DA98A AC SERVO DRIVE UNIT

User Manual

(Version 3.00)

广州数控设备有限公司

GSK CNC EQUIPMENT CO., LTD.

This user manual describes all items on this DA98A AC servo drive unit in detail. However, it's impractical to give particular descriptions for all unnecessary and/or unavailable operations on this product due to the content limit of the manual, specific product applications and other causes. Therefore, the operations not specified in this manual may be considered impossible or unallowable.

Dear Excellency,

It's our pleasure for your patronage and purchase of this DA98A AC servo drive unit made by GSK CNC Equipment Co., Ltd.

Company Profile

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

The GSK main products includes the NC equipments and devices such as GSK series turning machine, milling machine, machining center CNC system, DA98, DA98A, DA98B, DA98D series full digital AC servo drive device, DY3 series compound stepper motor drive device, DF3 series responsive stepper motor drive device, GSK SJT series AC servo motors, CT-L NC slider and so on. The current national standard (and international standard), industry standard, as well as the enterprise standard (or enterprise internal standard) as a supplementary, are completely implemented in GSK production process. The capability of abundant technology development and complete production and quality system qualified by GSK will undoubtedly ensure the reliable product to serve our customers. 24~48 hours technical support and service can be easily and promptly provided through GSK complete service mechanism and tens of service offices distributed in China and abroad. The pursuit of "excellent

product and superexcellent service" has made GSK what it is now, and GSK will continue to spare no efforts to consummate this South China CNC industry base and enhance China CNC industry by GSK's "century enterprise, golden brand" managerial concept.

Spot Technical Service

You can ask for spot service if you have problems that can't be solved by telephone. We will send the authorized engineers to your place to resolve the technology problems for you.

FOREWORD

This manual gives a full description on the functions and operations for DA98A AC servo drive unit and it will make you to get a full knowledge to use it properly and safely. In addition, this manual also involves some special knowledge and precautions on using.

Caution: Improper operation may lead to accidents! Before using this AC servo drive unit, please read the manual completely!

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

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

 **Warning**	**If operation is incorrect, a dangerous situation may occur, resulting in death or serious injuries.**
 **Caution**	**If operation is incorrect, a dangerous situation may occur, resulting in injuries to personnel or damage to equipment.**
 **Note**	**If operation is incorrect, damage to system or equipment may occur.**

This manual is reserved by final user.

We are full of heartfelt gratitude to you for supporting us in the use of GSK's products.

CONTENTS

WARNINGS

Warning

- Design and manufacturing of the product are not used for the mechanism and system that may cause danger to people.
- Precautions in design and making of the user machinery and system matched with this product should be taken into account to avoid accidents resulted by mal-operation or malfunction of this product.

Acceptance

Caution

- Product that is damaged or broken down can't be put into use.

Transportation

Caution

- Products should be stored and delivered in a proper storage and delivery environment.
- Do not put the packing boxes in too high piles to prevent from falling down.
- Proper package should be done for the product loading.
- Do not drag the servo motor wires, shaft or encoder when moving it.
- Prevent the servo drive unit and the servo motor from external force and collision.

Installation

Caution

For AC servo drive unit and servo motor:

- Do not fix them on or near flammable objects that fire may occur.
- Vibration should be avoided and protect them from shock.
- Don't assembly the product that is damaged or lack of parts.

For AC servo drive unit:

- It should be fixed in a control cabinet with a high protection degree.
- Sufficient clearance with other equipments should be set aside.
- A good heat radiation should be done.
- Prevent dust, corrosive gas, conductive objects, liquids and flammable or explosive material against entering it.

For servo motor:

- Fastness must be assured to avoid looseness by shaking.
- Prevent liquids from entering motor and encoder.
- Hammering motor and its shaft is unallowed to protect encoder from damage.
- Don't overload the motor shaft.

Connection

Warning

- Only qualified personnel can do or check the connection.
- Connection and checking can only be done in 5 minutes after the power supply is cut off.
- The AC servo drive unit and servo motor must be well grounded.
- Explosion or operation incident may be caused by false voltage or polarity of power supply.
- Connection can be done only after AC servo drive unit and servo motor are well installed.
- Ensure the wires insulation and not squeezing them to avoid electric shock.

Caution

- Correctness and fastness of connection must be ensured, otherwise the servo motor will run in a false direction or the equipment may be damaged by loosen contact.
- U, V, W terminals must not be connected reversely and connected with AC power supply.
- Servo motor should be directly connected with AC servo drive unit without connecting capacitance, inductance or filter.
- Prevent conductive fastener and wire odds and ends from entering into the drive unit.
- Wires and non-thermal protective objects are not permitted to approach to the drive unit radiator and servo motor.
- Freewheeling diode in parallel with DC relay of output signal must not be connected reversely.

Debugging

Caution

- Assembly and stable fixation of servo drive unit and servo motor, correctness of power voltage and connection must be ensured before the power-on.
- Servo motor should make a run in dry run mode while debugging. Loading debugging can be done after the parameters are correctly set to avoid the damage of machine and equipment caused by maloperation.

Usage

Caution

- Emergency circuit should be connected to ensure the machine stop and power cut off immediately when an incident occurs.
- The running signal must be off before resetting an alarm or it sudden restart may occur.
- The drive unit must be used with the suited servo motor.
- Do not frequently switch on/off the power supply of the drive unit to avoid damaging the unit system.
- Do not touch the drive unit radiator and the motor in running or the duration after power-off to avoid scalding by the heat generated in running.
- Don’t refit the drive unit.

Troubleshooting

Warning

- **Do not disconnect the cables and touch the terminal blocks within 5 minutes after power is off because of the residual voltage of the drive unit.**
- **Personnels undertaking disconnection and maintenance must be qualified with the corresponding knowhow knowledge and capabilities.**

Caution

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

Option

Note

- **Rated torque of servo motor should be higher than the effective continuous loading torque.**
- **Inertia ratio between the load and the servo motor should be less than the recommendation.**
- **The drive unit should be used with the matched servo motor.**

CHAPTER 1 OVERVIEW

1.1 Introduction

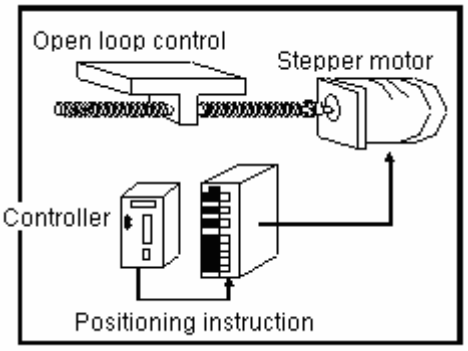
AC servo technology has been advanced and improved since the early of 90th last century and it has been widely applied to the fields such as CNC machine, printing packaging machinery, textile machinery, automatic production line.

DA98A AC servo drive unit (also called full digital AC servo drive unit) is a new generation of full digital AC servo drive unit provided by GSK CNC equipment co,. Ltd. The product has been employed with Digital Signal processor (DSP), Complex Programmable Logic Device （CPLD） and MITSUBISHI Intelligent Power modular(IPM), which has the good characteristics of high integration, lower volume, complete protection and liability. And it has applied optimum PID operation for PMW control. So this drive unit has ranked the advanced level among the same type products in the world.

DA98A AC servo drive unit has following advantages compared to stepping system:

- **No out-of-step**
  Servomotor is employed with an encoder, with position signal feedbacking to AC servo drive unit, which comprise a semi-closed loop control system as it is combined with an open loop position controller.

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

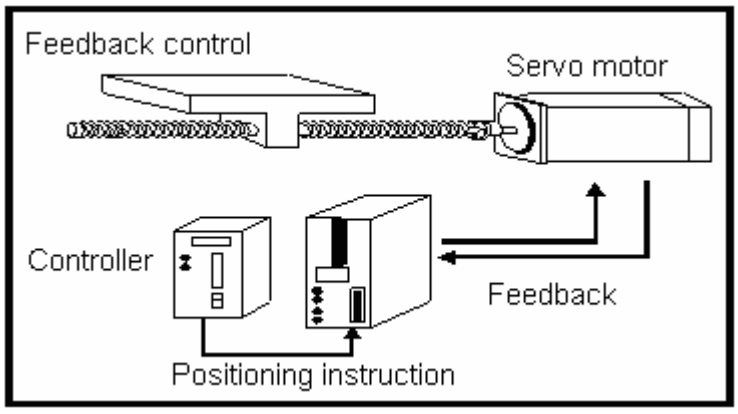


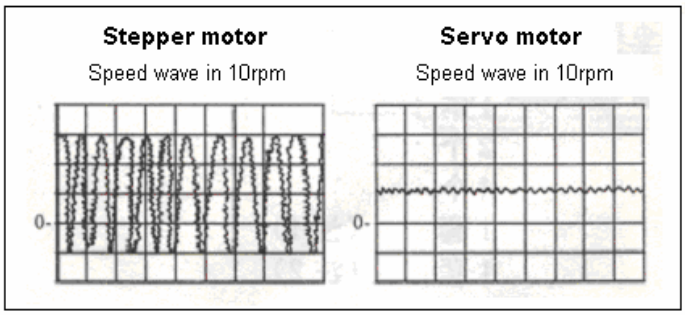
- **High speed, high precision**
  The max. speed of servo motor can be 3000rpm, and position precision of rotating is 1/10000r.

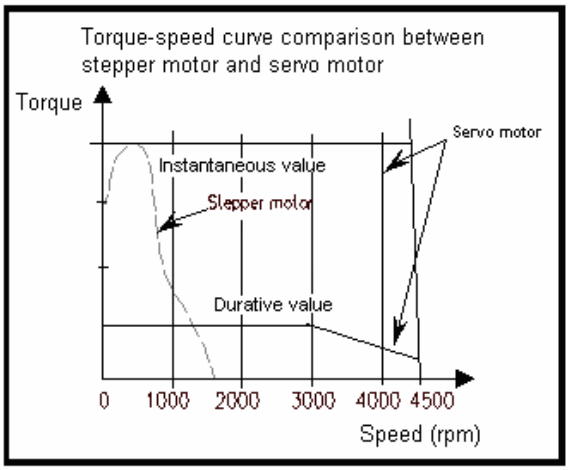
〖Note〗 There are different max. speeds for different servo motor models.

- **Simple and flexible control**

A proper setting for operating mode, running performance of the servo system by modifying parameters is suitable for different working requirements.







1.2 Reception check

1) Check the following items after delivery:

（1） Whether the packaging box is well or goods are damaged during transportation.

（2） Whether the AC servo drive unit, servo motor nameplates are consistent with the ordered ones.

（3） Whether the accessories completely conforms to the packing list.

Note

- **Do not install the servo drive unit which is damaged or lacks of components.**
- **The AC servo drive unit must be used with the suited servo motor.**
- **Please contact with us or suppliers if there are any questions after receiving goods.**

2）Model signification：

（1） Model for AC servo drive unit

DA98A-10-110SJT-M040D

- **110SJT-M040D**：Suited servo motor model（GSK SJT series） **※1**
- **10**：Output power：2 digits (04,06…23) corresponding to 0.4~2.3KW **※2**
- **DA98A**：Series code

※ 1：It can be matched with other domestic or imported servo motor which is needed to be ordered. This drive unit default parameters are only suitable for SJT, STZ, Star series servo motor. And the factory set parameters for other servo motors have been backup in the EEPROM area. Backup recovery but default recovery operation should be performed when the factory set parameters are to be recovered.

※ 2：Medium or small power (less than or equal to 1.5KW) is the standard configuration, and the medium power models(＞1.5 and ≤2.3KW) are employed with thicker radiators.

〖Note〗 Product model has been filled in the form before delivery and check the product with its nameplate.

（2） Servo motor model

DA98A AC servo drive unit can be matched with many domestic and abroad servo motor models which can be selected by user order. Servo motor models of GSK SJT series are introduced in Chapter 8 of this manual, and other servo motor models information are provided with servo motor delivery.

3） Accessories

（1） DA98A AC servo drive unit 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 (3m) can be provided when it is matched with our controller.

〖Note 2〗 Feedback cable (3m) can be chosen by user when servo motor is provided by us.

（2） The primary accessories for servo motor are provided according to the servo motor user manual.

1.3 Outline

1） Outline of AC servo drive unit

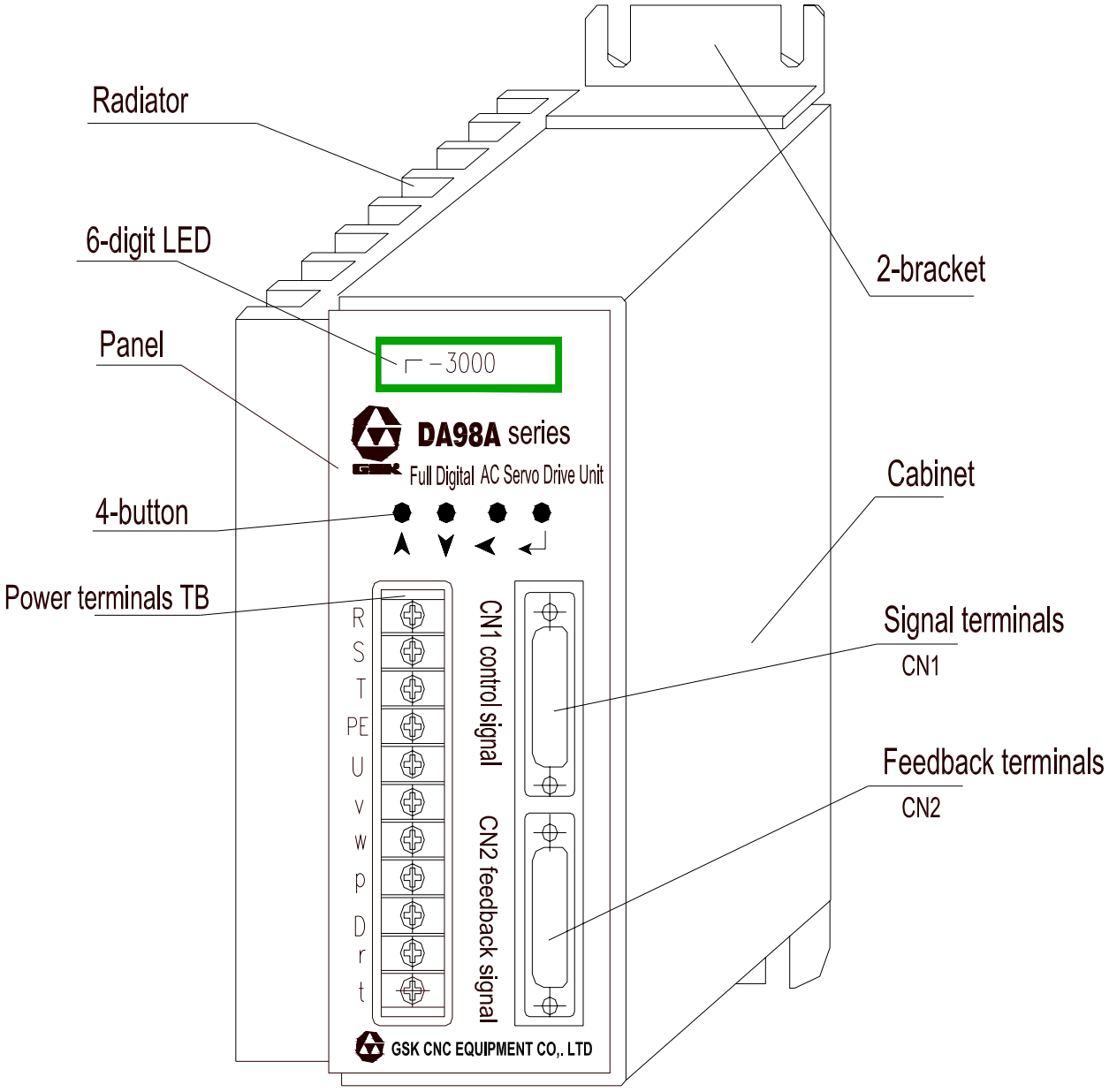


Fig. 1-1 Outline of AC servo drive unit

2） Outline of servo motor

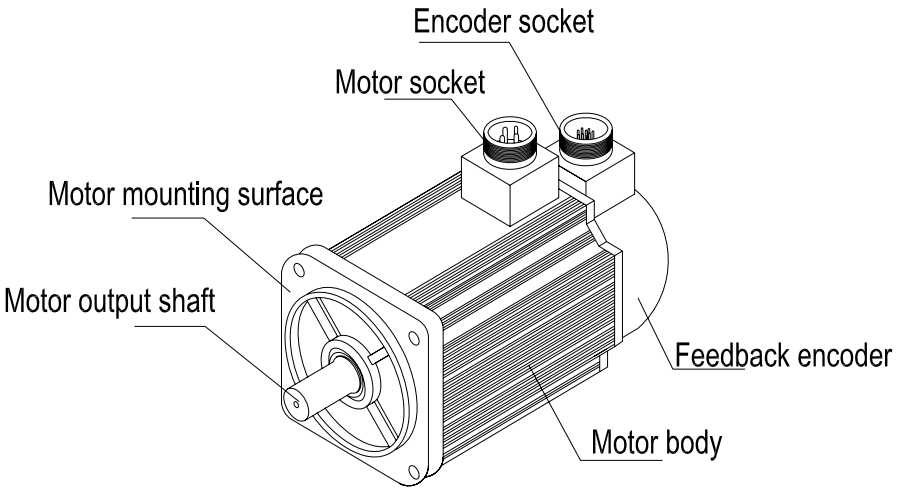


Fig. 1-2 Outline of SJT series servo motor

CHAPTER 2 INSTALLATION

Note

- **Storage and installation for this unit must be complied to the environmental requirement.**
- **Do not put the products into a pile to protect from being damaged or fallen down.**
- **Original packaging should be employed for products storage and delivery.**
- **Products which are damaged or shorten of parts must not be used.**
- **Fireproofing material should be used for the products installation and they should not be installed on or near flammable objects.**
- **Servo drive unit should be installed into cabinet to prevent dust, corrosive air, liquid, conductors and inflammable substances from entering it.**
- **The servo drive unit and motor should be protected from vibration and shock.**
- **The dragging of motor wire, motor shaft and encoder is unallowed.**

2.1 Environmental condition

Item	DA98A AC servo drive unit	GSK SJT series servo motor
Usage temperature/ humidity	0～+40℃（no icing） below 95%RH（no condensation）	-10～+40℃（no icing） below 90%RH（no condensation）
Storage/transport temperature/humidity	-40～55℃ 95%RH（no condensation）	-40～+55℃ below 80%RH（no condensation）
Atmosphere environment	No corrosive gas，flammable gas, oil fog or dust in cabinet	No corrosive gas，flammable gas, oil fog or dust inside house(no insolation)
Altitude	Altitude: below 1000m	Altitude: below 1000m
Vibration	Less than 0.5G（4.9m/s^2）10-60HZ（non-continuous run）	
Protection degree	IP43	IP65

2.2 Installation of AC servo drive unit

Note

- **It must be installed in a well protected cabinet.**
- **It must be installed by the specified direction and interval to get a good heat rediating.**
- **To fix the unit on or near flammable objects that fire may occur is unallowed.**

1） Installation environment

（1） Protection

The servo drive unit without guard must be installed in a well protected electrical cabinet to prevent corrosive or inflammable gas, liquid, electricity-conductor, metal particls or oil fog from entering it.

（2） Temperature and humidity

Environmental temperature should be 0-40℃, the long-term safe working temperature should be below 45℃. And a good heat radiating should be done.

（3） Vibration and shock

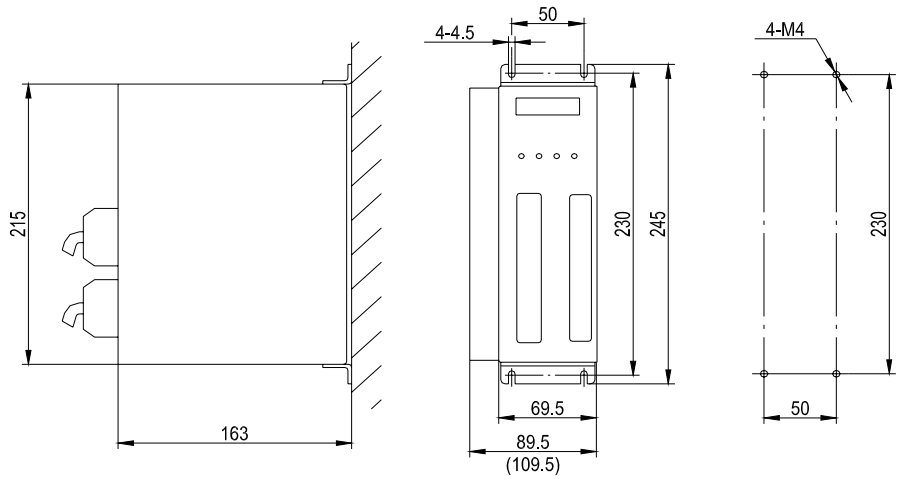
The measure to protect the AC servo drive unit from vibration should be below 0.5G ($4.9m/s^2$) and heavy pressure and impact during the unit installation should be avoided.

2） Installation method

（1） Fixation pattern

The drive unit can be fixed by bottom board or panel pattern with the direction upright to the fixation plane.

Fig. 2.1 is a sketch map for bottom board fixation and Fig. 2.2 is for panel fixation.



The data in bracket is suitable for medium power AC servo drive unit.

Fig. 2.1 Drive unit bottom board fixation pattern

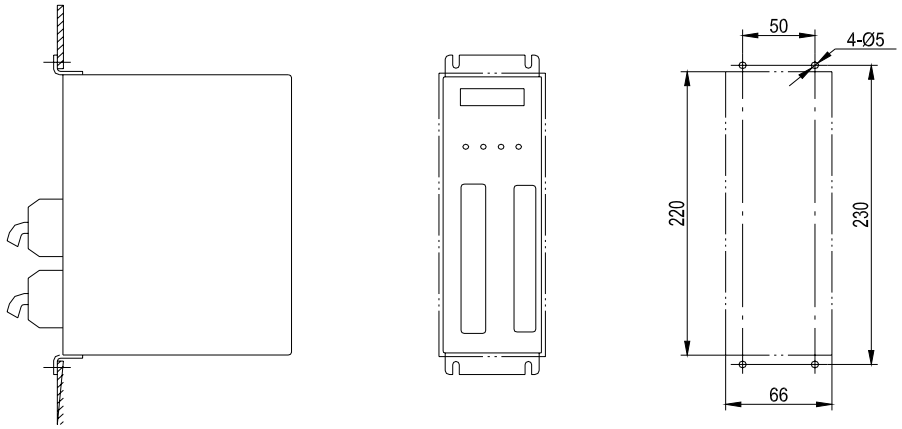


Fig. 2.2 Drive unit panel fixation pattern

（2） Fixation interval

The fixation interval for single drive unit is shown in Fig. 2.3 and intervals for multiple drive units are shown in Fig. 2.4. The interval for actual fixation should be as larger as possible to get a good heat dissipation.

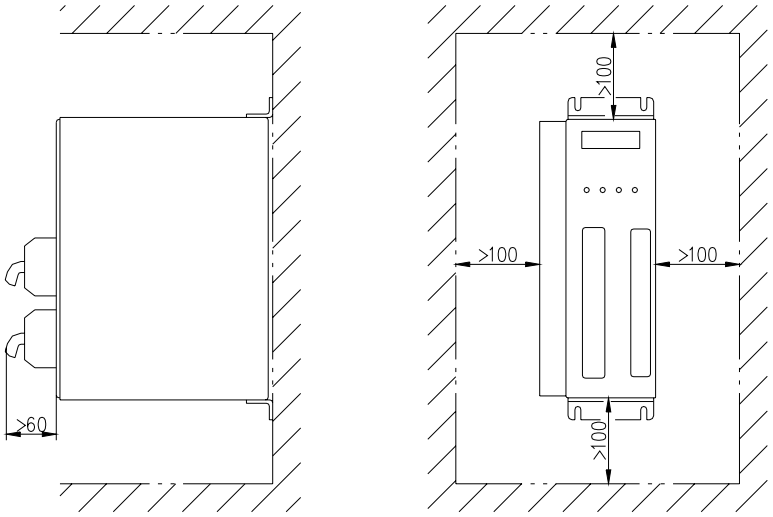


Fig. 2.3 Fixation interval for single drive unit

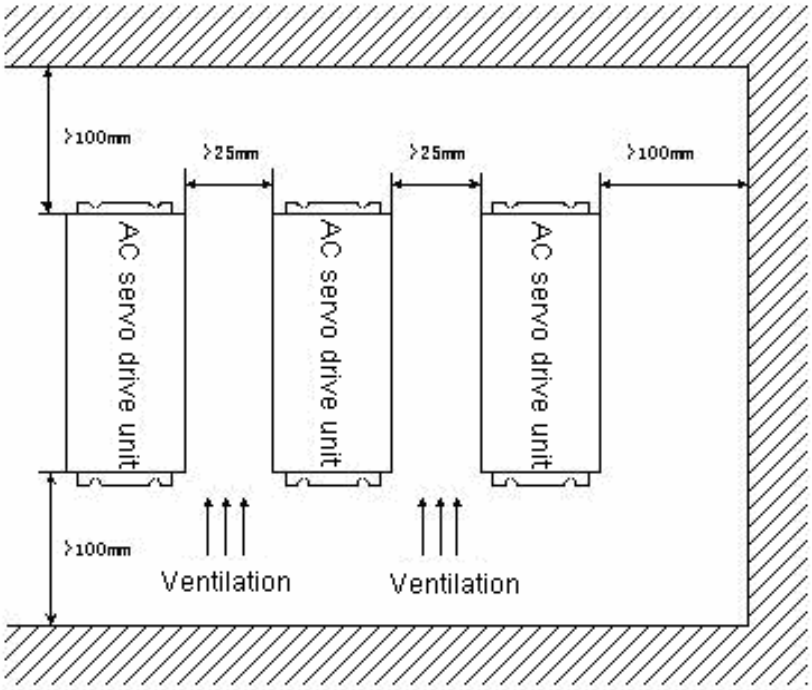


Fig. 2.4 Fixation intervals for multiple drive units

（3） Heat dissipation

There should be convective air blown to the drive unit radiator in the cabinet to prevent the ambient temperature of drive unit from continuous rising.

2.3 Servo motor installation

⚠ Note
● **Motor shaft or encoder hammering is impermissible.** ● **Do not drag the motor shaft, outlet wires or encoder.** ● **Motor shaft cannot be overloaded, otherwise the motor may be damaged.** ● **The motor must be secured firmly and there should be measures against loose.**

1）Installation environment

（1）**Guard**

GSK SJT series are not employed with waterproof device, so prevent liquid from splashing onto the motor and oil or water from entering into the motor along its lead wires and shaft.

〖Note〗 Please make a mark in order if waterproof servo motor is needed.

（2）**Temperature and humidity**

Environmental temperature should be kept in -10～+40℃(no icing). Measures of forced heat radiation should be done if there is little space or equipment emitting heat around when the motor's temperature rises owing to long-term run.

The environmental humidity should be no more than 90%RH and there is no condensation around.

（3）**Vibration**

The servo motor should be fixed in a place away from vibration and its vibration should be less than 0.5G（4.9m/s^2）.

2）Installation method

（1） **Installation type**

SJT series motors are installed by flange installation type and it may be installed in every direction.

（2） **Installation cautions：**

- Do not hammer the motor or its shaft to prevent the encoder from damaging. Helical tools should be employed to connect or disconnect the parts.
- SJT series motor cannot be loaded with heavy axial, radial loading. Flexible shaft coupling is recommended to connect the load.
- Anti-loose washer should be employed to secure the motor from loose.

CHAPTER 3 WIRING

⚠ Warning

- **The system wiring or check can only be done by qualified personnels.**
- **Wiring and check can only be done in 5 minutes to avoid electric shock after the power supply is cut off.**

⚠ Caution

- **The wiring must be done by terminal voltage and polarity to avoid equipment damage or personnel injury.**
- **Drive unit and servo motor must be well grounded.**

3.1 Standard wiring

The external connection of drive unit is relative to control mode.

1） Position control mode

Fig. 3.1 shows the standard wiring of position control mode.

2） Speed control mode

Fig. 3.2 shows the standard wiring of speed control mode.

3） Wiring

（1） Power supply terminal TB

- Wire diameter： wire diameter of R, S, T, PE, U, V, W terminals ≥1.5mm^2(AWG14-16)，wire diameter of r, t terminals≥1.0 mm^2(AWG16-18).
- Grounding: the grounding wire should be thick, PE terminals of drive unit and servo motor should be eathed and their resistances are less than 0.1Ω.
- The terminal connection is employed with JUT-1.5-4 pre-insulation cold-press terminals, and it must be secured firmly.
- It is suggested that three-phase isolation transformer is employed for the power to avoid the electric shock.
- It is suggested that power supply is connected to a noise filter to improve anti-interference capability.
- Install non-fusing breaker to cut off external power supply in time when the drive

unit is at fault.

（2） **Control signal CN1, feedback signal CN2**

- Wire diameter: it is employed with shield cable, wire diameter ≥0.12mm^2 (AWG24-26) and shield layer should be connected with FG terminal.
- Wire length: the cable length should be as possible as short, the CN1 cable should be less than 3m, and the feedback signal CN2 cable should be less than 20m.
- Wiring distribution: it should be far away from power circuit against antiinterference.
- Inductive components (coil) should be installed with surge absorbing elements: DC coil should be reversely connected with parallel freewheeling diode and AC coil should be connected with parallel RC absorption circuit.

Note

- **U, V, W should be connected with the corresponding motor winding one by one and reverse connection is unallowed.**
- **Cables and wires must be secured and their approaching to the drive unit radiator and motor should be avoided to ensure the insulation.**
- **Don't touch drive unit or motor within 5 minutes after the power supply is cut off because there is still a residual voltage on the electrolytic capacitance.**

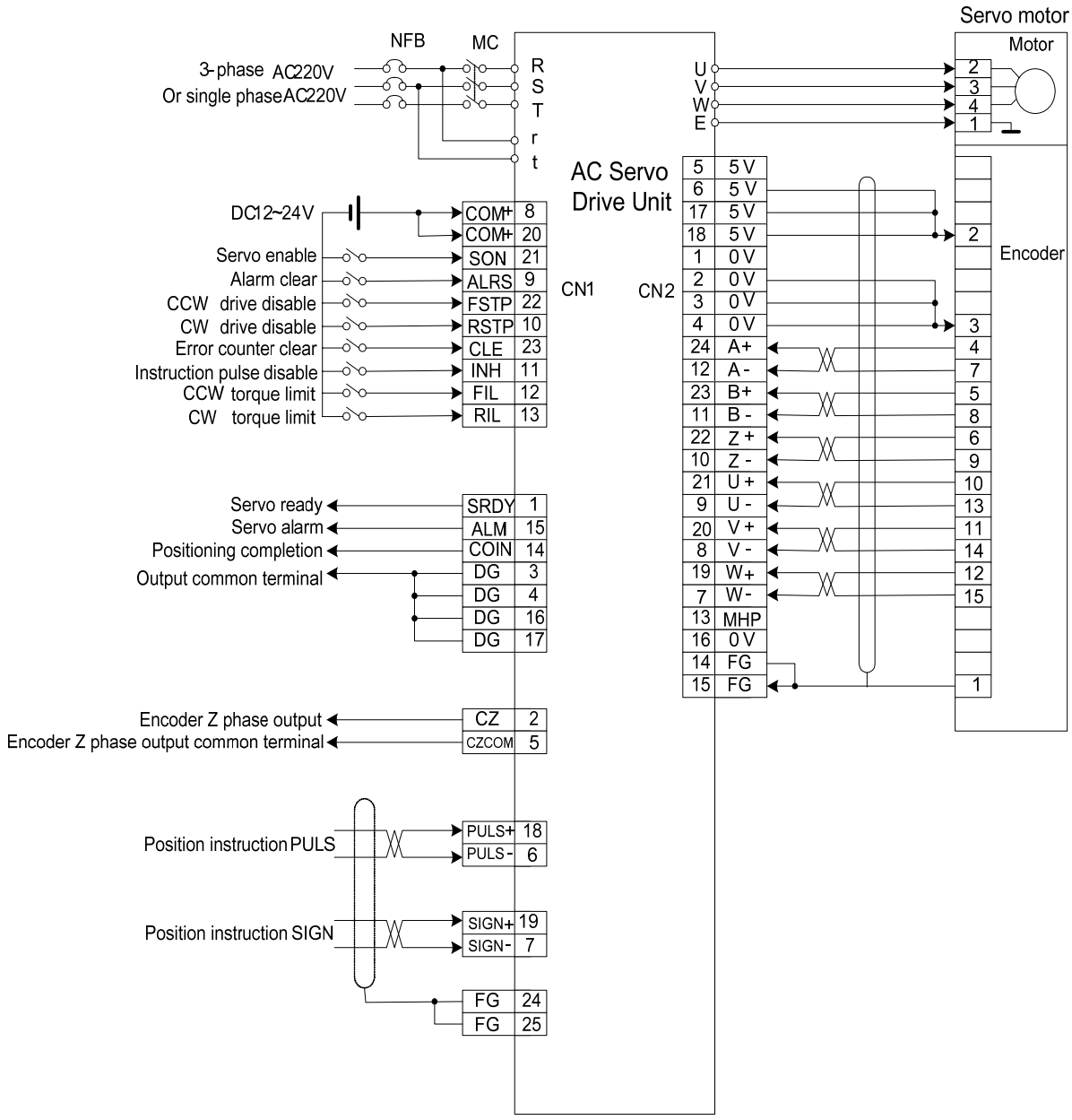


Fig. 3.1 Wiring of position control mode

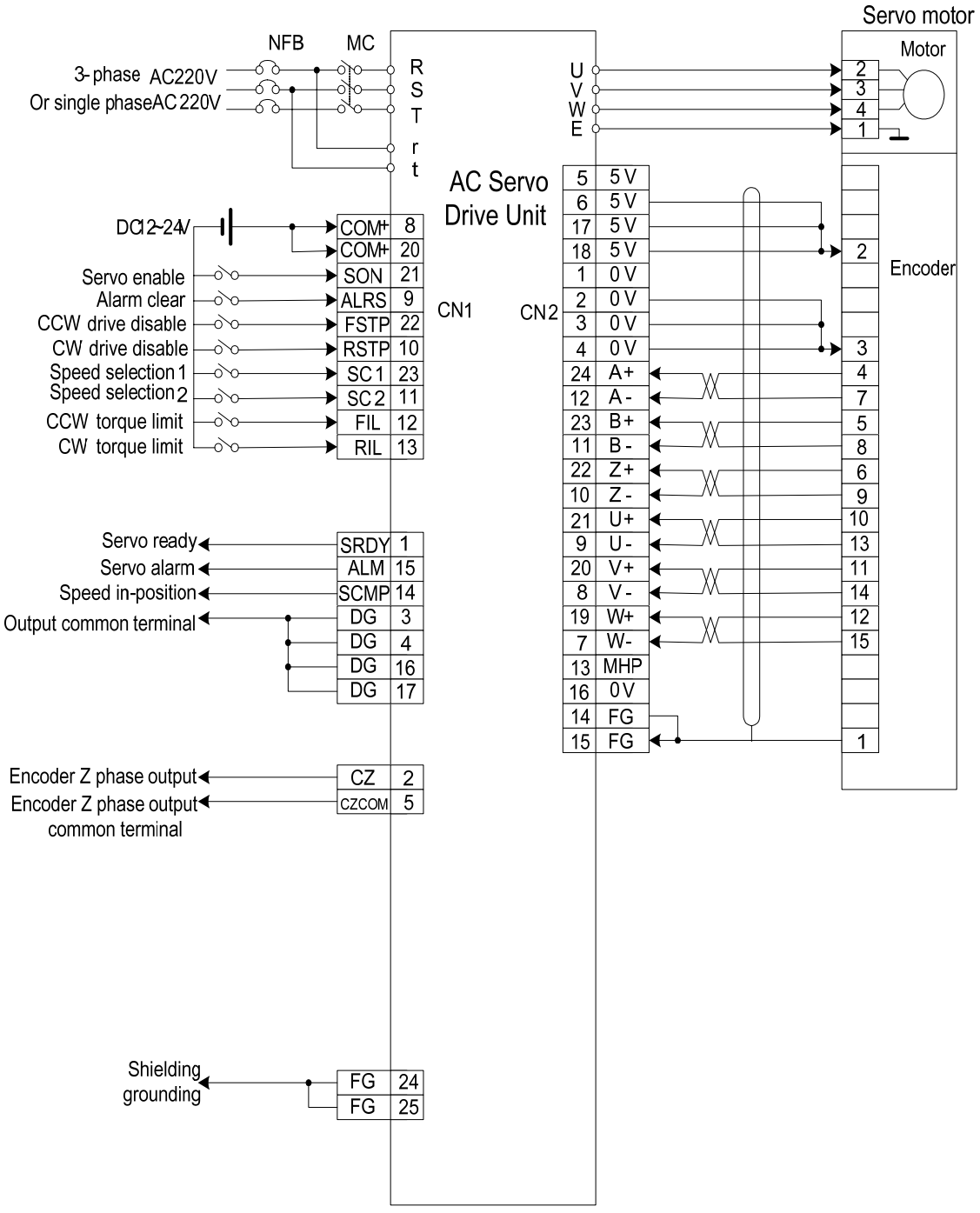
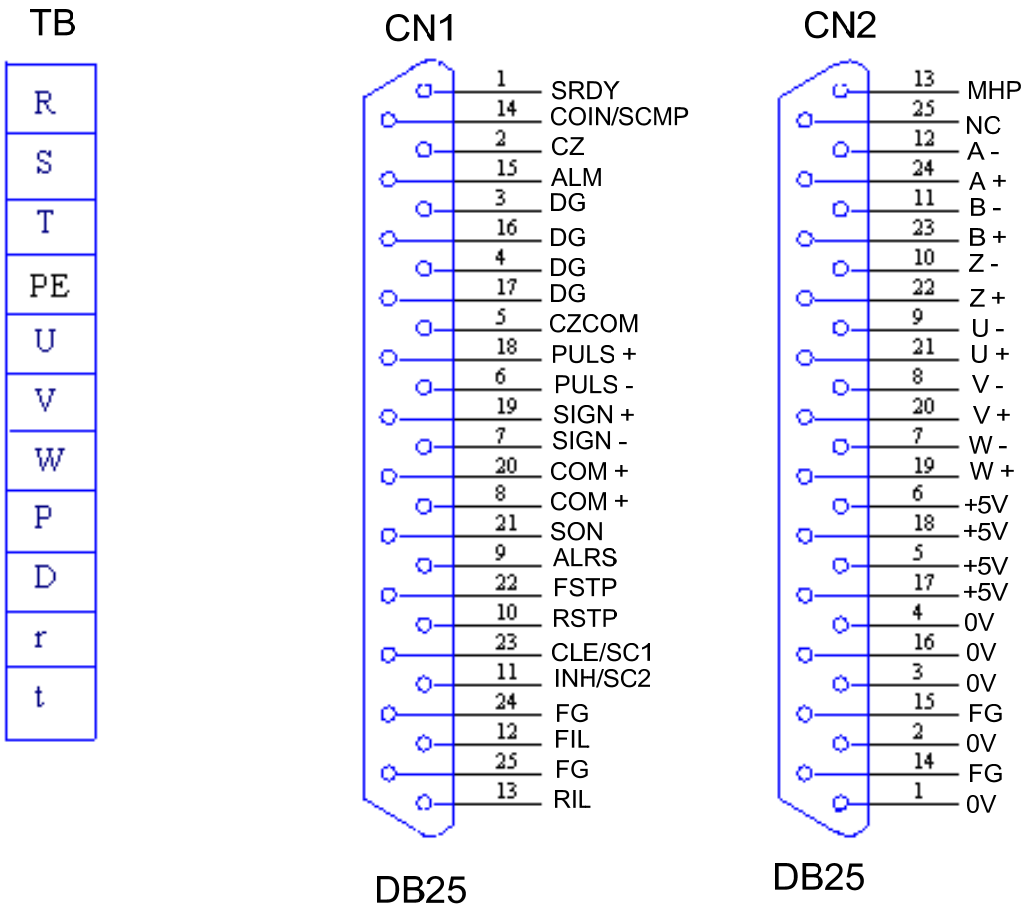


Fig. 3.2 Wiring of speed control mode

3.2 Terminals function

1） Terminals configuration

Fig. 3.3 is the interface terminal configuration of servo drive unit. TB is terminal block; CN1 is DB25 connector assembly，the socket is male type and the plug is female type; CN2 is DB25 connector assembly too, socket is female type and plug is male type.



Interface terminals configuration of AC servo drive unit`

2） Power supply terminal TB

Table3.1 Power supply terminal TB

Terminal No.	Terminal sign	Signal name	Function
TB-1	R	Main power supply (single phase or three-phase)	Main power supply input terminals ～220V 50Hz Note: Do not connect them with motor output terminals U, V, W.
TB-2	S		
TB-3	T		
TB-4	PE	System be grounded	Ground terminal Ground resistance＜0.1Ω Common terminal grounded of servo motor output and power supply input

TB-5	U	Servo motor output	Output terminals of servo motor must be connected correspondingly with U, V, W terminals of motor
TB-6	V		
TB-7	W		
TB-8	P	Standby	
TB-9	D	Standby	
TB-10	r	Control power supply single phase	Power supply input terminal of control circuit ～220V 50Hz
TB-11	t		

3） Control terminal CN1

Control mode name for short:

P for position control mode
S for speed control mode

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 terminals	COM+	Type 1		Power supply positive of input terminals Photoelectric coupling used for driving input terminals DC12～24V，Current≥100mA
CN1-21	Servo enable	SON	Type 1		Input terminal of servo enable SON ON：AC servo drive unit enable SON OFF：AC servo drive unit off and disabled and the motor is in free state. **Note 1** The motor must be resting before it is switched from SON OFF to SON ON; **Note 2** Wait for 50ms before inputting new command after it is switched to SON ON.
CN1-9	Alarm clear	ALRS	Type 1		Alarm clear input terminal ALRS ON： alarm clear ALRS OFF： alarm **Note** For the alarm whose code is more than 8 it can't be cleared by this means. It needs to cut off the power for reparation and then repower.
CN1-22	CCW drive stop	FSTP	Type 1		CCW drive stop input terminal FSTP ON：CCW drive enable FSTP OFF：CCW drive stop **Note 1** It is used for mechanical overload. When the switch is put for OFF, the torque in CCW direction is kept for 0. **Note 2** This function can be shielded by parameter No.20 setting or always keep the switch for ON.

CN1-10	CW drive stop	RSTP	Type 1		CW drive stop input terminal RSTP ON：CW drive enable RSTP OFF：CW drive stop **Note 1** It is used for mechanical overload. When the switch is put for OFF, the torque in CW direction is kept for 0. **Note 2** This function can be shielded by parameter No.20 setting or always keep the switch for ON.
CN1-23	Deviator clear	CLE	Type 1	P	Input terminal of position deviator clear CLE ON： position deviator clear in position control
	Speed selection 1	SC1	Type 1	S	Input terminal of speed selection 1 The combination of SC1 and SC2 is used for selecting different internal speed in speed control mode SC1 OFF，SC2 OFF： internal speed 1 SC1 ON，SC2 OFF： internal speed 2 SC1 OFF，SC2 ON： internal speed 3 SC1 ON，SC2 ON： internal speed 4 Note The values of internal speed 1～4 can be modified by parameters.

Table 3.2 Input/output terminal CN1 of control signal (continued)

Terminal No.	Signal name	Sign	I/O	Mode	Function
CN1-11	Instruction pulse disable	INH	Type 1	P	Terminal of position instruction pulse input disable INH ON： input disable of instruction pulse INH OFF： instruction pulse input valid
	Speed selection 2	SC2	Type 1	S	Input terminal of speed selection 2 The combination of SC1 and SC2 is used for selecting different internal speed in speed control mode. SC1 OFF，SC2 OFF： internal speed 1 SC1 ON：SC2 OFF： internal speed 2 SC1 OFF，SC2 ON： internal speed 3 SC1 ON，SC2 ON： internal speed 4
CN1-12	CCW torque limit	FIL	Type 1		CCW input terminal of CCW torque limit FIL ON： CCW torque is limited by the parameter No.36. FIL OFF： CCW torque is not limited by the parameter No.36. **Note** Whether FIL is valid or not, CCW torque is also limited by parameter No.34.

					Usually, parameter No.34> parameter No.36.
CN1-13	CW torque limit	RIL	Type 1		Input terminal of CW torque limit RIL ON：CW torque is limited by parameter No.37. RIL OFF：CW torque is not limited by parameter No.37. **Note** Whether RIL is valid or not, CW torque is also limited by parameter No.35. Usually, parameter No.35> parameter No.37.
CN1-1	Servo ready output	SRDY	Type 2		Servo ready output terminal SRDY ON： If control and main power are normal, the AC servo drive unit has no alarm, the servo ready is set for ON. If main power is not making, or the AC servo drive unit has an alarm, the servo ready is set for OFF.
CN1-15	Servo alarm output	ALM	Type 2		Output terminal of servo alarm ALM ON：If AC servo drive unit has no alarm, servo alarm is set for ON. ALM OFF：If AC servo drive unit has an alarm, servo alarm is set for OFF.
CN1-14	Positioning completion output	COIN	Type 2	P	Output terminal of positioning completion COIN ON： When the position deviator value is within the set positioning range, the positioning completion is set for ON.
	Speed in-position output	SCMP	Type 2	S	Output terminal of speed in-position SCMP ON： When the actual speed reaches or exceeds the speed specified, speed in-position is set for ON.
CN1-3 CN1-4 CN1-16 CN1-17	Common terminals of output	DG			Common ground terminals of control signal output terminals(except CZ)
CN1-2	Encoder Z phase output	CZ	Type 2		Output terminal of encoder Z phase Z phase pulse output of servo motor photoelectric encoder CZ ON： Z phase signal occuring
CN1-5	Common terminal of encoder Z phase output	CZCOM			Common terminal of encoder Z phase
CN1-18	PLUS input of instruction pulse	PULS +	Type 3	P	Input terminals of external instruction pulse **Note** The pulse input mode is set by parameter 04. ① instruction pulse +sign mode ② CCW/CW instruction pulse mode
CN1-6		PULS -			
CN1-19	SIGN input of instruction pulse	SIGN +	Type 3	P	
CN1-7		SIGN -			
CN1-24 CN1-25	Shielding grounding	FG			Shielding grounding terminals

4） Feedback signal terminal CN2

Table 3.3 CN2 input/output terminal of encoder signal

Terminal No.	Signal name	Terminal mark			Color	Function
		Mark	I/O	Mode		
CN2-5 CN2-6 CN2-17 CN2-18	Power supply output (+)	+5V				The servo motor photoelectric encoder is employed with +5V power supply; multi-core cable in parallel are used as the length of cable is too long.
CN2-1 CN2-2 CN2-3 CN2-4 CN2-16	Power supply output (-)	0 V				
CN2-24	Encoder (A+) input	A+	Type 4			Connecting with servo motor photoelectric encoder（A+）
CN2-12	Encoder (A-) input	A-				Connecting with servo motor photoelectric encoder（A-）
CN2-23	Encoder (B+) input	B+	Type 4			Connecting with servo motor photoelectric encoder（B+）
CN2-11	Encoder (B-) input	B-				Connecting with servo motor photoelectric encoder（B-）
CN2-22	Encoder (Z+) input	Z+	Type 4			Connecting with servo motor photoelectric encoder（Z+）
CN2-10	Encoder (Z-) input	Z-				Connecting with servo motor photoelectric encoder（Z-）
CN2-21	Encoder (U+) input	U+	Type 4			Connecting with servo motor photoelectric encoder（U+）
CN2-9	Encoder (U-) input	U-				Connecting with servo motor photoelectric encoder（U-）
CN2-20	Encoder (V+) input	V+	Type 4			Connecting with servo motor photoelectric encoder（V+）
CN2-8	Encoder (V-) input	V-				Connecting with servo motor photoelectric encoder（V-）
CN2-19	Encoder (W+) input	W+	Type 4			Connecting with servo motor photoelectric encoder（W+）
CN2-7	Encoder (W-) input	W-				Connecting with servo motor photoelectric encoder（W-）

3.3 I/O Interface principle

1） Input interface of switching volume

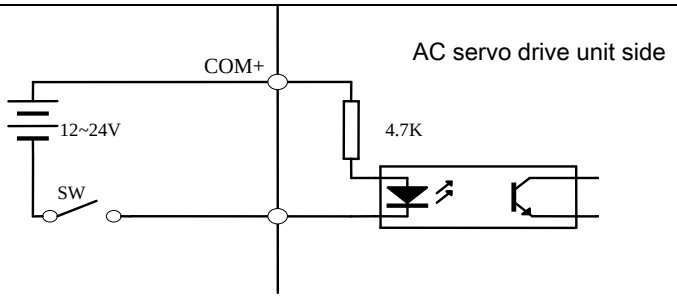


Fig. 3.4 Type 1 Input interface of switching volume

（1）Power suppy is provided by user，DC12～24V，current≥100mA；

（2）**Note** If current polarity is connected reversely, the drive unit will not run.

2） Output interface of switching volume

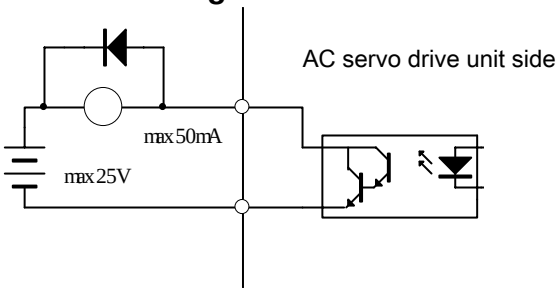


Fig. 3.5 Type 2 Output interface of switching volume

（1） External power supply is provided by user; if its polarity is connected reversely, the drive unit will be damaged.

（2） The output is by collector open circuit, and its max. current is 50mA, external max. power supply voltage is 25V. So the load of switching volume output signal must conform to these restrictions. If the load exceeds them or the output is connected directly with power supply, the servo drive unit may be damaged.

（3） If the load is an inductive one such as relay, the both terminals of load must be connected with freewheeling diode in parallel reversely. If the freewheeling diode is connected reversely, the servo drive unit may also be damaged.

3） Pulse volume input interface

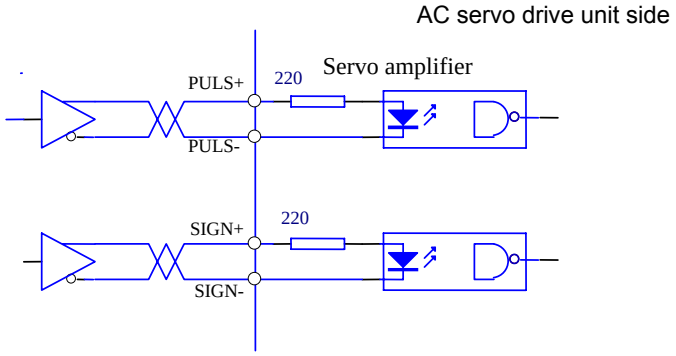


Fig. 3.6 Type 3 Differential drive mode of pulse volume input interface

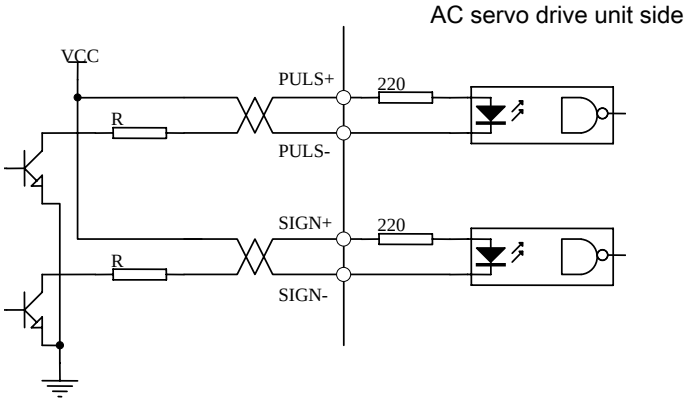


Fig. 3.7 Type 3 Single terminal drive mode of pulse volume input interface

（1） Differential drive mode is recommended to be used to transmit pulse data.

（2） AM26LS31, MC3487 or the similar RS422 linear driver are employed in the differential drive mode.

（3） Action frequency will be reduced in single terminal drive mode. Decide the value of resistance R according to the pulse input circuit, the 10～15mA drive current and the max. 25V voltage of the external power. Practical data: VCC=24V，R=1.3K～2K；VCC=12V，R=510～820Ω；VCC=5V，R=82～120Ω.

（4） In single terminal drive mode, the external power supply is provided by user. And if its polarity is connected reversely, the servo drive unit may be damaged.

（5） Refer to Table 3.4 about pulse input form, arrowhead represents counting edge, and pulse input time sequence and parameter are shown in Table 3.5.

Table 3.4 Pulse input form

Pulse instruction type	CCW	CW	Parameter setting value
Pulse string Sign string	PULS SIGN		0 Instruction pulse + signal
CCW pulse string CW pulse string	PULS SIGN		1 CCW pulse /CW pulse

Table 3.5 Time sequence parameter of pulse input

Parameter	Differential drive input	Single terminal drive input
T_{ck}	>2μs	>5μs
T_h	>1μs	>2.5μs
T_l	>1μs	>2.5μs
T_{rh}	<0.2μs	<0.3μs
T_{rl}	<0.2μs	<0.3μs
T_s	>1μs	>2.5μs
t_{qck}	>8μs	>10μs
T_{qh}	>4μs	>5μs
T_{ql}	>4μs	>5μs
t_{qrh}	<0.2μs	<0.3μs
t_{qrl}	<0.2μs	<0.3μs
T_{qs}	>1μs	>2.5μs

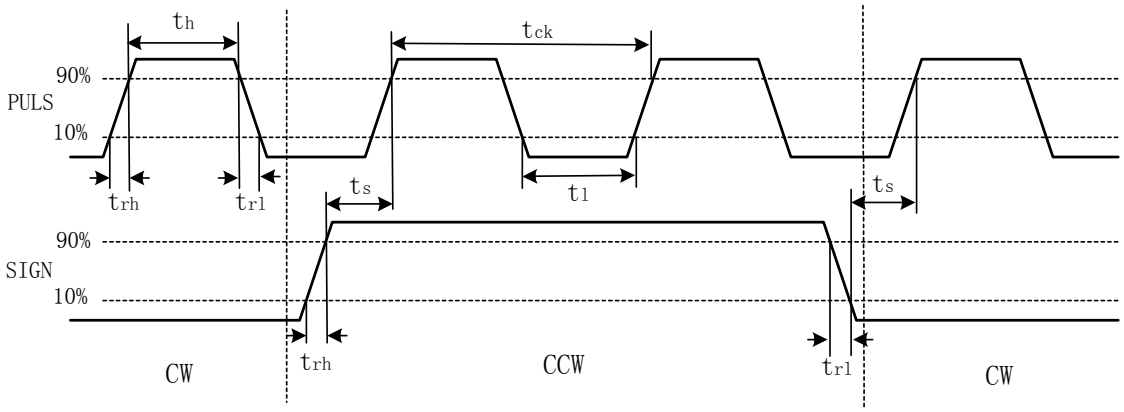


Fig. 3.8 Time sequence of pulse +sign input interface (max. pulse frequency 500kHz)

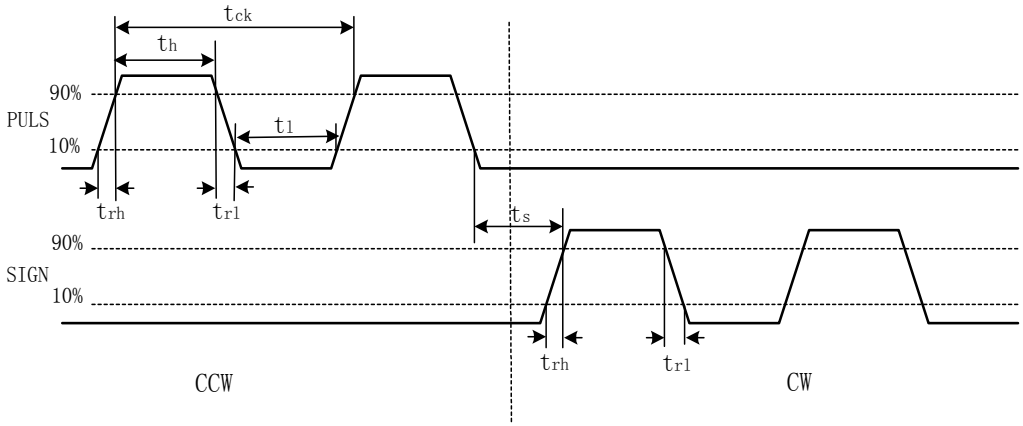


Fig. 3.9 Time sequence of CCW/CW pulse input interface (max. pulse frequency 500kHz)

4) Input interface of servo motor photoelectric encoder

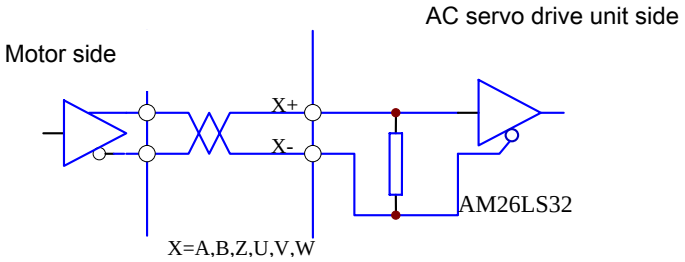


Fig. 3.10 Input interface of servo motor photoelectric encoder

CHAPTER 4 PARAMETERS

⚠ Note

- **Personnel for parameters setting must have a good knowledge of the parameter meanings and the false setting may cause damage to the equipments or injury to people.**
- **Parameter adjustment is suggested to be done in the servo motor dry run mode.**
- **The motor parameter defaults the servo motors of GSK SJT series,Huazhong STZ, Star series, and the corresponding parameters must be adjusted if other servo motor is used, otherwise, the motor may run abnormally.**

4.1 Parameter list

Values set by factory in Table 4.1 are applicable for the AC servo drive unit matching GSK 110SJT-M020E（2N•m, 3000r/min）motor. The parameters for different motors are not identical.

Table 4.1 Parameter list

No.	Name	Applicable mode	Range	Value set by factory	Unit
0	Password	P，S	0~9999	315	
1	Model code	P，S	0~69	60*	
2	Software version (read-only)	P，S	*	*	
3	Initial display state	P，S	0~20	0	
4	Control mode selection	P，S	0~5	0	
5	Speed proportional gain	P，S	5~2000	170*	Hz
6	Speed integration time constant	P，S	1~1000	50*	
7	Torque instruction filter	P，S	1~500	30	%
8	Speed detecting lowpass filter	P，S	1~500	120	%
9	Position proportional gain	P	1~1000	30	1/s
10	Position feedforward gain	P	0~100	0	%
11	Lowpass filter cut-off frequency of position feedforward	P	1~1200	300	Hz
12	Frequency division numerator of position instruction pulse	P	1~32767	1	
13	Frequency division denominator of position instruction pulse	P	1~32767	1	
14	Position instruction pulse input mode	P	0~1	0	

15	Position instruction pulse reverse direction	P	0~1	0	
16	Positioning completion range	P	0~30000	20	Pulse
17	Position out-of-tolerance detection range	P	0~30000	200	×100 pulse
18	Position out-of-tolerance error invalid	P	0~1	0	
19	Position instruction smooth filter	P	0~30000	0	0.1ms
20	Drive stop input invalid	P，S	0~1	0	
21	JOG running speed	S	-3000~3000	120	r/min
22	Reserved				
23	Max. speed limit	P，S	0~4000	3600	r/min
24	Internal speed 1	S	-3000~3000	0	r/min
25	Internal speed 2	S	-3000~3000	100	r/min
26	Internal speed 3	S	-3000~3000	300	r/min
27	Internal speed 4	S	-3000~3000	-100	r/min
28	In-position speed	S	0~3000	500	r/min
29	Reserved				
30	Conversion numerator of linear speed	P，S	1~32767	10	
31	Conversion denominator of linear speed	P，S	1~32767	1	
32	Decimal point of linear speed	P，S	0~5	3	
33	Reserved				
34	Internal CCW torque limit	P，S	0~300	300*	%
35	Internal CW torque limit	P，S	-300~0	-300*	%
36	External CCW torque limit	P，S	0~300	100	%
37	External CW torque limit	P，S	-300~0	-100	%
38	Trial speed, JOG torque limit	S	0~300	100	%
39	Reserved				
40	Acceleration time constant	S	1~10000	0	ms
41	Deceleration time constant	S	1~10000	0	ms

4.2 Parameter function

Table 4.2 Parameter function

No.	Name	Function	Parameter range
0	Password	①It is used for parameter to be modified by mistake. Usually set this parameter for a required password and then set the parameter to be modified. After debugging, set this parameter for 0 to ensure it not to be modified by mistake later. ②The password is classified into several levels which correspond to user parameter, system parameter and all the other parameters. ③Use the model password to modify model parameter (No.1) and the model parameter can't be modified by other password. ④The user password is 315. ⑤The drive unit model password is 385.	0~9999
1	Model code	①It corresponds to the AC servo drive unit and motor with different power level in the same series. ②Different models correspond to different parameter default value. Ensure the parameter is right when using default parameter recovery function. ③This parameter should be set again after reparation for EEPROM alarm (No.20), then recover the default parameter. Or else the drive unit may act abnormally or be damaged. ④First set the password(parameter No. 0) for 385, then modify this parameter. ⑤Refer to this chapter for the parameters significance.	0~69
2	Software version (read-only)	Software version can be viewed but cannot be modified.	*

3	Initial display state	Select display state after the AC servo drive unit is powered on. 0：Motor speed display; 1：Current position lower 5-bit display; 2：Current position higher 5-bit display; 3：Position instruction (instruction pulse accumulation) lower 5-bit display; 4：Position instruction (instruction pulse accumulation) higher 5-bit display; 5：Position error lower 5-bit display; 6：Position error higher 5-bit display; 7：Motor torque display; 8：Motor current display; 9：Linear speed display; 10：Control mode display; 11：Position instruction pulse frequency display; 12：Speed instruction display; 13：Torque instruction display; 14：Rotor absolute position display in one revolution; 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.	0~20
4	Control mode selection	Set control mode of drive unit by this parameter: 0：Position control mode; 1： Speed control mode 2：Trial run control mode; 3：JOG control mode; 4：Encoder zeroing mode; 5：Open loop mode(for motor and encoder test) ①Position control mode Position instruction is input from the pulse input interface. ②Speed control mode Speed instruction is input from the input terminal. The internal speed is selected by the combination of SC1 and SC2. SC1 OFF，SC2 OFF ：internal speed 1 SC1 ON，SC2 OFF ：internal speed 2 SC1 OFF，SC2 ON ：internal speed 3 SC1 ON，SC2 ON ：internal speed 4 ③Trial run control mode Speed instruction is input from the keyboard, which is used for drive unit and servo motor test. ④JOG control mode In this mode, pressing down ↑ key and holding it on, the motor runs by JOG speed, releasing the key, the motor stops and keeps zero speed; pressing down ↓ key and holding it on, the motor runs reversely by JOG speed; releasing the key, the motor stops and keeps zero speed. ⑤Encoder zeroing mode It is used for encoder factory zeroing adjustment of motor.	0~5

5	Speed proportional gain	①Set the proportional gain of speed loop regulator. ②The bigger the setting value is, and the higher the gain is, the bigger the rigidity is. The parameter value is defined by specific AC servo drive unit model and load. Generally, the bigger the load inertia， the bigger the setting value is. ③Set the bigger value if there is no oscillation in system.	5 Hz ~2000Hz
6	Speed integration time constant	①Set integral time constant of speed loop regulator. ②The bigger the setting value is, the faster the integral speed and the smaller the rigidity is. The parameter value is defined by specific AC servo drive unit model and load. Generally, the larger the load inertia， the larger the setting value is. ③Set bigger value if there is no oscillation in system.	1 ~1000
7	Torque instruction filter	①Set the torque instruction filter characteristic. It can suppress the the resonance resulted by torque (piercing noise from motor). ②If the motor makes piercing noise in running, please reduce this parameter. ③The smaller the value is and the lower the cut-off frequency is, the smaller the noise from the motor is. If the load inertia is too large, reduce the setting value properly. If the value is too small, the response will be slow which may cause instability. ④The larger the value is and the higher the cut-off frequency is, the faster the response is. If a higher mechanic rigidity is needed, increase the setting value properly.	1%~500%
8	Speed detecting lowpass filter	①Set speed detecting lowpass filter characteristics. ②The smaller the setting value is, the lower the cutoff frequency, the smaller the motor noise is. Properly reduce setting value if the load inertia is too large. If the value is too small, the response will be slow which may cause oscillation. ③The larger the value is and the higher the cutoff frequency is, the faster the speed feedback response is. Properly increase setting value if faster speed response is needed.	1%~500%
9	Position proportional gain	①Set proportional gain of position loop regulator. ②The larger the setting value is, the higher the gain is, and the larger the rigidity is in the same frequency instruction pulse, the smaller the position lag is. If the value is too large, the oscillation or overshooting may occur. ③The parameter value is defined by specific servo drive unit model and load.	1/s ~1000 /s
10	Position feedforward gain	①Set the feedforward gain of the position loop. ②If it is set for 100%, it means the position lag is always 0 in any instruction pulse frequency. ③If the feedforward gain of the position loop increases, the quick response characteristic of the control system will be enhanced. But it will make the system position loop unstable and oscillation may occur. ④Unless the high response characteristic is needed, the feedforward gain of the position loop is usually 0.	0%~100%
11	Lowpass filter cut-off frequency of position feedforward	①Set the cutoff frequency of lowpass filter of position loop feedforward. ②The filter is used for enhancing the stability of complex position control.	1Hz~1200Hz

12	Frequency division numerator of position instruction pulse	①Set frequency division/multiplication (electronic gear) of position instruction pulse. ②In position control mode, various pulse resource can be conveniently matched by parameter No.12, No.13 setting to get a desirable control resolution(i.e. angle/pulse) by user. ③ $P \times G = N \times C \times 4$ P：pulse amount of input instruction; G：electronic gear ratio; G= frequency division numerator / frequency division denominator N：motor rotating circles; C：photoelectric encoder pulses/rev, this system C=2500 ④〖Example〗If the input instruction pulse is 6000, and servo motor revolution 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 for 5 and No. 13 is set for 3. ⑤Range of electronic gear ratio recommended is: $\frac{1}{50} \le G \le 50$	1~32767
13	Frequency division denominator of position instruction pulse	Refer to parameter No.12.	1~32767
14	Position instruction pulse input mode	①Set the input mode of position instruction pulse. ②2 input modes by parameter setting: 0： pulse+sign 1： CCW pulse/CW pulse ③Viewed from the servo motor shaft axially, the counterclockwise rotation is defined as negative. ④Viewed from the servo motor shaft axially, the clockwise rotation is defined as negative.	0~1
15	Position instruction pulse reverse direction	Set for: 0：normal 1：position instruction pulse reverse direction	0~1
16	Positioning completion range	①Set positioning completion pulse range in position control mode. ②This parameter provides factors for the drive unit judging whether the positioning is completed in position control. When the remaining pulses in position deviator is less than or equal to the setting value by this parameter, the drive unit defaults that the positioning is completed and the signal for it is COIN ON, otherwise, it is COIN OFF. ③It outputs positioning completion signal COIN in position control mode, and speed in-position signal SCMP in other control mode.	0~30000 pulse
17	Position out-of-tolerance detection range	①Set the range of position out-of-tolerance alarm detection. ②In position control mode, the drive unit gives position out-of-tolerance alarm when the counting value of position deviator exceeds this parameter setting value.	0~30000 ×100 pulse
18	Position out-of-tolerance error invalid	Set for: 0：The detection of position out-of-tolerance alarm is valid. 1：The detection of position out-of-tolerance alarm is invalid, and stop detecting the position out-of-tolerance error.	0~1

19	Position instruction smooth filter	①It filters the instruction pulse smoothly, which has an exponential acceleration/deceleration. Its value represents the time constant. ②The filter doesn't lose input pulse, but the instruction lag may occur. ③The filter is used for: ● Superordination controllor has no acceleration/deceleration function; ● The frequency division/multiplication of the electronic gear is large(>10) ● The instruction frequency is low; ● Motor step leap or unstability may occur in the running. ④If it is set for 0, the filter doesn't act.	0~30000×0.1 ms
20	Drive stop input invalid	Set for 0： For CCW, CW input disable valid. As the CCW drive switch （FSTP）is ON, CCW drive is enabled; as the CCW drive switch （FSTP）is OFF, the reverse torque in CCW direction is held for 0; vice versa for CW. If CCW, CW drive switch are both OFF, the drive input error alarm will be issued. 1： For CCW, CW input disable cancel. No matter the CCW, CW drive switches are in any mode, the CCW, CW drive are both allowed. If the CCW, CW drive switches are both OFF, no drive input error alarm is issued.	0~1
21	JOG running speed	Set the JOG running speed	-3000 r/min ~3000 r/min
22	Reserved		
23	Max. speed limit	①Set the max. speed of servo motor. ②It is irrelevant to rotary direction. ③If the setting value exceeds the rated speed, the actual max. speed is the rated speed.	0 r/min ~3000 r/min
24	Internal speed 1	① Set the internal speed 1. ② In speed control mode, if SC1, SC2 are both OFF, the internal speed 1 is regarded as speed instruction.	-3000 r/min ~3000 r/min
25	Internal speed 2	①Set the internal speed 2. ②In speed control mode, if SC1 is ON，SC2 is OFF, the internal speed 2 is regarded as speed instruction.	-3000 r/min ~3000 r/min
26	Internal speed 3	①Set the internal speed 3. ②In speed control mode, if SC1 is OFF，SC2 is ON, the internal speed 3 is regarded as speed instruction.	-3000 r/min ~3000 r/min
27	Internal speed 4	①Set the internal speed 4. ②In speed control mode, if SC1 is ON，SC2 is ON, the internal speed 4 is regarded as speed instruction.	-3000 r/min ~3000 r/min
28	In-position speed	①Set in-position speed. ②In non-position control mode, if the motor speed exceeds this setting value, SCMP is set for ON，or else SCMP is set for OFF. ③This parameter is not used in position control mode. ④It is irrelevant to rotary direction. ⑤The comparator has a retardation characteristic.	0 r/min ~3000 r/min

30	Conversion numerator of linear speed	①It is used for displaying the system linear running speed ② $\text{linear speed} = \text{motor speed (r/min)} \times \frac{\text{conversion numerator of linear speed}}{\text{conversion denominator of linear speed}}$ ③The decimal point location of linear speed is defined by the parameter No.32. 0 stands for no decimal point, 1 for ten's place, 2 for hundred's place, and so on. ④〖Example〗 If a servo motor drives a 10mm ball screw, the conversion numerator of the linear speed is set for 10, conversion denominator for 1, and the decimal point location is set for 3. So this linear speed with the unit m/min can be displayed. When the motor speed is 500r/min, it displays 5.000m/min.	1~ 32767
31	Conversion denominator of linear speed	See parameter No.30.	1~ 32767
32	Decimal point of linear speed	See parameter No.30.	0~5
34	Internal CCW torque limit	①Set the CCW internal torque limit of servo motor. ②The setting value is the percentage of the rated torque. E.g. if it is set for the double of the rated torque, the setting value is 200. ③The limit is valid in any conditions. ④If the setting value exceeds the allowable max. overload of the system, the actual torque limit is the allowable max. overload of the system.	0%~ 300%
35	Internal CW torque limit	①Set the CW internal torque limit of the servo motor. ②The setting value is the percentage of the rated torque. e.g. if it is set for the double of the rated torque, the setting value is -200. ③The limit is valid in any conditions. ④If the setting value exceeds the allowable max. overload of the system, the actual torque limit is the allowable max. overload of the system.	-300% ~0%
36	External CCW torque limit	①Set the CCW external torque limit of the servo motor. ②The setting value is the percentage of the rated torque. e.g. if it is set for the rated torque, the setting value is 100. ③The limit is only valid when the input terminal (FIL) of CCW torque limit is set for ON. ④When the limit is valid, the actual torque limit is the minimum of the allowable max. overload, internal CCW torque limit, external CCW torque limit of the system.	0%~ 300%
37	External CW torque limit	①Set the CW external torque limit of the servo motor. ②The setting value is the percentage of the rated torque. e.g. if it is set for the rated torque, the setting value is -100. ③The limit is only valid when the input terminal (RIL) of CW torque limit is set for ON. ④When the limit is valid, the actual torque limit is the minimum of the allowable max. overload, internal CW torque limit, external CW torque limit of the system.	-300% ~0%
38	Trial speed, JOG torque limit	①Set the torque limits in trial speed, JOG mode. ②It is valid for bi-direction and irrelevant to the rotary direction. ③The setting value is the percentage of the rated torque. e.g. if it is set for the rated torque, the setting value is 100. ④Internal and external torque limits are still valid.	0%~ 300%

40	Acceleration time constant	①The setting value represents the motor acceleration time from 0r/min~1000r/min ②The acceleration/deceleration characteristic is linear. ③It is only used in speed control mode, but not in position control mode. ④If the AC servo drive unit is combined with external position loop, this parameter is set for 0.	1 ms ~10000ms
41	Deceleration time constant	①The setting value represents the motor deceleration time from 1000r/min~0r/min. ②The acceleration/deceleration characteristic is linear. ③It is only used in speed control mode, but not in position control mode. ④If the AC servo drive unit is combined with external position loop, this parameter is set for 0.	1 ms ~10000ms

4.3 Correspondence of model code parameter and motor

Table 4.3 Correspondence of parameter No.1 and GSK SJT series servo motor

Parameter №1	Servo motor model and technical parameter	Remark
61	110SJT-M040D,1.0kW,300V, 4.5A,4.0N.m,2500r/min	
62	110SJT-M060D,1.5kW300V, 7.0A,6.0N.m,2500r/min	
63	130SJT-M040D,1.0kW,300V, 4.0A,4.0N.m,2500r/min	
64	130SJT-M050D,1.3kW,300V, 5.0A,5.0N.m,2500r/min	
65	130SJT-M060D,1.5kwW,300V, 6.0A,6.02N.m,2500r/min	
66	130SJT-M075D,1.88kW,300V, 7.5A,7.5N.m,2500r/min	※
67	130SJT-M100B,1.5kW,300V, 6.0A,10.0N.m,1500r/min	
68	130SJT-M100D,2.5kW,300V, 10.0A,10.0N.m,2500r/min	※
69	130SJT-M150B,2.3kW,300V, 8.5A,15.0N.m,1500r/min	※

Table 4.4 Correspondence of parameter No.1 and GSK STZ series servo motor

Parameter №1	Servo motor model and technical parameter	Remark
0	110STZ2-1-HM, 0.4kW,300V, 2.5A,2000r/min,5.4×10^{-4}kg.m^2	
1	110STZ2-2-HM, 0.6kwW,300V, 4A,3000r/min,5.4×10^{-4}kg.m^2	
2	110STZ4-1-HM, 0.8kW,300V, 3A, 2000r/min,9.1×10^{-4}kg.m^2	
3	110STZ4-2-HM, 1.2kW,300V, 5A, 3000r/min,9.1×10^{-4}kg.m^2	
4	110STZ5-1-HM, 1.0kW,300V, 4A,2000r/min,1.1×10^{-3}kg.m^2	
5	110STZ5-2-HM, 1.5kW,300V, 5.5A,3000r/min,1.1×10^{-3}kg.m^2	
6	110STZ6-1-HM, 1.2kW,300V, 4.5A,2000r/min,1.29×10^{-3}kg.m^2	
7	130STZ7.5-1-HM, 1.4kW,300V, 5.5A,2000r/min ,2.8×10^{-3}kg.m^2	
8	130STZ10-1-HM, 1.4kW,300V, 5.5A,1500r/min,3.6×10^{-3}kg.m^2	
9	130STZ5-1-HM, 1.0kW,300V, 4A,2000r/min,2.0×10^{-3}kg.m^2	
10	130STZ5-2-HM, 1.5kW,300V, 5.5A,3000r/min,2.0×10^{-3}kg.m^2	

11	130STZ7.5-2-HM, 2.0kW,300V, 9.5A,3000r/min,2.8×10^{-3}kg.m^2	※
12	130STZ10-2-HM, 2.3kW,300V, 9.5A,2500r/min,3.6×10^{-3}kg.m^2	※
13	130STZ15-1-HM, 2.1kW,300V, 8A,1500r/min,5.2×10^{-3}kg.m^2	※
14	90STZ1-HM, 0.3kW,300V, 2.0A,3000r/min,2.1×10^{-4}kg.m^2	
15	90STZ2-HM, 0.6kW,300V, 3.0A,3000r/min,3.1×10^{-4}kg.m^2	
16	110STZ6-2-HM,1.7kW,300V, 7A,3000r/min,1.29×10^{-3}kg.m^2	※
17	130STZ4-1-HM, 0.8kW,300V, 4A,2000r/min,1.6×10^{-3}kg.m^2	
18	130STZ4-2-HM, 1.2kW,300V, 5.5A,3000r/min,1.6×10^{-3}kg.m^2	
19	130STZ6-1-HM, 1.2kW,300V, 4A,2000r/min,2.4×10^{-3}kg.m^2	
20	130STZ6-2-HM, 1.8kW,300V, 5.5A,3000r/min,2.4×10^{-3}kg.m^2	※

Table 4.5 Correspondence of parameter No.1 and HUAZHONG Star series servo motor

Parameter №1	Servo motor model and technical parameter	Remark
30	110ST-M02030H，0.6kw,300V, 3000r/min,4A,0.33×10^{-3}kg.m^2	
35	110ST-M04030H，1.2kw,300V, 3000r/min,5A,0.65×10^{-3}kg.m^2	
36	110ST-M05030H，1.5kw,300V, 3000r/min,6A,0.82×10^{-3}kg.m^2	
37	110ST-M06020H，1.2kw,300V, 2000r/min,6A,1.00×10^{-3}kg.m^2	
38	110ST-M06030H，1.6kw,300V, 3000r/min,8A,1.00×10^{-3}kg.m^2	※
39	130ST-M04025H，1.0kw,300V,2500r/min,4A,0.85×10^{-3}kg.m^2	
45	130ST-M05025H，1.3kw,300V, 2500r/min,5A,1.06×10^{-3}kg.m^2	
46	130ST-M06025H，1.5kw,300V, 2500r/min,6A,1.26×10^{-3}kg.m^2	
47	130ST-M07720H，1.6kw,300V, 2000r/min,6A,1.58×10^{-3}kg.m^2	※
49	130ST-M10015H，1.5kw,300V, 1500r/min,6A,2.14×10^{-3}kg.m^2	
50	130ST-M10025H，2.6kw,300V, 2500r/min,10A,2.14×10^{-3}kg.m^2	※
51	130ST-M15015H，2.3kw, 300V, 1500r/min,9.5A,3.24×10^{-3}kg.m^2	※

Table 4.6 Correspondence of parameter No.1 and LIYUAN SN series servo motor

Parameter №1	Servo motor model and technical parameter	Remark
0	80SNSA2IE, 0.4kW, 300V, 2.8A, 2000r/min, 0.165×10^{-3}kg.m^2	
0	80SNSA1.6IE, 0.4kW, 300V, 3.1A, 3000r/min, 0.152×10^{-3}kg.m^2	
0	110SNMA2IE, 0.4kW,300V, 2.0A,2000r/min, 0.246×10^{-3}kg.m^2	
2	110SNMA4IE, 0.8kW,300V, 3.3A,2000r/min, 0.42×10^{-3}kg.m^2	
3	110SNMA4IIE, 1.2kW,300V, 5.0A,3000r/min, 0.488×10^{-3}kg.m^2	
3	110SNMA4IIEZ, 1.2kW,300V, 5.0A,3000r/min,0.488×10^{-3}kg.m^2	With hold
6	110SNMA6IE, 1.2kW,300V, 5.0A,2000r/min, 0.718×10^{-3}kg.m^2	
16	110SNMA6IIEZ, 1.8kW,300V, 7.0A,3000r/min,0.718×10^{-3}kg.m^2	※,with hold
17	130SNMA4IIE, 0.8kW,300V, 3.5A,2000r/min, 0.717×10^{-3}kg.m^2	
9	130SNMA5IE, 1.0kW,300V, 4.2A,2000r/min, 0.74×10^{-3}kg.m^2	
19	130SNMA6IIE, 1.2kW,300V, 5.8A,2000r/min, 1.0×10^{-3}kg.m^2	
7	130SNMA7.5IE, 1.4kW,300V, 5.8A,2000r/min,1.31×10^{-3}kg.m^2	
8	130SNMA10IE, 1.4kW,300V, 6.8A,1500r/min, 1.74×10^{-3}kg.m^2	※
13	130SNMA15IE, 2.1kW,300V, 8.6A,1500r/min, 2.37×10^{-3}kg.m^2	※

Note 1 **For the motor with "※"sign, a thick radiator should be employed to the AC servo drive unit matched with it.**

Note 2 **The factory set parameters for LIYUAN series servo motor have been backup in the EEPROM area of DA98A AC servo drive unit. When these parameters are to be recovered in DA98A AC servo drive unit, the user should perform backup recovery but default parameter recovery operation.**

CHAPTER 5 ALARM AND TROUBLESHOOTING

Note

- **Personnel undertaking check and maintenance should be qualified with the knowhow knowledge and capability.**
- **Do not touch the drive unit and motor within 5 minutes after they are cut off to avoid electric shock and burning.**
- **The drive unit that fault alarm occurs can be put into use only after its fault is eliminated according to its alarm code.**
- **Make sure the SON signal (servo valid) invalid before resetting alarm to avoid the unexpected accident owing to motor suddenly start.**

5.1 Alarm list

Table 5.1 Alarm list

Alarm code	Alarm name	Content
--	Normal	
1	Overspeed	The servo motor speed exceeds its setting value.
2	Main circuit overvoltage	Power voltage of main circuit is too high.
3	Main circuit undervoltage.	Power voltage of main circuit is too low.
4	Position out-of-tolerance	The value of position deviator exceeds its setting value.
5	Motor overheated	Motor temperature is too high.
6	Saturation fault of speed amplifier	Speed amplifier saturation is too long.
7	Drive stop abnormal	Both CCW, CW drive stop inputs are OFF.
8	The position deviator overflow	Absolute value of position deviator exceeds 2^{30}.
9	Encoder fault	Encoder signal has errors.
10	Control power supply undervoltage	Control power supply is ±15V lower.
11	IPM module fault	IPM intelligent module is at fault.
12	Overcurrent	Motor current is too large.
13	Overload	The AC servo drive unit and motor are overloaded (instantaneous overheating).
14	Brake fault	Brake circuit is at fault.

15	Encoder counting error	Encoder counting is abnormal.
16	Motor heat overloading	The electrothermal value of the motor exceeds the setting value (I^2t detection).
19	Thermal reset	The system is thermally reset.
20	IC4(EEPROM) error	IC4 (EEPROM) is at fault.
21	IC3(PWM chip) error	IC3 (PWM chip) is at fault.
22	IC2(CODER chip) error	IC2 (CODER chip) is at fault.
23	IC7(A/D chip) error	IC7 (A/D chip) or current sensor is at fault.
30	Encoder Z pulse lost	Encoder Z pulse is at fault.
31	Encoder UVW signal error	Encoder U, V, W signal is at fault or not suited with encoder.
32	Encoder UVW signal illegal encoding	U,V,W signals are all high level or all low level.

5.2 Alarm troubleshootings

Table 5.2 Alarm troubleshootings

Alarm code	Alarm name	Status	Cause	Troubleshootings
1	Overspeed	Occuring as control power supply is powered on	①Control circuit board fault ②Encoder fault	①Change the AC servo drive unit. ②Change the servo motor.
		Occuring as motor is running	The pulse frequency of input instruction is too high.	Correctly set the input instruction pulse.
			Acceleration/deceleration time constant is too small to make the speed overshooting too large.	Increase acceleration/ deceleration time constant.
			The input electronic gear ratio is too large.	Set it correctly.
			Encoder fault	Change the servo motor.
			Encoder cable is inferior.	Change the encoder cable.
			Servo system is not stable that causes overshooting.	①Set the related gain again. ②If the gain can not be set to a proper value, reduce the moment inertia ratio of load.

		Occuring as motor is started	The load inertia is too large.	①Reduce the load inertia. ②Change the drive unit and motor by larger power ones.
			Encoder zero fault	①Change the servo motor. ②Adjust the encoder zero by the manufacturer.
			① Motor U, V, W lead wires are wrongly connected. ② Lead wire of encoder cable is wrongly connected.	Connect the wire correctly.
2	Main circuit overvoltage	Occuring as control power supply is powered on	The circuit board fault	Change the AC servo drive unit.
		Occuring as main power supply is powered on	① Power voltage is too high. ② Power voltage wave is abnormal.	Check power supply.
		Occuring as motor is running	Brake resistance connection is broken off.	Connect it again.
			①Brake transistor is damaged. ②Internal brake resistance is damaged.	Change the AC servo drive unit.
			Capacity of brake circuit is not enough.	①Reduce on-off frequency. ②Increase acceleration /deceleration time constant. ③Reduce the torque limit. ④Reduce load inertia. ⑤Change the drive unit and motor with larger power ones.
3	Main circuit undervoltage	Occuring as main power supply is powered on	①Circuit board fault ②Fuse of power supply is damaged. ③Soft starting circuit fault ④Rectifier is damaged.	Change the AC servo drive unit.
			①Power voltage is low. ②Temporary power off is more than 20ms.	Check power supply.
		Occuring as motor is running	①Power capacity is not enough. ②Instantaneous power down	Check power supply.
			Radiator is overheated.	Check loading.

4	Position out-of-tolerance	Occuring as control power supply is powered on	Circuit board fault	Change the AC servo drive unit.
		Motor doesn't run after the main power supply and control circuit are connected and instruction pulse is input	①Motor U, V, W lead wires are wrongly connected. ②Lead wires of encoder cable are wrongly connected.	Connect the wires correctly.
			Encoder fault	Change the servo motor.
			The position out-of-tolerance detecting range is too small.	Increase the detecting range.
			The position proportional gain is too small.	Increase the gain.
			Torque is not enough..	① Check the torque limit. ② Reduce the load capacity. ③ Change the drive unit and motor with larger power ones.
			Instruction pulse frequency is too high.	Reduce the frequency.
5	Motor overheated	Occuring as control power supply is powered on	Circuit board fault	Change the AC servo drive unit.
			①Cable is broken off. ②Internal temperature relay of motor is damaged.	①Check the cable. ②Check the motor.
		Occuring as motor is running	Motor is overloaded.	①Reduce the load. ②Reduce the on-off frequency. ③Reduce the torque limit. ④Reduce the related gain. ⑤Change the drive unit and motor with larger power ones.
			Motor internal fault	Change the servo motor.
6	Saturation fault of speed amplifier	Occuring as motor is running	Motor is mechanically locked.	Check the loading mechanical part.
			Load is too large.	①Reduce the load. ②Change the drive unit and motor with larger power ones.

7	**Drive stop abnormal**		Input terminals of CCW, CW drive stop are both broken off.	Check the connection and the power supply of the input terminals.
8	**The position deviator overflow**		① Motor is mechanically locked. ②Input instruction pulse is abnormal.	①Check mechanical part of the load. ②Check the instruction pulse. ③Check whether the motor runs by instruction pulse.
9	**Encoder fault**		Encoder connection is wrong.	Check the connection.
			Encoder is damaged.	Change the motor.
			Encoder cable is inferior.	Change the cable.
			Encoder cable is too long to cause the encoder voltage too low.	①Shorten the cable. ②Use multi-core parallel power supply.
10	**Control power supply undervoltage**		15V internal voltage of input control is low.	Check the control power supply.
			①Internal connector assembly of drive unit is inferior. ②Switch power supply is abnormal. ③Chip is damaged.	①Change the AC servo drive unit. ②Check the connector assembly. ③Check the switch power supply.
11	**IPM module fault**	Occuring as control power supply is powered on	Circuit board is at fault.	Change the AC servo drive unit.
		Occuring as motor is running	①Power voltage is low. ②Overheated.	①Check the AC servo drive unit. ②Power on again. ③Change the AC servo drive unit.
			U, V, W of drive unit are short circuit.	Check the connection.
			Grounding is not good.	Be grounded correctly.
			Motor insulation is damaged.	Change the motor.
			It is interfered.	①Increase the circuit filter. ②Be far away from the interference source.

12	Overcurrent		U, V, W of drive unit are short circuit.	Check the connection.
			Grounding is not good.	Be grounded correctly.
			Motor insulation is damaged.	Change the motor.
			AC servo drive unit is damaged.	Change the AC servo drive unit.
13	Overload	Occuring as control power supply is powered on	Circuit board is at fault.	Change the AC servo drive unit.
		Occuring as motor is running	Running exceeds the rated torque.	①Check the load. ②Reduce the on-off frequency. ③Reduce the torque limit. ④Change the drive unit and motor with larger power ones.
			Hold brake is not open.	Check the hold brake.
			Motor vibrates unstablely.	①Regulate the gain. ②Increase the acceleration/ deceleration time. ③Reduce the load inertia.
			①One of the drive unit U, V, W is broken off. ②The encoder connection is wrong.	Check the connection.
14	Brake fault	Occuring as control power supply is powered on	Circuit board fault.	Change the AC servo drive unit.
		Occuring as motor is running	Brake resistance connection is broken off.	Connect the wire again.
			①Brake transistor is damaged. ②Internal brake resistance is damaged.	Change the AC servo drive unit.
			Brake loop capacity is not enough.	①Reduce the on-off frequency. ②Increase the acceleration/ deceraltion time constant. ③Reduce the torque limit. ④Reduce the load inertia. ⑤Change the drive unit and motor with larger power ones.
			Main circuit power voltage is too high.	Check the main power supply.

15	Encoder counting error		Encoder is damaged.	Change the motor.
			Encoder connection is wrong.	Check the connection.
			Grounding is not good.	Do right grounding.
16	Motor heat overloading	Occuring as control power supply is powered on	Circuit board fault.	Change the AC servo drive unit.
			Parameter setting error.	Correctly set the parameters.
		Occuring as motor is running	Long running exceeding rated torque.	①Check the load. ②Reduce the on-off frequency. ③Reduce the torque limit. ④Change the drive unit and motor with larger power ones.
			Mechanical transmission is not good.	Check the mechanical part.
19	Thermal reset		The control power of input is unsteady.	Check the control power.
			It is disturbed.	①Increase the circuit filter. ②Be away from the interference source.
20	IC4 (EEPROM) error		Chip or circuit board is damaged.	Change the AC servo drive unit. After restoring, the model of the AC servo drive unit should be set again, (parameter No.1), then recover the default parameters.
21	IC3(PWM chip) error		Chip or circuit board is damaged.	Change the AC servo drive unit.
22	IC2(CODER chip) error		Chip or circuit board is damaged.	Change the AC servo drive unit.
23	IC7(A/D chip) error		①Chip or circuit board is damaged. ②Current sensor is damaged.	Change the AC servo drive unit.
30	Encoder Z pulse lost		①Z pulse doesn't exist, and encoder is damaged. ②Cable is inferior. ③Cable shielding is not good. ④Shield grounding is not well connected. ⑤Encoder interfacing circuit is at fault.	①Change the encoder. ②Check the encoder interfacing circuit.

31	Encoder UVW signal error		① Encoder UVW phase are damaged. ② Encoder Z phase is damaged. ③ The cable is inferior. ④ The cable shielding is not good. ⑤ Shield grounding is not well connected. ⑥ Encoder interfacing circuit is at fault.	①Change the encoder. ②Check the encoder interfacing circuit.
32	Encoder UVW signal illegal encoding		① Encoder U, V, W phase are damaged. ② The cable is inferior. ③ Cable shielding is not good. ④ Shield grounding is not well connected. ⑤ Encoder interfacing circuit is at fault.	①Change the encoder. ②Check the encoder interfacing circuit.

CHAPTER 6 DISPLAY AND OPERATION

6.1 Keyboard operation

- The drive unit panel is comprised by 6 LED nixie tube displayer and 4 keys of ↑, ↓, ←, Enter, which is used for displaying system modes and parameters setting etc. And the functions for keys are as followings:

↑ : Sequence number, numerical number increment or forward item

↓ : Sequence number, numerical number reduction or backward item

← : Back to upper menu or cancellation of operation

Enter : Enter into next menu or confirmation of input

〖Note〗 Holding ↑ or ↓ key down, the operation is executed repetitively, the longer the holding time is, and the faster the repetitive speed is.

- The 6-digit LED nixie tube can display mode and data of system, flashing of all nixie tubes or the decimal point of rightmost nixie tube means alarm.
- Operation is performed by multilayer operating menus. The first level is the main menu that includes 8 operating modes and the second is the functional menu of operating mode. Fig.6.1 is block diagram of main menu operation:

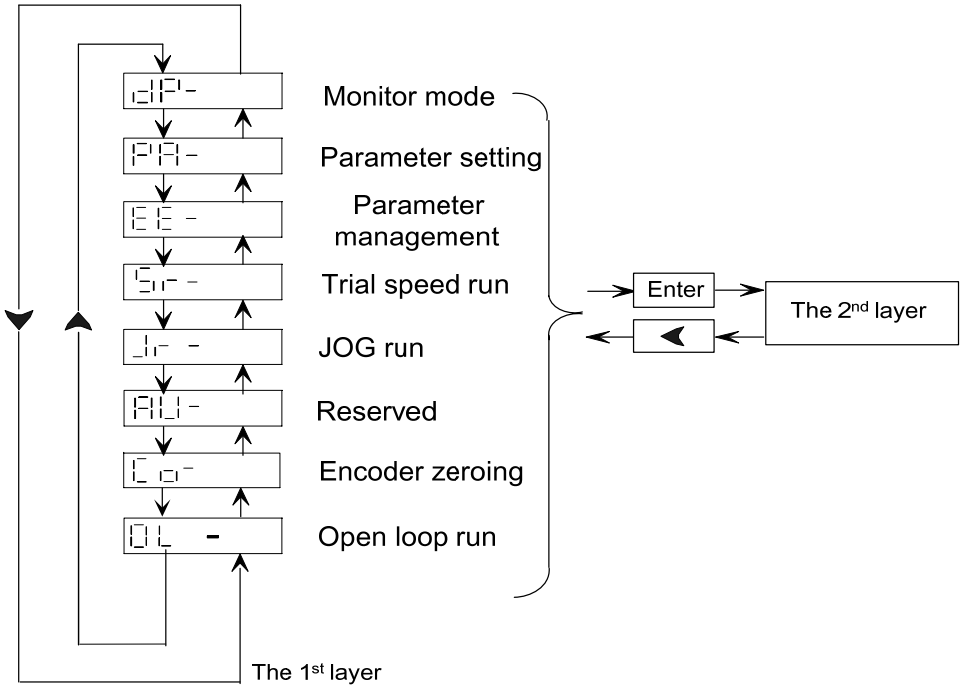


Fig. 6.1 Operation block diagram of mode selection

6.2 Monitoring mode

Select “dP-” in the first layer and press Enter to enter monitoring mode which includes 21 display modes. Select the desired display mode by ↑, ↓ key, then press Enter to enter display mode.

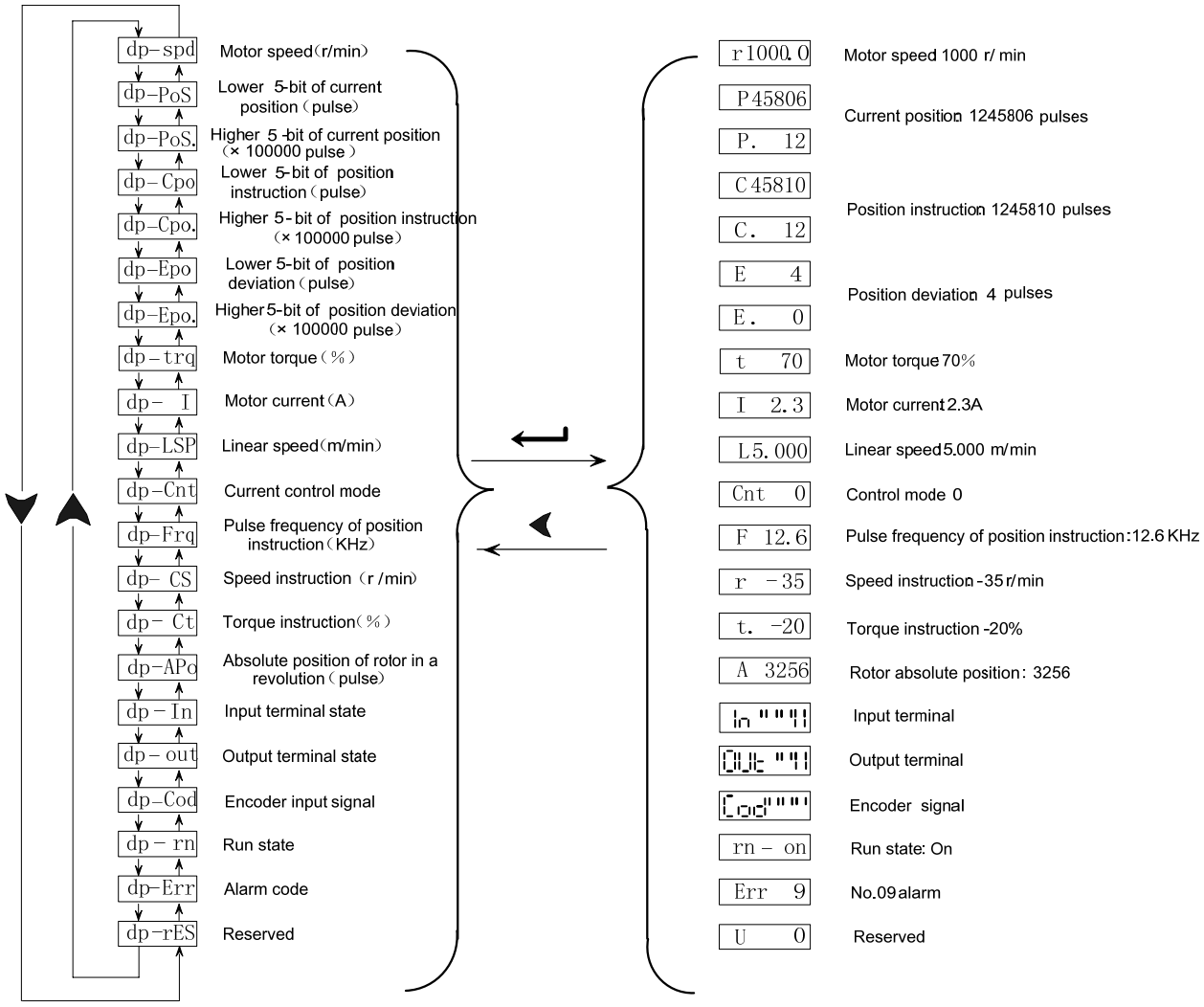


Fig. 6.2 Operation block diagram of monitoring mode

[Note 1] Position pulse and instruction pulse value are the magnified ones via the electronic gear.

[Note 2] Pulses unit is the internal pulse unit that is 10,000 pulses/rev in this system. And it is expressed by high 5-bit plus low 5-bit and its caculation method is as follows:

Pulses =high 5-bit numerical value×100,000+low 5-bit numerical value

[Note 3] Control mode：0-position control；1- speed control；2- trial speed run; 3- JOG mode; 4- encoder zeroing; 5- open loop run.

[Note 4] If the numerical value displayed has 6 digits (e.g. -12345), the prompt character will not be displayed.

[Note 5] Before magnified by the electronic gear, pulse frequency of position instruction is the actual frequency with positive number for positive direction and negative number for negative direction and its min. unit is 0.1kHz.

[Note 6] Calculation of motor current I is as follows:

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

[Note 7] The absolute position of rotor in a rev means a position the rotor relative to the stator, one rev is one period, and its range is 0~9999.

[Note 8] Input terminals are shown as Fig.6.3, output terminals as Fig.6.4, and encoder signal display as Fig.6.5.

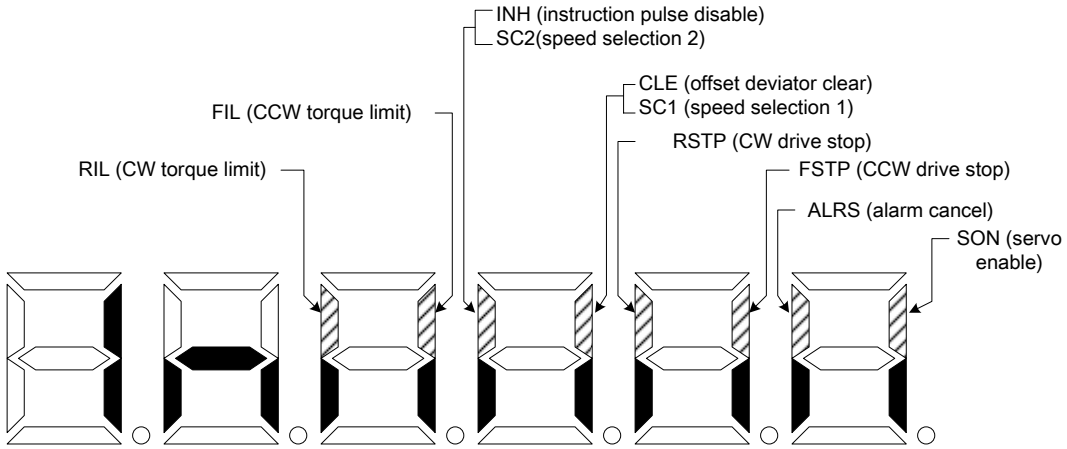


Fig. 6.3 Input terminals display (lighting part for ON and poor light part for OFF)

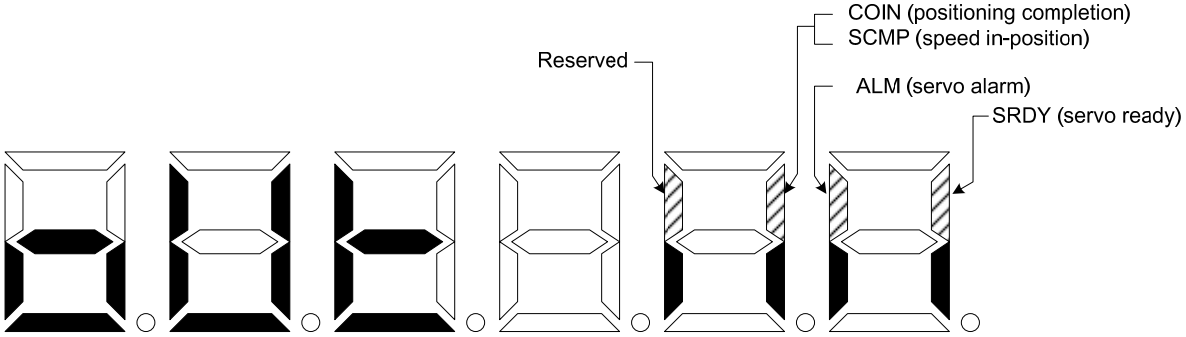


Fig. 6.4 Output terminal display(lighting part for ON and poor light part for OFF)

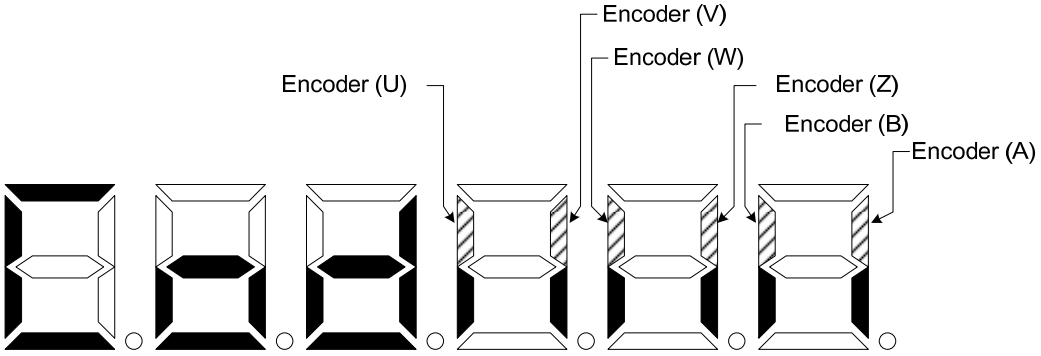


Fig. 6.5 Encoder signal displaying (light is ON and poor light is OFF)

[Note 9] Run state:

"cn- oFF": The main circuit is not charged and the servo system does not run;

"cn- CH": The main circuit is charged and the servo system does not run(the servo is disabled and an alarm is issued.);

"cn- on": The main circuit is charged and the servo system is running;

[Note 10] The alarm "Err --" displayed means the system is normal and no alarm is issued.

6.3 Parameter setting

Note
● **Other parameters can be modified after parameter No.0 is set to its corresponding value.**
● **Setting of parameters effect immediately and accident may occur by false action resulted by false setting.**

Select "PA-"in the first level and press Enter to enter parameter setting mode. Select parameter number by ↑, ↓key, then press Enter key to display the parameter value, the value can be modified by ↑, ↓. Press ↑or ↓key for once to increase or decrease 1 for the parameter value, press and hold on ↑ or ↓ key to continuously increase or decrease the value. When the parameter value is modified, the decimal point of rightmost LED nixie tube lights up, press Enter key to confirm the modification, and then the decimal point of rightmost LED nixie tube is put out. And the modified value will immediately take effect in the control, press ↑, ↓key to go on modify the parameters, then press ←to go back to parameter selection mode after modification. Do not press Enter key to confirm the modification if the parameter value modified is not appropriate. Press ←key to cancel the modified value to recover its original value and back to the parameter selection mode.

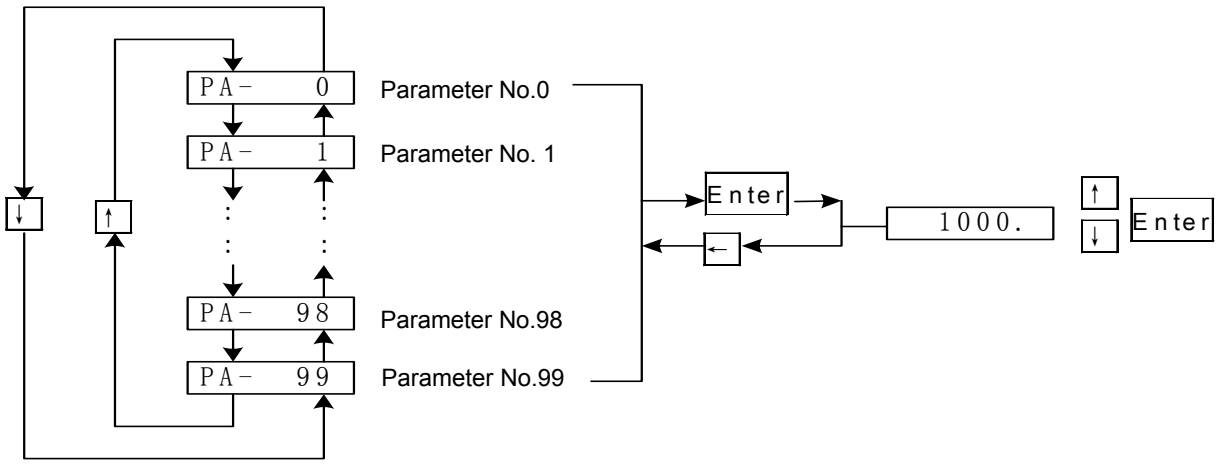


Fig. 6.6 Operation block diagram of parameter setting

6.4 Parameter management

⚠ **Note**	**If read operation is not performed for the parameter modified, the modified value of the parameter is not saved after power-down and the parameter modification is not valid.**

The parameters management mainly processes memory and EEPROM operation. Select “EE-” in the first level and press Enter key to enter parameter management mode. Firstly select the operation modes that includes 5 modes by ↑,↓key. For example, for “ parameter write ” , select “EE-Set”， then press Enter key and hold it on for over 3 seconds, the monitor displays “StArt” that means the parameters are being writen into EEPROM. After 1~2 seconds, the monitor displays “FInISH” if the writing is successful, otherwise“Error” is displayed. Press ←key again to return to operation mode.

- EE－Set: parameter write It means to write the parameters in the memory into EEPROM parameter area. The parameter modification by user only changes the parameter values in the memory and they will be recovered to their original values when power on again. If the parameter values are to be changed permanently, parameter write operation is needed. Write the parameters in the memory into the EEPROM parameter area, then the modified parameter values will be valid after power on again.
- EE－rd: parameter read It means to read the data in EEPROM parameter area 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 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 data in EEPROM parameter area can be read again into the memory by parameter read operation to restore the original parameters at power-on.
- EE－bA: parameter backup It means to write the parameters in the memory into EEPROM backup area. The EEPROM area consists of parameter area and backup area that can store two sets of parameters. EEPROM parameter area is used for power on, parameter writing and reading operation, and EEPROM backup area for parameter backup and parameter backup recovery. If user is satisfied with one set of parameters and requires further modification, he can save the memory parameters into the EEPROM backup area by performing the parameter backup operation in advance, then modify the parameters. If the modification is not satisfied, the parameters which are saved in EEPROM backup area last time can be read into the memory for further modification or completion. Besides, after the parameters are set, the parameter write and backup operation can be performed to make the data in EEPROM parameter and backup area same to avoid parameters to be modified by mistake later. And parameter backup recovery operation can also be performed to read the data in EEPROM backup area into the memory and write the data in the memory into EEPROM parameter area by parameter write operation.
- EE－rS：backup recovery It means to read the data in EEPROM backup area into the

memory. In this operation parameter writing is not executed and the data in EEPROM parameter area will be read into the memory again when power on. If user want to permanently use the parameters in EEPROM backup area, another parameter write operation is needed.

- **EE－dEF:** default recovery It means to read all default values (factory set values) of parameters into memory and write them into EEPROM parameter area to be used when power on again. Perform this operation to restore all parameters to their factory set values if these parameters are disordered by user causing the system abnormal running. Because the different AC servo drive unit model corresponds to different parameter default values, ensure that the AC servo drive unit model is right (parameter No.1) when performing this default recovery operation.

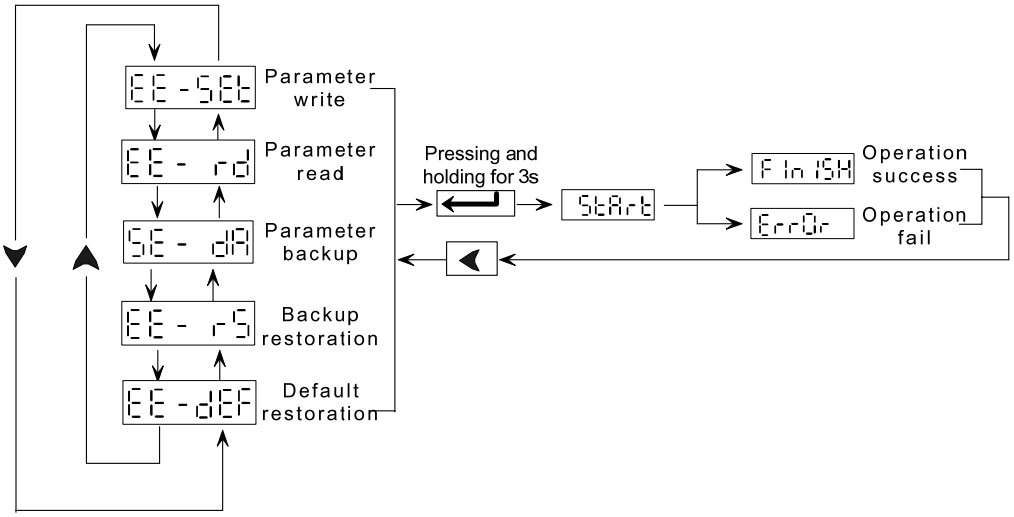


Fig. 6.7 Operation block diagram of parameter management

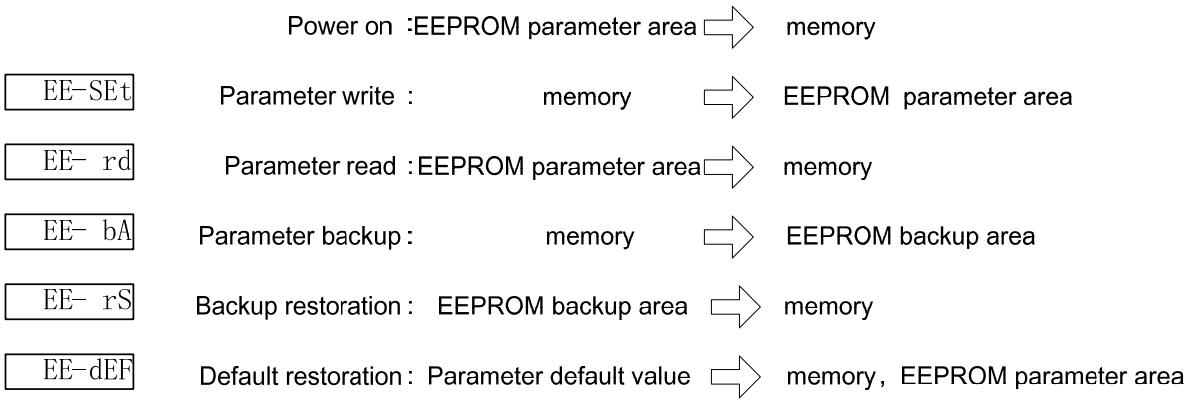


Fig. 6.8 Meaning of parameter management

Note

- **It is suggested that the trial speed run or JOG run is done in motor dry run mode in order to avoid the unexpected accident.**
- **The AC servo drive unit SON (servo enable) should be valid and CCW, CW stop invalid in trial run.**

6.5 Trial speed run

Select “Sr-” in the first level and press Enter key to enter the trial run mode. The trial speed run prompt is “S” and the unit is r/min. The system is in speed control mode and speed instructions are input by keys, which can be changed by ↑, ↑key, and the motor runs by the specified speed. Press ↑ key to increase positive speed and press ↓ key to decrease positive speed (or increase negative speed). The motor runs forward for the positive speed, and reverse for negative speed.

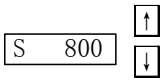


Fig. 6.9 Operation block diagram frame of trial speed run

6.6 JOG run

Select “Jr-” in the first level and press Enter key to enter JOG run. The prompt for JOG run is “J” and the unit is r/min. The system is in speed control mode and its speed instructions are input by keys. After entering JOG mode, press ↑ key and hold it on, the motor runs in a JOG speed, release the key, motor stops with zero speed; press ↓key and hold it on, the motor runs reversely in a JOG speed, and release the key, the motor stops with zero speed. The JOG speed is set by parameter No.21.

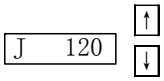


Fig. 6.10 Operation block diagram for JOG run

6.7 Miscellaneous

The encoder zeroing is used by motor manufacturer but not user.

The open loop run is used by motor manufacturer but not user.

CHAPTER 7 RUNNING

Note

- **The drive unit and the motor must be well grounded, and the PE terminal of drive unit must be well connected with the device grounding part.**
- **It is suggested that the power supply of drive unit is provided via isolation transformer and power supply filter to get better security and anti-interference capability.**
- **Only after wiring is correctly completed could the power supply be switched on.**
- **An emergent stop circuit should be connected to cut off the power supply immediately if there is a fault in the system. (Refer to Fig. 7.1).**
- **After alarm is issued by the drive unit, it should be ensured that the fault has been resolved and SON signal is invalid before restart.**
- **Do not touch the AC servo drive unit and motor within at least 5 minutes to avoid electric shock after their power is cut off.**
- **Be careful of the scalding by the temperature rising of the drive unit and motor running for a span of time.**

7.1 Power supply connection

Refer to Fig. 7.1 for power supply connection and connect it by following steps:

1) Connect the power supply with the power input terminals (3-phase to R, S, T and single phase to R,S) of the main circuit via electromagnetism contactor.

2) The control circuit power supply r, t and the main power supply are switched on simultaneously or the former is prior to the latter. If power supply of control circuit is switched on singly, the servo ready signal (SRDY) is set for OFF.

3) After the main power supply is switched on and 1.5s delay, and the servo ready signal (SRDY) is set for ON for receiving the servo enable (SON)signal and if the SON signal is detected to be valid，the AC servo drive unit output is valid and the motor is excited for running. When the SON signal is detected to be invalid or alarm is issued with the PWM circuit off, the motor is in a free state.

4) The PWM circuit is put on in about 1.5s when the SON and power supply are through.

5) If the power supply is switched on or off frequently, the soft start circuit and the energy brake circuit may be damaged. The on-off frequency should be less than 5 times in one hour and 30 times less each day. Owing to the overheating of the drive unit and the motor, the power supply can be switched on only after the fault is resolved and 30-minute cooling.

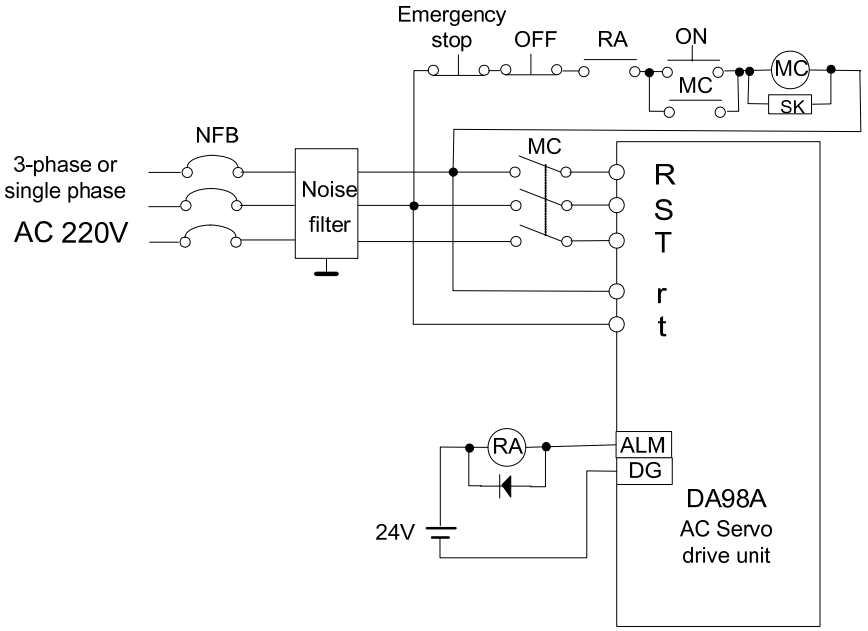


Fig. 7.1 Power supply wiring diagram

Time sequence of power on and alarm:

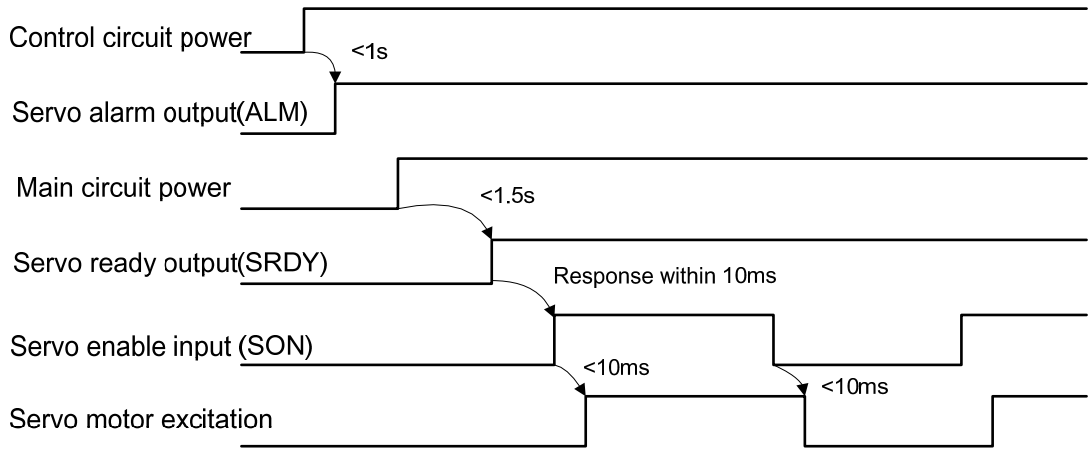


Fig. 7.2 Time sequence at power on

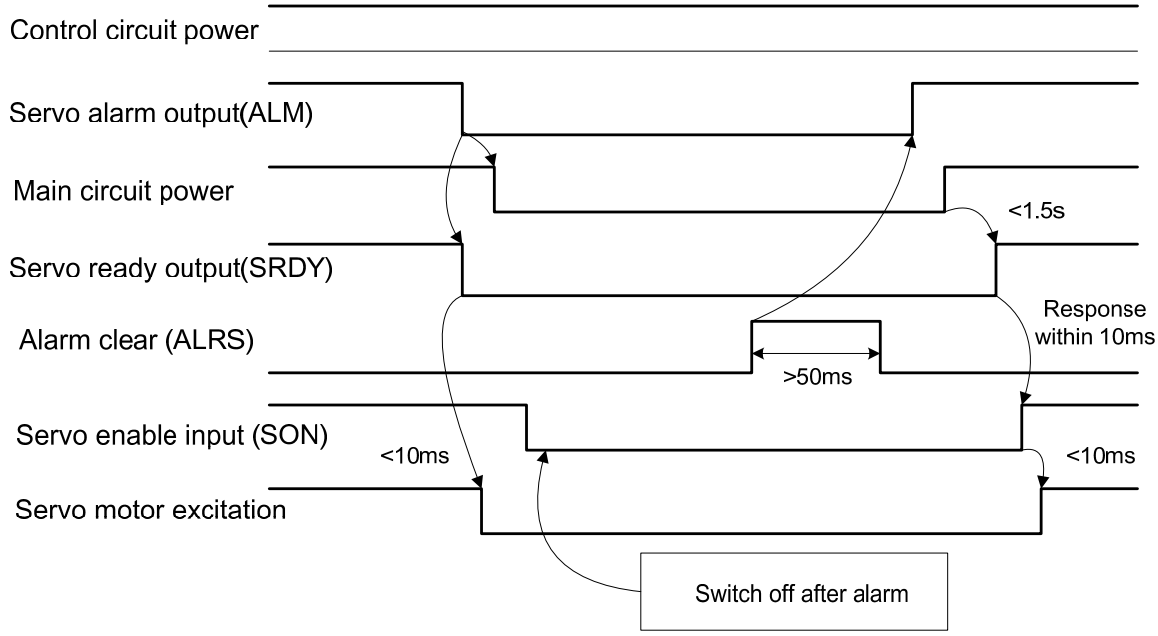


Fig. 7.3 Time sequence of alarm

7.2 Trial run

1）Check before running

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

- Make sure the terminal connection of power supply and the input voltage are reliable and right.
- Whether the power and motor wires are short circuit or grounded.
- Whether the cable connection of encoder is right.
- Whether the control signal terminals connection, the power polarity and voltage, current are right.
- Whether the drive unit and motor are properly secured.
- Whether the motor shaft is loaded.

2）Trial run after power on

A： Trial mode

（1）Connect CN1 to make input control signal: the servo enable（SON）is set for OFF, CCW drive stop（FSTP） for ON, CW drive stop（RSTP）for ON.

（2）Switch on the control circuit power (main power is off), AC servo drive unit monitor is turned on. If an alarm is issued, check the connection.

（3）Set control mode (parameter No.4) for trial speed mode (for 2).

（4）Switch on the main power.

（5）If there is no alarm or any abnormality occurring, set servo enable (SON) for ON, and the motor is excited for zero speed.

（6）Enter trial speed mode by pressing keys, the prompt of it is “S” , and the unit is r/min. When the system is in speed control mode, the speed instructions are input by pressing keys or ↑ or ↓ keys for alteration, and the motor runs by the specified speed.

B： JOG mode

（1）Connect CN1 to make input control signal: the servo enable (SON) set for OFF, CCW drive stop（FSTP）for ON, CW drive stop（RSTP）for ON.

（2）Switch on the control circuit power (main power is off), AC servo drive unit monitor is turned on. If an alarm is issued, check the connection.

（3）Set control mode (parameter No.4) for JOG mode (for 3).
（4）Switch on the main power.
（5）If there is no alarm or any abnormality occurring, set servo enable (SON) for ON, and the motor is excited for zero speed.
（6）Enter JOG mode by pressing keys, the prompt of it is “J”, and the unit is r/min. When the system is in speed control mode, the speed value and direction are defined by parameter No.21, pressing ⇑ keys, the motor runs by the specified speed and direction; pressing ⇓ keys for the reverse running.

C： Position mode

（1） Connect CN1 to make input control signal: the servo enable (SON) is set for OFF, CCW drive stop（FSTP）for ON, CW drive stop（RSTP）for ON.
（2） Switch on the control circuit power (main power is off), AC servo drive unit monitor is turned on. If an alarm is issued, check the connection.
（3） Set control mode (parameter No.4) for position mode (for 0). Set parameter No.14 by controller output signal and set a proper electronic gear ratio.
（4） Switch on the main power.
（5） If there is no alarm or any abnormality occurring, set servo enable (SON) for ON, and the motor is excited for zero speed.
（6） Make the position controller to output signal to the CN16, 18, 7, 19 terminals to run the motor by instructions.

D： Speed mode

（1） Connect CN1 to make input control signal: the servo enable (SON), speed selection 1 (SC1), speed selection 2 (SC2) set for OFF, CCW drive stop（FSTP）for ON, CW drive stop（RSTP）for ON.
（2） Switch on the control circuit power (main power is off), AC servo drive unit monitor is turned on. If an alarm is issued, check the connection.
（3） Set control mode (parameter No.4) for Speed mode (for 1). Then set speed parameter No.24～27 by requirement.
（4） Switch on the main power.
（5） If there is no alarm or any abnormality occurring, set servo enable (SON) for ON, and the motor is excited for internal speed 1.
（6） Change the input signal SC1, SC2 mode to make the motor run by a specified speed.

7.3 Adjustment

⚠ Note

- **Ensure the parameters to be correct before starting to protect against unexpected accident caused by mistaken parameter setting.**
- **Debug the system in dry run mode prior to the loading debugging.**

1） Primary gain adjustment

- **Speed control**

（1） [Speed proportional gain] (parameter No.5) Its setting value should be set as large as possible without oscillation occurring. Generally, the bigger the load inertia is, the larger the setting value of < speed proportional gain> is.

（2） [Speed integral time constant] (parameter No.6) Its setting value should be set as big as possible according to the given conditions. If it is too big, the response will be quick but that will result oscillation. So set a bigger value if no oscillation occurs. [Speed integral time constant] If its value is too small, the speed will be greatly

changed as the load is changed. Generally, the bigger the load inertia is, the smaller the [Speed integral time constant] setting value is.

- **Position control**

（1） Set proper [Speed proportional gain] and [Speed integral time constant] by the methods above.

（2） Set <position feedforward gain> (parameter No.10) for 0%.

（3） [Position proportional gain]（parameter No.9） Its setting value should be as large as possible in a stable range. If it is too large, the track characteristic of position instruction is good and the lag error is small, but there may be oscillation when positioning stops.

（4） If high position track characteristic is required, the setting value of <position feedforward gain> may be increased. If it is too big, overshooting may occur.

【Note 1】 If [position proportional gain] setting value is small, the system is stable, but of position track characteristic gets bad and lag error is large. If high [position proportional gain] is needed, increase the setting value of [acceleration/deceleration time constant] (parameter No.40, 41) to avoid the overshooting.

【Note 2】 When [position feedforward gain] setting value is to be increased, if the system is unstable, [acceleration/deceleration time constant] setting value can be increased to avoid the overshooting.

【Note 3】 [Position proportional gain] setting values are as following table:

Rigidity	[Position proportional gain]
Low rigidity	10～20/s
Medium rigidity	30～50/s
High rigidity	50～70/s

2） Adjustment diagram of primary parameters

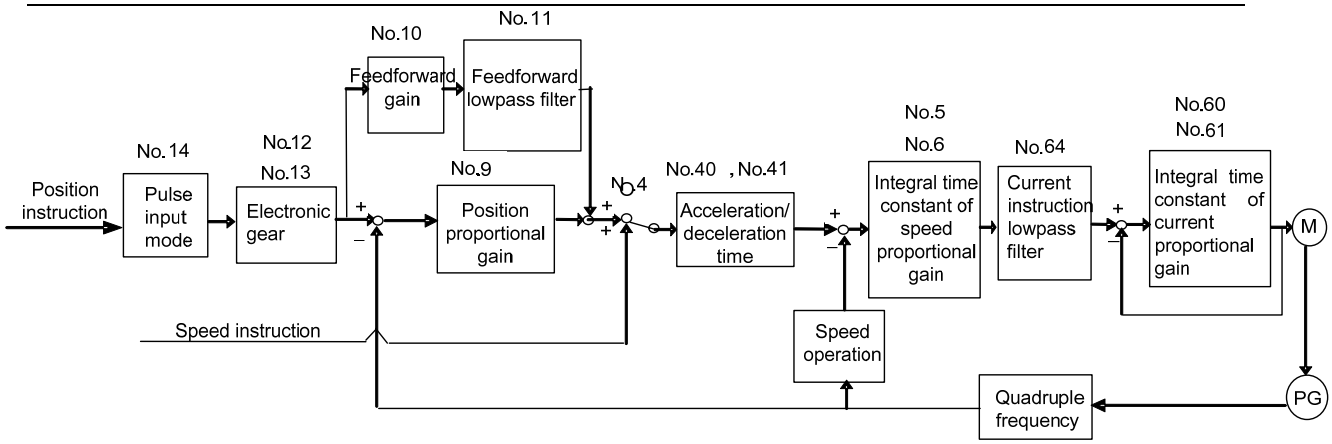


Fig. 7.4 Adjustment block diagram of primary parameters

3） Resolution and electronic gear setting

The position resolution (one pulse travel △l) is defined by the travel △S per rev of the servo motor and feedback pulse P_t per rev of encoder and their equation is as follows:

$$\triangle l = \frac{\Delta S}{Pt}$$

△l：travel per pulse（mm）;

△S：travel per rev of servo motor（mm/rev）;

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

Because there is quadruple frequency circuit in the system, P_t=4×C and C is pulses per rev of encoder. In this system, C=2500 pulses/rev and P_t=10000 pulses/rev.

The instruction pulse multiplied by the electronic gear ratio G equals the position control pulse, so one instruction pulse travel △l* is expressed as follows:

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

$$\text{And} \quad G = \frac{\text{Numerator of instruction pulse frequency division}}{\text{Dominator of instruction pulse frequency division}}$$

4） ON-OFF adjustment

The on-off characteristic of servo system, i.e. acceleration and deceleration time, is determined by the load inertia and on-off frequency and also restrained by the servo unit and servo motor. Frequently on-off, too small acceleration and deceleration time and too large load inertia may result in the overheating of servo drive unit and motor as well as the alarm for the main circuit overvoltage, so it should be adjusted according to the actual situation.

（1） Load inertia and on-off frequency

In a high frequency situation, first make sure whether they are within the allowable frequency range. The allowable frequency range varies with the motor type, capacity, load inertia and motor speed. If the load inertia is m folds of the motor inertia, the allowable on-off frequency and the recommended acceleration and deceleration time for the servo motor are as following table:

Load inertia multiplier	Allowable on-off frequency
m≤3	＞100 times/min: acceleration/deceleration time 60ms or less
m≤5	60 ～ 100 times/min: acceleration/deceleration time 150ms or less
m＞5	＜60 times/min: acceleration/deceleration time 150ms above

（2） Effect of the servo motor

The allowable on-off frequency and acceleration/deceleration time constant of different model servo motor varies with factors of load, running time, occupation, ambient temperature. Please adjust them by the actual situation referring to motor manual to protect the motor life against overheating or alarm.

（3） Adjustment

Usually the load inertia should be within five folds of the motor rotor inertia. If it is used in large load inertia, main circuit overvoltage or brake abnormality in deceleration may occur frequently, and it can be resolved by follows:

- Increase acceleration/deceleration time (parameter No.40, No.41).
- Reduce the internal torque limit (parameter No.34, No.35).
- Reduce the max. motor speed (parameter No.23).
- Fix an additional regenerative brake device.
- Change the motor by a larger one on power and inertia.

CHAPTER 8 SPECIFICATIONS

> **Note** **The AC servo drive unit should be matched with a suited servo motor in user order. In this manual the servo motor involved with this drive unit is GSK SJT series motor. Please remark in your order if you want other model servo motors.**

8.1 AC servo drive unit specifications

Table 8.1 AC servo drive unit specifications

Output power (KW)		0.4～0.8	1.0～1.5	1.7～2.3
Motor (zero-speed) rated torque (Nm)		2～4	4～10	6～15
Input power supply		Single phase or 3-phase AC220V -15%～+10% 50/60Hz	3-phase AC220V -15～+10% 50/60Hz	
Applicable environment	Temperature	Working：0～45℃ Storage：-40℃～+55℃		
	Humidity	Less than 95%（no condensation）		
	Vibration	Less than 0.5G（4.9m/s^2）,10～60 Hz (non-continuous running)		
Control mode		①Position control② Speed control ③Trial speed run ④JOG ⑤ Open loop run		
Regenerative brake		Built-in		
Control characteristics		Speed frequency response: 200Hz or more		
		Speed fluctuation rate: ＜±0.03（load 0～100%）; ＜±0.02（power supply -10～+10%）(numerical value corresponding to rated speed）		
		Timing ratio: 1:5000		
		Pulse frequency: ≤500kHz		
Control input		①Servo enable ②Alarm clear ③CCW drive stop ④CW drive stop ⑤Deviator clear / speed selection 1 ⑥Instruction pulse disable/ speed selection 2 ⑦CCW torque limit ⑧CW torque limit		
Control output		① Servo ready output ② Servo alarm output③ Positioning completion output /speed in-position output		
Position control		Input mode	① Pulse+ symbol ②CCW pulse /CW pulse	
		Electronic gear ratio	1～32767/1～32767	
		Feedback pulse	10,000 pulse/rev	
Speed control		4 internal speeds		

Acceleration and deceleration function	Parameter setting acceleration/deceleration time 1ms～10,000ms（0r/min←→1000r/min）	
Monitoring function	Speed, current position, instruction pulse accumulation, position error, motor torque, motor current, linear speed, rotor absolute position, instruction pulse frequency, running state, input/output terminal signal etc.	
Protection function	Overspeed, overvoltage / undervoltage of main power, overcurrent, overload, brake abnormity, encoder abnormity, control power abnormity, position out-of-tolerance etc.	
Display, operation	6-digit LED nixie tube, 4 keys	
Applicable load inertia	Less than 5 times of motor inertia	
Weight	2.67 Kg	3.48 Kg
Dimension	244mm×163mm×92mm（Refer to outline）	244mm×163mm×112mm

8.2 Servo motor specification

1） Brief

Characteristics of GSK SJT series 3-phase AC permanent magnetism synchronous servo motor are as follows:

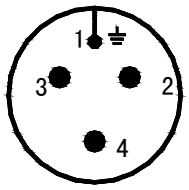
√ Latest rare-earth material employed ensures big output power.
√ Good low speed performance of motor with timing ratio>1:10000.
√ High dielectric strength and insulation resistance ensures safety.
√ Strong overload capability, instantaneous torque can reach 8 times of rated one.

2） Terminal

（1）SJT series motor winding

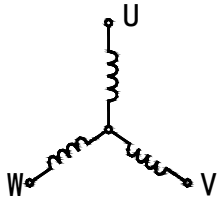
Motor winding principle is as following:

U, V, W are the lead out terminals of the winding.
Lead-out type: 4-core socket



Plug sketch map
(welding side)

Motor lead wire	U	V	W	Shell (grounding)
Socket No.	2	3	4	1



Motor winding

（2）SJT series motor encoder interface

Photoelectric encoder lead-out type: 15-core socket

Table 8.3 Encoder connection

Mark	2	3	4	7	5	8	6	9	10	13	11	14	12	15
Pin-out	V_{CC}	GND	A	$\overline{A}$	B	$\overline{B}$	Z	$\overline{Z}$	U	$\overline{U}$	V	$\overline{V}$	W	$\overline{W}$
Remark	GND is the grounding terminal of the encoder power V_{CC}. Pin 1 is for protection grounding (shell).													

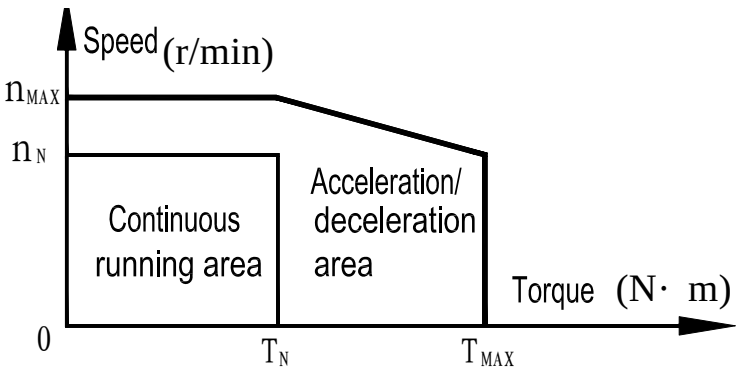
3） SJT series motor specification

Table 8.4 Some SJT series motor specification

Specification / Item	110SJT—M040D	110SJT—M060D	130SJT—M040D	130SJT—M050D
Rated power (kW)	1.0	1.5	1.0	1.3
Pole pairs	4	4	4	4
Drive unit input voltage (V)	AC220 3-phase or (single phase)	AC220 3-phase	AC220 3-phase	AC220 3-phase
Rated current (A)	4.5	7	4	5
Zero-speed torque (N·m)	4	6	4	5
Rated torque (N·m)	4	6	4	5
Max. torque (N·m)	12	12	10	12.5
Rated speed (r/min)	2500	2500	2500	2500
Max. speed (r/min)	3000	3000	3000	3000
Moment inertia (kg·m²)	0.68×10^{-3}	0.95×10^{-3}	1.1×10^{-3}	1.1×10^{-3}
Specification / Item	130SJT—M060D	130SJT—M075D	130SJT—M100B	130SJT—M100D
Rated power (kW)	1.5	1.88	1.5	2.5
Pole pairs	4	4	4	4
Drive unit input voltage (V)	AC220 3-phase	AC220 3-phase	AC220 3-phase	AC220 3-phase
Rated current (A)	6	7.5	6	10
Zero-speed torque (N·m)	6	7.5	10	10

Rated torque (N·m)	6	7.5	10	10
Max. torque (N·m)	18	20	25	25
Rated speed (r/min)	2500	2500	1500	2500
Max. speed (r/min)	3000	3000	2000	3000
Moment inertia (kg·m²)	1.33×10^{-3}	1.85×10^{-3}	2.42×10^{-3}	2.42×10^{-3}
Specification / Item	130SJT—M150B	130SJT—M150D		
Rated power (kW)	2.3	3.9		
Pole pairs	4	4		
Drive unit input voltage (V)	AC220 3-phase	AC220 3-phase		
Rated current (A)	8.5	14.5		
Zero-speed torque (N·m)	15	15		
Rated torque (N·m)	15	15		
Max. torque (N·m)	30	30		
Rated speed (r/min)	1500	2500		
Max. speed (r/min)	2000	3000		
Moment inertia (kg·m²)	3.1×10^{-3}	3.6×10^{-3}		

4） Motor mechanical characteristic curve

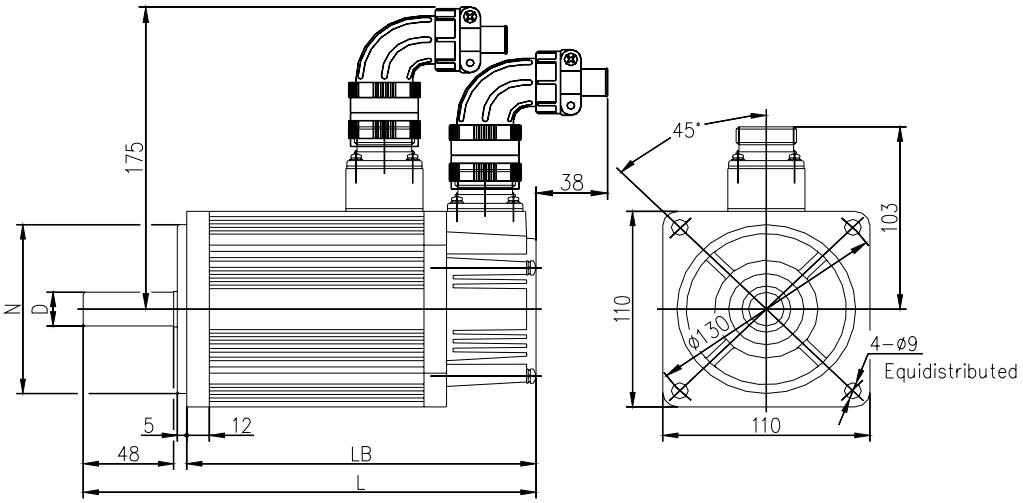


T_N ———— Rated torque； T_{MAX} ———— Max. torque；

n_N ———— Rated speed； n_{MAX} ———— Max. speed.

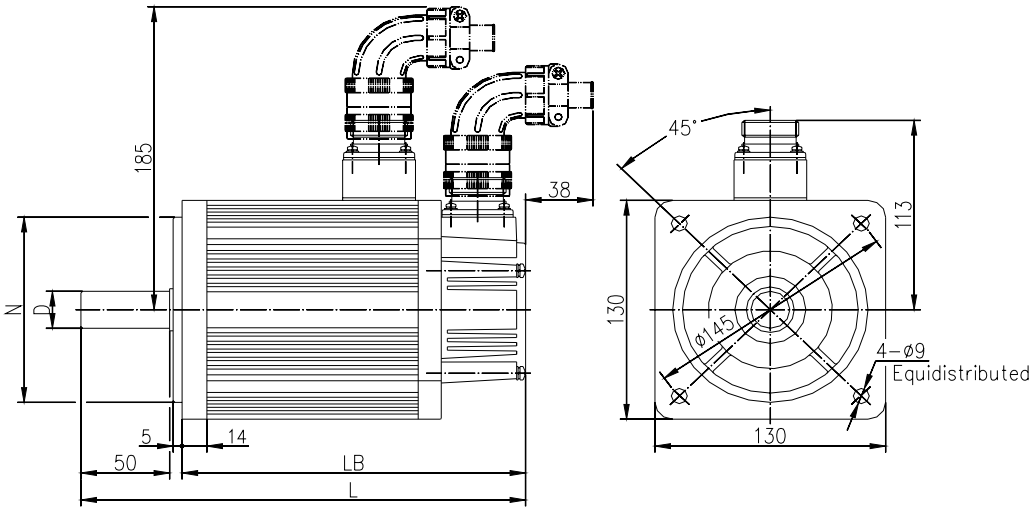
5） Motor outline and installation dimensions

(1) The outline and installation dimensions of 110SJT series motor are as following:



Specification	D(mm)	N(mm)	LB(mm)	L(mm)
110SJT—M020E	$\varphi 19^{0}_{-0.013}$	$\varphi 95^{0}_{-0.035}$	156 (207)	211 (262)
110SJT—M040D	$\varphi 19^{0}_{-0.013}$	$\varphi 95^{0}_{-0.035}$	186 (237)	241 (292)
110SJT—M060D	$\varphi 19^{0}_{-0.013}$	$\varphi 95^{0}_{-0.035}$	212 (263)	267 (318)
Note: The values of LB, L in the brackets are the lengths of corresponding motors with power-down brake.				

(2) The outline and installation dimensions of 130SJT series motor are as following:



Specification	D(mm)	N(mm)	LB(mm)	L(mm)
130SJT—M040D	$\varphi 22^{0}_{-0.013}$	$\varphi 110^{0}_{-0.035}$	168 (227)	225 (284)
130SJT—M050D	$\varphi 22^{0}_{-0.013}$	$\varphi 110^{0}_{-0.035}$	168 (227)	225 (284)
130SJT—M060D	$\varphi 22^{0}_{-0.013}$	$\varphi 110^{0}_{-0.035}$	190 (249)	247 (306)
130SJT—M075D	$\varphi 22^{0}_{-0.013}$	$\varphi 110^{0}_{-0.035}$	190 (249)	247 (306)
130SJT—M100B	$\varphi 22^{0}_{-0.013}$	$\varphi 110^{0}_{-0.035}$	208 (267)	265 (324)
130SJT—M100D	$\varphi 22^{0}_{-0.013}$	$\varphi 110^{0}_{-0.035}$	208 (267)	265 (324)
130SJT—M150B	$\varphi 22^{0}_{-0.013}$	$\varphi 110^{0}_{-0.035}$	238 (297)	295 (354)
130SJT—M150D	$\varphi 22^{0}_{-0.013}$	$\varphi 110^{0}_{-0.035}$	248 (307)	305 (364)
Note: The values of LB, L in the brackets are the lengths of corresponding motors with power-down brake.				

8.3 Isolation transformer

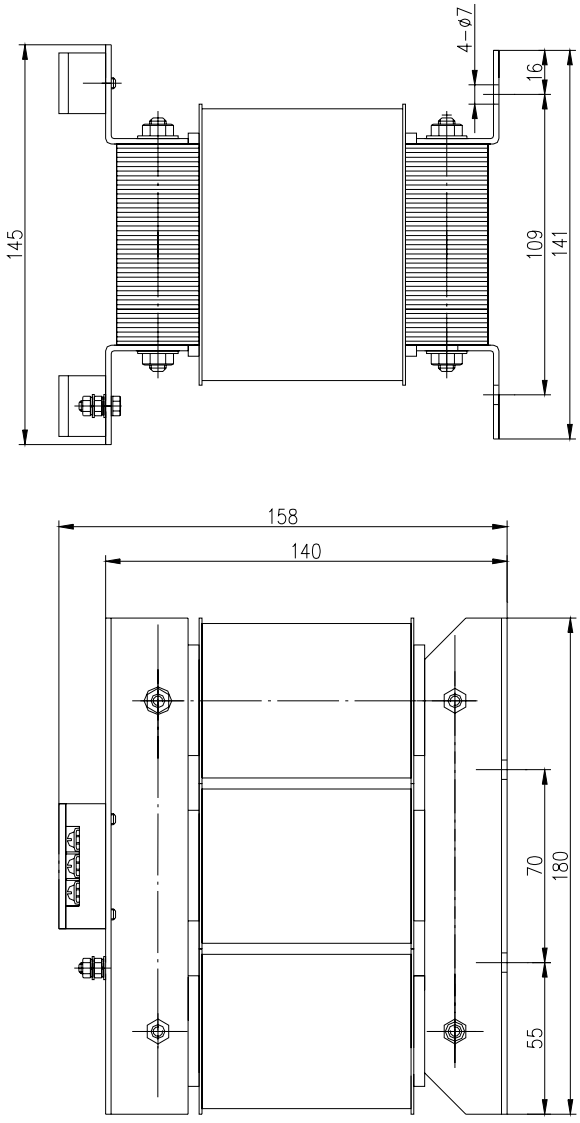
⚠ Note

- **It is suggested the AC servo drive unit is powered by isolation transformer to reduce electric shock or interference by power supply or electromagnetic field.**
- **The drive unit of 0.8KW or less may be employed with single phase power supply, but those above 0.8KW must be employed with 3-phase power supply.**

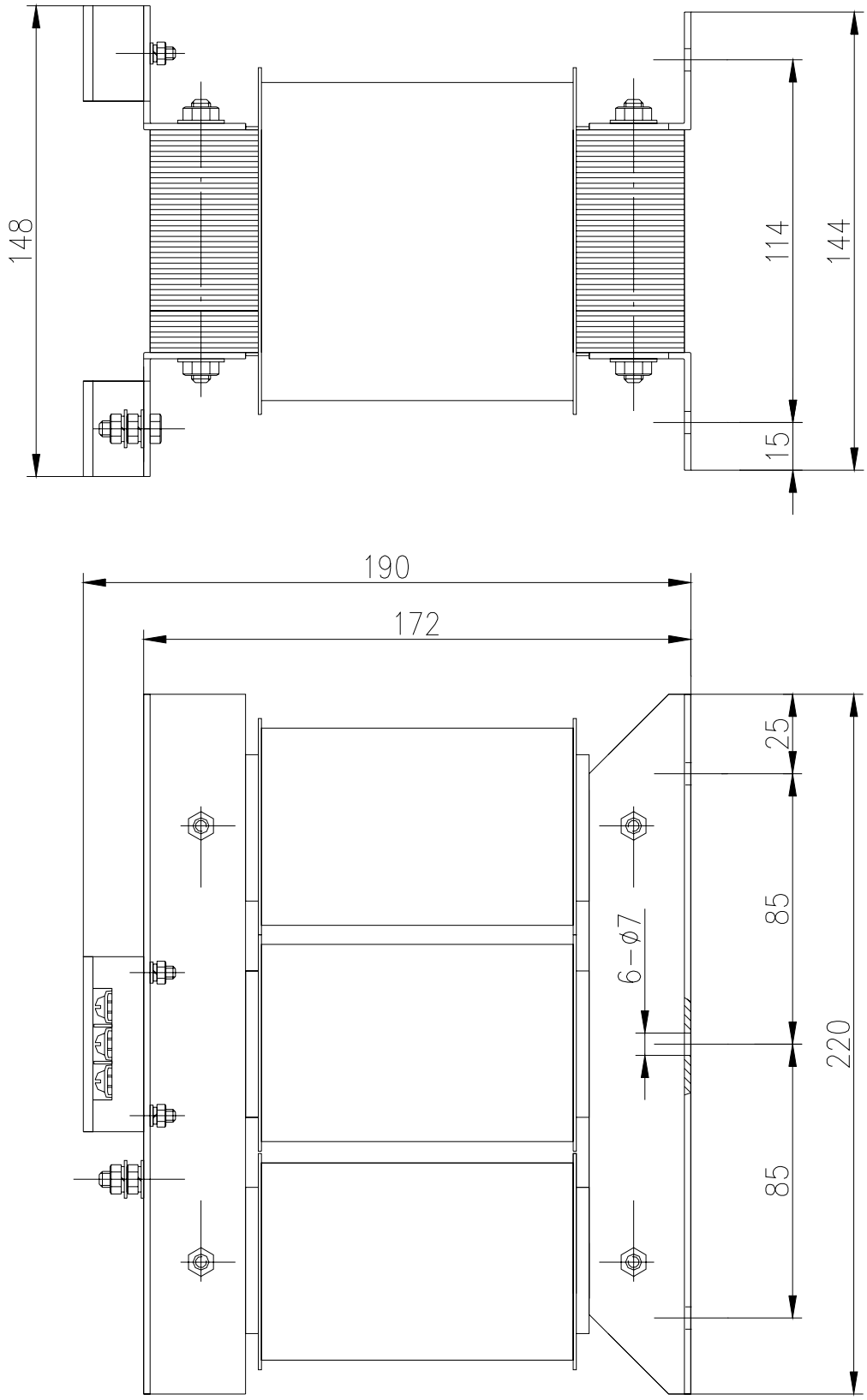
The following isolation transformer models are provided by us and they can be chosen according to the user servo motor power and actual load.

Table 8.5 Isolation transformer specification

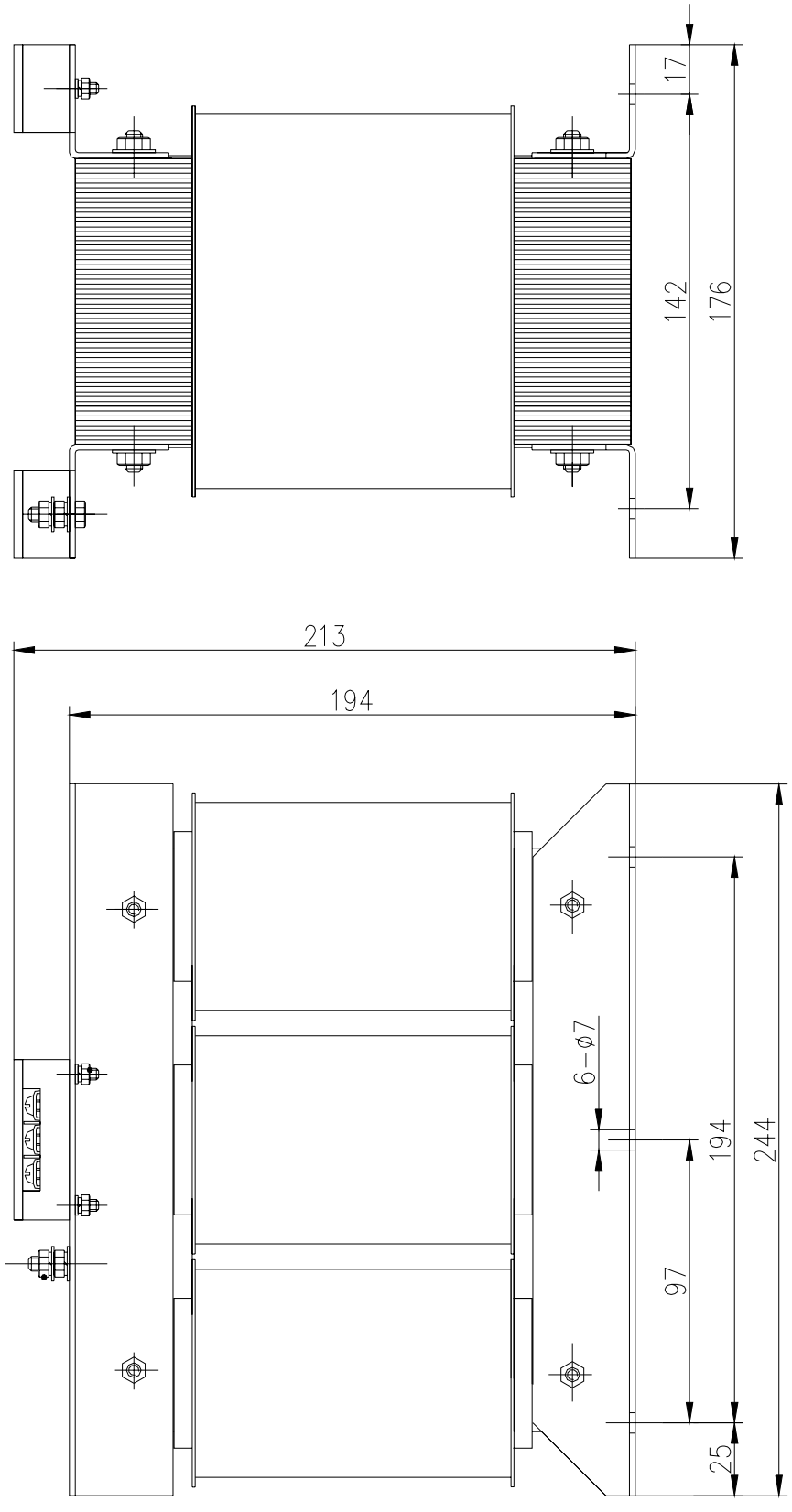
Model	Capacity (KVA)	Phases	Input voltage (V)	Output voltage (V)
BS--120	1.2	3	380	220
BS--200	2.0			
BS--300	3.0			
BD--80	0.8	1		
BD--120	1.2			



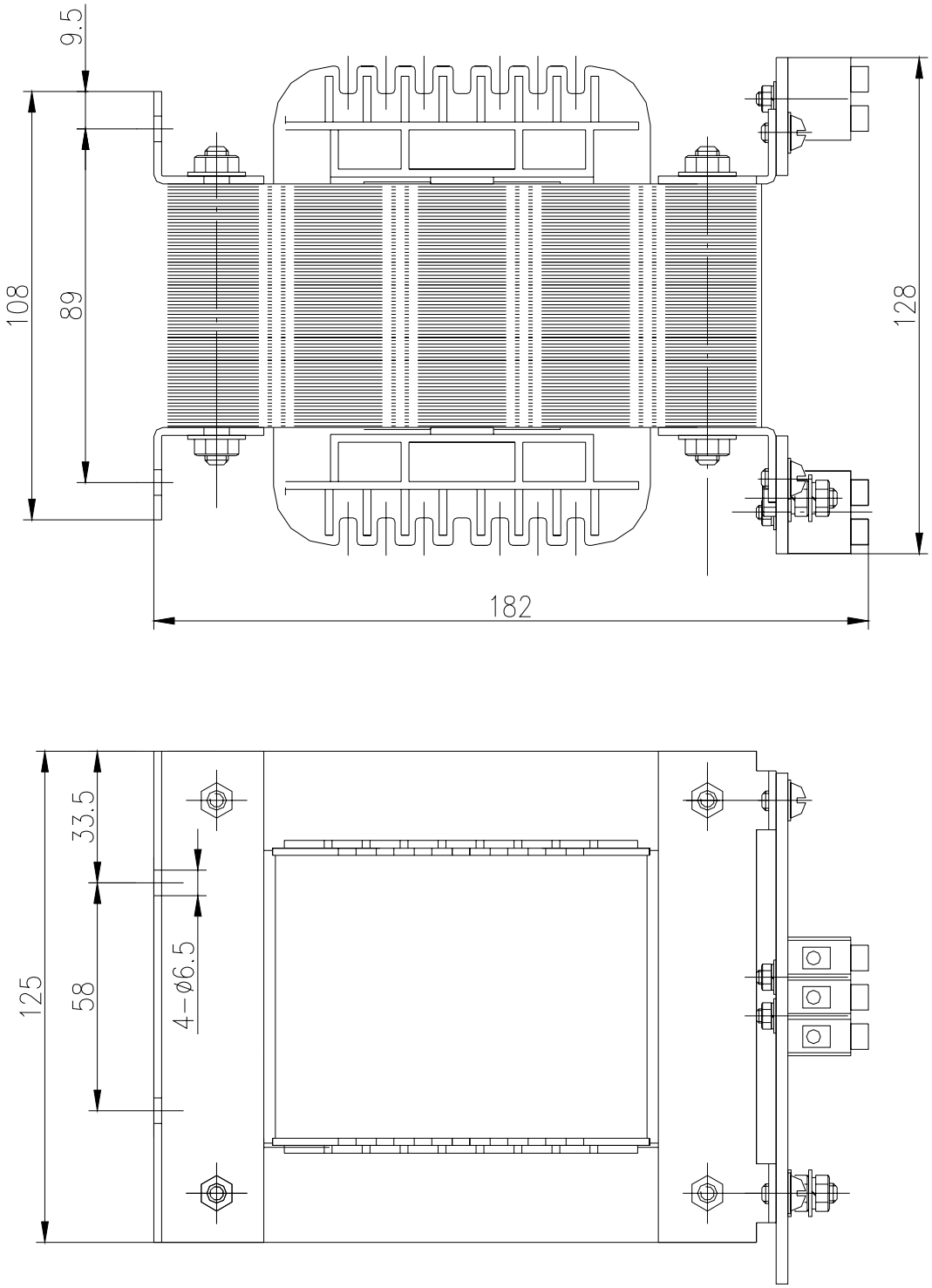
Outline and installation dimensions for model BS—120



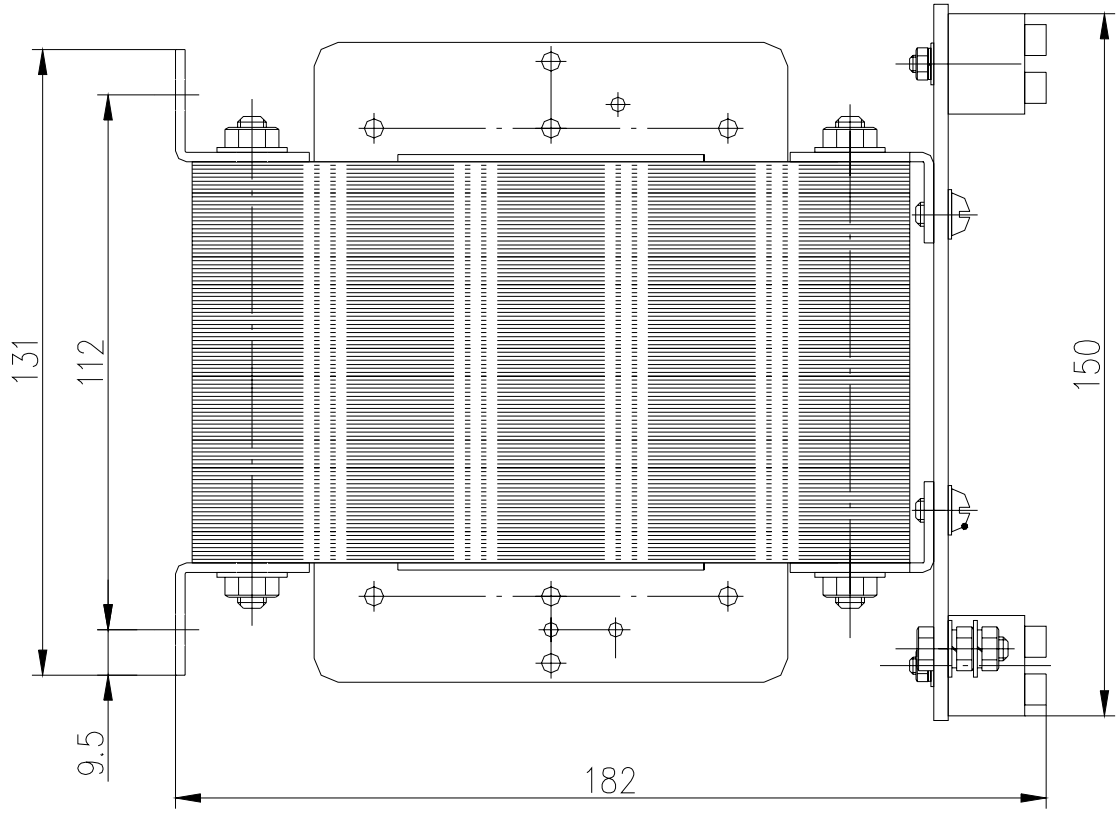
Outline and installation dimensions for model BS—200

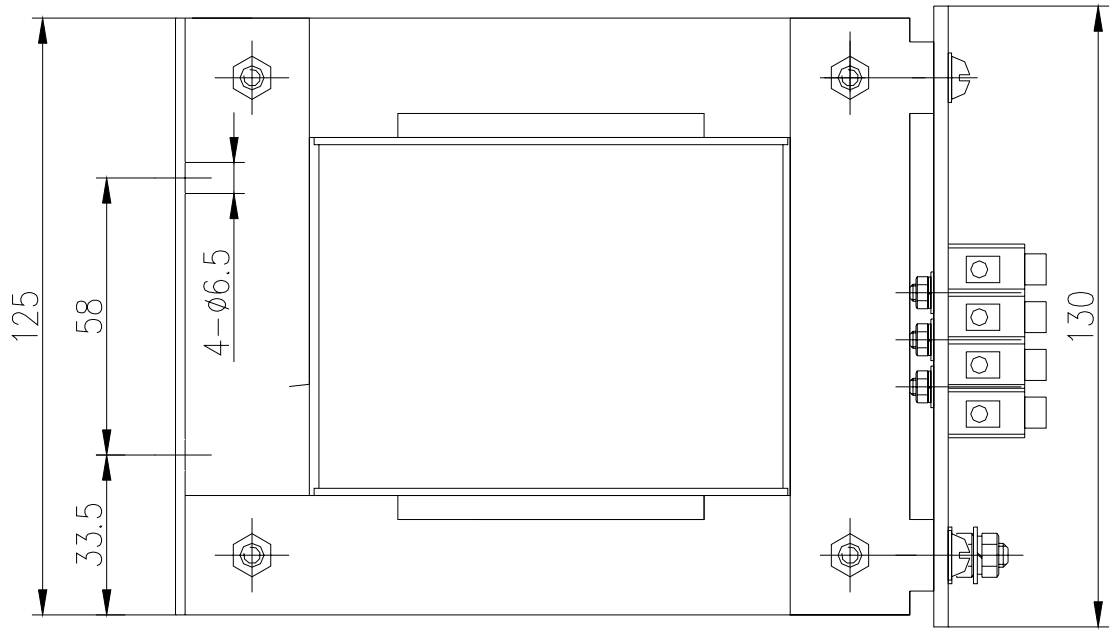


Outline and installation dimensions for model BS—300



Outline and installation dimensions for model BD—80





Outline and installation dimensions for model BD—120

CHAPTER 9 ORDER GUIDE

9.1 Capacity selection

This servo drive unit capacity is involved with load inertia, load torque, desired positioning precision and max. speed, it is recommended to consider it by the following steps:

1) To calculate the load inertia and torque

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

2) To determine preliminary mechanical gear ratio

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

3) To check the inertia and torque

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

9.2 Electronic gear ratio

Refer to Chapter 4 (Table 4.2 Parameter function), Chapter 6 (6.3 Parameter setting), Chapter 7 (7.3 Debugging) for the significance and adjustment of the electronic gear ratio G:

Under the position control mode, the actual loading speed is:

Instruction pulse speed×G ×mechanical deceleration ratio

Under the position control mode, the actual min. displacement of loading is:

Min. instruction pulse travel×G ×mechanical deceleration ratio

〖Note〗 If the electronic gear ratio G is not 1, there might be a compliment in a gear ratio division operation, which may lead to position error. And the max. error is the motor min. rotation amount (min. resolution).

9.3 Stop characteristics

Lag pulse is defined to a difference value between the instruction pulse and feedback pulse when the servo motor is controlled by pulse strings in position control mode. The difference value is accumulated in the position deviator, and the relationship of this difference value and instruction pulse frequency, electronic gear ratio and position proportional gain is as following equation:

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

ε：lag pulse （Puls）；

f：instruction pulse frequency（Hz）；

K_p：position proportional gain（1/s）；

G：electronic gear ratio.

〖Note〗 The equation is obtained when [position feedforward gain] is 0%; if the [position feedforward gain] is more than 0%, the lag pulse will be less than the value computed by the above equation.

9.4 Servo unit and position controller model selection by computation

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 frequency multiplication coefficient;

CD： instruction frequency division coefficient;

DR： servo frequency multiplication coefficient;

DD： servo frequency division coefficient;

ST： indexing per rev of servo motor;

ZD： gear teeth of motor side;

ZM： gear teeth of lead screw side;

L： lead screw pitch mm.

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

1. Max. instruction speed of CNC：

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

F：instruction speed mm/min;

f_{max}： max. output frequency of CNC Hz（128,000 for GSK980）.

2. Max. speed of servo unit：

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

V_{max}： max. speed allowed by servo system, mm/min；

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

The actual max. speed of machine is restrained by the max. speed of CNC and servo unit.

3. Min. moving amount of machine:

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

α： min. moving amount of machine mm;

N： natural number;

INT（ ）： number round-off;

INT[ ]$_{min}$： min. integer.

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