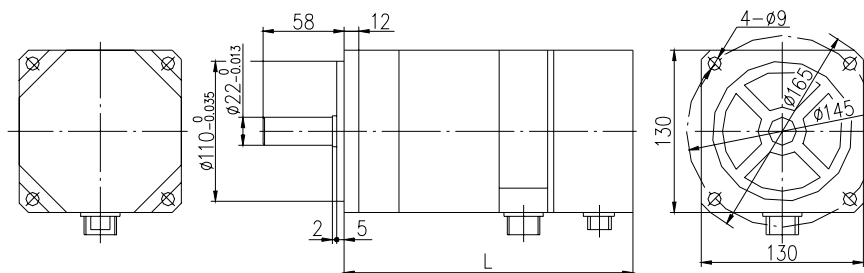
Specification	D(mm)	N(mm)	LB(mm)	L(mm)
110SJT-M020C	$\phi 19^{0}_{-0.013}$	$\phi 95^{0}_{-0.035}$	158	205
110SJT-M040C	$\phi 19^{0}_{-0.013}$	$\phi 95^{0}_{-0.035}$	186	233
110SJT-M060C	$\phi 19^{0}_{-0.013}$	$\phi 95^{0}_{-0.035}$	218	265

(3) STZ series 110 chassis AC servomotor contour



Zero speed torque	2Nm	4Nm	5Nm	6Nm
D(mm)	19	19	22	22
L(mm)(no braker)	196	234	253	272
L(mm)(with braker)	252	290	309	328

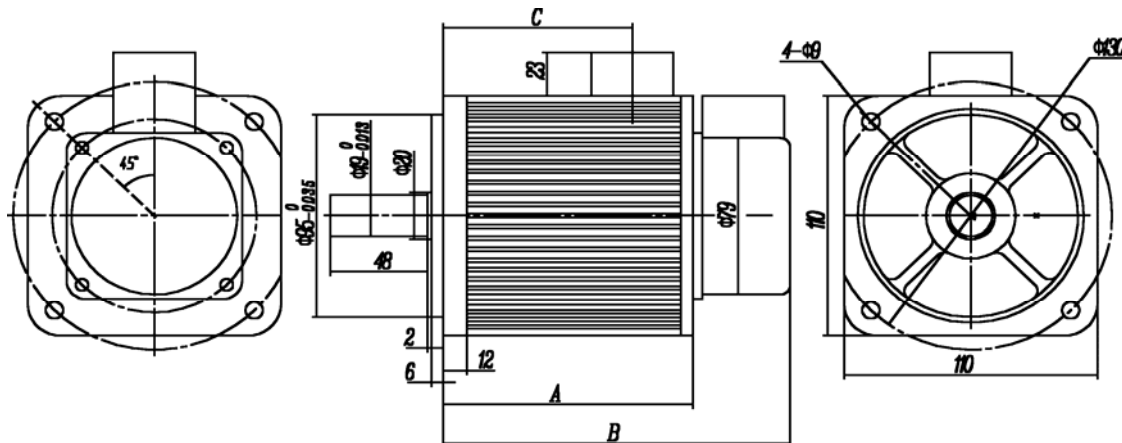
(4) STZ series 130 chassis AC servomotor contour



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Zero speed torque	4Nm	5Nm	6Nm	7.5Nm	10Nm	15Nm
L(mm)(No braker)	207	217	227	242	267	317
L(mm)(with braker)	263	273	283	298	323	373

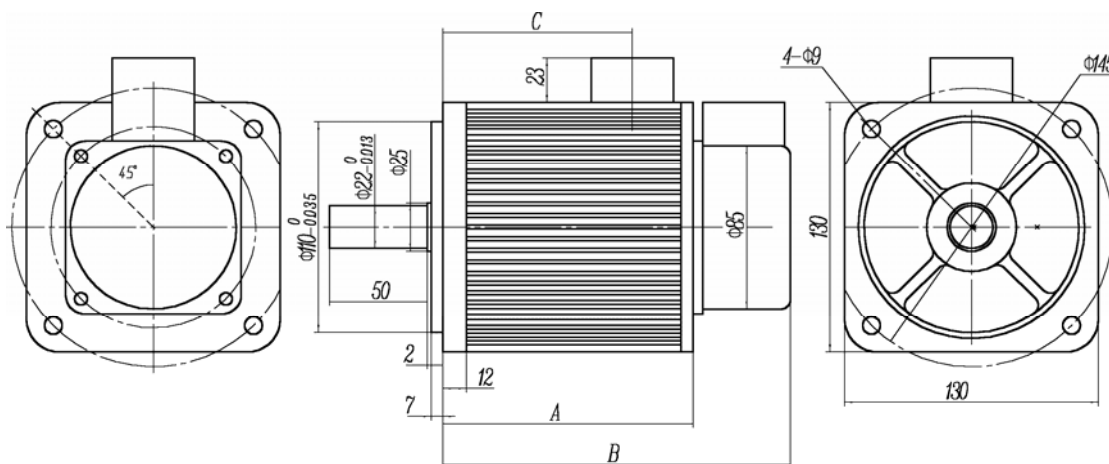
(5) Star series 110 chassis AC servomotor contour



Zero speed torque (Nm)	2	4	5	6
A(mm)	106	132	148	164
B(mm)	158(205)	184(231)	200(247)	216(263)
C(mm)	76	102	118	134

Note: B value in the above-mentioned bracket is a length with power-down braker.

(6) Star series 130 chassis AC servomotor contour



Zero speed torque (Nm)	4	5	6	7.7	10	15
A(mm)	110	119	128	142	166	214
B(mm)	162(209)	171(218)	180(227)	194(241)	218(265)	266(313)
C(mm)	80	89	98	112	136	184

Note: B value in the above-mentioned bracket is a length with power-down braker.

8.3 Isolation transformer

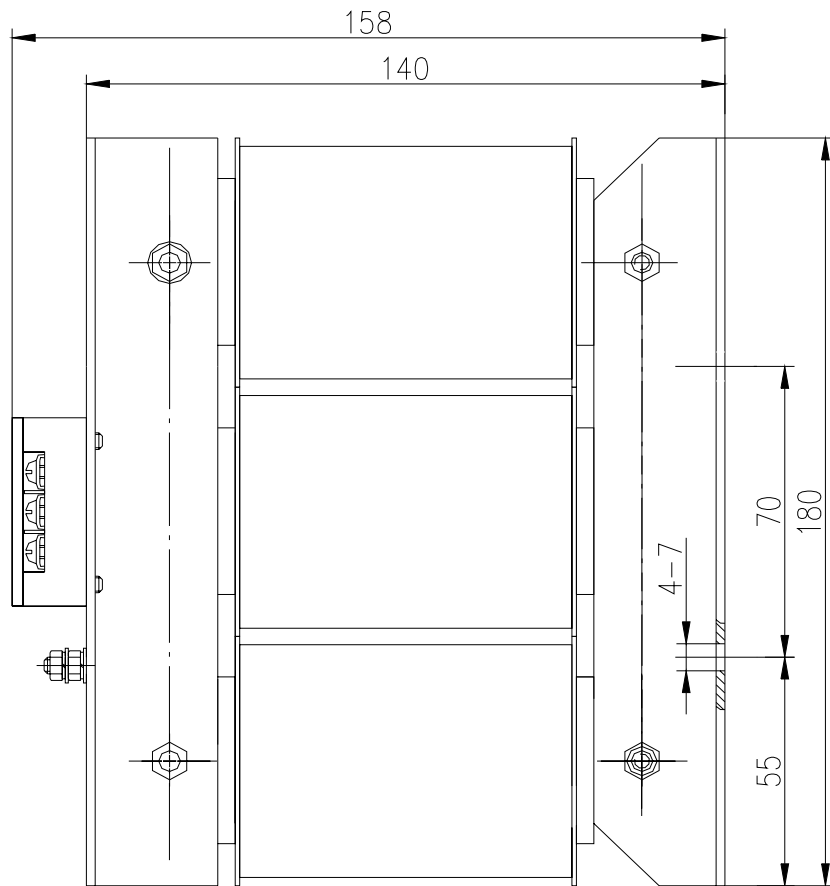
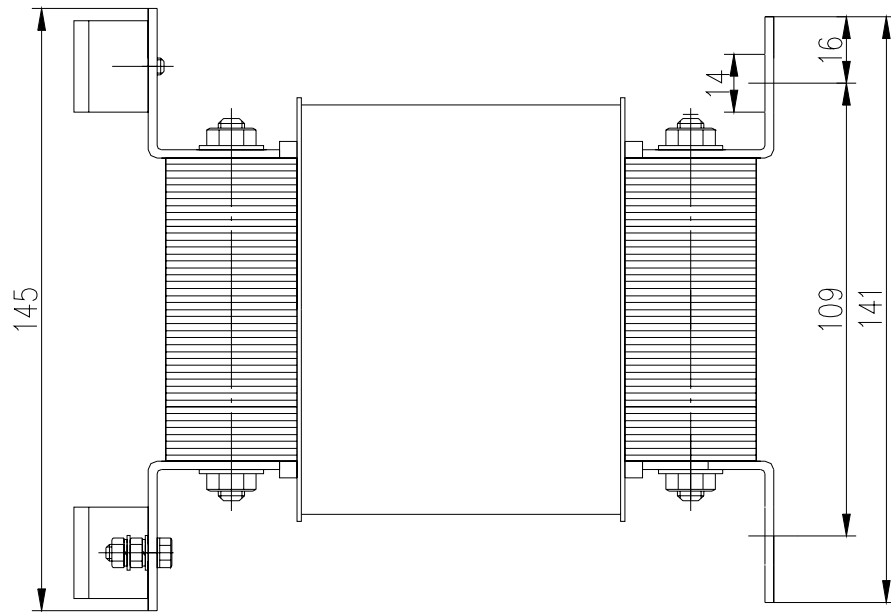
 **Note**

- The isolation transformer should be employed to driver to reduce electric shock or interference from power supply and electromagnetism.
- The driver with 0.8KW and less can be employed with single phase, and ones with more must be employed with three-phase.

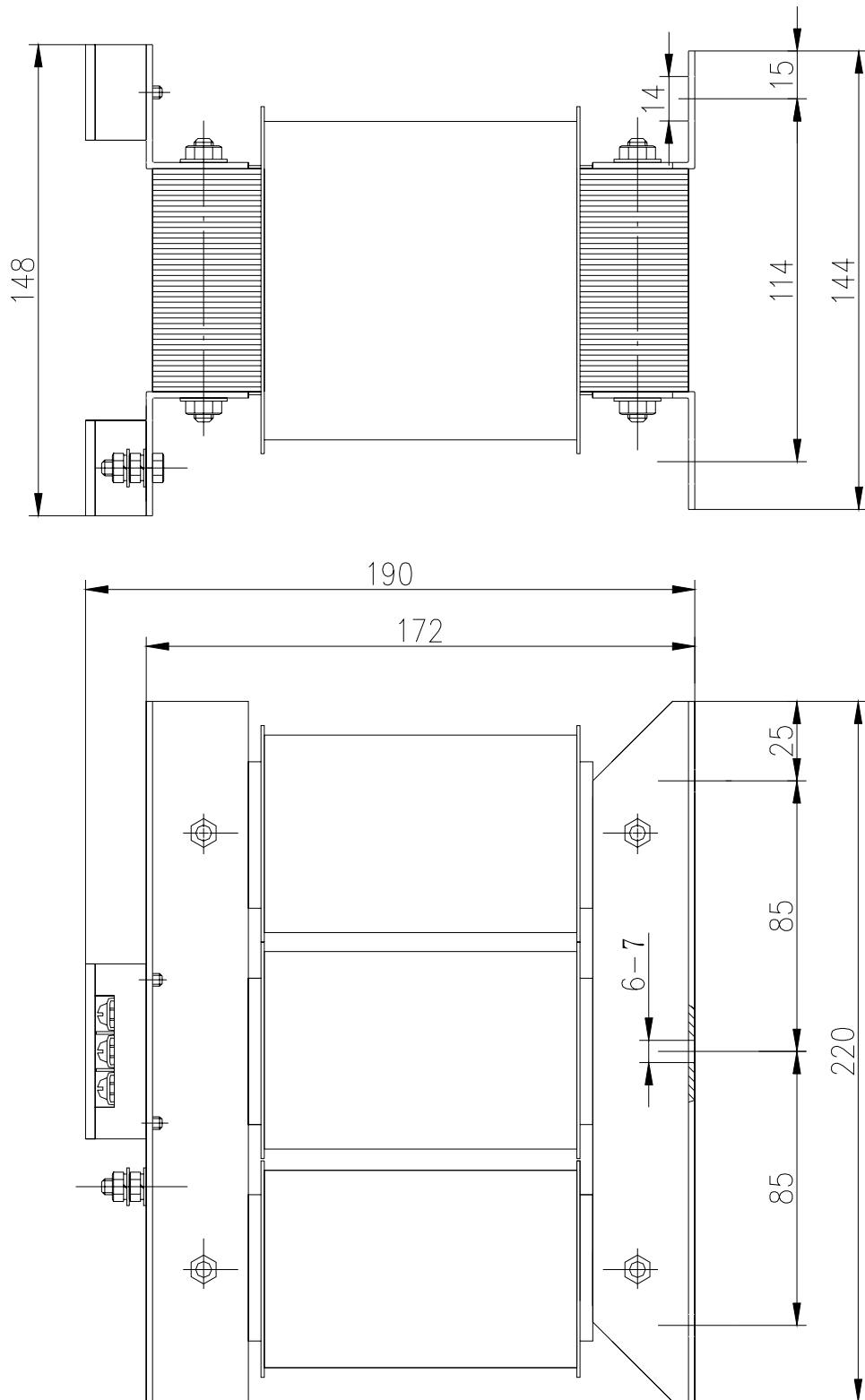
The following isolation transformers are provided by us and user can choose according to servomotor power and actual load.

Table 8.11 Isolation transformer specification

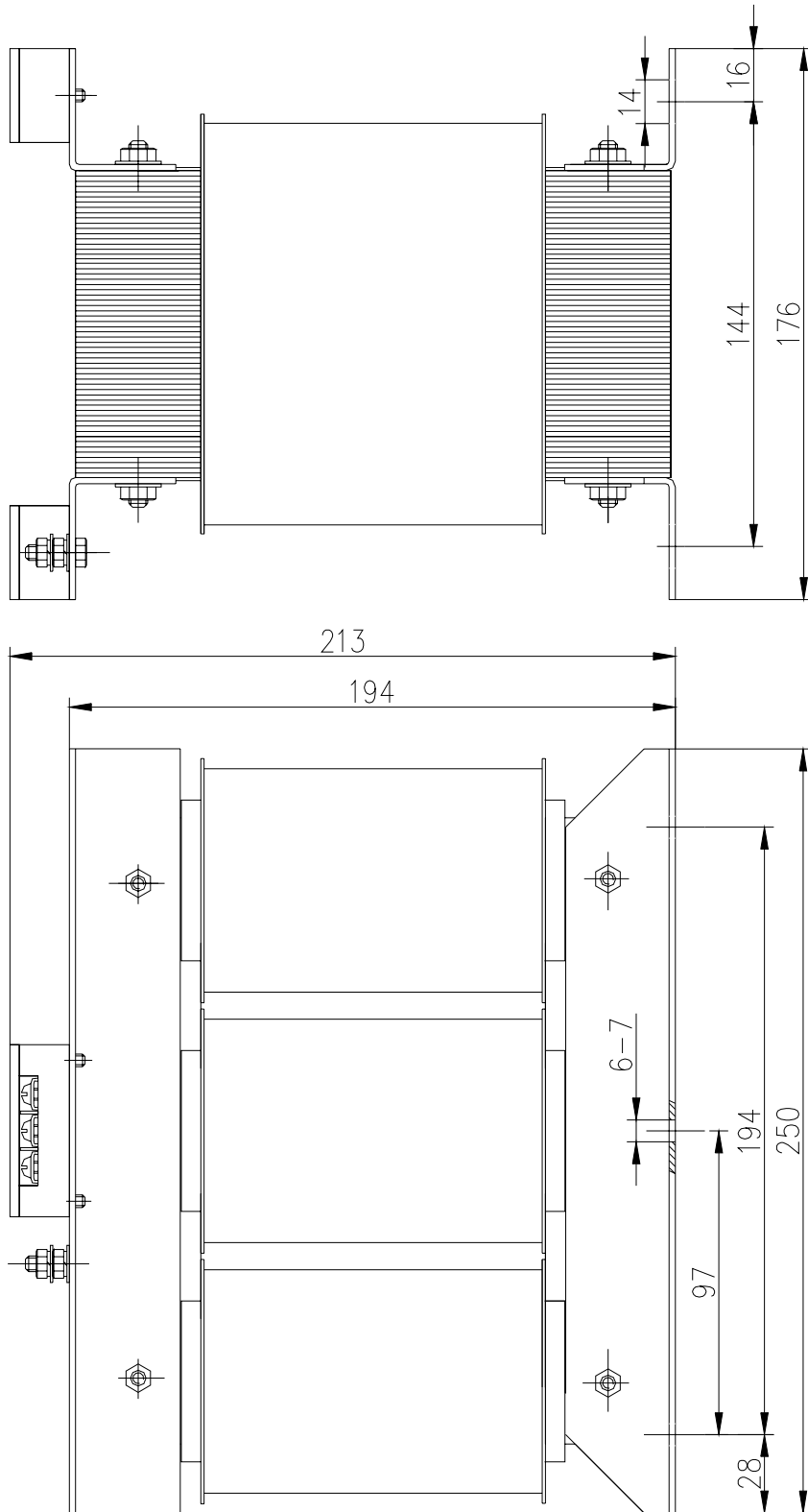
Type	Capacity (KVA)	Phase	Input voltage(V)	Output voltage (V)
BS--120	1.2	Three-phase	380	220
BS--200	2.0			
BS--300	3.0			
BD--80	0.8	Single phase		
BD--120	1.2			



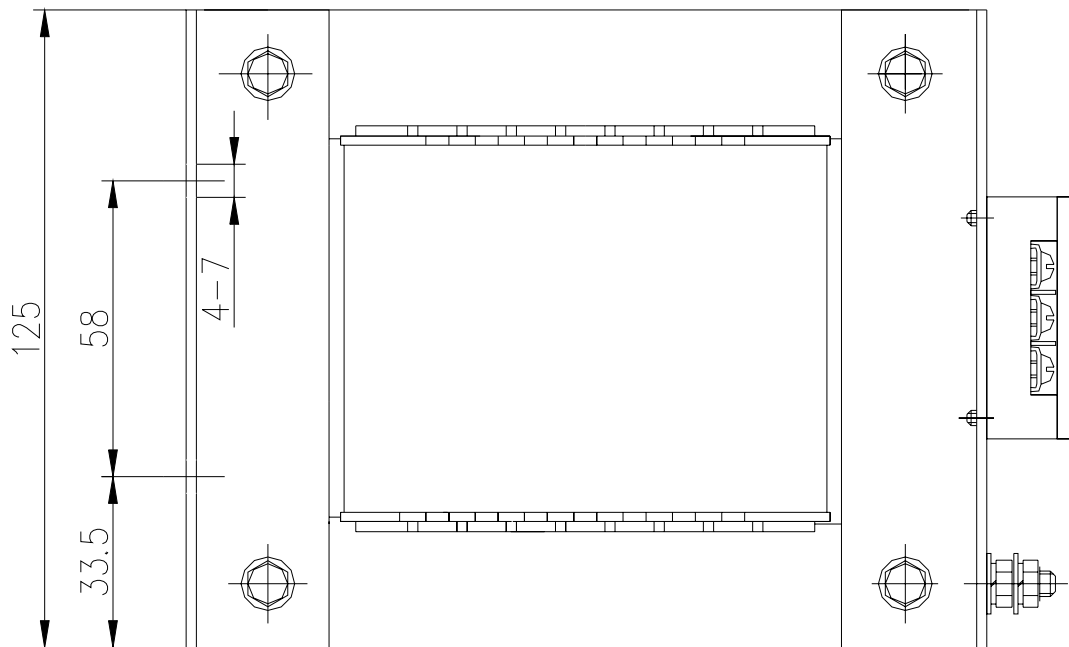
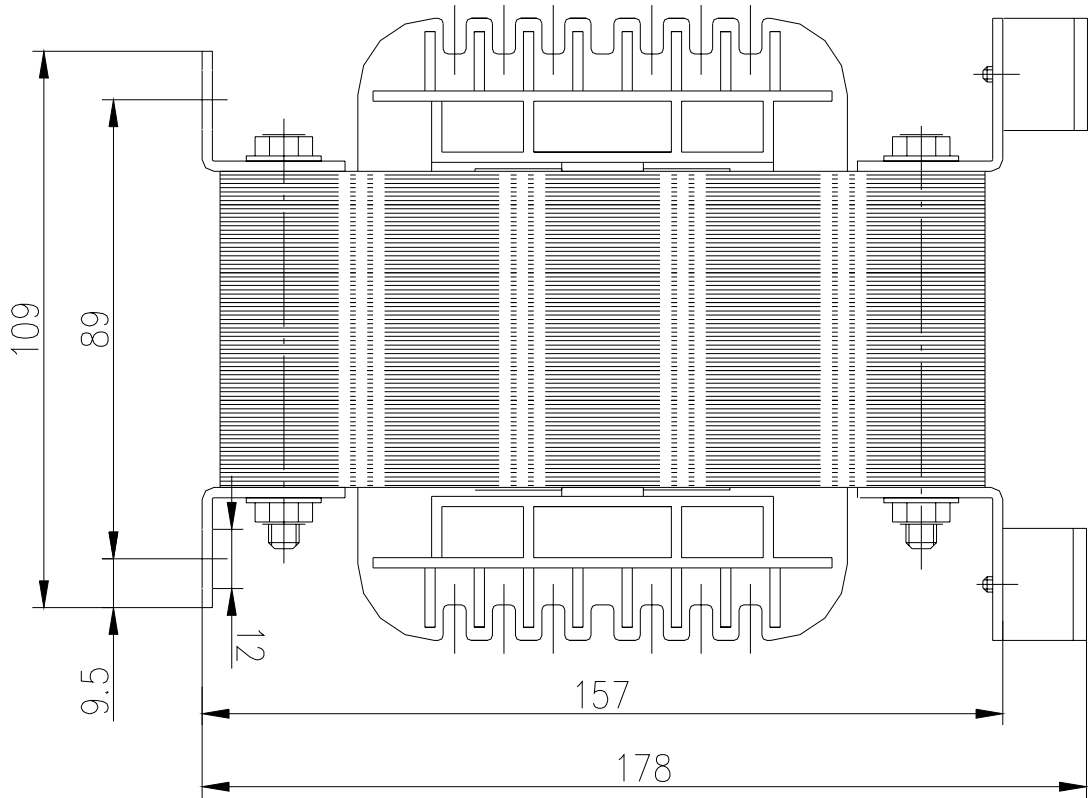
BS—120 contour and installation dimension



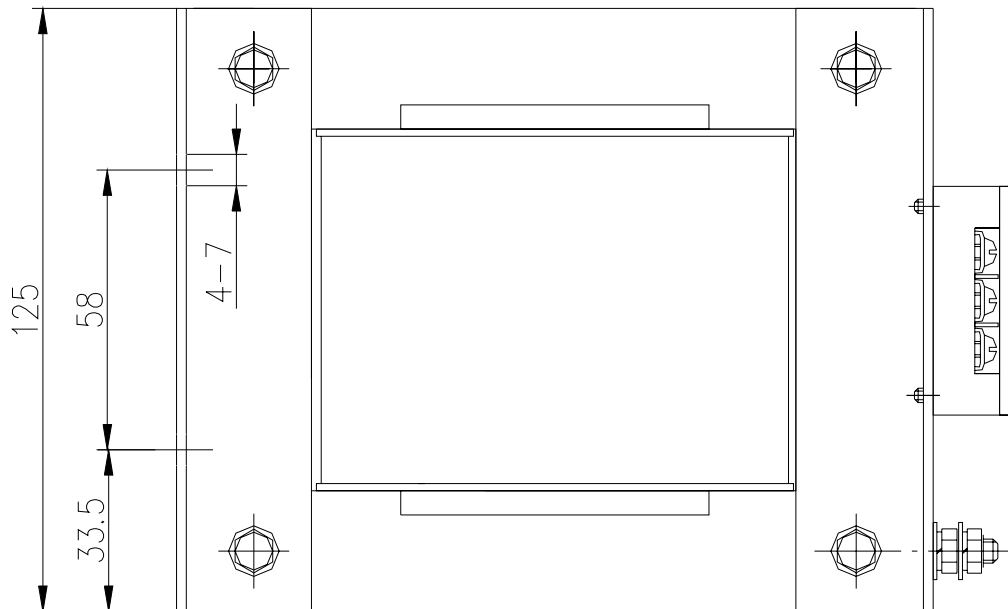
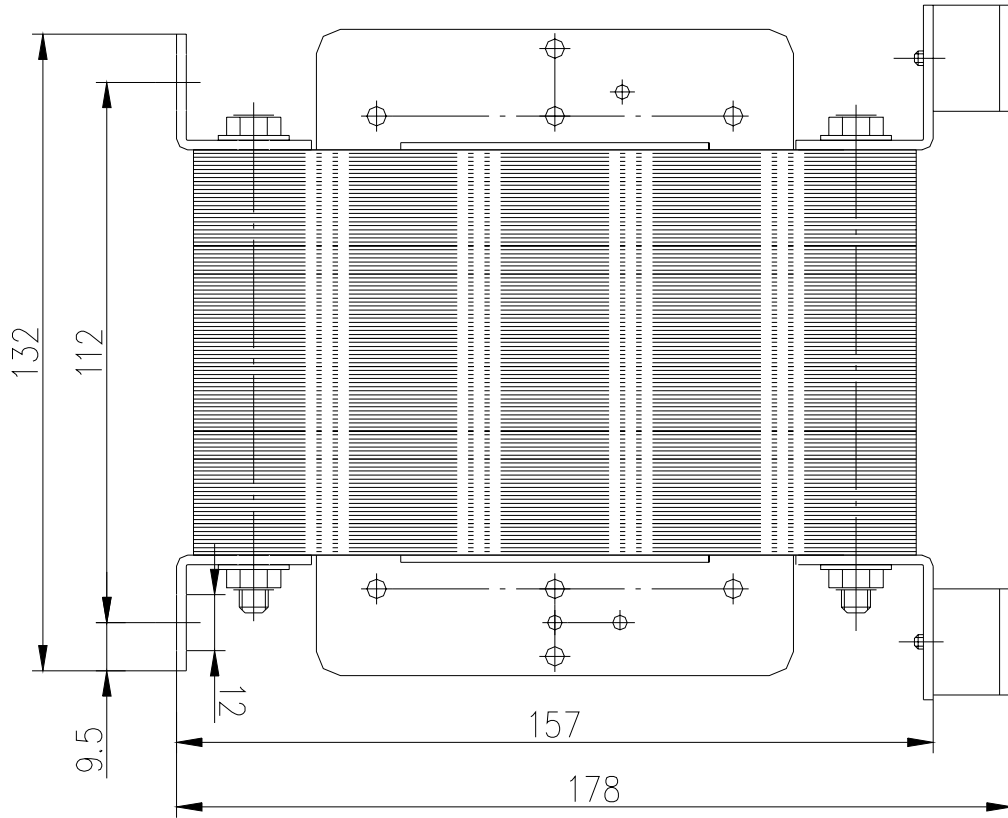
BS—200 contour and installation dimension



BS—300 contour and installation dimension



BD—80 contour and installation dimension



BD—120 contour and installation dimension

Order**9.1 Capacity selections**

Servo capacity is relative to the load inertia, the loading torque, the required positioning precision and max.speed as the following steps:

1) Counting load inertia and torque

To calculate load inertia, loading torque, dynamic and acceleration/deceleration torque, effective torque by the relevant data to make it the base for the next selection.

2) Preliminary confirming mechanical gear ratio

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

3) Check inertia and torque

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

9.2 Electronic gear ratio

Refer to chapter 4 (table 4.2 parameter function), chapter 6 (6.3 parameter setting), chapter7(7.3 debugging)

In the location control mode, the actual loading speed is:

$\text{Instruction pulse speed} \times G \times \text{mechanical deceleration ratio.}$

In the location control mode, the actual minimum displacement of loading is:

$\text{Minimum instruction pulse displacement} \times G \times \text{mechanical deceleration ratio}$

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

9.3 Stop characteristics

Lag pulse is defined to different value between the instruction pulse and feedback pulse when the servomotor is controlled by pulse serial in the position control mode. The above different value is accumulated in the position deviation counter, and it has relationship with the instruction pulse frequency, the electronic gear ratio and position proportional gain as follows:

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

- ε : lagging pulse (Puls) (Puls);
- f: instruction pulse frequency (Hz) (Hz);
- K_p: position proportional gain (1/S);
- G: electronic gear ratio.

Note: The relation is obtained when [position feedback gain] is 0% and the lag pulse will be less than the computation value counted by the above formula.

9.4 Servo and position controller computation method

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 double frequency coefficient;
 - CD: instruction division frequency coefficient;
 - DR: servo double frequency coefficient;
 - DD: servo division frequency coefficient;
 - ST: graduation per rev of servomotor ;
 - ZD: gear teeth of motor side;
 - ZM: gear teeth of guide screw;
 - L: guide screw pitch mm
- Generally, S=I, the instruction value is equal to actual one.

2. Max. instruction speed of CNC:

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

- F: instruction speed mm/min;
- f_{max}: Max. output frequency of CNC Hz (GSK980 is 128000) .

3. Max. speed of servo:

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

- V_{max}: max. speed of worktable permitted by servo, mm/min;
 - n_{max}: max speed permitted by servomotor, r/min;
- Actual max. speed of machine is limited by max. speed of CNC and servo system.

4. Min. movement of machine tool:

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

- α : min. movement of machine tool, mm;
- N: natural number.;

INT (): rounding ;

INT[]_{min}: min. integer

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