Preface

Dear customers,

We are honored and thankful for your purchase

This manual describes items concerning GS Series Spindle Servo Drive Unit in detail, such as performance, installation, connection, commissioning, usage and maintenance etc.

To ensure safe and effective running, please read this manual carefully before installation and operation.

To avoid injury to operators and other personnels, and damage to the mechanical equipments, please pay special attention to the following warning signs when reading this manual.

 Danger Mal-operation may lead to serious injury or death.

 Caution Mal-operation may lead to minor injury or physical damage.

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

 It reminds users of the important instructions and requirements.

 Forbidden (definitely cannot be done)

 Compulsive (must be done)

Danger

Tighten all terminals of main circuits properly.

Failure to observe it may result in loose connection which can easily lead to spark hazard or even fire disaster.

Mount the drive unit on noncombustible, and keep it far away from inflammables.

Failure to observe it may result in fire disaster.

Make sure that the input power is OFF before wiring.

Failure to observe it may result in electric shock.

Make sure the grounding terminal PE of servo unit is well grounded.

Failure to observe it may result in electric shock.

Wire layout or overhaul should be done by electrical engineering technician.

Failure to observe it may result in electric shock or fire disaster.

Moving, checking, and maintaining equipments or wiring should be performed 5 minutes after power-off.

Failure to observe it may result in electric shock.

Wiring should be performed according to the method described in *User Manual*.

Failure to observe it may result in equipment damage and electric shock.

DO tighten the power terminals and motor output terminals.。

Failure to observe it may result in fire disaster.

DO NOT operate the switch with wet hand.

Failure to observe it may result in electric shock.

DO NOT put hand into servo unit.

Failure to observe it may result in electric shock.

DO NOT open the terminal strip cover after power-on or in running state.

Failure to observe it may result in electric shock.

DO NOT touch the wiring terminals of servo unit main circuits.

Failure to observe it may result in electric shock.

Danger

The servo unit may be activated suddenly after power resumption, so DO NOT operate the servo motor axes connection device immediately.

Failure to observe it may result in personal injury.

DO NOT prevent radiation or put objects in cooling fan or radiator.

Failure to observe it may result in equipment damage or fire disaster.

DO NOT place cables beside sharp edges, and AVOID heavy load or tension imposing on cables.

Failure to observe it may result in electric shock, equipment fault or damage.

DO NOT perform live-wire operation on the servo drive device when the cover of terminal strip is taken apart.

Failure to observe it may result in electric shock.

Caution

The motor should be matched with appropriate servo unit.

Failure to observe it may result in device damage.

The voltage of each terminal should be loaded according to the stimulated voltage class in *User Manual.*

Failure to observe it may result in device damage.

On-load running can only be done after the motor dry run is successful.

Failure to observe it may result in device damage.

When an alarm is generated, troubleshooting should be done prior to the device running.

Failure to observe it may result in device damage.

DO NOT drag or grasp cables and motor shaft to move motor.

Failure to observe it may result in device damage.

When any shortage or damage of component is found, contact our sales person immediately rather than run the spindle servo unit.

Failure to observe it may result in device damage.

Caution

DO NOT connect power input wires R, S, T to motor output wire terminals U, V, W.

Failure to observe it may result in device damage.

DO NOT turn ON/OFF the input power frequently.

Failure to observe it may result in device damage.

DO NOT touch the radiation device of motor and servo unit when they are running, because high temperature may be caused.

Failure to observe it may result in scald.

DO NOT make excessive changes to parameters.

Failure to observe it may result in device damage.

DO NOT alter, dismantle or repair the drive unit without authorization.

Failure to observe it may result in device damage.

The scrapped components of servo unit should be handled as industrial waste and cannot be reused.

Failure to observe it may result in accident.

Safety Responsibility

Manufacturer's Responsibility

——Be responsible for the danger which should be eliminated and/or controlled on design and configuration of the provided Servo Drive Unit and accessories.

——Be responsible for the safety of the provided Servo Drive Unit and accessories.

——Be responsible for the provided information and advice for the users.

User's Responsibility

——Be trained with the safety operation of Servo Drive Unit and familiar with the safety operation procedures.

——Be responsible for the dangers caused by adding, changing or altering to the original Servo Drive Unit and the accessories.

——Be responsible for the failure to observe the provisions for operation, adjustment, maintenance, installation and storage in the manual.

Contents

CHAPTER I INSTRUCTION

1.1 Basics

- **Fundamental principles and circuits of spindle servo drive**

The spindle servo drive is composed of spindle servo unit and spindle servo motor (three-phase AC asynchronous servo motor, hereinafter called servo motor). The servo unit rectifies AC to DC, and by controlling the ON/OFF of power transistor, it generates current approximated to sinewave whose phase difference is 120° in the three-phase stator winding of servo motor (i.e., DC-AC). Thus, a magnetic field is created in the servo motor, and the rotator generates current as a result of magnetic field induction. The interaction between the inductive current and magnetic field leads to the generation of a torque which causes the rotator to work. Higher frequency of current which goes through the servo motor winding corresponds to quicker servo motor speed; the larger current amplitude corresponds to larger output torque of the servo motor (torque= force × arm length). Figure 1-1 shows the main circuit of servo unit; PG represents the encoder.

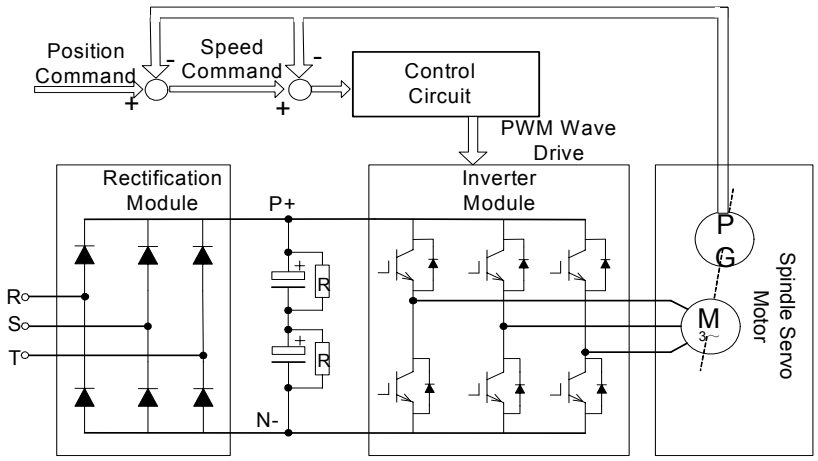


Fig. 1-1 Main circuit of spindle servo unit

- **Basic structure of spindle servo drive**

The servo unit receives speed (or position) commands from control device (also called upper computer) such as CNC system. It controls the frequency and magnitude of current which goes through the servo motor winding, so that the rotation speed (or angle) of servo motor rotator can be approximated to the speed (or position) command value, and the difference between actual rotation speed (or angle) and commanded value can be detected. By constantly adjusting the frequency and magnitude of current, the servo unit can limit the differences within the required range. Figure 1-2 shows the basic structure of spindle servo drive.

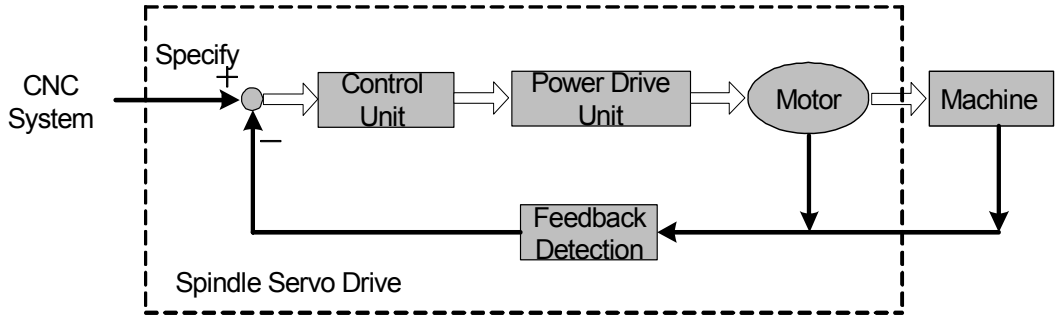


Fig. 1-2 Basic structure of spindle servo drive

➢ **General concept of control**

- **Control:** A process of the characteristics (such as speed) of an object (such as servo motor) reaching or approximating to the desired value is called CONTROL. The object herein is called PLANT; and its characteristic is called CONTROLLED VARIABLES; the unit which realizes the control is called CONTROL UNIT; the process of receiving the desired value by the control unit is called SPECIFY; the process of inputting and reacting to controlled variable is called FEEDBACK; the unit that detects the controlled variables is called FEEDBACK UNIT; the feedback can be divided into positive feedback (same direction) and negative feedback(reversed direction) according to the controlled variables and output direction. The drive is composed of plant, feedback unit and control unit. There are two kinds of drives: open-loop control device and closed-loop control device. They are distinguished by the absence/presence of feedback unit and its position in drive. The closed-loop control device described in this manual is negative feedback closed-loop control device.

In this manual, the spindle servo unit is the control unit; the plant is the servo motor; the motor rotation speed (or angle) is the controlled variable; the encoder is the feedback unit; the speed feedback is realized when actual speed is detected by encoder for speed control. Spindle servo unit belongs to closed-loop control device.

- **Open-loop control device:** Feedback unit is absent in the control device, so the actual controlled variables do not affect the output of control unit. Take stepper motor drive for example: after the servo unit outputs the phase sequence changes of current, the rotator of stepper motor should follow the change; however, since there is no feedback unit, the rotator may not catch up with the changes due to overload or fast acceleration/deceleration, this is the so-called “out-of-synchronism”. Shown in Figure 1-3.

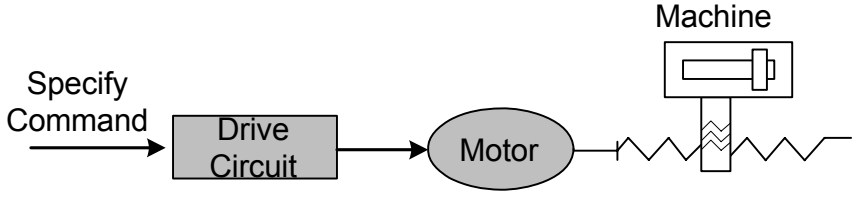


Fig. 1-3 Open-loop control device

- **Closed-loop control**: The controlled variable is detected by feedback unit and sent to

control unit. According to the detection points, the closed-loop control device can be divided into full-closed-loop control and semi-closed-loop control. The former one is to detect the controlled variables directly for feedback (see Fig. 1-4); the mechanical position is controlled variables; the grating ruler mounted on the machine is taken as feedback unit; the encoder on the servo motor serves as speed feedback unit. Thus the full-closed-loop control can be realized. If there is no grating ruler, the encoder serves as both position and speed feedback unit (see Fig. 1-5). Thus, the semi-closed-loop control can be realized.

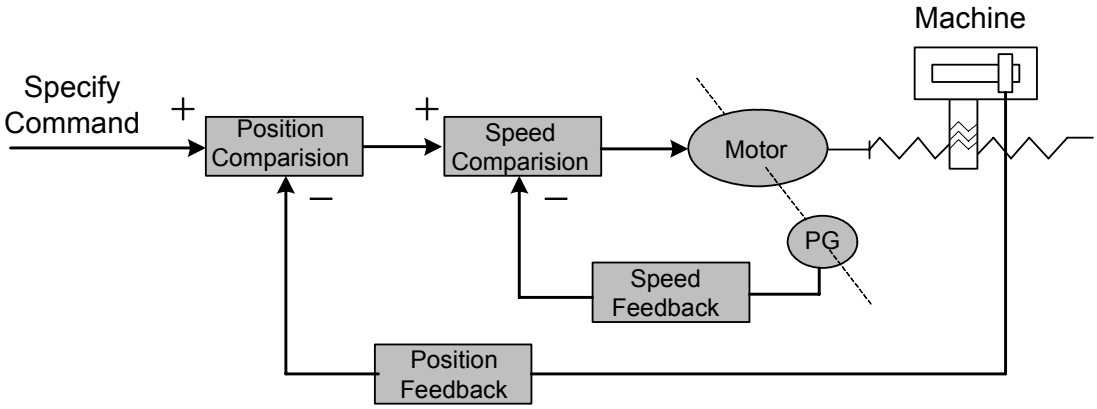


Fig. 1-4 Full-closed-loop control device

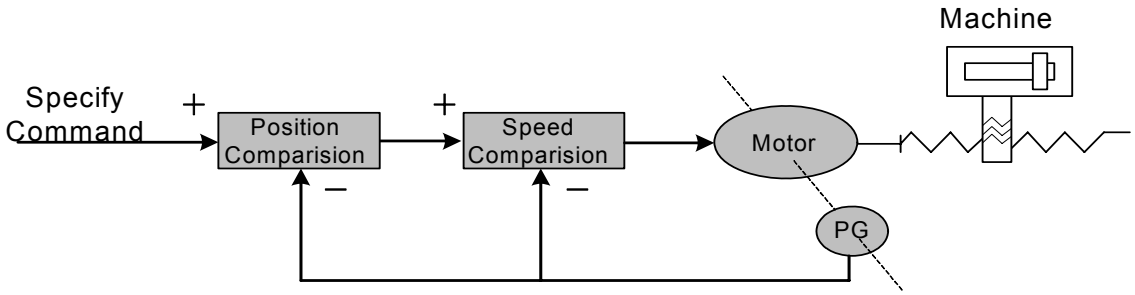


Fig. 1-5 Semi-closed-loop control device

- **PID control**: It is the most commonly used algorithm. “P” is Proportional, representing the linear proportional relationship between input and output of control unit. The larger the value is, the more sensitive the system is, and the smaller the steady-state error will be (impossible to eliminate); however, too large proportional coefficient will lead to system instability. “I” is Integral, representing the accumulation of past errors. Larger integral time constant means the system is more stable till the stead-state error is eliminated; however, it also may lead to lower response of the system. “D” is Differential, representing the prediction of future errors, based on current rate of change. It can decrease the following error and improve the dynamic property. When the integral is too large, the system will be unstable. P, I, D are interacted for the balance among system response, control precision and stability. Since the integral control will easily cause impact and oscillation, PI control (i.e., proportion and integral control) is mainly described in this manual.

➢ **Concept about servo control**

There are three kinds of control mode: position control, speed control and torque control. Shown

in Fig. 1-6:

- Position control: Specify the rotation direction and angle (position) of the motor in forms of digital pulse or data communication.
- Speed control: Specify the rotation direction and speed of the motor in forms of analog voltage or data communication.
- Torque control: Specify the magnitude and direction of output torque of the motor in forms of analog voltage or data communication.

The servo drive described in this manual repels the torque control signal, therefore the torque control mode is not provided here.

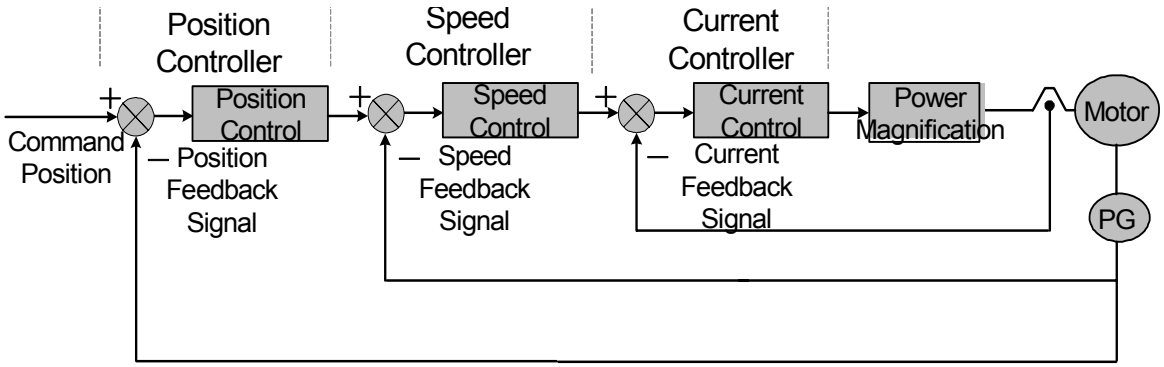


Fig. 1-6 Three-loop control system

➢ **Performance norm of spindle servo drive**

Dynamic performance: means the response speed, dynamic error and steady-state error of spindle servo drive when the load is specified or changed. The following figure shows the dynamic response of step signal specified by spindle servo drive (the full line represents the specified signal and dashed line represents the output signal; similarly hereinafter).

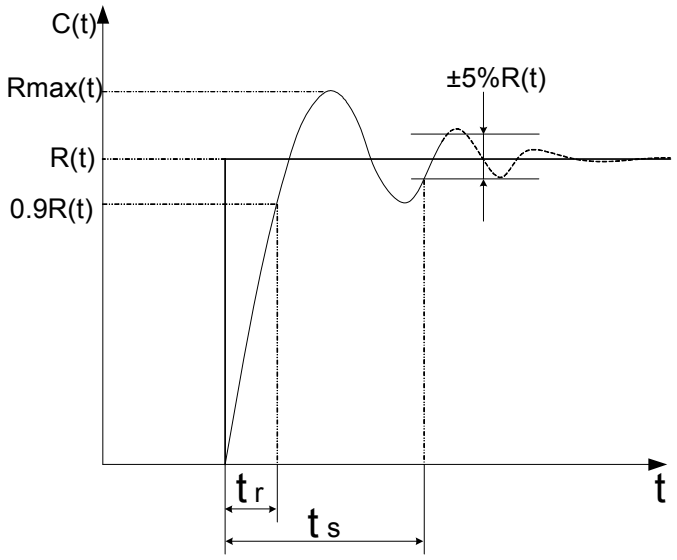


Fig. 1-7 Dynamic response curve

Rise time t_r: The duration that the rotation output value rises from 0 to 90% of the steady-state value for the first time. It represents the speed of dynamic response.

Settling time t_s: The range -5%~+5% of the steady-state value is taken as permitted error zone. The settling time is the minimum duration of the response curve to reach the zone (no excess any more). It is used to measure the speed of the whole control process.

Percent overshoot σ: It is the maximum fraction by which the response overshoots the steady-state value and expressed as a percentage, i.e.

$$\sigma(\%) = \frac{R_{\max}(t) - R(t)}{R(t)} \times 100\%$$

Steady-state error: The difference between the steady-state output value to the reference input value at steady state is called the steady state error of the system.

Static performance: Stability is the crucial factor of a spindle servo drive. The static performance mainly refers to positioning accuracy which means the difference between the reference state and actual state after the transient process. The static precision can be affected by measurement device error as well as the system error which is related to the system structure and parameters. Fig. 1-8 shows the static curve of position servo drive.

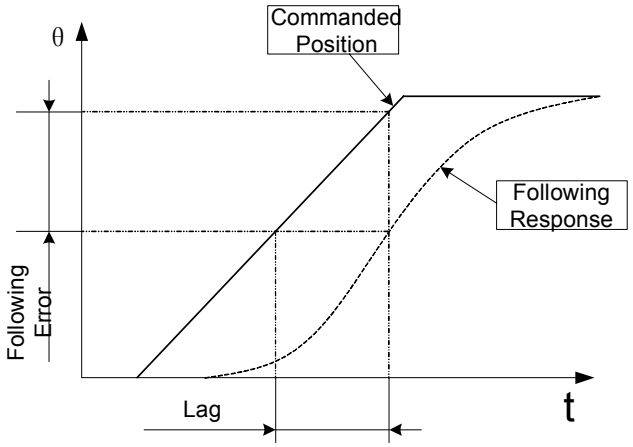


Fig. 1-8 Static curve

Following error: The difference between the required position and actual position is called following error. It equals to commanded position value minus actual position value.

Servo rigidity: The capacity of resisting deviation which is caused by load.

- **Comparison between spindle servo drive and inverter drive**

Although both two kinds of devices can realize the conversion of AC-DC-AC, and drive the three-phase asynchronous motor, the spindle servo drive bears larger current frequency range and wider valid regulating range. Since an encoder is mounted on servo motor, the spindle servo drive belongs to closed-loop control device. Whereas, no encoder is mounted on an inverter-fed motor, the inverter drive belongs to open-loop control device. Motor's rotation speed will change as the load changes; however, since feedback control function is not available, the inverter cannot recover the speed like the servo unit does. To reduce cost, the overload capacity of inverter is 10%~20%, and that of servo unit is greater than 50%. Higher overload capacity means faster acceleration and response.

Compared with inverter drives, the spindle servo drives have the following advantages:

- Both speed and position control are available; the control precision is high;
- Wider regulating range; capable of outputting valid torque in zero-speed state;
- Small speed fluctuation when load changes; quick to recover;
- Strong overload capacity; fast response; high efficiency; adaptable to sudden start/stop conditions;

1.2 Product Confirmation

Check the following items after receiving the products. Please contact us or the supplier if you come across any question.

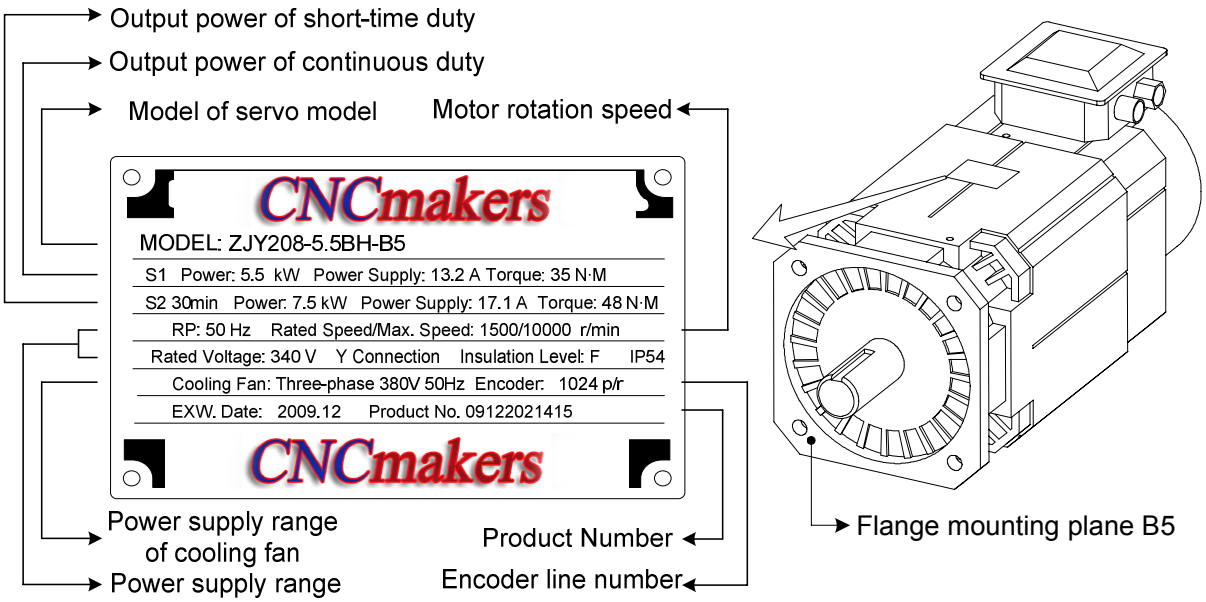
Item	Remark
Check the consistency of servo unit and servo motor	Check the nameplate.
Check the completeness of accessories	Check the contents on packing list and contact the supplier if an inconsistency is found.
Check whether the product is damaged during delivery	Check the overall appearance.
Check whether the screw is loose	Check for loose connection with a screwdriver.

Caution

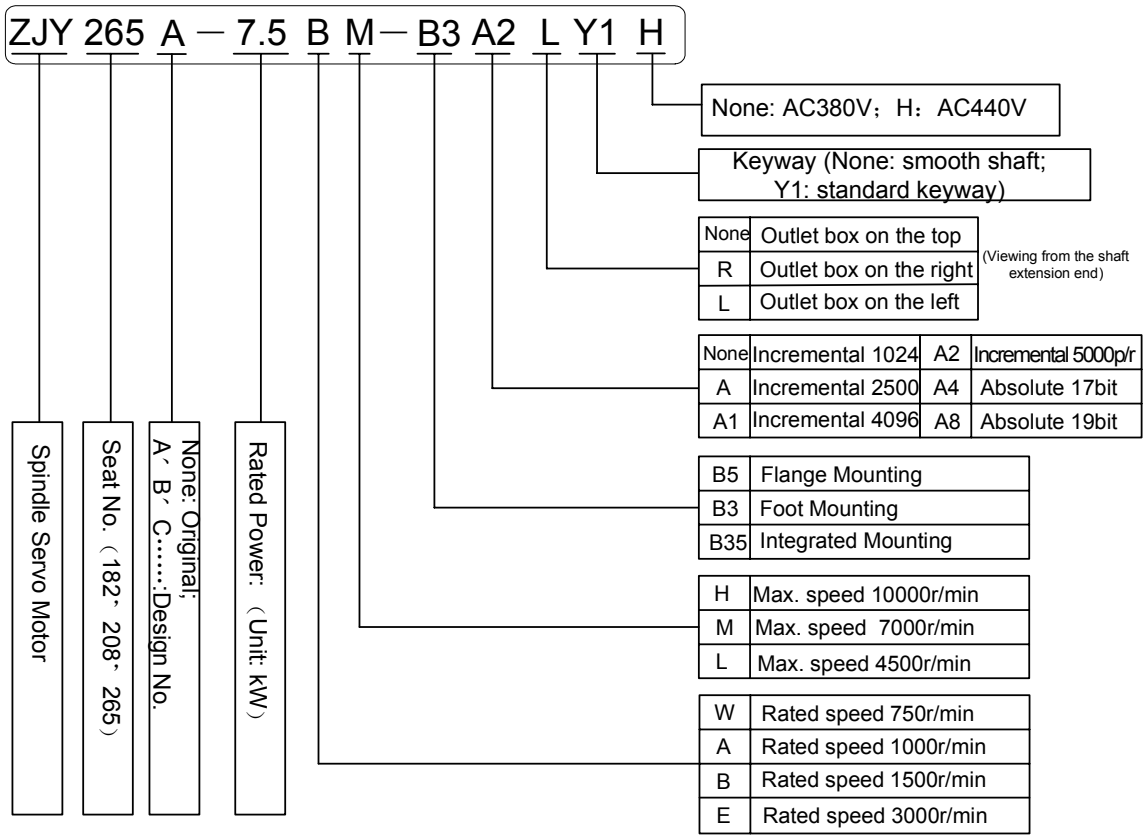
1. Spindle servo unit with loss or damage of parts should not be installed.
2. Servo unit should be matched with a servo motor with suitable power.
3. There are two types of GS series products: D-SUB and MDR. Make sure that the used product meets the requirements.

1.2.1 Instruction of AC Spindle Servo Motor Model

➢ Nameplate of spindle servo motor:

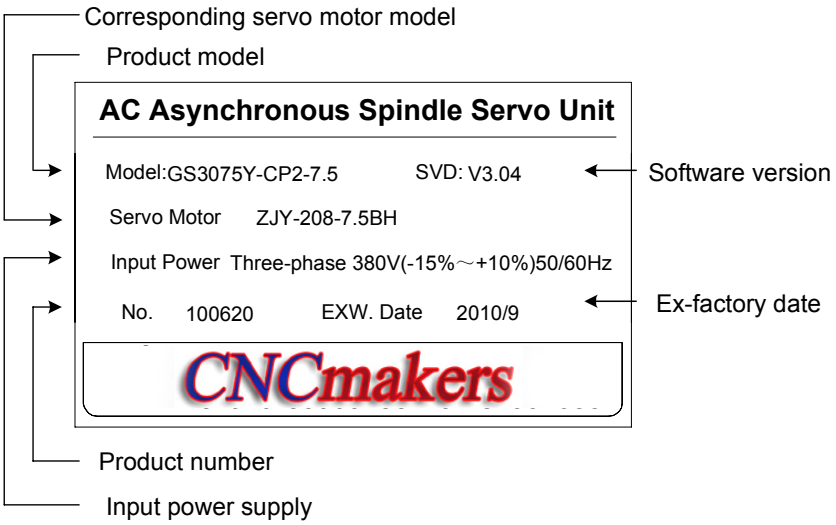


➢ Instruction of spindle servo motor model:



1.2.2 Instruction of Spindle Servo Unit

Example: (nameplate)



Model instruction:

GS	3	075	Y	-	C	P	2
①	②	③	④		⑤	⑥	⑦

①	GS Series MDR Servo Unit, G: GSK; S: SERVO
②	Voltage grade code, 2: 220V; 3: 380V; 4: 440V.

③	Nominal current of power component (in three digits): 048, 050, 075, 100, 148, 150 (unit: A)
④	Motor type: T: synchronous servo motor; Y: asynchronous servo motor.
⑤	Communication bus code; N: none; C: GSK-CAN; L: GSK-Link
⑥	Feedback (encoder) interface type code; P: incremental encoder; A: Absolute encoder, no backup battery; B: absolute encoder (with backup battery which is used when power-off).
⑦	Feedback (encoder) interface configuration code (in 1 digit); 1: The input interface CN2 for motor feedback (i.e., the 1st position feedback); 2: Input interfaces CN2 and CN3 for motor feedback and the 2nd position feedback.

Position feedback signal interface type and configuration:

⑥	⑦	Instruction for feedback (encoder) interface type and configuration
P	1	CN2; incremental encoder;
	2	CN2 and CN3; incremental encoder;
A（B）	1	CN2; incremental encoder or absolute encoder (compatible with Biss and TAMAGAWA communication protocols; automatic identification);
	2	CN2 and CN3; incremental encoder or absolute encoder (compatible with Biss and TAMAGAWA communication protocols; automatic identification);

1.2.3 Overall Appearance of Spindle Servo Unit

According to different signal interfaces, the GS Series Spindle Servo Unit can be divided into D-SUB type and MDR type. The products that adopt D-SUB interfaces provided by WIESON Company belong to D-SUB type. They are matched with incremental encoder and not equipped with GSK-CAN. The products that adopt MDR interfaces provided by 3M Company belong to MDR type. They are compatible with absolute encoder and equipped with GSK-CAN bus.

- **Overall Appearance of GS Series AC Spindle Servo Unit (D-SUB Type)**

The figure below shows the structure of following products: GS3048Y-N Series, GS3050Y-N Series, GS3075Y-N Series GS3100Y-N Series, GS3148Y-N Series, GS4048Y-N Series, GS4050Y-N Series, GS4075Y-N Series, GS4100Y-N Series, GS4148Y-N Series.

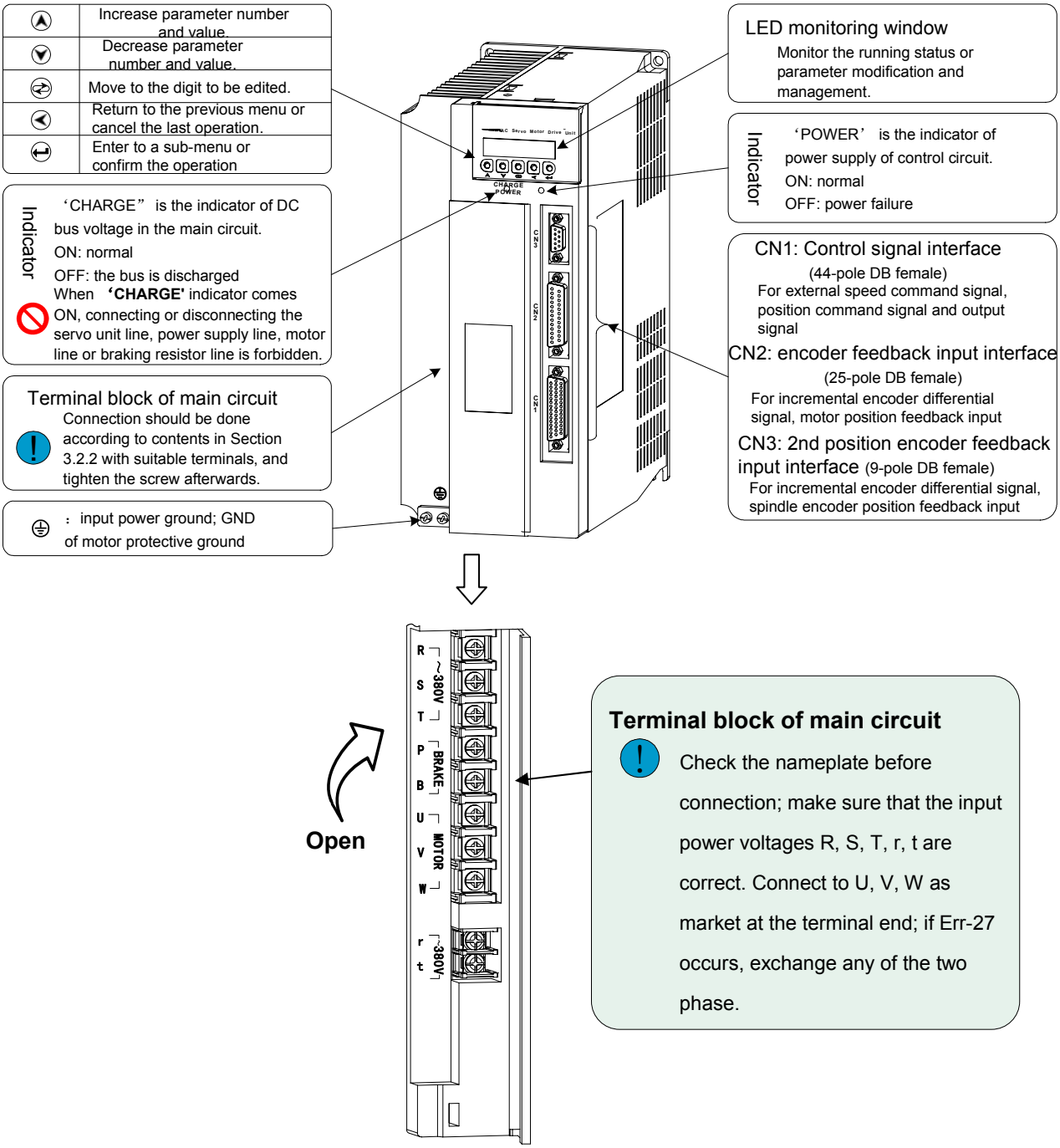


Fig. 1-9 (a) Overall appearance of GS Series AC spindle servo unit (D-SUB type)

The figure below shows the structure of following D-SUB products: GS3150Y-N Series, GS4150Y-N Series.

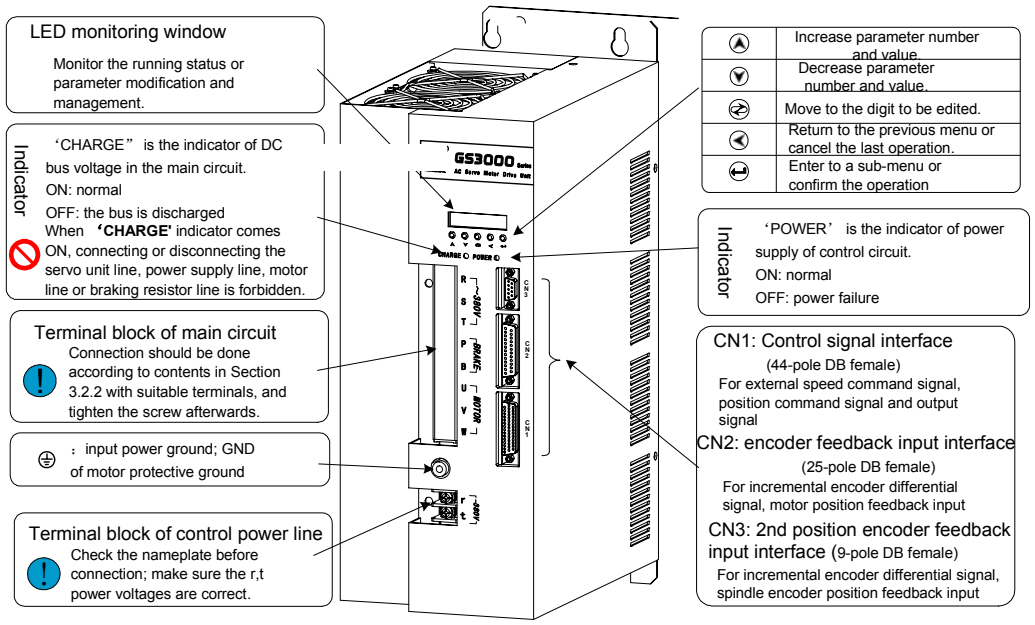


Fig. 1-9 (b) Overall appearance of GS Series AC spindle servo unit (D-SUB type)

- **Overall Appearance of GS Series AC Spindle Servo Unit (MDR Type)**

The figure below shows the structure of following products: GS3048Y-C Series, GS3050Y-C Series, GS3075Y-C Series, GS3100Y-C Series, GS3148Y-C Series, GS4048Y-C Series, GS4050Y-C Series, GS4075Y-C Series, GS4100Y-C Series, GS4148Y-C Series.

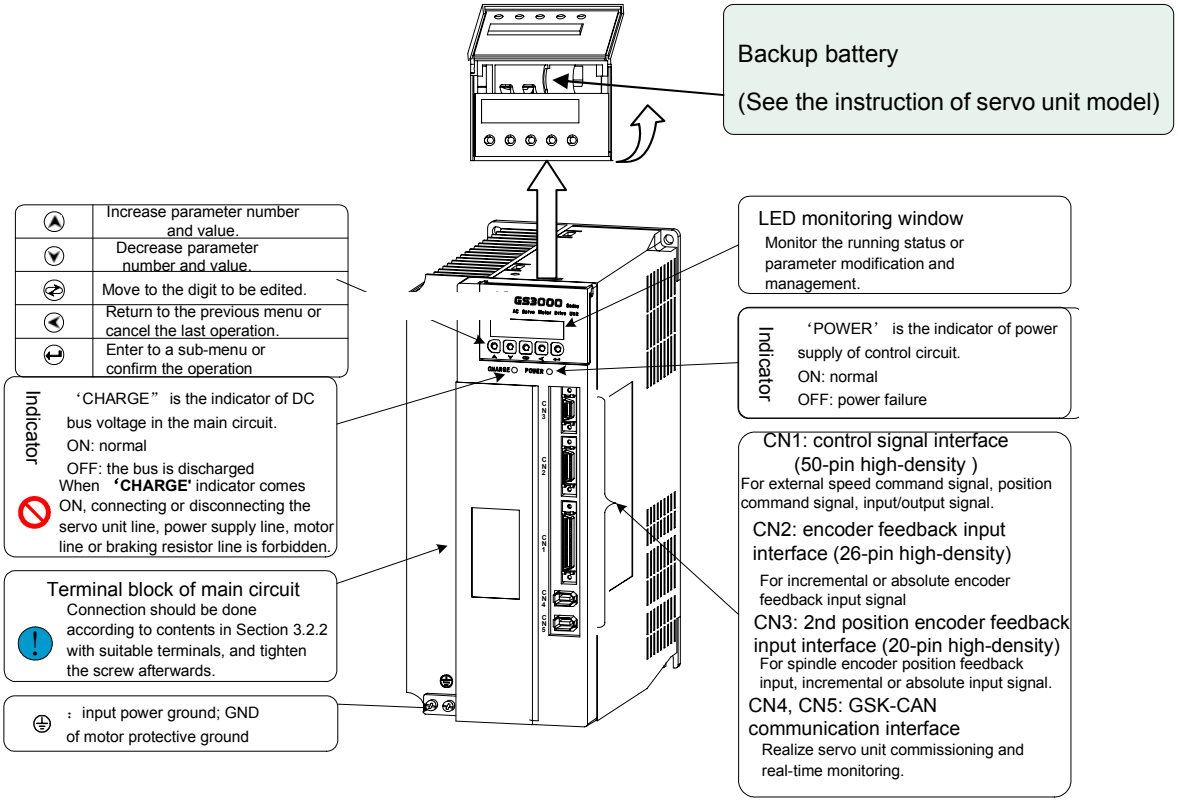


Fig. 1-10 (a) Overall appearance of GS Series AC spindle servo unit (MDR type)

The figure below shows the structure of following products: GS3150Y-C Series, GS4150Y-C Series.

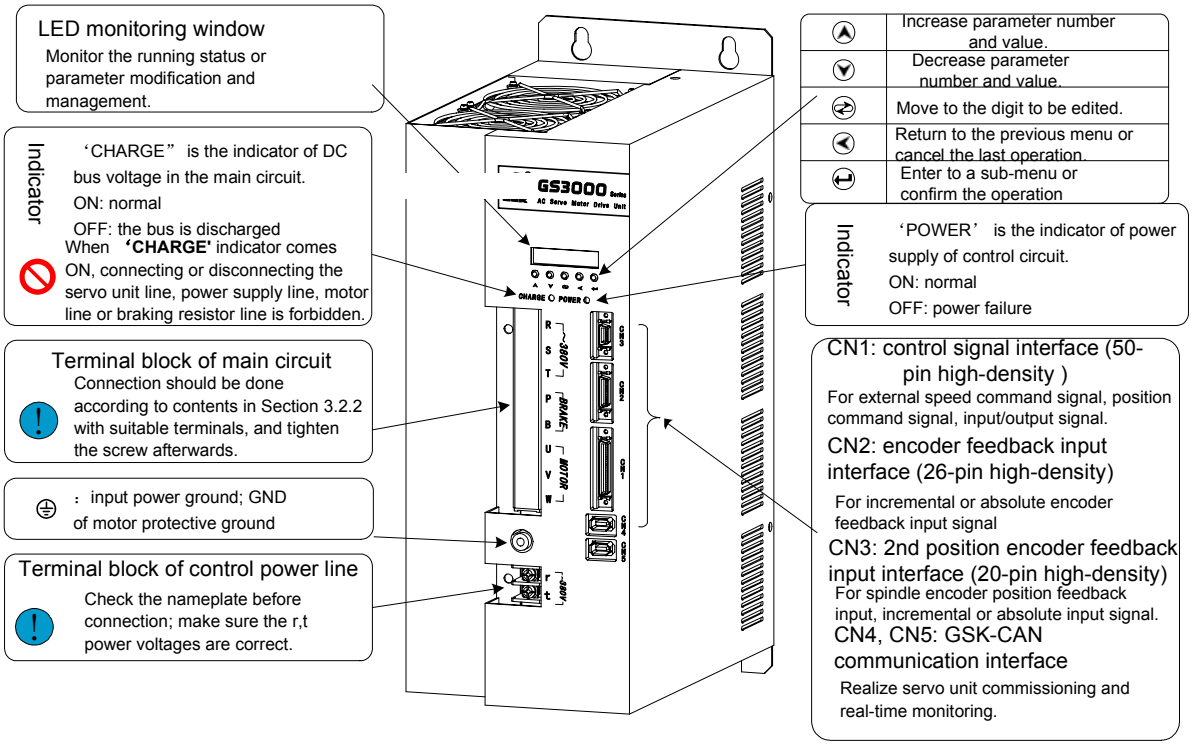


Fig. 1-10 (b) Overall appearance of GS Series AC spindle servo unit (MDR type)

1.3 Technical Specification

1.3.1 Technical Specification of Spindle Motor

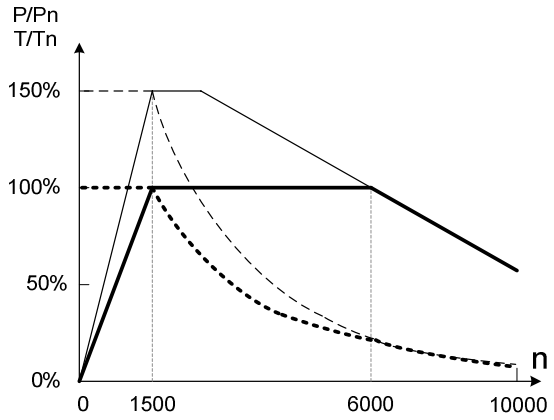
SPEC / Item	ZJY208 -2.2AM	ZJY208 -3.7AM	ZJY208 -5.5AM	ZJY265 -7.5AM	ZJY265 -11AM	ZJY265 -15AM	ZJY182 -1.5BH	ZJY182 -2.2BH
Rated power (kW)	2.2	3.7	5.5	7.5	11	15	1.5	2.2
Servo Unit Power Supply	Three-phase AC 380V 50 Hz /60Hz							
Rated Current (A)	6.7	10.2	15.5	21	31	48.3	7.3	7.5
Rated Frequency(Hz)	33.3	33.3	33.3	33.3	33.3	33.3	50	50
Rated Torque(N·m)	21	35	53	72	105	143	9.5	14
30min Power	3.7	5.5	7.5	11	15	18.5	2.2	3.7
30min Current (A)	9.8	13.8	19.6	28	39	56	9.3	11
30min Torque (N·m)	35	53	72	105	143	177	14	24
Rated Speed (r/min)	1000	1000	1000	1000	1000	1000	1500	1500
Constant Power Range	1000～4000							
Max. Speed	M:7000						H:10000	

SPEC / Item	ZJY208 -2.2AM	ZJY208 -3.7AM	ZJY208 -5.5AM	ZJY265 -7.5AM	ZJY265 -11AM	ZJY265 -15AM	ZJY182 -1.5BH	ZJY182 -2.2BH
Rotary Inertia	0.0168	0.0238	0.0309	0.0413	0.0826	0.086	0.0056	0.0074
Weight (kg)	51	66	77	51	125	143	27	32
Installation	IM B5 or B3						IM B35	
Power Supply of Cooling Fan	Three-phase AC 380V 50Hz 40W 0.14A			Three-phase AC 380V 50Hz 70W 0.21A			Three-phase AC 380V 50Hz 30W 0.08A	

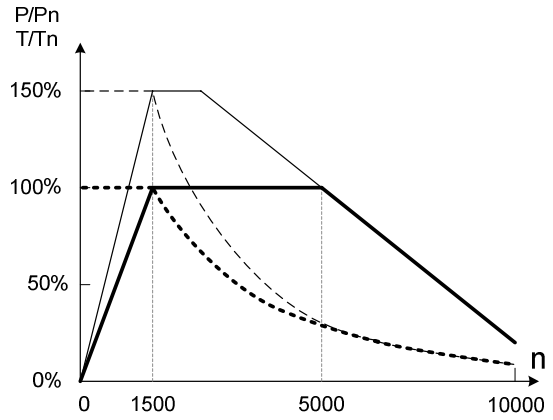
SPEC / Item	ZJY182-3.7BH	ZJY208-3.7 B	ZJY208-5.5 B	ZJY208-7.5 B	ZJY265-7.5B M	ZJY265-11B M	ZJY265-15B M
Rated Power (Kw)	3.7	3.7	5.5	7.5	7.5	11	15
Servo Unit Power Supply	Three-phase AC 380V 50 Hz /60Hz						
Rated Current (A)	15.5	8.9	13.7	18.4	18	26	35
Rated Frequency (Hz)	50	50	50	50	50	50	50
Rated Torque (N·m)	24	24	35	48	49	72	98
30min Power (kW)	5.5	5.5	7.5	11	11	15	18.5
30min Current (A)	19.6	13	18	25	26	34	42
30min Torque (N·m)	35	35	48	70	74	100	123
Rated Speed (r/min)	1500	1500	1500	1500	1500	1500	1500
Constant Power Range	1500～5000						
Max. Speed	H:10000	M:7000, H:10000			M:7000		
Rotary Inertia	0.0115	0.0168	0.0238	0.0309	0.0413	0.0744	0.0826
Weight (kg)	43	51	66	77	89	107	125
Installation	IM B35	IM B5 or B3					
Power Supply of Cooling Fan	Three-phase AC 380V 50Hz 30W 0.08A	Three-phase AC 380V 50Hz 40W 0.14A			Three-phase AC 380V 50Hz 70W 0.21A		
Protection Level	IP54（GB/T 4942.1—2006）						
Insulation Level	F （GB 755—2008）						
Vibration Level	R（GB 10068—2008）						
Internal Encoder	Incremental encoder1024 p/r						

Mechanical Characteristics of Motor

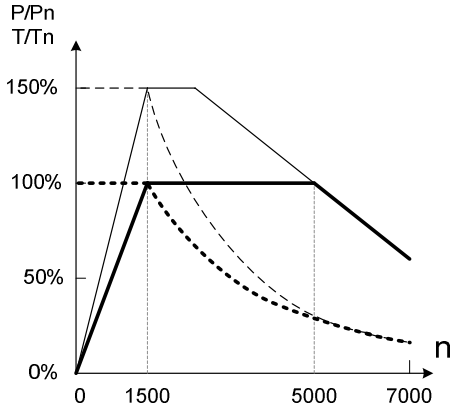
P/P_N: Power/Rated power; T/TN: Torque/Rated torque; n: Rotation speed of spindle servo motor;



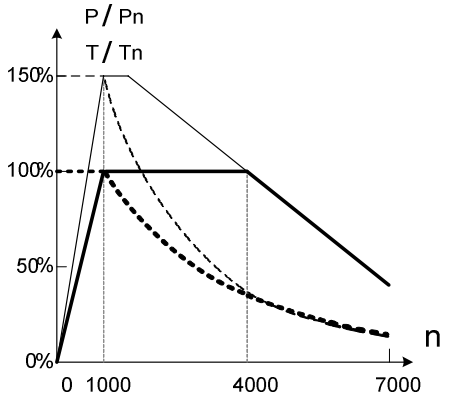
ZJY182 rated rotation speed: 1500r/min



ZJY208 rated rotation speed: 1500r/min



ZJY265 rated rotation speed: 1500r/min



ZJY208, ZJY265 rated rotation speed: 1500r/min

Power in continuous working status; Power in 30min's working status;

Torque in continuous working status; Torque in 30min's working status

1.3.2 Technical Specification of AC Spindle Servo Unit

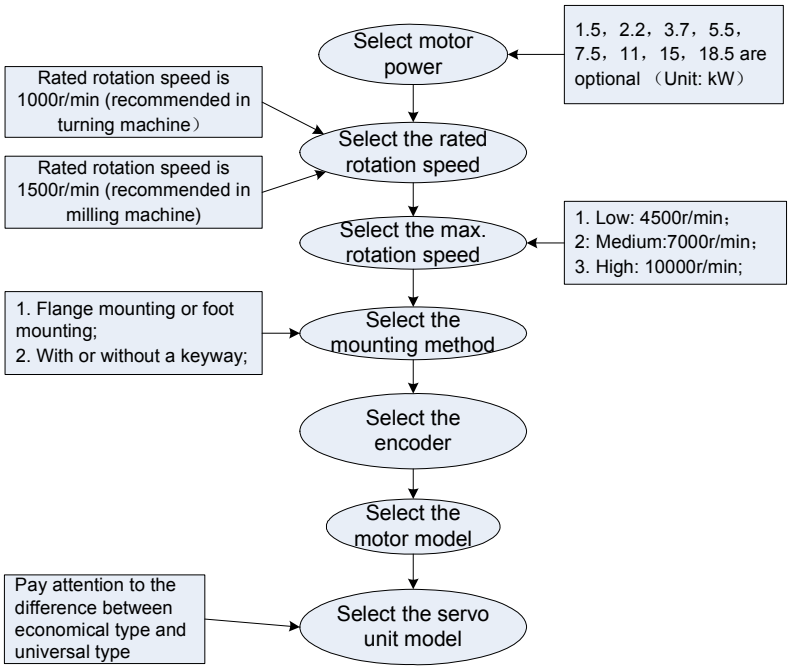
Model	GS3048Y GS4048Y	GS3050Y GS4050Y	GS3075Y GS4075Y	GS3100Y GS4100Y	GS3148Y GS4148Y	GS3150Y GS4150Y
Rated Power (kW)	1.5, 2.2	3.7, 5.5	5.5, 7.5	7.5, 11	11	15, 18.5
Input Power	Input power of GS3□□□Y Series is: Three-phase AC380V（0.85～1.1）, 50/60Hz±1Hz Input power of GS4□□□Y Series is: Three-phase AC440V（0.85%～1.1）, 50/60Hz±1Hz					
Dimension (mm) (width×height×depth)	112×230×182	120×270×218	130×305×248.5	160×305×273.5		160×370×273.5
Regulating Range (r/min)	1～10000					
Speed Fluctuation Rate	＜ Rated Speed ×0.1%					
Working Mode	MANUAL, JOG, SPEED, POSITION, SPEED/POSITION					

Internal Speed Mode	Motor rotates at the speed set by internal parameters (speed closed-loop control)\ Running speed is selected by input signal.
External Speed Mode	Motor rotates at the speed specified by external analog voltage (speed closed-loop control)
External Speed Command Mode	－10V～+10V or 0V～+10V, selected by parameters
Speed Command Electronic Gear	Speed command frequency multiplication; frequency division coefficient:1~100
Position Mode	Motor rotates by position pulse command (position closed-loop control); the direction and quantity of pulse command determine the rotation direction and angle; the pulse frequency determines the rotation speed.
Position Command Pulse Mode	Pulse/direction; CCW pulse/CW pulse; A/B two-phase orthogonal pulse; max. pulse frequency: 1HZ
Position Command Electronic Gear	Command pulse frequency multiplication coefficient: 1～32767; Command pulse frequency division coefficient: 1～32767
Positioning Accuracy	±0.088° (matched with incremental encoder with 1024 lines)
Orientation	4-point orientation; 4 orientation angle is set by parameters; orientation position is selected through input signal; orientation error is ±180°/C (C is the line number of position feedback encoder)
Motor Feedback Input	GS3□□□Y-NP2 and GS4□□□Y-NP2（D-SUB type: adopt incremental encoder; GS3□□□Y-C□2 and GS4□□□Y-C□2（MDR type: adopt incremental encoder or absolute encoder (compatible with two communication protocols: Biss and TAMAGAWA).
2nd Position Feedback Input (optional)	GS3□□□Y-NP2（D-SUB type: adopt incremental encoder; GS3□□□Y-C□2（MDR type: adopt incremental encoder or absolute encoder (compatible with two communication protocols: Biss and TAMAGAWA).
Position Feedback Output	GS3□□□Y-NP2（D-SUB type: motor feedback input signal or 2nd position feedback input signal output in 1:1; GS3□□□Y-C□2（MDR type）: motor feedback input signal or 2nd position feedback input signal output in frequency division; the range of numerator and dominator in position feedback output gear ratio is 1～32767, and the dominator should be larger than or equal to numerator;
Communication Bus	GS3□□□Y-NP2 and GS4□□□Y-NP2（D-SUB type）: no communication bus; GS3□□□Y-C□2 and GS4□□□Y-C□2（MDR type）: GSK-CAN
Input Signal	Servo enable; CCW start; CW start; orientation/speed selection; orientation start; 2nd speed gain selection; spindle clamping interlock signal; zero-speed clamping; alarm clear; speed/position switching
Output Signal	Servo ready; zero speed output; position/speed arrival; orientation completed; alarm output speed/position status; encoder zero point;
Function Protection	Undervoltage protection; overvoltage protection; servo unit overcurrent protection; servo motor thermal overload protection; overspeed protection; overshoot protection; brake abnormality protection; encoder abnormality protection; motor overheat protection.
Operation and Display	5 keys for manual, JOG operation and parameter modification, setting, writing and backup; 6-digit LED displays rotation speed, current position, command pulse accumulation, position deviation, motor torque, motor current, absolute position of rotator, I/O signal status etc.
Braking Resistor	Externally connected (no internal braking resistor)

Note: CCW mean the motor rotates in counter clockwise direction (viewing from the shaft extension side).
CW means the motor rotates in clockwise direction (viewing from the shaft extension side).

1.4 Ordering Guidelines

1.4.1 Model Selection Process



After selecting the motor model, you can select the servo unit model according to the relationship described in 1.4.2.

1.4.2 Examples

1. The model of GS Series servo device (including ZJY Series spindle servo motor) is shown as follows:

GS servo unit model — ZJY spindle servo motor model

Example: GS3075Y-NP2—ZJY208-7.5BM -B5LY1

Instruction: the model of spindle servo unit is GS3075Y-NP2, and the corresponding model of spindle servo motor is ZJY208-7.5BM -B5ALY1. The accessories are the standard ones (see Section 1.4.3).

2. The model of GS Series servo device (not including ZJY Series spindle servo motor) is shown as follows:

GS servo unit model —（Servo motor model）

Example: GS3075Y-NP2—（ZJY208-7.5BM -B5LY1）

Instruction: the model of spindle servo unit is GS3075Y-NP2, and the ex-factory parameters should be set according to the model in the brackets. The accessories are the standard ones (see Section 1.4.3).

Model list of GS Series servo unit and ZJY Series servo motor:

Servo Unit Model	Motor Model	Major Parameters of Spindle Motor				
		Rated Power	Rated Speed	Max. Speed	Rated Current	Standard Encoder
GS3048Y-NP2 GS3048Y-CP2 GS4048Y-NP2 GS4048Y-CP2	ZJY182-1.5BH	1.5kW	1500 rpm	10000rpm	7.3 A	1024-line incremental encoder
	ZJY182-2.2BH	2.2kW	1500 rpm	10000rpm	7.5 A	1024-line incremental encoder
	ZJY208-2.2AM	2.2kW	1000rpm	7000rpm	6.7A	1024-line incremental encoder
	ZJY208-2.2BM	2.2kW	1500rpm	7000rpm	9.3A	1024-line incremental encoder
GS3050Y-NP2 GS3050Y-CP2 GS4050Y-NP2 GS4050Y-CP2	ZJY182-3.7BH	3.7kW	1500 rpm	7000rpm （10000rpm）	15.5 A	1024-line incremental encoder
	ZJY208-3.7AM	3.7kW	1000rpm	7000rpm	10.2A	1024-line incremental encoder
	ZJY208-3.7BM （ZJY208-3.7BH）	3.7kW	1500rpm	7000rpm （10000rpm）	8.9A	1024-line incremental encoder
	ZJY208-5.5BM （ZJY208-5.5BH）	5.5kW	1500rpm	7000rpm （10000rpm）	13.7A	1024-line incremental encoder
GS3075Y-NP2 GS3075Y-CP2 GS4075Y-NP2 GS4075Y-CP2	ZJY208-5.5AM	5.5kW	1000rpm	7000rpm	15.5A	1024-line incremental encoder
	ZJY208-7.5BM （ZJY208-7.5BH）	7.5kW	1500rpm	7000rpm （10000rpm）	18.4A	1024-line incremental encoder
	ZJY265-7.5BM	7.5kW	1500rpm	7000rpm	18A	1024-line incremental encoder

Servo Unit Model	Motor Model	Major Parameters of Spindle Motor				
		Rated Power	Rated Speed	Max. Speed	Rated Current	Standard Encoder
GS3100Y-NP2 GS3100Y-CP2 GS4100Y-NP2 GS4100Y-CP2	ZJY265-7.5AM	7.5kW	1000rpm	7000rpm	21A	1024-line incremental encoder
	ZJY265-11BM	11kW	1500rpm	7000rpm	26A	1024-line incremental encoder
GS3148Y-NP2 GS3148Y-CP2 GS4148Y-NP2 GS4148Y-CP2	ZJY265-11AM	11kW	1000rpm	7000rpm	31A	1024-line incremental encoder
GS3150Y-NP2 GS3150Y-CP2 GS4150Y-NP2 GS4150Y-CP2	ZJY265-15AM	15kW	1000rpm	7000rpm	48.3A	1024-line incremental encoder
	ZJY265-15BM	15kW	1500rpm	7000rpm	35A	1024-line incremental encoder
	ZJY265-18.5BM	18.5kW	1500rpm	7000rpm	48.7A	1024-line incremental encoder

1.4.3 Standard Ex-factory Accessories

The standard ex-factory accessories are listed in the table below. If additional accessories are needed otherwise, please contact our sales office or technical personnels.

- GS Series MDR product accessories list

Type	Name	Model	Number	Explanation	Remark
Servo unit (separate order -no spindle servo motor)	DB-44 male plug and plastic case		1	CN1 connecting plug	
	DB-25 male plug and plastic case		1	CN2 connecting plug	
	DB-9 male plug and plastic case		1	CN3 connecting plug	
	Aluminum-shell braking resistor			Including 1m connecting line (refer to Appendix C for the specification and quantity)	

Type	Name	Model	Number	Explanation	Remark
	GS Series Spindle Servo Unit Manual		1	Technical materials	
Servo unit and spindle servo motor	DB-44 male plug and plastic case		1	CN1 connecting plug	Matched with ZJY Series spindle servo motor
	DB-9 male plug and plastic case		1	CN3 connecting plug	
	Motor encoder line	-00-761A	1	Standard length: 3m	
	Motor encoder line	-00-765*	1	Standard length: 3m	
	Motor fan line	-00-768A	1	Standard length: 3m	
	Aluminum-shell braking resistor			Including 1m connecting line (refer to Appendix C for the specification and quantity)	
	GS Series Spindle Servo Unit Manual		1	Technical materials	
Servo unit (without spindle servo motor) and CNC system	DB-25 male plug and plastic case		1	CN2 connecting plug	CN1-CNC signal connecting cable is provided together with CNC system
	DB-9 male plug and plastic case		1	CN3 connecting plug	
	Aluminum-shell braking resistor			Including 1m connecting line (refer to Appendix C for the specification and quantity)	
	GS Series Spindle Servo Unit Manual		1	Technical materials	
Servo unit, spindle servo motor and CNC system	DB-9 male plug and plastic case		1	CN3 connecting plug	CN1-CNC signal connecting cable is provided together with CNC system
	Motor encoder line	-00-761A	1	Standard length: 3m	
	Motor power line	-00-765*	1	Standard length: 3m	
	Motor fan line	-00-768A	1	Standard length: 3m	
	Aluminum-shell braking resistor			Including 1m connecting line (refer to Appendix C for the specification and quantity)	
	GS Series Spindle Servo Unit Manual		1	Technical materials	

Note 1: A fan with 440V power should be selected to match with GS4000 Series spindle motor.

- GS Series MDR product accessories list

Type	Name	Model	Number	Explanation	Remark
Servo unit, servo	MDR20 (20pin) plug and plastic case		1	CN3 connecting plug	Servo signal line,
	Motor encoder line	-00-761A	1	Standard length: 3m	

motor and CNC system	Motor power line	-00-765*	1	Standard length: 3m; "*" indicates the suffix letters (see the Motor Power Line Specification)	GSK-CNC communication line and terminal plug are provided together with CNC system
	Aluminum-shell braking resistor			Including 1m connecting line; see Appendix C for specification and quantity	
	GS Series Spindle Servo Unit Manual		1	Technical materials	

Note 2: So far, GSK-CAN serial bus is supported in GSK988T. GS300Y-CP2 Series MDR spindle servo unit is applicable.

1. Make clear the model, quantity of products to be ordered (servo unit, servo motor, isolation transformor and CNC). When you need a exclusive software/hardware version or optional accessaries, write it on the order sheet.
2. Make clear the type, specification, quantity of non-standard accessaries (such as special cable or cable length, or special cable processing).
3. Make clear the code of shaft-extension, structure or leading-out pattern of servo motor. Write special items on the order sheet.
4. When only servo unit (without servo motor) is ordered, write the model of servo model behind the servo unit mode (for example: GS3050T-NP2（ZJY182-3.7BH）). So that relevant parameters can be set before delivery.
5. The spindle servo unit and servo motor with 3-phase AC440V input power are out of stock. They are produced according to the order.

CHAPTER II INSTALLATION/MOUNTING

2.1 Spindle Servo Motor

2.1.1 Dimensions for Spindle Motor Installation

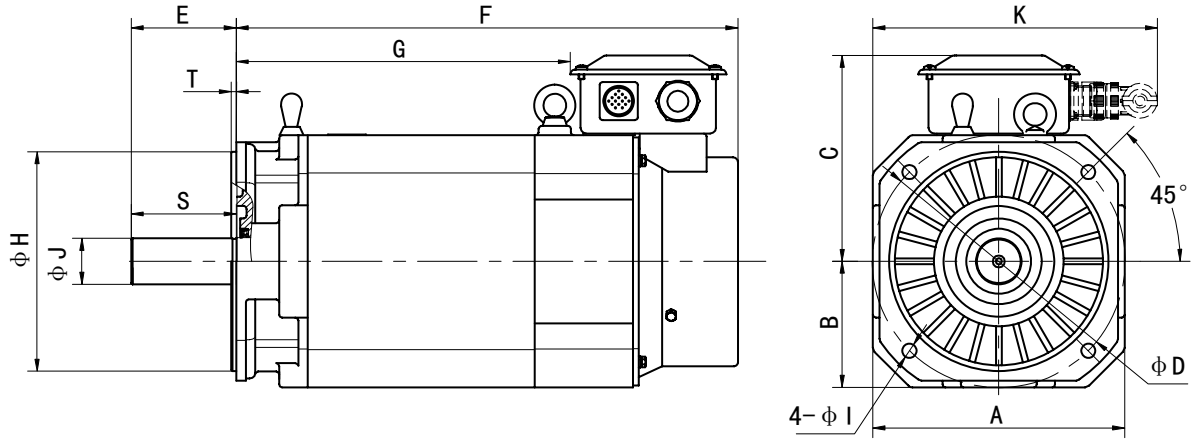


Fig. 2-1 Flange mounting (B5)

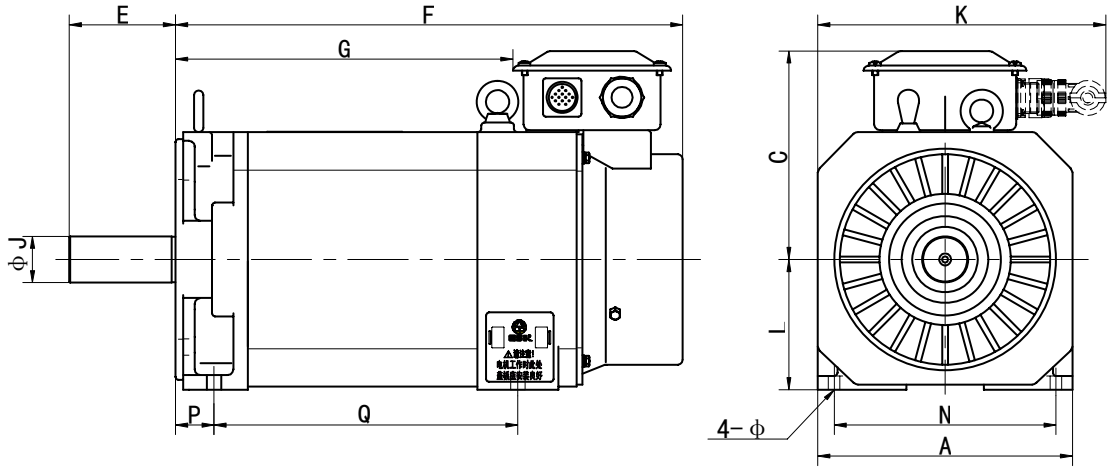


Fig. 2-2 Foot mounting (B3)

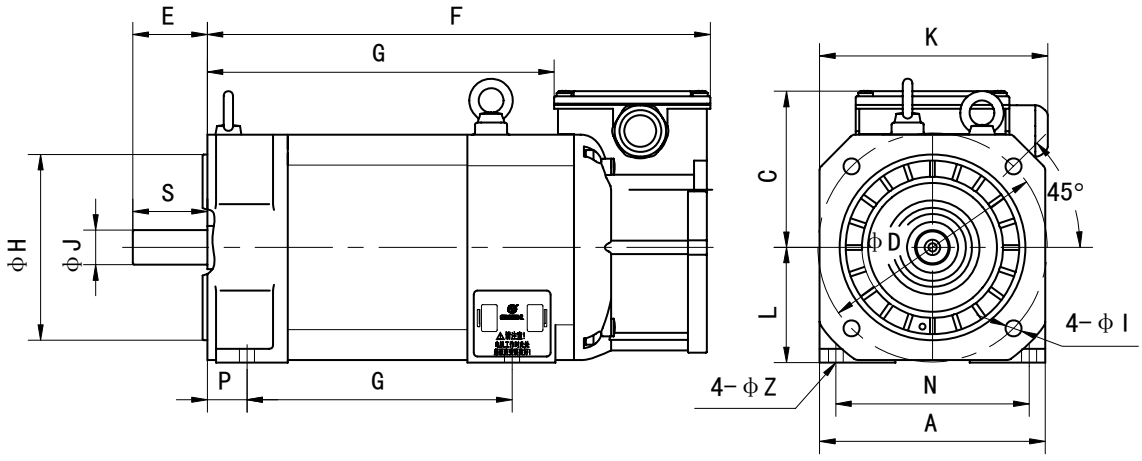


Fig. 2-3 Integrated Mounting (B35)

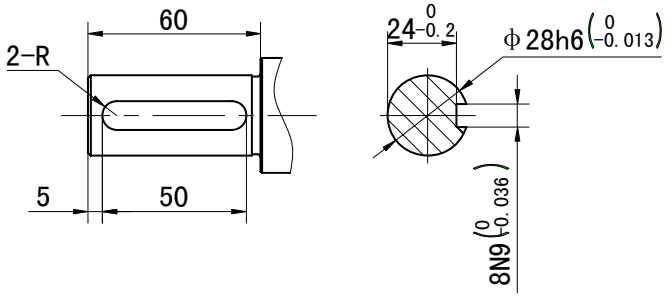
Table 2-1 Motor Dimensions

DIM \ SPEC		ZJY208-2.2AM	ZJY208-3.7AM	ZJY208-5.5AM	ZJY265-7.5AM	ZJY265-11AM	ZJY265-15AM	ZJY182-1.5BH	ZJY182-2.2BH
Eternal Dimension	A	208	208	208	265	265	265	182	182
	B	104	104	104	132	132	132		
	C	188	188	188	216	216	216	126	126
	D	215	215	215	265	265	265	185	185
	E	60	80	80	110	110	110	60	60
	F	413	468	523	443	533	578	324	351
	G	237	292	347	260	350	395	198	225
	H	180h7	180h7	180h7	230h7	230h7	230h7	150h7	150h7
	I	15	15	15	15	15	15	12	12
	J	28h6	38h6	38h6	48h6	48h6	48h6	28h6	28h6
	K	272	272	272	300	300	300	184	184
	L	106	106	106	135	135	135	93	93
	N	180	180	180	230	230	230	156	156
	P	40	40	40	40	40	40	32	32
	Q	210	265	320	225	315	355	132	159
	S	60	80	80	110	110	110	60	60
	T	5	5	5	5	5	5	4	4
	Z	12	12	12	15	15	15	12	12

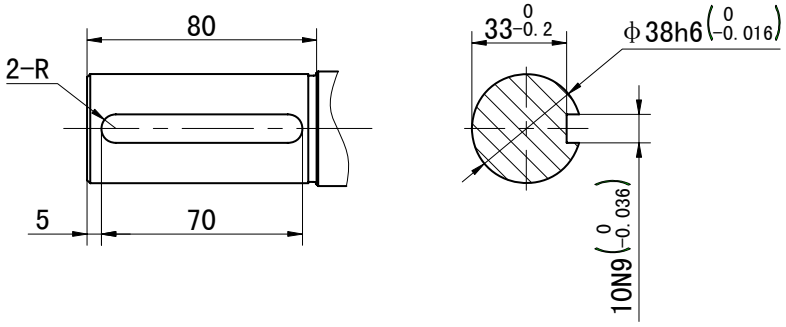
DIM \ SPEC		ZJY182-3.7BH	ZJY208-3.7B	ZJY208-5.5B	ZJY208-7.5B	ZJY265-7.5BM	ZJY265-11BM	ZJY265-15BM	ZJY265-18.5BM	ZJY265-22BM
Eternal Dimension	A	182	208	208	208	265	265	265	265	265
	B		104	104	104	132	132	132	132	132
	C	126	188	188	188	216	216	216	216	216
	D	185	215	215	215	265	265	265	265	265
	E	60	60	80	80	110	110	110	110	110
	F	406	413	468	523	443	488	533	578	633
	G	280	237	292	347	260	305	350	395	450
	H	150h7	180h7	180h7	180h7	230h7	230h7	230h7	230h7	230h7
	I	12	15	15	15	15	15	15	15	15
	J	28h6	28h6	38h6	38h6	48h6	48h6	48h6	55h6	55h6
	K	184	272	272	272	300	300	300	300	300
	L	93	106	106	106	135	135	135	135	135
	N	156	180	180	180	230	230	230	230	230
	P	32	40	40	40	40	40	40	40	40
	Q	214	210	265	320	225	270	315	355	410
	S	60	60	80	80	110	110	110	110	110
	T	4	5	5	5	5	5	5	5	5
	Z	12	12	12	12	15	15	15	15	15

Standard Keyway Dimension

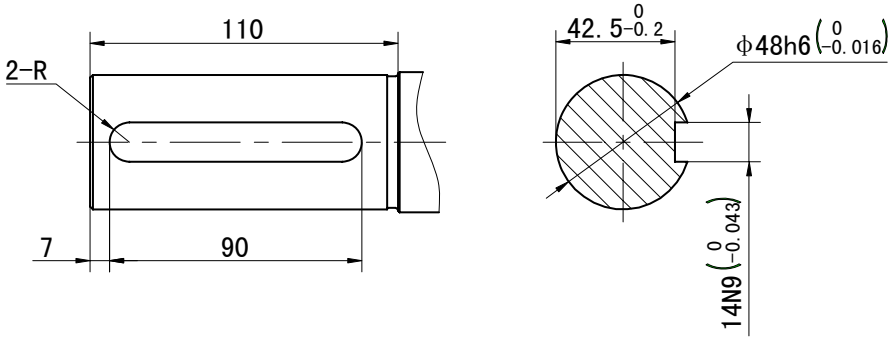
A: GB/T 1096—2003; dimension: 8×7×50; adaptable to motors ZJY182-1.5B, ZJY182-2.2B, ZJY182-3.7B, ZJY208-3.7B. The shaft keyway dimension is shown in following figure:



B: GB/T 1096—2003; dimension: 10×8×70; adaptable to motors ZJY208-5.5B, ZJY208-7.5B. The shaft keyway dimension is shown in following figure:



C: GB/T 1096—2003; dimension: 14×9×90; adaptable to motors ZJY265-7.5B, ZJY265-11B, ZJY265-15B. The shaft keyway dimension is shown in following figure:



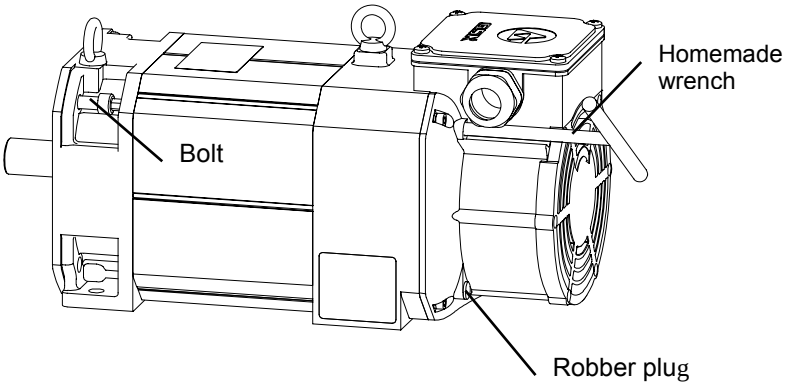
2.1.2 Installation of Spindle Motor

Ambient for installation, storage and transportation:

Item	Norm
Working Temperature	0℃～40℃
Storage and Transportation Temperature	-40℃～70℃
Working Humidity	30%～95% (Non-condensing)
Storage and Transportation Humidity	≤95% (40℃)
Atmospheric Environment	No corrosive and flammable gas, oil fog or dust
Altitude	Below 1000m

- **B5 flange mounting (or B35 flange mounting)**

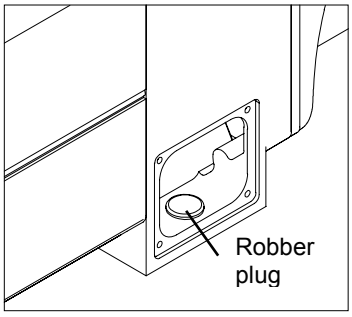
Motor ZJY182 adopts M10×35 Bolt or hex socket head bolt. A homemade socket head wrench whose length is greater than that of the motor can be used to detach the robber plug on the cooling fan. The robber plug should be pushed back after the bolt at the rear end is fastened. Shown as follows:



Motor ZJY208 and ZJY265 adopt M12×45 Bolt or hex socket head bolt.

- **B3 foot mounting (or B35 foot mounting)**

Detach the covers of two sides at the rear end. For B35, it is needed to detach the robber plug on the foot hole (see the following figure). Motor ZJY182 and ZJY208 adopt M10 Bolt or hex socket head bolt; ZJY265 adopts M12 Bolt or hex socket head bolt.



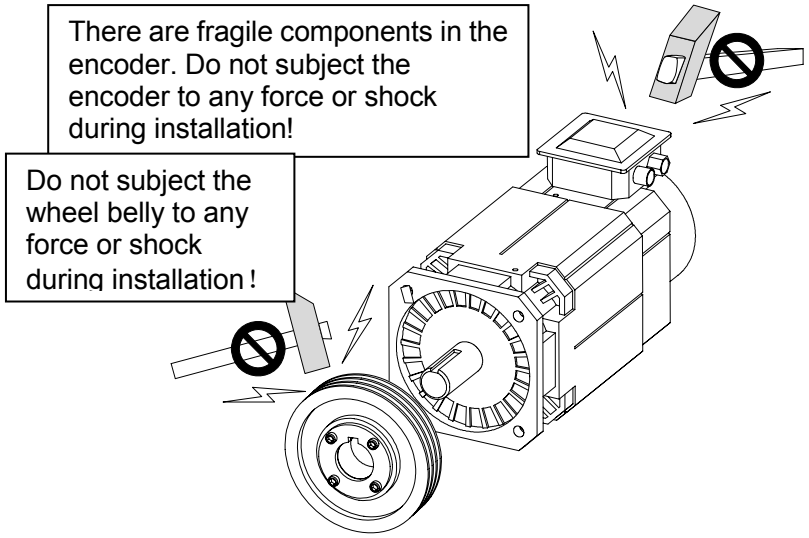
Caution The covers at two sides of the rear end should be mounted after the motor is firmly fixed; otherwise, the cooling effect will be reduced as a result of air leak, thus causing motor overheat.

1. If the motor running speed needs to be more than 2000r/min, a motor with smooth shaft is recommended. Fasten the belt pulley with keyless locking device. Both of them have undergone the dynamic balancing and meet the requirement of G1; otherwise, great vibration will occur during high-speed running.

2. Reserve a certain space near outlet box cover for the convenience of screw detaching and wiring. Please contact us if you cannot do it by yourself. Do not change the structure of the motor.

Caution

- Prevent the motor from direct sun light and rain splash. The mounting parts need to be ventilated, dampproof and dust-proof.
- Avoid flammable atmosphere in case of fire disaster.
- Do not strike the spindle motor with hard objects during installation and dismantling.



2.2 Spindle Servo Unit

The installation ambient greatly affects the servo unit function and life cycle; please pay attention to the following cautions:

Caution

- **Avoid rain splash and direct sunlight.**
- **Install the servo unit in electrical cabinet to avoid the invasion of dust, corrosive gas, conductive contents and combustibles.**
- **The mounting parts need to be ventilated, dampproof and dust-proof.**
- **Avoid flammable atmosphere in case of fire disaster.**
- **Select a proper installation position for easy maintaining and inspection.**

Item	Norm
Working Temperature	0℃～40℃
Storage and Transportation Temperature	-40℃～70℃
Working Humidity	30%～95% (Non-condensing)
Storage and Transportation Humidity	≤95%（40℃）
Atmospheric Environment	No corrosive and flammable gas, oil fog or dust
Altitude	Below 1000m
Vibration	≤0.6G(5.9m/s^2)
Atmospheric Pressure	86kPa～106kPa

2.2.1 Installation Dimension

The dimensions of GS Series spindle servo unit are shown as follows:

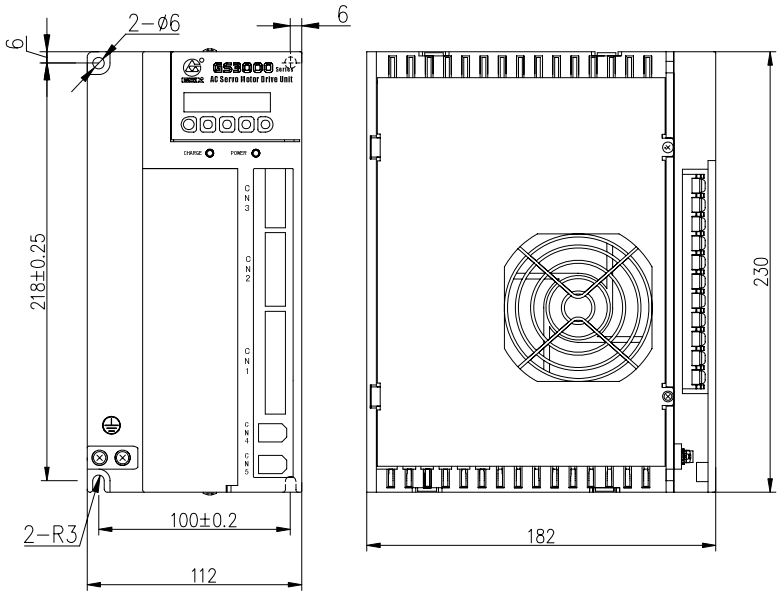


Fig. 2-4 GS3048, GS4048 Series installation dimension (Unit: mm)

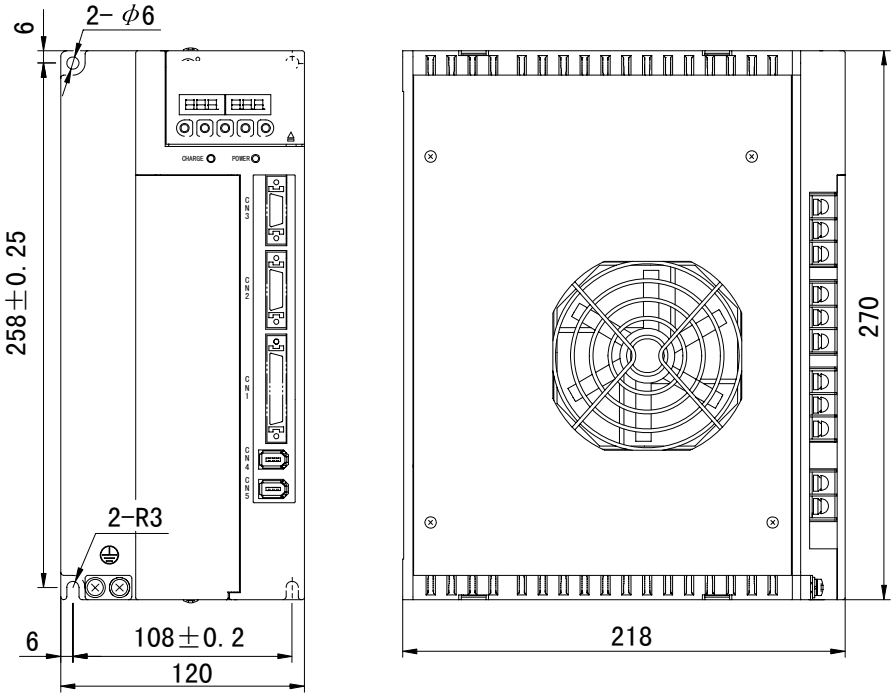


Fig. 2-5 GS3050, GS4050 Series installation dimension (Unit: mm)

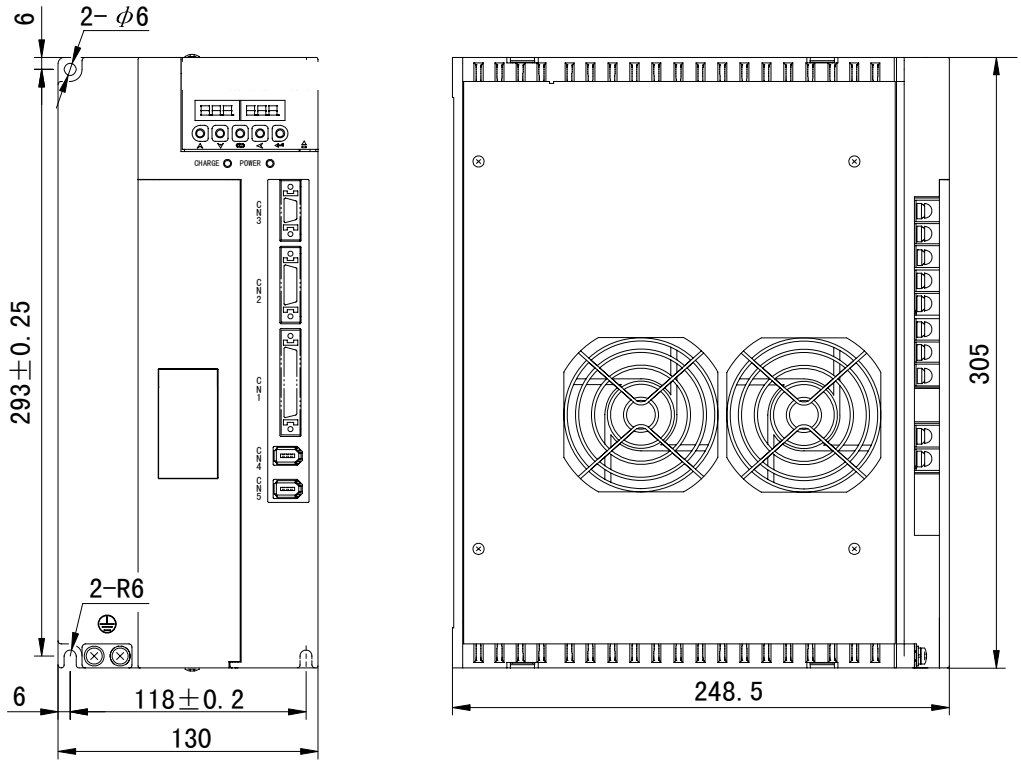


Fig. 2-6 GS3075, GS4075 Series installation dimension (Unit: mm)

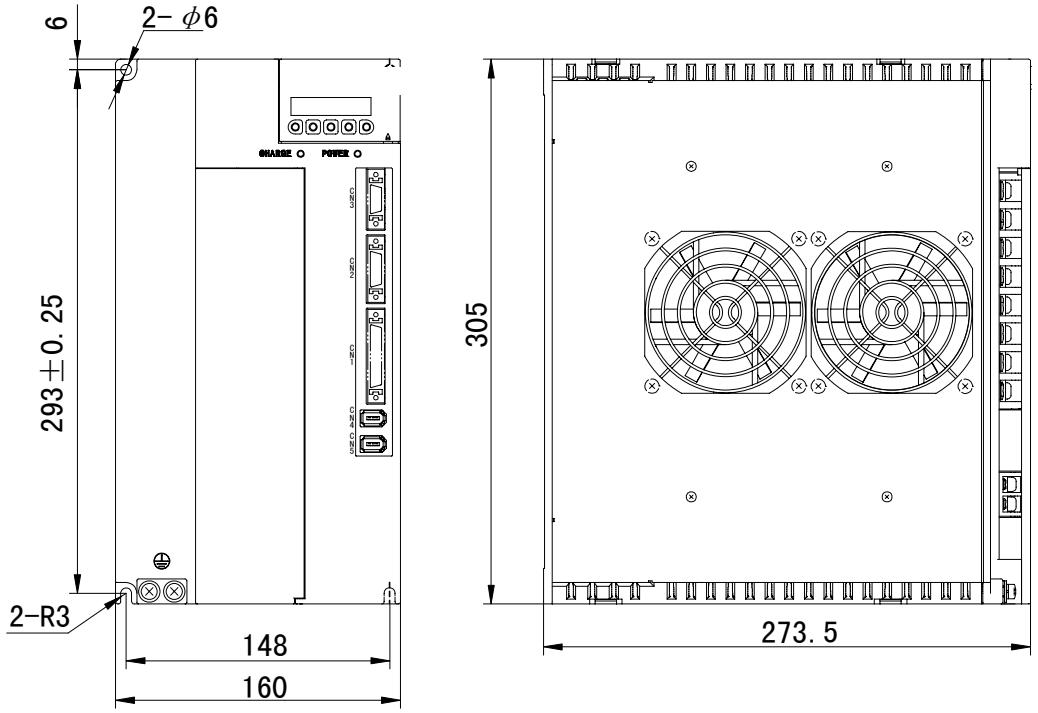


Fig. 2-7 GS3100, GS3148, GS4100, GS4148 Series installation dimension (Unit: mm)

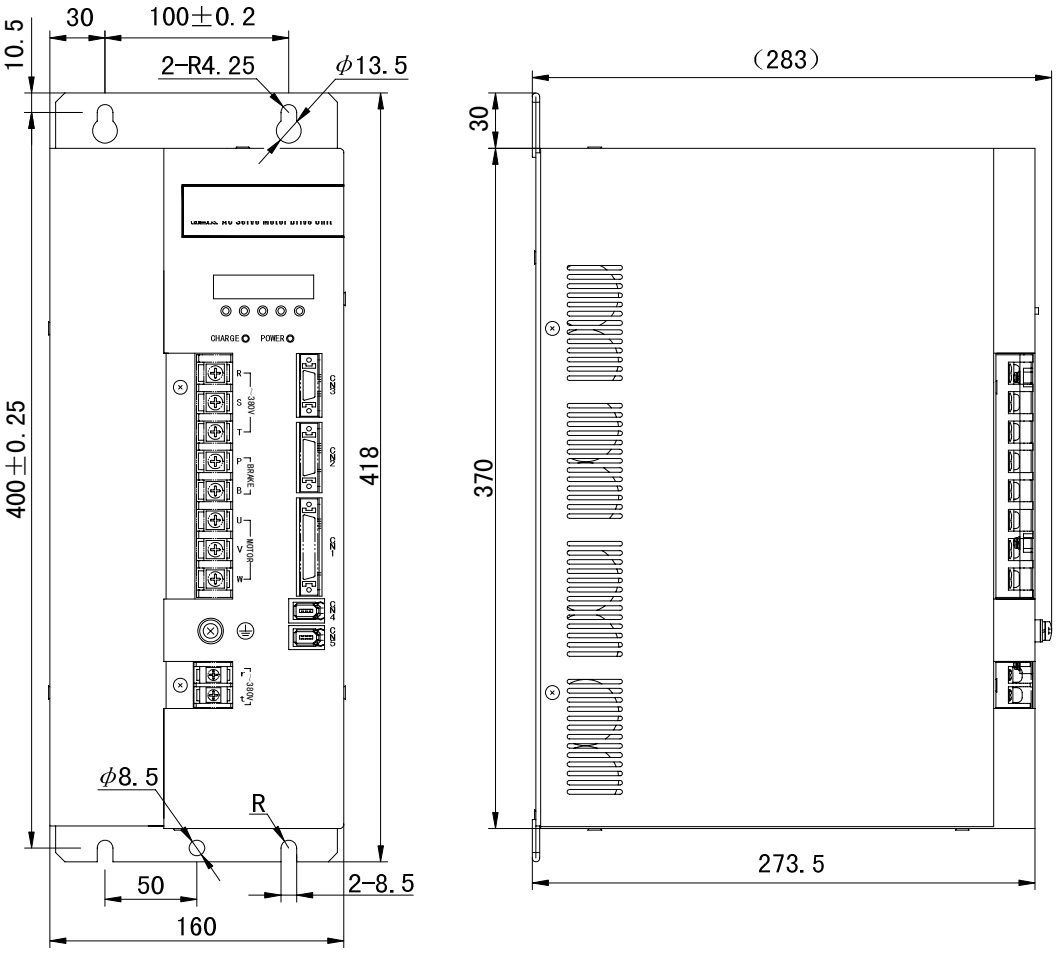


Fig. 2-8 GS3150, GS4150 Series installation dimension (Unit: mm)

2.2.2 Installation Intervals

GS Series spindle servo unit is installed vertically on the motherboard with the front side facing forward and top side facing upward. Enough intervals should be reserved.

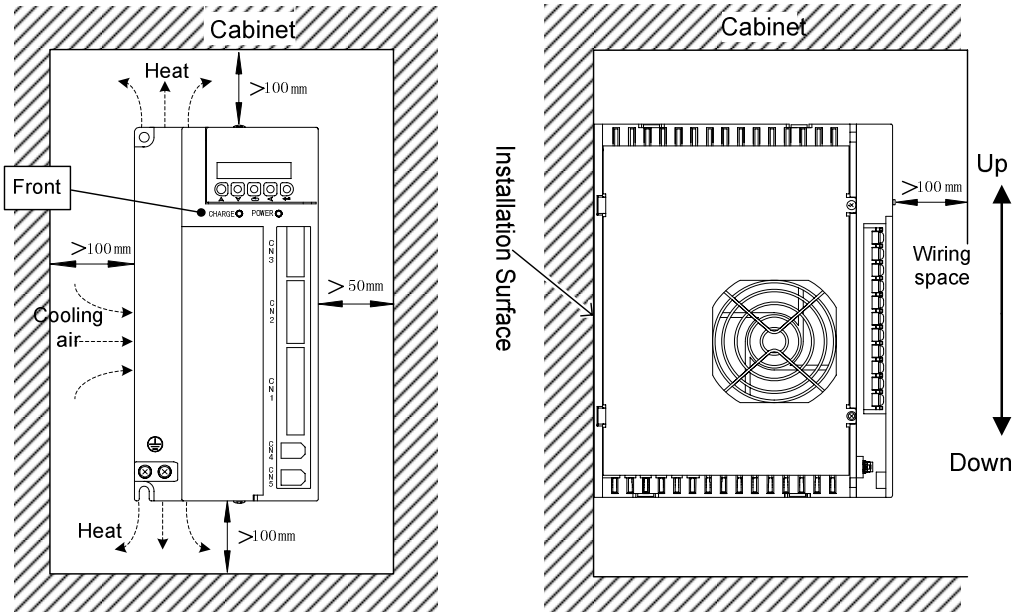


Fig. 2-9 Minimum intervals of GS3049, GS4048 Series spindle servo unit installation

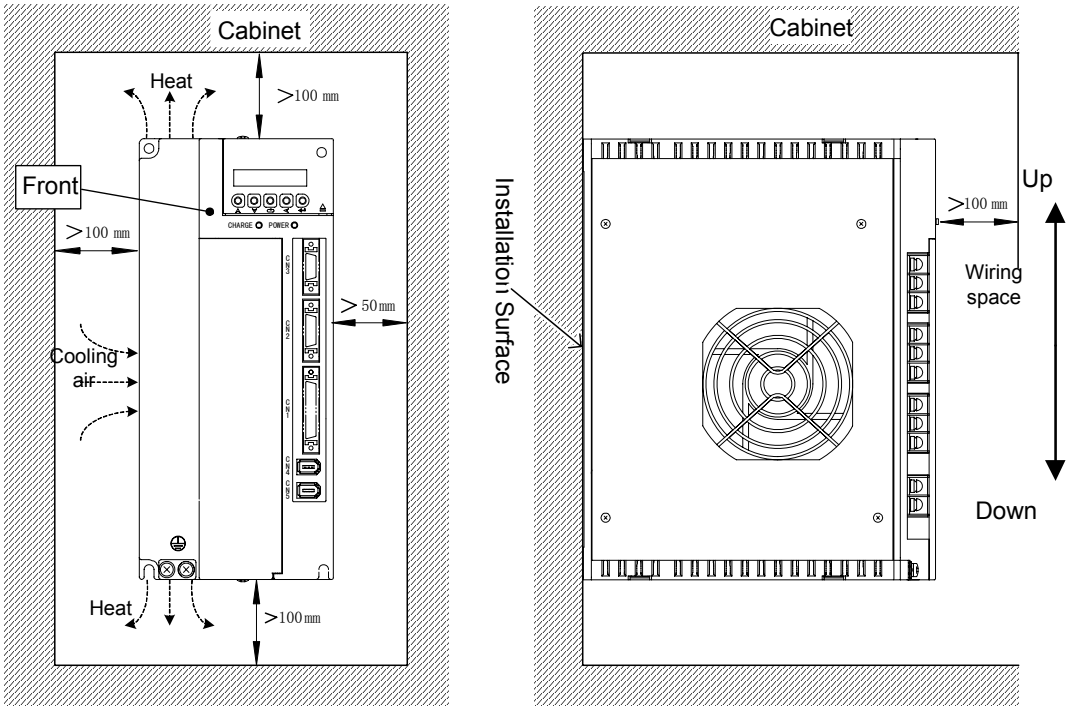


Fig. 2-10 Minimum interval of GS3050, GS4050 Series spindle servo unit installation

Radiator from which cool air blows to the servo unit should be installed in the electric cabinet in case of the increase in temperature.

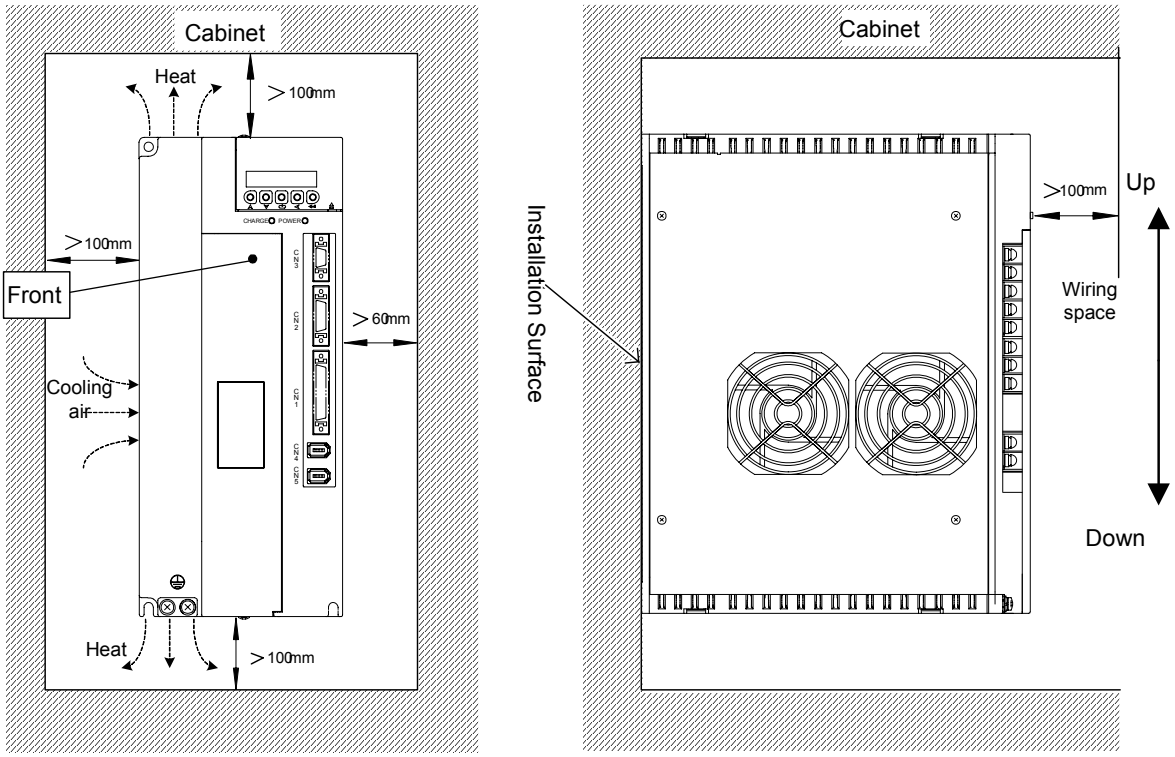


Fig. 2-11 Minimum interval of GS3075, GS4075 Series spindle servo unit installation

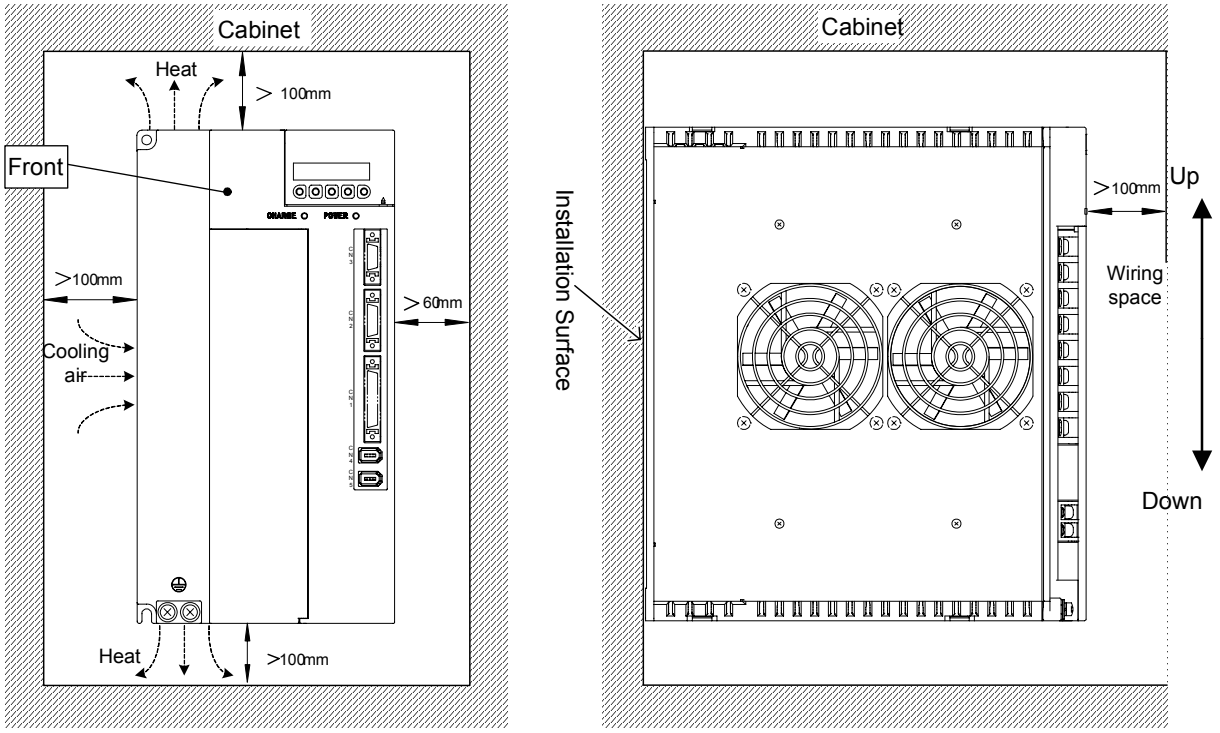


Fig. 2-12 Minimum interval of GS3100, GS3148, GS4100, GS4148 Series spindle servo unit installation

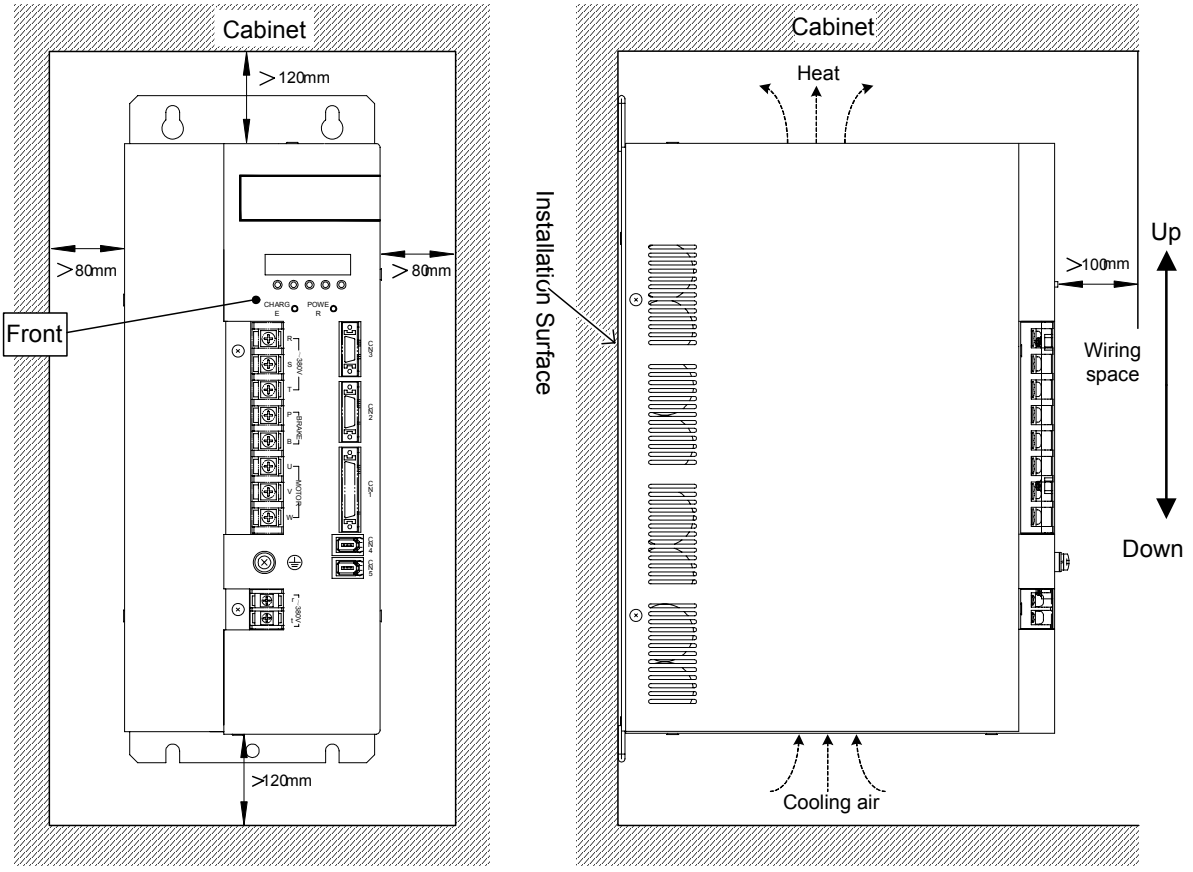


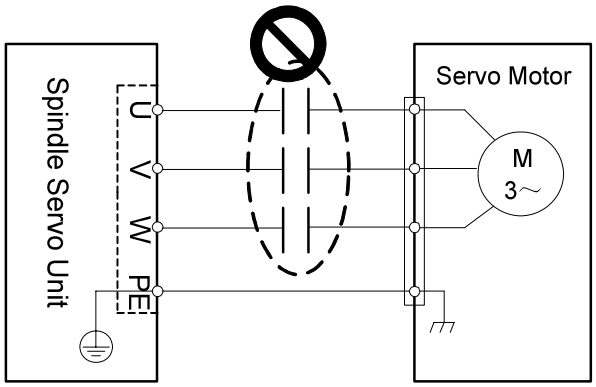
Fig. 2-13 Minimum interval of GS3150, GS4150 Series spindle servo unit installation

When more than one servo units are installed, enough intervals should be reserved for well radiating.

CHAPTER III CONNECTION

The following cautions should be read carefully and observed strictly so as to ensure safe and success operation.

- The connection should be done by professional personnel according to relevant instructions.
- Connection or inspection should be done 5min later after the servo unit is power-off and the grounding voltage of main circuit terminal is confirmed to be safe; otherwise, it is easy too get electric shock.
- Ensure that the servo unit and servo motor are properly grounding.
- Wire layout should be carefully done to avoid pointed objects. Cables should not be dragged by force; otherwise, it is easy to lead to electric shock or poor connection.
- Do not lay the main circuit and the signal line in one pipe nor bound them together. They should be laid independently or crossly, and the distance should be over 30cm, thus to prevent high voltage circuit's interference to signals and ensure normal working of the servo unit.
- Do not turn ON or OFF the power frequently. Since in the spindle servo unit, there is large bulk capacitance which will generate large charging current at power-on, frequent ON/OFF switching will cause performance degradation on inner components. It is advised that the interval between power ON and OFF should be more than 3min.
- Devices such as power capacitor, surge absorber and radio noise filter should not be installed between spindle servo unit output side and serve motor side.



- The main circuit and signal lines should be kept away from radiator and motor in case of insulation performance degradation because of heating.
- After the main circuit is connected, the terminals should be protected by a cover to avoid electric shock.

3.1 Connection of Peripheral Equipments

Some peripheral equipments are needed for the running of spindle servo unit. Proper peripheral equipments ensure the stable running of servo unit and servo motor and prolong the life cycle.

In the connection diagram, the following points should be noted:

- The equipments in the dashed box are free to choose; the equipments in the solid line box are available from GSK.
- The selections for circuit breaker, AC filter, isolation transformer, AC reactor and AC contactor are described in Appendix B.
- Refer to Appendix C for the selection of braking resistor.
- The equipments marked with “essential” can ensure safe and reliable operation of the servo unit and minimize the loss to the greatest extent when fault occurs.
- The equipments marked with “optional” can ensure stable running in poor power supply environment.

- Peripheral equipments connection of Series (D-SUB type) GS3048Y-N, GS3050Y-N, GS3075Y-N, GS3100Y-N, GS3148Y-N and Series GS4048Y-N, GS4050Y-N, GS4075Y-N, GS4100Y-N, GS4148Y-N should be done according to the following figure; as for the later group of Series products, L1, L2, L3 should be connected to 3N～50/60Hz 440V.

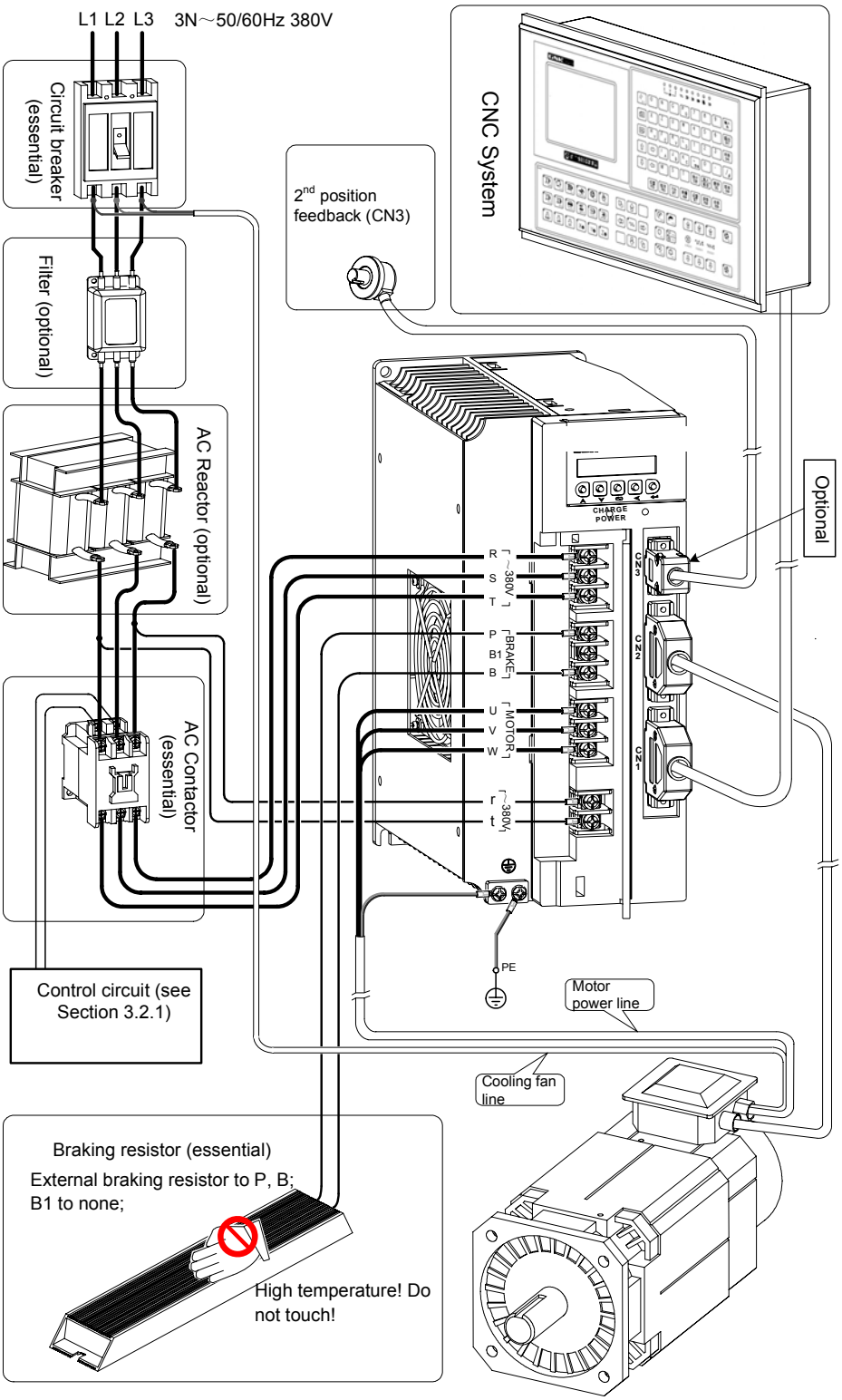


Fig. 3-1 (a) Connection diagram of GS Series spindle servo unit (D-SUB type) peripheral equipments

- Peripheral equipment connection of Series (D-SUB type) GS3150Y-N and Series GS4150Y-N should be done according to the following figure; as for the later Series, L1, L2, L3 should be connected to 3N～50/60Hz 440V.

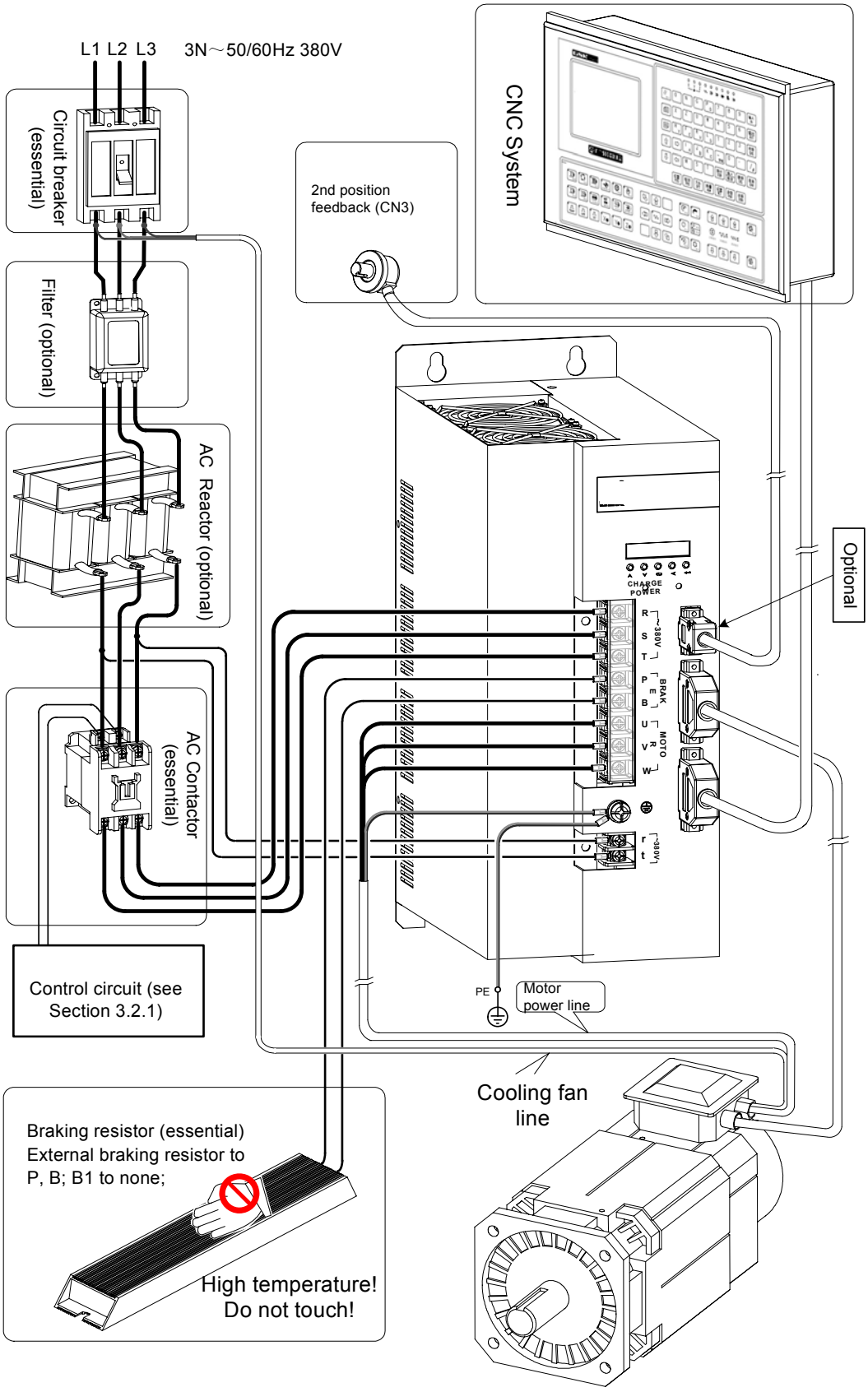


Fig. 3-1 (b) Connection diagram of GS Series spindle servo unit (D-SUB type) peripheral equipments

- Peripheral equipments connection of Series (MDR type) GS3048Y-C, GS3050Y-C, GS3075Y-C, GS3100Y-C, GS3148Y-C and Series GS4048Y-C, GS4050Y-C, GS4075Y-C, GS4100Y-C, GS4148Y-C should be done according to the following figure; as for the later group of Series, L1, L2, L3 should be connected to 3N～50/60Hz 440V.

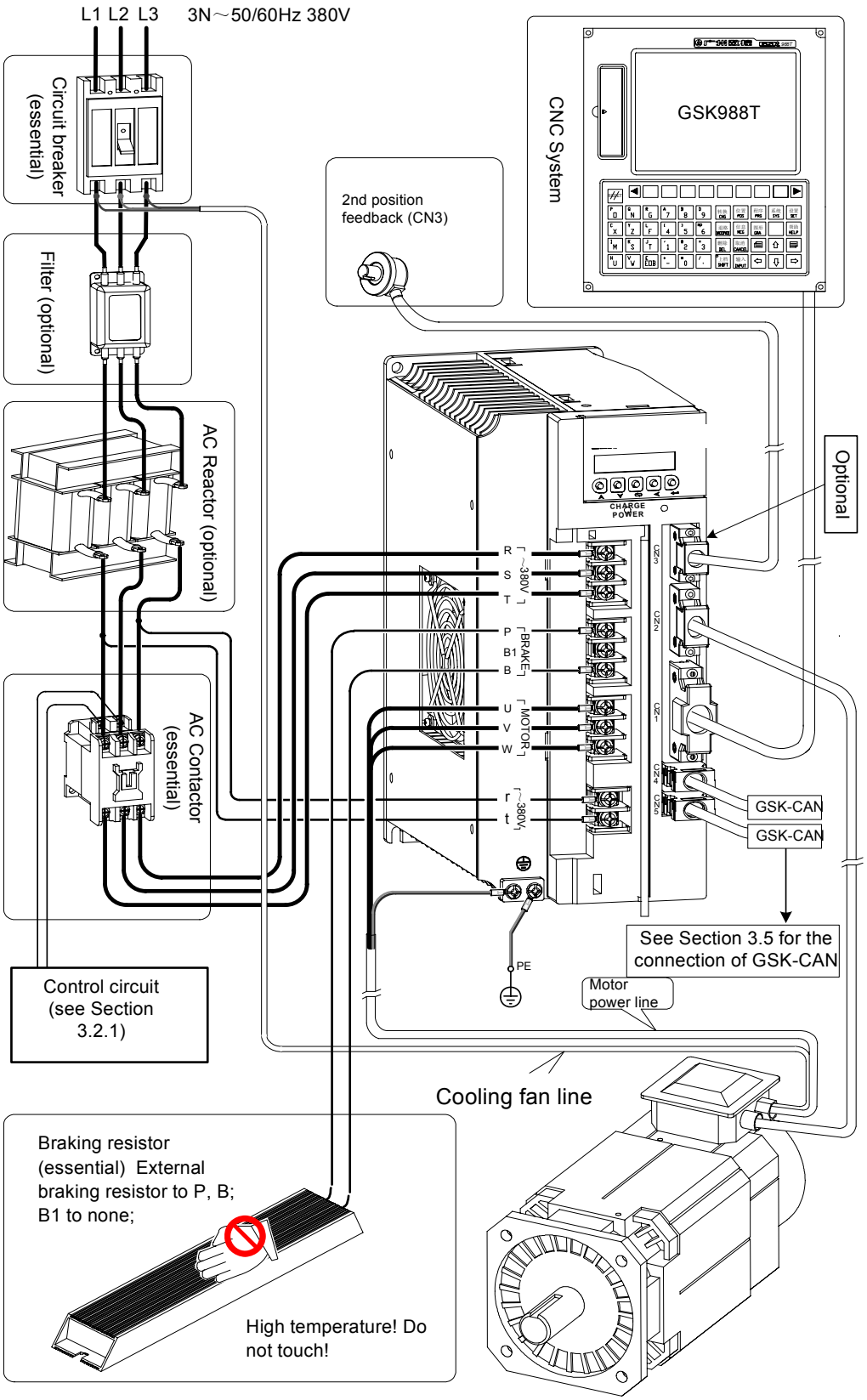


Fig. 3-2 (a) Connection diagram of GS Series spindle servo unit (MDR type) peripheral equipments

- Peripheral equipments connection of Series (MDR type) GS3150Y-C and Series GS4150Y-C should be done according to the following figure; as for the later Series, L1, L2, L3 should be connected to 3N～50/60Hz 440V.

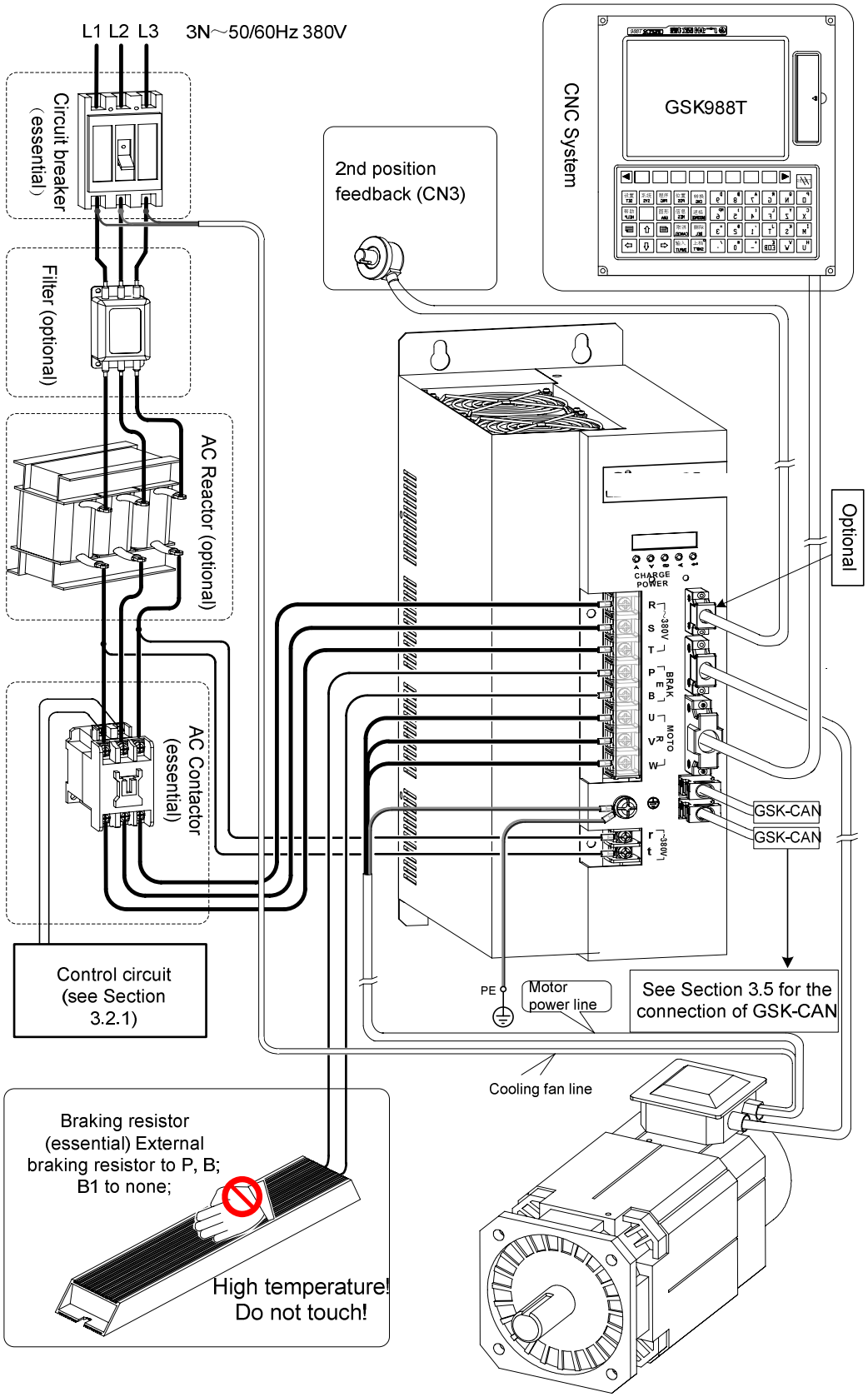


Fig. 3-2 (b) Connection diagram of GS Series spindle servo unit (MDR type) peripheral equipments

3.2 Connection of Main Circuit

3.2.1 Connection

- Example of GS3□□□ Series spindle servo unit main circuit connection
- The input power of GS4□□□ Series spindle servo unit and motor cooling fan is 3N～ 50/60Hz 440V.

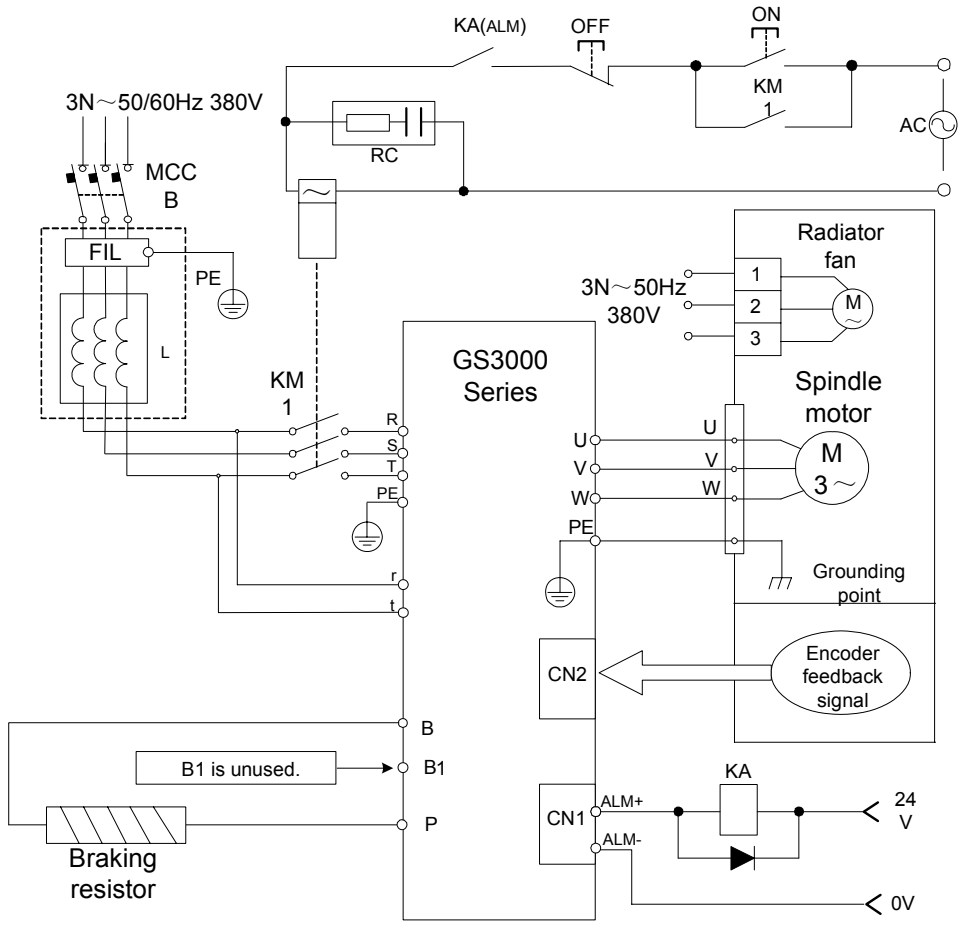


Fig. 3-3 GS Series spindle servo unit main circuit connection

- Not all the motor's U, V, W phase sequences are corresponding to the U, V, W of drive unit. If Err-27 occurs during the first running, it means the phase sequence are incorrect (not drive unit fault). Turn OFF the power for 5 min and exchange any of the two phases.
- The equipments in the dashed box are optional. When the ambient condition cannot guarantee the normal running of drive unit, these equipments can be installed (refer to Appendix B).
- The minimum power of DC switching power supply (15V-24V) specified externally should not be less than 35W.
- The grounding resistance should be less than 10Ω.

3.2.2 Wiring of Main Circuit

Terminal Mark	Name	Description
R, S, T	AC power input terminal	Three-phase AC power input
U, V, W	Three-phase AC output terminal	Connected to three-phase winding U, V, W
B, P	Braking resistor terminal	The braking resistor is used for dynamic braking; The spindle servo unit works normally only when the braking resistor is externally connected.
PE ⏚	Protective grounding terminal	The protective grounding resistance should be less than 10Ω.

It is advised that the cables and terminals meet the following requirements:

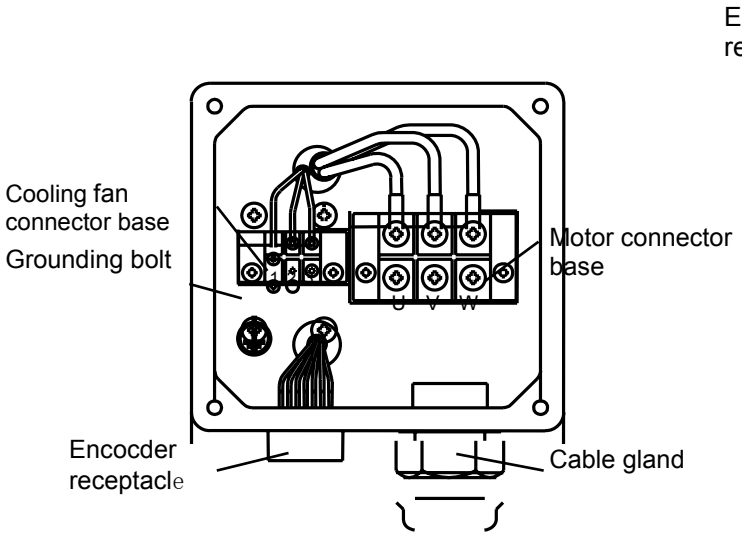
Model	Motor Power	R, S, T, U, V, W		r, t		P, B		PE	
		Terminal Bolt Size φmm	Cable diameter mm^2	Terminal Bolt Size φmm	Cable diameter mm^2	Terminal Bolt Size φmm	Cable diameter mm^2	Terminal Bolt Size φmm	Cable diameter mm^2
GS3048 GS4048	1.5kW, 2.2kW, 3.7kW,	3.5	2.5	3.5	1	3.5	2.5	4	2.5
GS3050 GS4050	3.7kW, 5.5kW	4	2.5	4	1	4	2.5	5	2.5
GS3075 GS4075	5.5kW，7.5kW	6	4	4	1	6	2.5	5	2.5
GS3100 GS4100	7.5kW，11kW	6	6	4	1	6	4	6	4
GS3148 GS4148	11kW	6	6	4	1	6	4	6	4
GS3150 GS4150	15kW, 18.5kw	6	10	4	1	6	4	6	6

3.2.3 Servo Motor Connection Instruction

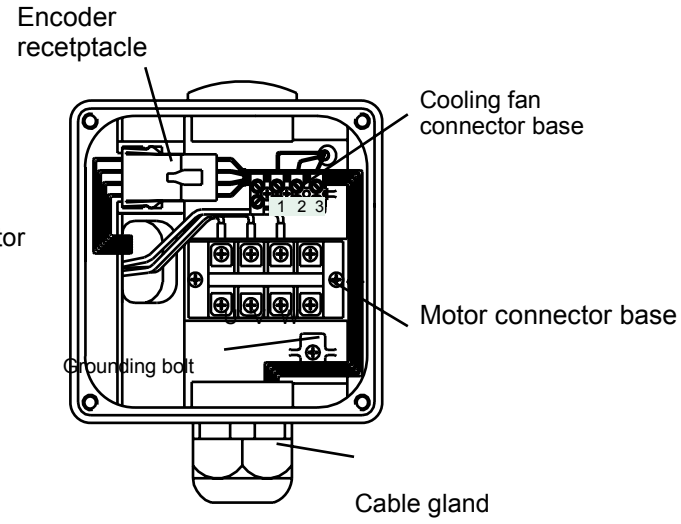
- **Instruction of ZJY spindle servo motor terminal box:**

The three-phase winding U, V, W and the casing (grounding) are lead out through cable glands. Their position in terminal box is shown in following figure. U, V, W and casing are connected to U, V, W, and PE terminal of servo unit main circuit respectively. The wind from cooling fan blows from motor shaft extension side to the end. Three-phase AC power supply is connected externally.

(See Section 1.2.1 for the voltage level)

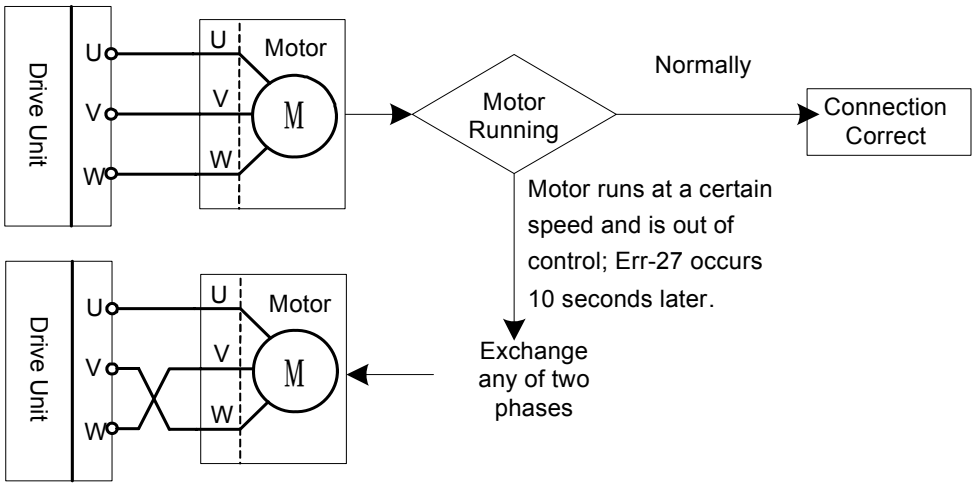


ZJY208, ZJY265 Series Motor Terminal Box



ZJY182 Series Motor Terminal Box

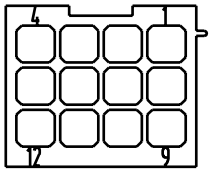
Caution When the spindle servo unit is matched with a different servo motor, the U, V, W of drive unit may be different from the U, V, W of the motor. If the motor rotates, at a certain uncontrollable speed, and Err-7 occurs, it means the phase sequences are not consistent. Please turn OFF the power for 5 minutes, and exchange any two of the U, V, W phases.



- **Connection of encoder signal receptacle pins**

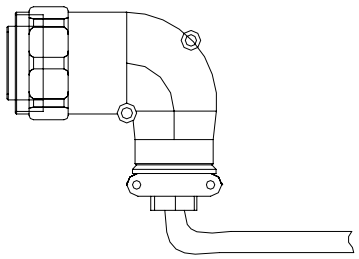
The leading wire of ZJY182 Series servo motor incremental encoder is lead out through the 12-pin male plug, shown as follows: (refer to Section 3.4.1 for the leading wire connection diagram)

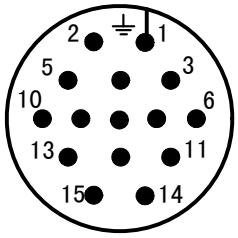
Male plug drawing (back view)



Encoder Pin	Casing （PE）	VCC	GND	A	$\overline{A}$	B	$\overline{B}$	Z	$\overline{Z}$
Pin No.	1	9	5	6	10	7	11	8	12

The industrial female receptacle (aviation) of encoder signal line of ZJY208 Series, ZJY265 Series servo motor is shown in following figures:





Receptacle
（welded side）

Encoder Pin	Casing （PE）	VCC	GND	A	$\overline{A}$	B	$\overline{B}$	Z	$\overline{Z}$
Pin No.	1	2	3	4	7	5	8	6	9

3.3 Connection of Control Signal

3.3.1 CN1 Control Signal

- Layout of GS Series D-SUB type CN1 pins

The control signal interface CN1 of GS Series D-SUB product is 44-pole female receptacle. The connector is 44-pin male plug (model G3101-44MBNS1X1, provided by WIESON). The pin description is shown in following figure:

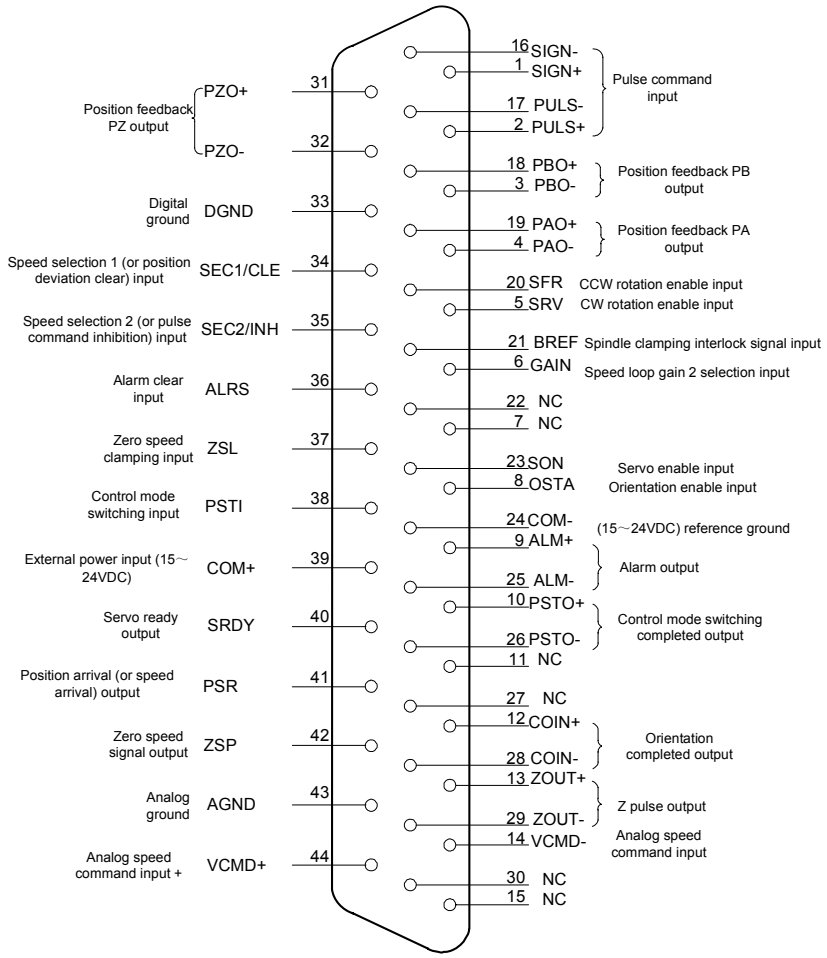
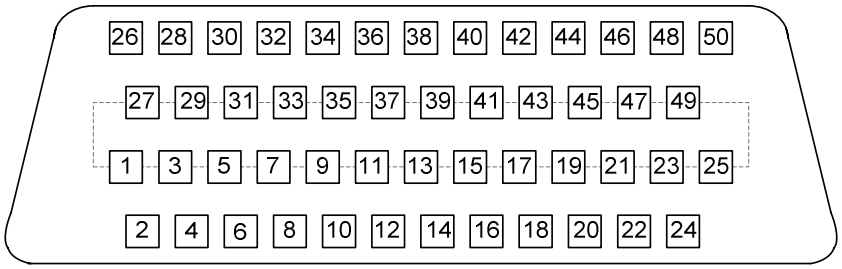


Fig. 3-4 CN1 pins diagram

The control signal interface CN1 of GS Series MDR product is 50-pole female receptacle (model MDR10150-3000-PE, provided by 3M). The pin description is shown in following figure:



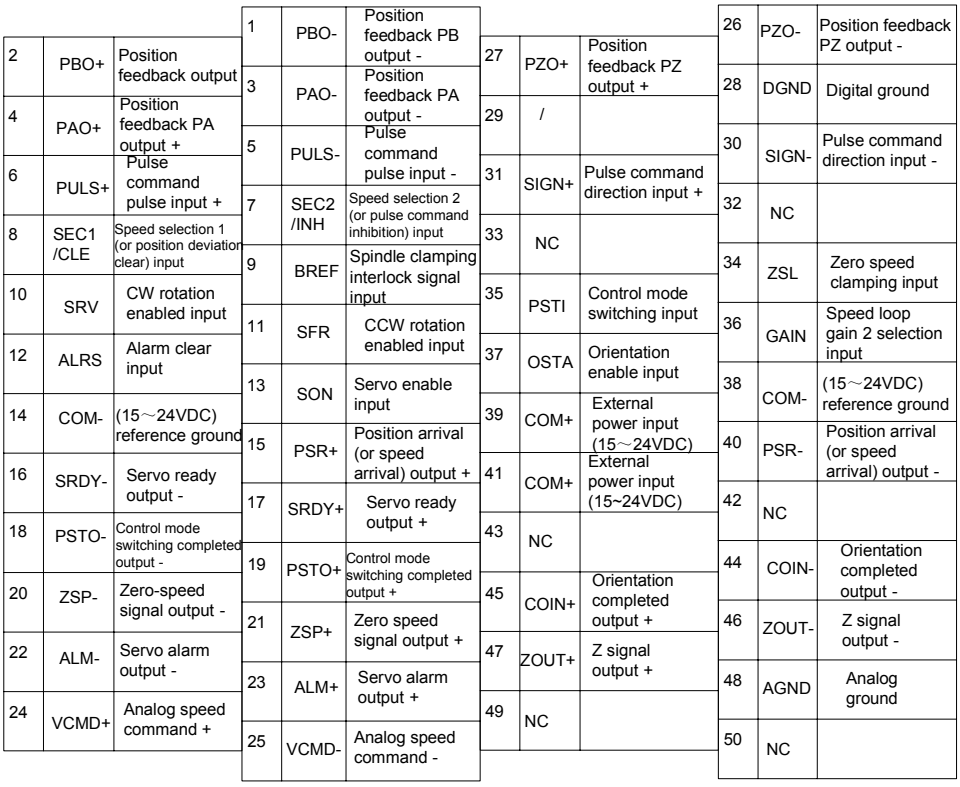


Fig. 3-5 CN1 pins diagram

- **I/O signal comparison between D-SUB type and MDR type**

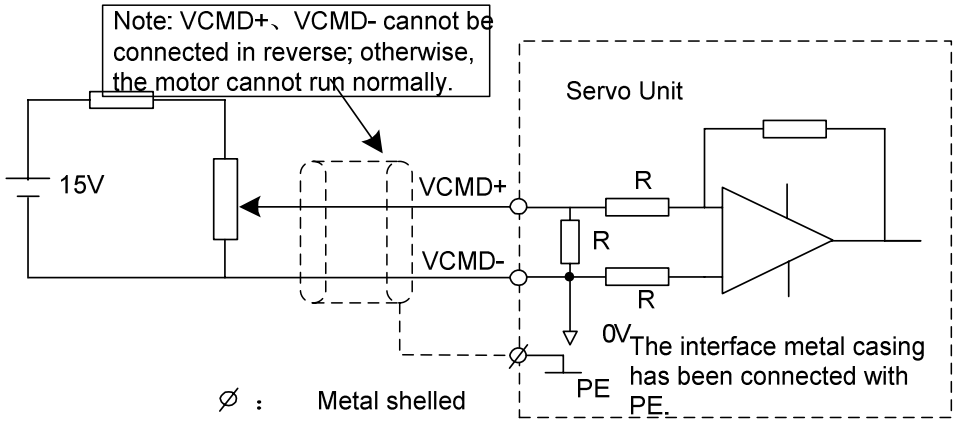
P: Position Control S: Speed Control

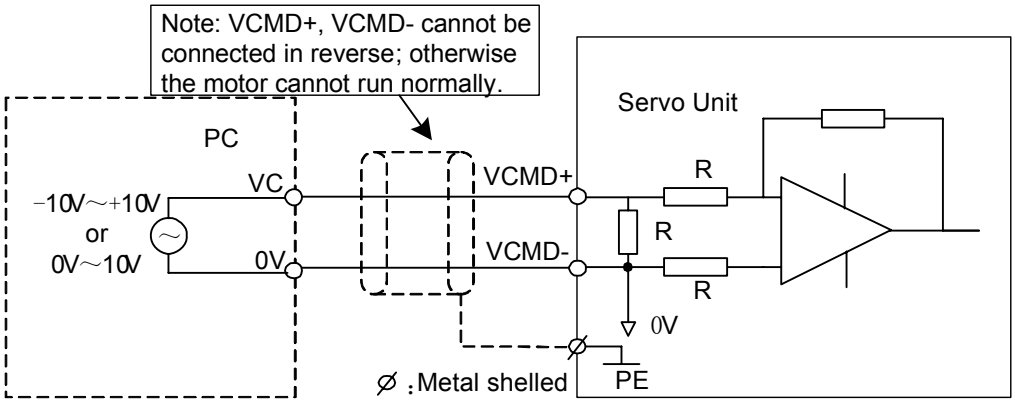
Type	GS D-SUB Interface		GS MDR Interface		Function	Reference
	Signal	Pin No.	Signal	Pin No.		
P, S	COM＋	39	COM＋	39, 41	Common port of Input point; the input port of external DC power 15~24V	\
	COM－	24	COM－	14, 38	Connected to external DC 15V~24V power ground.	\
	SON	23	SON	13	Servo enable input	3.3.4
	ALRS	36	ALRS	12	Alarm clear input	3.3.4
S	VCMD＋ VCMD－	44 14	VCMD＋ VCMD－	24 25	Analog speed command input	3.3.2
	AGND	43	AGND	48	Analog ground	\
	SFR	20	SFR	11	PA6=1, CCW rotation enable input; PA6=0, drive unit enable permit input;	5.2.1
	SRV	5	SRV	10	PA6=1, CCW rotation enable input; PA6=0, invalid;	5.2.1
	ZSL	37	ZSL	34	Zero speed clamping input	6.5.4
	OSTA	8	OSTA	37	Orientation enable input	6.5.1
S	SEC1	34	SEC1	8	For internal speed selection function: speed selection 1;	5.2.2
P	CLE		CLE		For position control: position deviation clear	6.4.3
S	SEC2	35	SEC2	7	For internal speed selection function: speed selection 2;	5.2.2
P	INH		INH		For position control: pulse command inhibition	6.4.4
P	BREF	21	BREF	9	Spindle clamping interlock signal input;	6.6

P	PULS＋ PULS－	2 17	PULS＋ PULS－	6 5	Position command pulse input ① Pulse + direction ② CCW pulse+ CW pulse; ③ A/B phase pulse;	3.3.3
	SIGN＋ SIGN－	1 16	SIGN＋ SIGN－	31 30		
P, S	GAIN	6	GAIN	36	Speed loop gain 2 selection input	6.1.2
S/P	PSTI	12	PSTI	35	Speed / position switching (it is valid when PA4=5)	5.4
P, S	ALM+ ALM-	9 25	ALM+ ALM-	23 22	Alarm output	3.3.5
	SRDY	40	SRDY+ SRDY-	17 16	Servo ready output	3.3.5
	PSTO+ PSTO-	10 26	PSTO+ PSTO-	19 18	Control mode switching completed output	\
	ZOUT＋ ZOUT－	13 29	ZOUT+ ZOUT-	47 46	Position feedback Z pulse signal OC output	3.3.5
	PAO＋ PAO－	19 4	PAO＋ PAO－	4 3	Position feedback signal output Refer to parameters PA69~71	3.3.6
	PBO＋ PBO－	18 3	PBO＋ PBO－	2 1		
	PZO＋ PZO－	31 32	PZO＋ PZO－	27 26		
S	ZSP	42	ZSP+ ZSP-	21 20	Zero speed signal output	3.3.5
	COIN+ COIN-	12 28	COIN+ COIN-	45 46	Orientation completed output	6.5.1
P, S	PSR	41	PSR+ PSR-	15 40	Position arrival output in position mode	6.4.2
					Speed arrival output in speed mode	6.5.3

3.3.2 Speed Command Input

VCMD+/VCMD- is the input port of speed command. It can receive 10V DC voltage signal. The input impedance is 15kΩ. The following figures are two examples of connection.





1. When the external analog command taken as speed command, it is easily affected by external environment, thus causing vibration of the servo motor. Therefore, the analog command signal line should be shielded with twisted pair.
2. The shielding wire connection method in the above figure is recommended, but it is not used universally.

3.3.3 Position Command Input

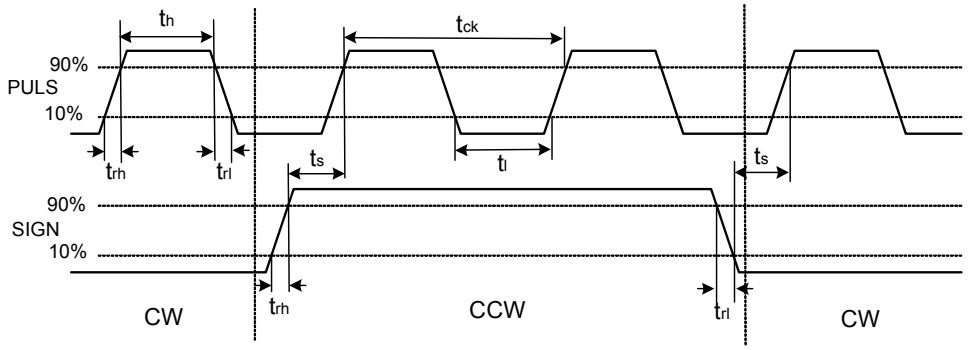
There are three position command input modes set by PA5 (see the following table). The arrow indicates the counting edge.

PA28 sets the reversed position command direction. It can change the rotation direction of the motor.

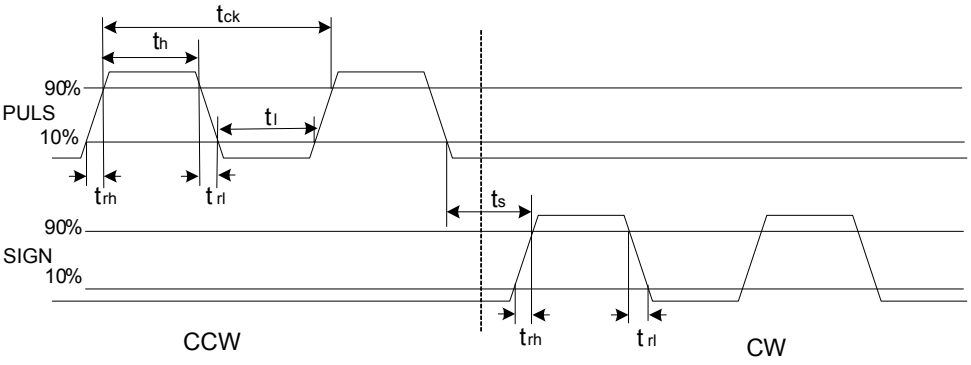
Standard Mode：PA28=0			
Pulse command mode	CCW	CW	PA5 setting value
Pulse train direction	PULS SIGN		PA5=0 Command pulse+ direction
CCW pulse train CW pulse train	PULS SIGN		PA5=1 CCW pulse ＋ CW pulse
A phase pulse train B phase pulse train	PULS SIGN		PA5=2 A/B phase command pulse

Reverse Mode：PA28=1			
Pulse command mode	CW	CCW	PA5 setting value
Pulse train direction	PULS+ SIGN+		PA5=0 Command pulse + direction
CCW pulse train CW pulse train	PULS+ SIGN+		PA5=1 CCW pulse ＋CW pulse
A phase pulse train B phase pulse train	PULS+ SIGN+		PA5=2 A/B phase command pulse

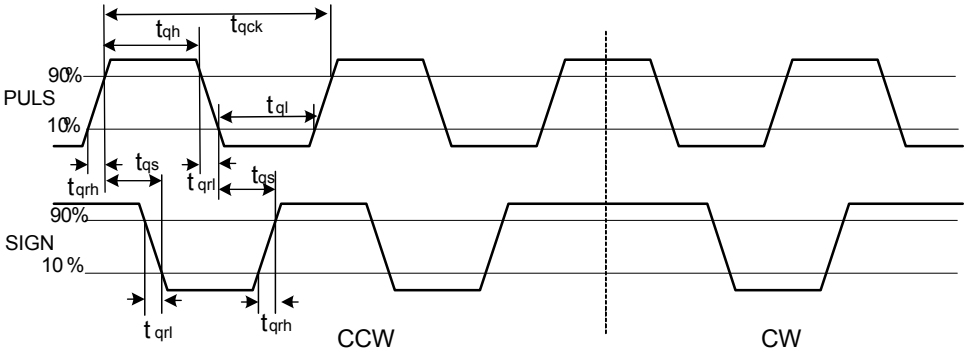
a, Pulse + Direction: pulse input sequence diagram (maximum pulse frequency 1MHz)



b, CCW pulse /CW pulse: pulse input sequence diagram (maximum pulse frequency 1MHz)



c, two-phase command pulse: input sequence diagram (maximum pulse frequency 1MHz)

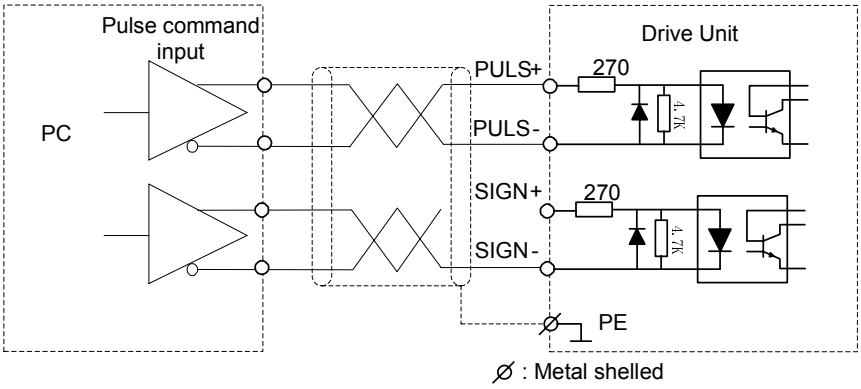


The following table lists the parameters about the pulse input sequence:

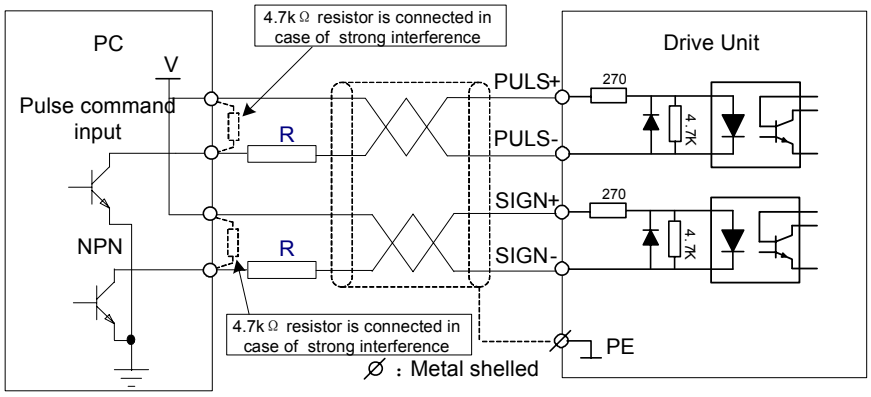
PAR.	t_{ck}	t_h	t_l	t_{rh}	t_{rl}	t_s	t_{qck}	t_{qh}	t_{ql}	t_{qrh}	t_{qrl}	t_{qs}
Differential input （μs）	>1	>0.3	>0.3	<0.2	<0.2	>2	>1	>0.3	>0.3	<0.2	<0.2	>0.2
Single-ended input （μs）	>5	>2.5	>2.5	<0.3	<0.3	>2.5	>10	>5	>5	<0.3	<0.3	>2.5

The position command connection adopts differential connection or single-ended connection. Shown as follows:

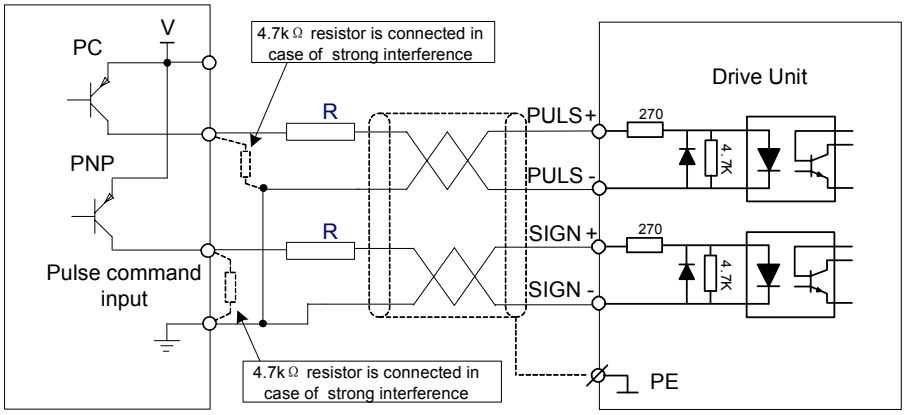
- Differential connection



- Single-ended connection



(a) NPN single-ended connection

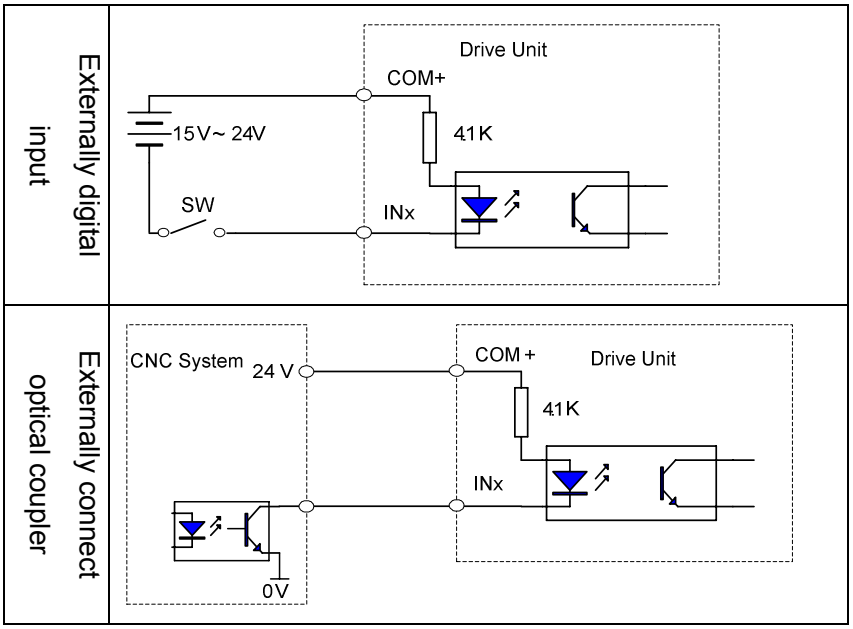


(b) PNP single-ended connection

- It is advised to adopt differential connection to enhance the anti-interference capability; AM26LS31, MC3487 or driver chips silmilar with RS422 are recommanded as interface circuit.
- The use of the single-ended mode will lower down the action frequency. The current is 10mA~15mA according to pulse input circuit. Limit the external power voltage to 25V and determine the value of resistance R. Empirical data: VCC=24V, R=1.3 kΩ～2kΩ; VCC=12V, R=510Ω～820Ω; VCC=5V, R=0Ω

3.3.4 Digital Input

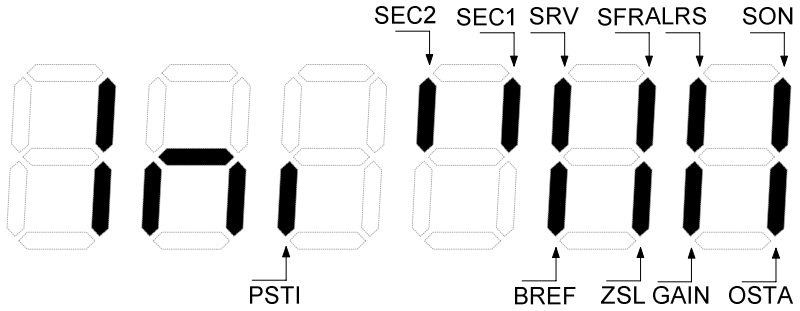
The following figures are examples of common-used connection; INx represents the input point: SON, ALRS, SFR, SRV, SEC1, SEC2, ZSL, OSTA, GAIN, PSTI, BREF.



There is not 24V power output. It should be externally equipped. The specification requirement is DC15V～24V, above 100mA. It is recommended to use the same power supply as with output circuit.

When the input signal INx is connected to 0V, the input optical coupler conducts. The signal INx is ON, and the input is valid. It can be checked through dP- In. If the corresponding LED digit light is ON, the input is valid; if it is OFF, the input is invalid. In this case, the corresponding circuit should be check for troubleshooting.

The status of monitoring contents is:

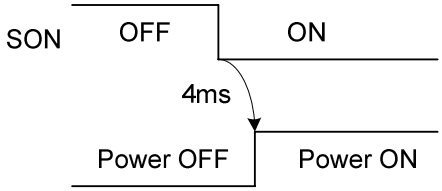


SON and ALRS are general input signal. The sequence is shown as follows: (refer to Chapter 6 for the sequence of other signals)

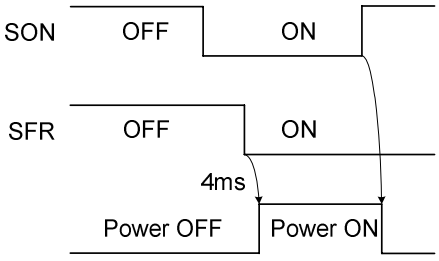
➢ When SON is ON, the servo enable is ON, dP- on will be displayed after ↵ is pressed under monitoring menu dP- rn.

Relevant Parameter	Meaning	Unit	Default Value	Applicable Mode
PA118	When PA118=1, servo internal enable; SON signal is not detected; PA118=0, servo enable signal is given by SON.		0	P, S

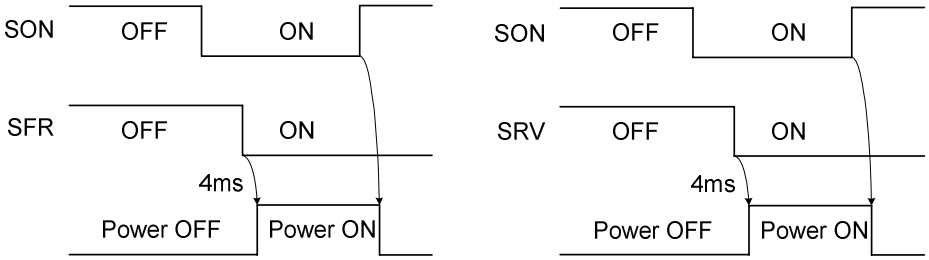
1. In position mode, manual mode, JOG mode and speed mode (when internal digital command is valid):



2. Speed mode in which the -10V~10V analog command is valid, i.e., PA6=0:



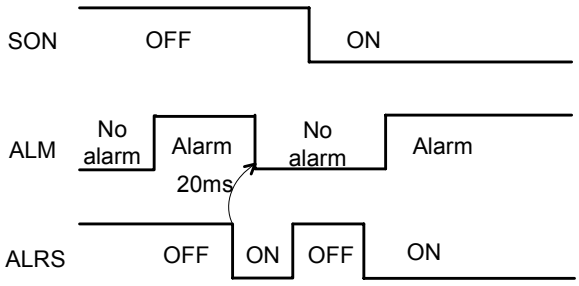
3. Speed mode in which the 0-10V analog command is valid, i.e., PA6=1:



If the spindle servo unit is faulty, the motor can not be energized.

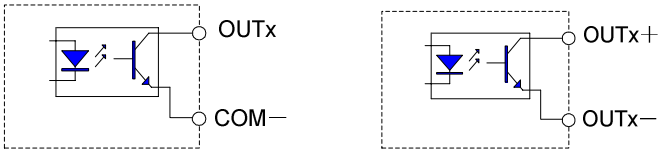
An alarm will be displayed in the monitoring window of spindle servo unit.

- When SON is OFF, and ALRS jumps from OFF to ON, the number 1~9 alarms can be reset. The alarms whose number is larger than 9 can be automatically reset after power-on again. When SON is ON, the ALRS signal function invalid.



3.3.5 Digital Output

1. Among the GS Series D-SUB product digital output signals, signals ALM, SRDY, ZSP are single-ended transistor output. The output optical coupler emitter has been connected to COM-. Other output signals are double-end transistor output.

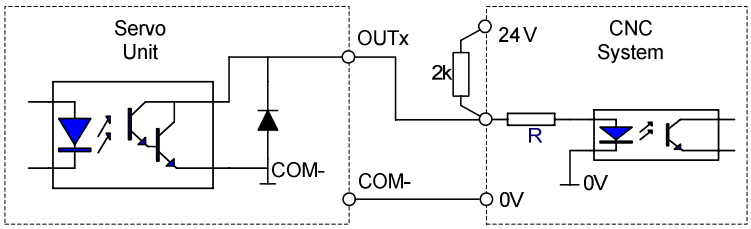


2. Please note that some GS Series D-SUB products digital output signal and GS Series MDR products digital output signals are double-end transistor output.

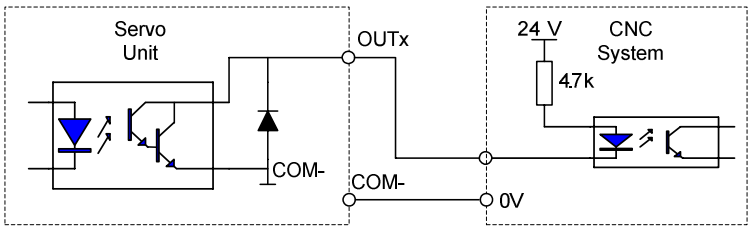
- The connectivity of single-ended transistor output

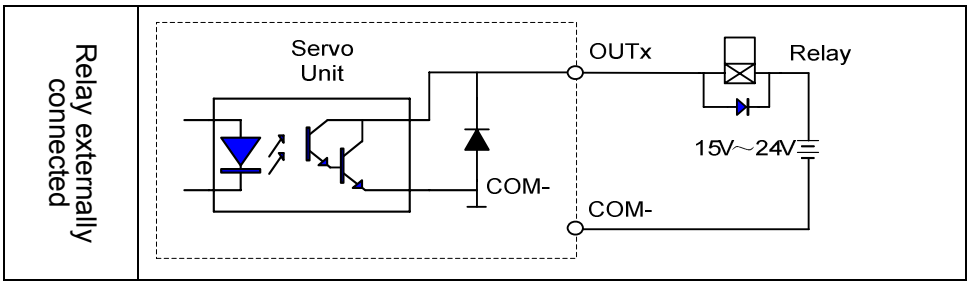
Controller externally connected

Example1: applicable to 980TDa CNC system

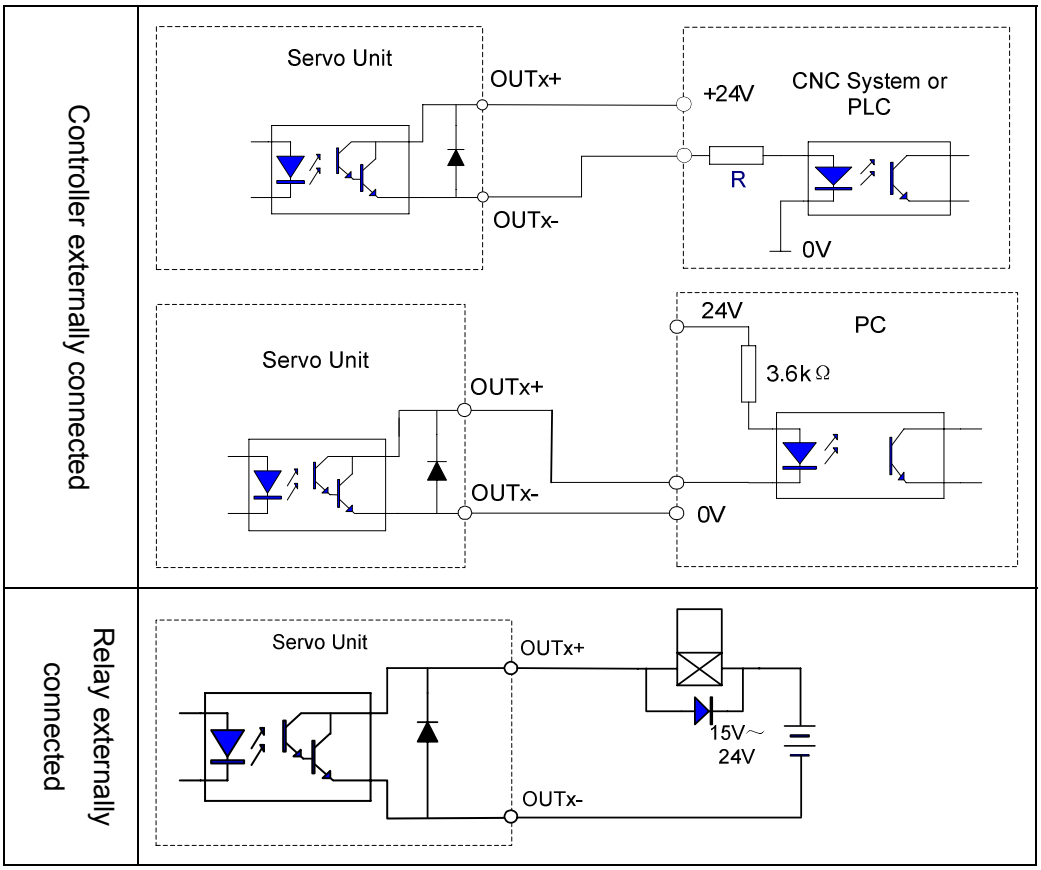


Example 2: applicable to 983M CNC system

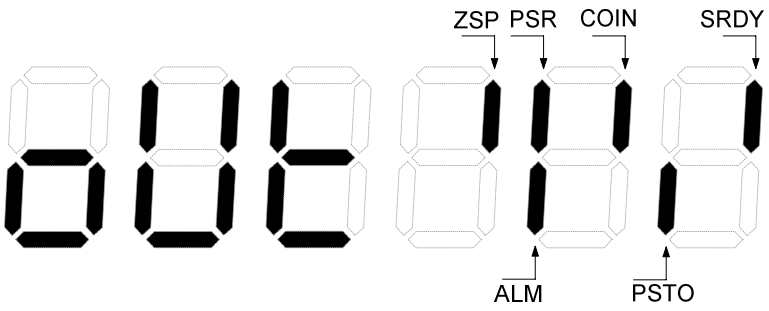




- Connectivity of double-end transistor output

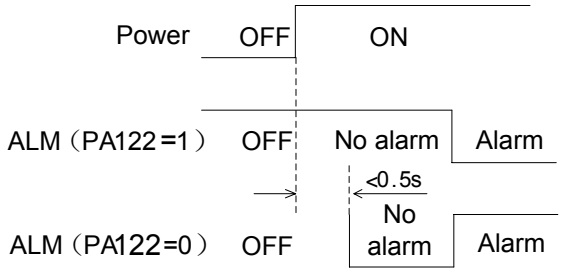


When the output signal OUTx and COM- conduct, or OUTx and OUTx conduct, the output signal is ON. It can be known from the monitoring window dP-OUt. When the output signal is ON, the corresponding LED light will come ON; when the output signal is OFF, the LED light will come OFF.

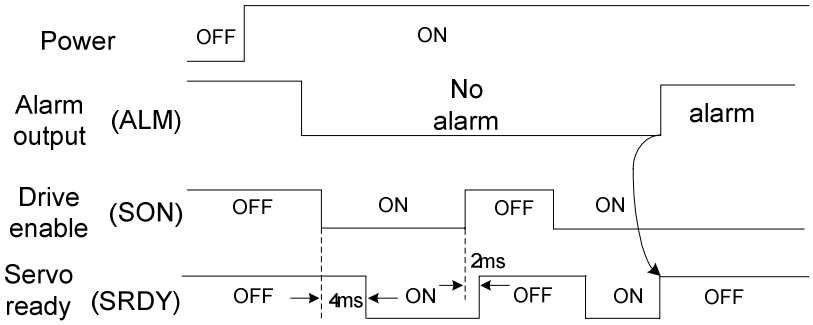


- ALM is the output signal when abnormality is detected in the servo unit. The output status is related to parameter PA122.

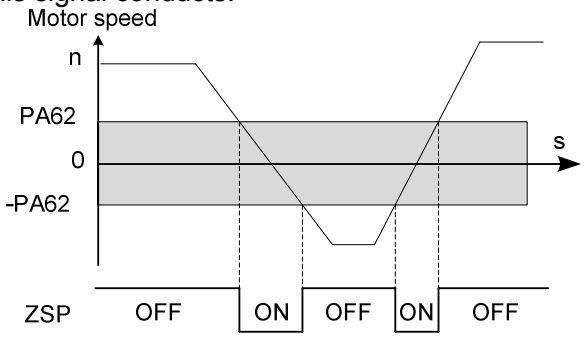
PA122=0	When an alarm is issued in servo unit, the ALM signal output optical coupler is OFF.
PA122=1	When an alarm is issued in servo unit, the ALM signal output optical coupler conducts.



➢ SRDY servo unit ready signal; when the motor is energized, the output optical coupler of this signal conducts.



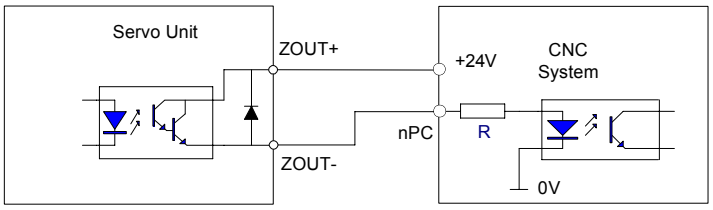
➢ ZSP is zero speed output; when the motor running speed is less than the setting value of PA62, the output coupler of this signal conducts.



ZOUT+/ZOUT- are position feedback output Z pulse signal, i.e., the one-rotation signal;

PA33=1: Select the motor encoder Z pulse signal which is input by CN2;

PA33=1: Select the Z pulse signal of 2nd position feedback signal which is input by CN3.



Caution

1. The output signal is of open collector. The maximum load current is 100mA; the maximum voltage of external DC power is 25V. If these requirements are not met or the output signal is connected to power directly, the servo unit will be damaged.

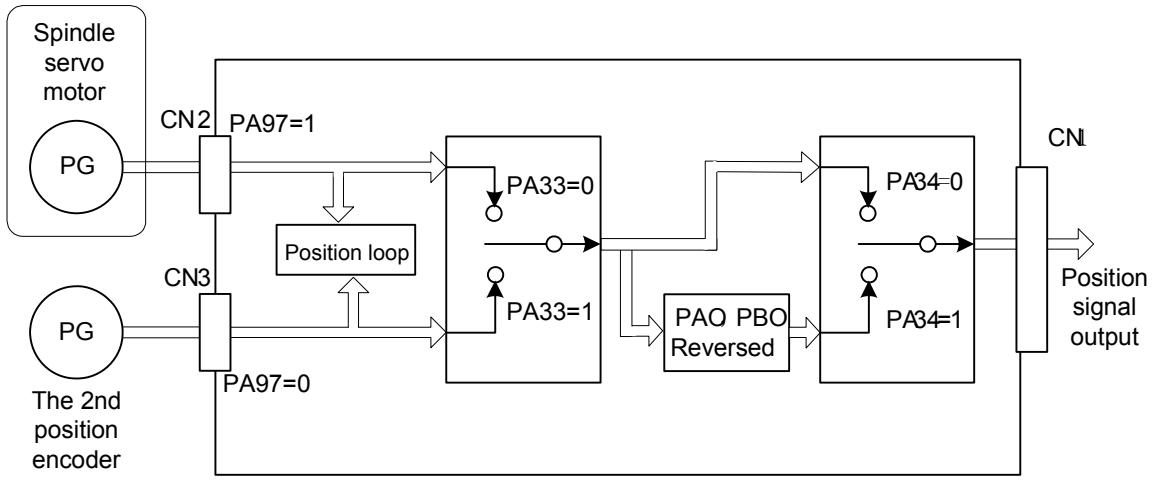
2. If the load is inductive. FWD (free wheeling diode) should be connected in series at

two ends of the load; if the connection is reversed, the servo unit will be damaged.

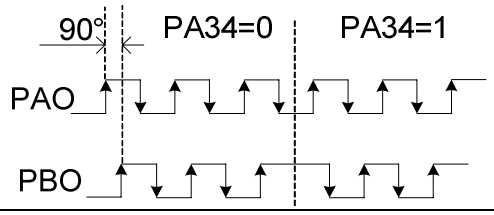
3.3.6 Position Signal Output

The PAO+/PAO-, PBO+/PBO-, PZO+/PZO- are the position signals output from the servo unit in differential form. The signal is output position signal in proportion as 1:1 after the servo unit processes the position signal which is input by CN2 and CN3 and feedbacked by encoder.

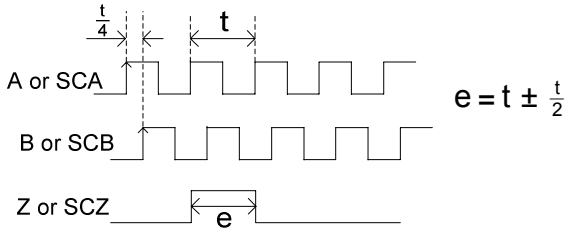
Output Form	Position Signal Name	Function
Differential output	PAO＋/PAO－	A phase of encode feedback signal
Differential output	PBO＋/PBO－	B phase of encoder feedback signal
Differential output	PZO＋/PZO－	Z phase of encoder feedback signal



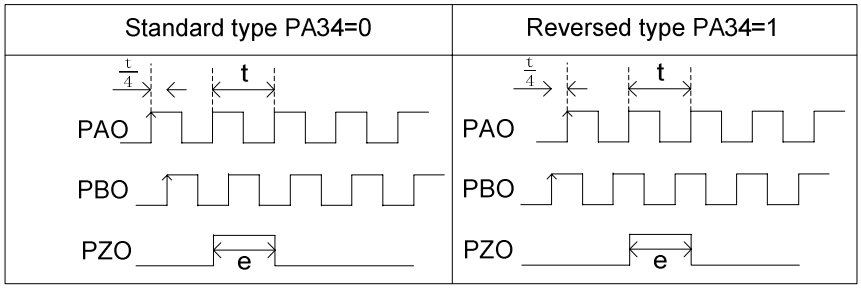
Relevant Parameter	Name	Parameter Range	Default Value	Applicable Mode
PA97	Position feedback input signal selection	0～1	0	P, S
	PA97=1, select the motor encoder signal as the position input signal; PA97=0, select the 2nd position input signal as the position input signal; CN3 must be connected to the feedback signal of the 2nd position encoder; otherwise, Err-24 will occur in the servo unit.			
PA33	Position output signal selection	0～1	0	P, S
	PA33=1, select the motor encoder signal as the position input signal; PA33=0, select the 2nd position input signal as the position input signal; CN3 must be connected to the feedback signal of the 2nd position encoder; otherwise, Err-24 will occur in the servo unit.			
PA34	Position output signal reversed	0～1	0	P, S

	PA34=0, maintain the original relationship of CN1 position feedback output signal; PA34=1, reverse the phase relationship of PA, PB. Shown as follows: 

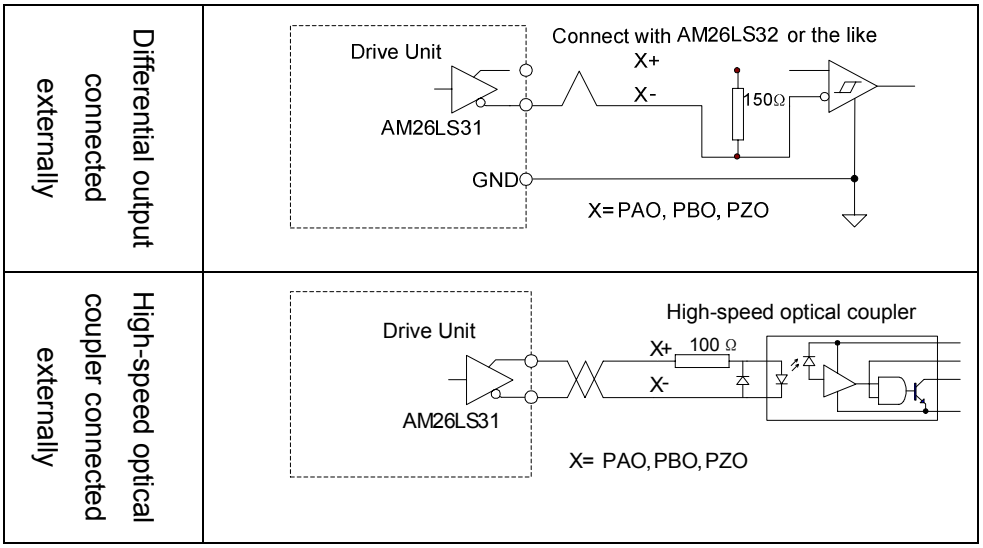
For example: When the position input signal is the TAMAGAWA incremental encoder signal, its form is:



Then, the position signal output wave includes two types:



The connectivity is:



3.4 Connection of Position Feedback Signal

3.4.1 Motor Encoder Position Feedback Signal Interface CN2

- **Interface CN2 of GS Series D-SUB servo unit**

The interface CN2 is 25-pole female receptacle, therefore the connector should be 25-pin male plug (type is G3151-25MBNS1X1, provided by WIESON company). The pin definition is shown as follows:

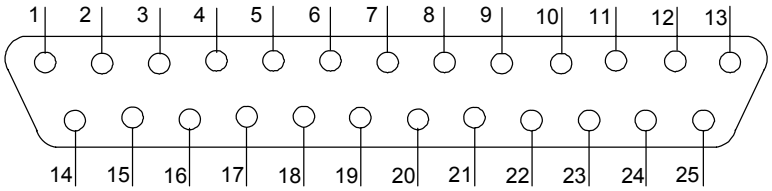


Fig. 3-6 CN2 DB 25-pole female receptacle drawing

Pin No.	Name	Meaning	Pin No.	Name	Meaning
1	0V	Encoder power supply (-)	14	FG	Shielding ground
2	0V		15	FG	
3	0V		16	0V	Encoder power supply (-)
4	0V		17	5V	Encoder power supply (+)
5	5V	Encoder power supply (+)	18	5V	
6	5V		19	W＋	Incremental encoder feedback W+
7	W－	Incremental encoder feedback W-	20	V＋	Incremental encoder feedback V+
8	V－	Incremental encoder feedback V-	21	U＋	Incremental encoder feedback U+
9	U－	Incremental encoder feedback U-	22	Z＋	Incremental encoder feedback Z+
10	Z－	Incremental encoder feedback Z-	23	B＋	Incremental encoder feedback B+
11	B－	Incremental encoder feedback B-	24	A＋	Incremental encoder feedback A+
12	A－	Incremental encoder feedback A-	25	NC	
13	OH	Motor temperature sensor input end			

- **Interface CN2 of GS Series MDR servo unit**

The interface CN2 is 26-pole female receptacle, therefore, the connector should be 26-pin male plug (the type is MDR10126-3000-PE, provided by 3M Company). Shown in the following figure:

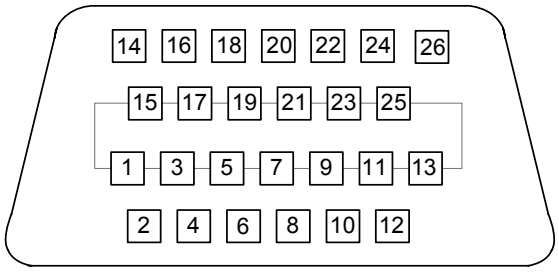
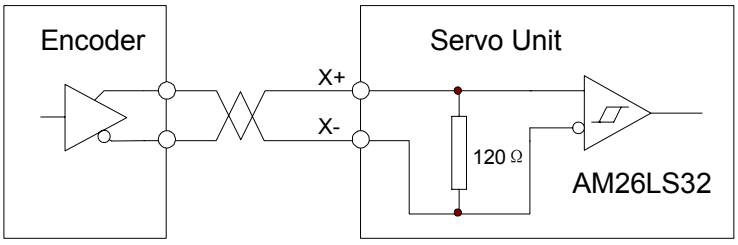


Fig. 3-7 CN2 MDR male plug drawing (welded side)

Pin No.	Name	Meaning	Pin No.	Name	Meaning
1	OH	Motor temperature sensor input end	14	BAT3V6	Power supply
2	NC	Incremental encoder feedback signal	15	0V	
3	NC		16	0V	Encoder power (-)
4	NC		17	0V	
5	NC		18	NC	
6	NC		19	5V	Encoder power (+)
7	NC		20	5V	
8	Z+		21	5V	
9	Z-		22	NC	
10	B+		23	MA+	Absolute encoder feedback signal
11	B-		24	MA-	
12	A+		25	SL+	
13	A-		26	SL-	

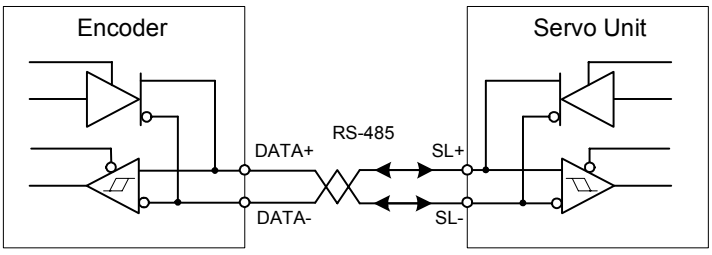
- **Position input signal connection circuit**

1. Incremental encoder feedback signal line adopts differential connection; the connectivity is shown as follows:

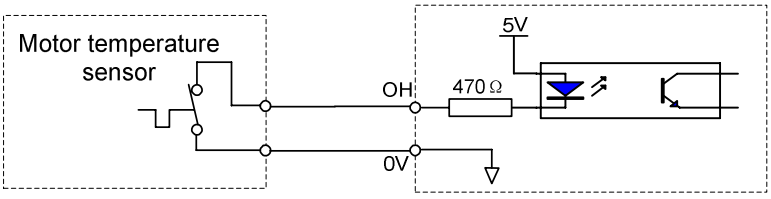


X=A、B、Z、U、V、W

2. The input circuit of absolute encoder feedback signal is 4-channel differential bus transceiver which meets the requirements of ANSI EIA/TIA-422-B and RS-485 standard. The connectivity is shown as follows:



3. OH is used to connect the overheat detector in servo motor, thus motor overheat protection function can be controlled by the servo unit. The connectivity is:



If there is no motor temperature sensor, this signal is not connected.

- **Connection of motor encoder line**

Caution

1. The length of motor power line and motor encoder feedback signal line should be within 20m, and the distance of the two lines should be more than 30cm. These two lines cannot be in the same pipe or bound together.
2. Stranded shielding cable should be used as the signal lines and the cross section of line should be 0.15mm2～0.20mm2 ; The shielding layer must be connected with PE terminals.

1. The following figure is the standard diagram of GS Series D-SUB spindle servo unit and incremental motor encoder connection. When other feedback signal line is used, this diagram can also be a reference.

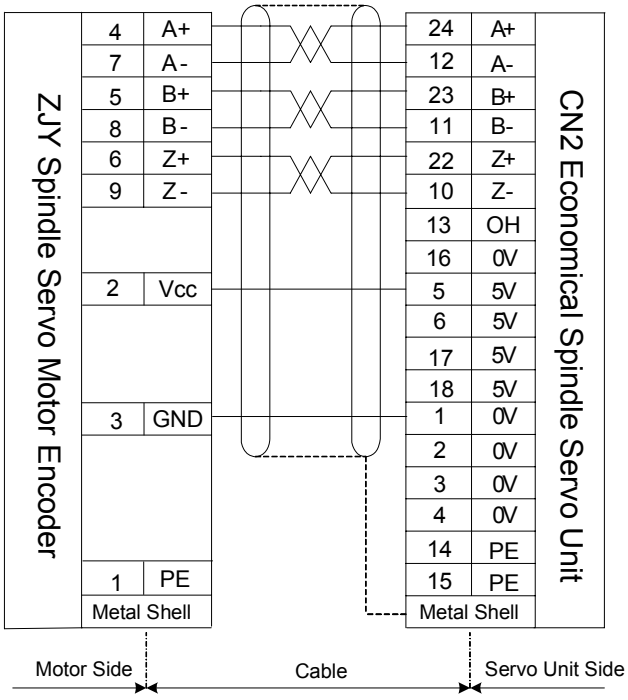


Fig 3-8 GS Series spindle servo unit and motor encoder connection diagram

2. The following figure is standard diagram of GS MDR spindle servo unit and incremental motor encoder connection. When other feedback signal line is used, this diagram can also be a reference.

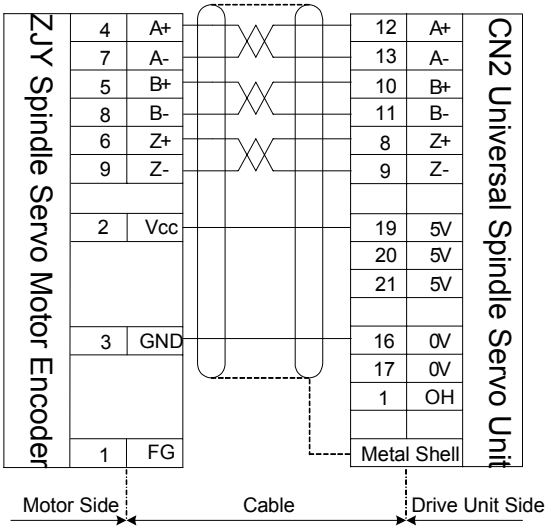


Fig 3-9 MDR spindle servo unit and motor encoder connection diagram

2. The following figure is standard diagram of GS MDR spindle servo unit and absolute motor encoder connection. When other feedback signal line is used, this diagram can also be a reference.

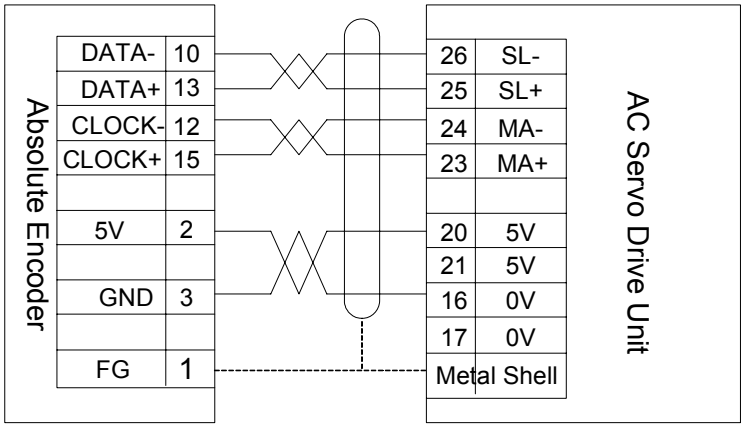


Fig. 3-10 Absolute encoder connection diagram

3.4.2 2nd Position Feedback Signal Interface CN3

CN3 is the input interface for the 2nd position feedback signal (spindle encoder input signal). It is 9-pole female receptacle. The connector should be 9-pin male plug (type: G3151-09MBNS1X1, provided by WIESON company). For example, the spindle encoder feedback signal is taken as the 2nd position feedback signal.

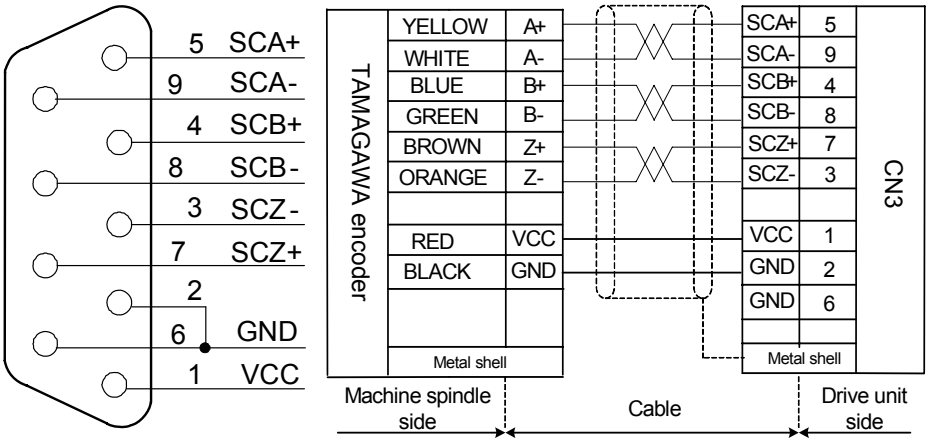


Fig. 3-12 Connection between CN3 and TAMAGAWA TS5308n512 encoder (the 2nd position encoder)

3.4.3 Interface CN3 of GS Series MDR Products

CN3 is the input interface for the 2nd position feedback signal (spindle encoder input signal). It is 20-pole female receptacle. The connector should be 20-pin male plug (type: MDR10120-3000-PE, provided by 3M company). The pin distribution is shown as follows:

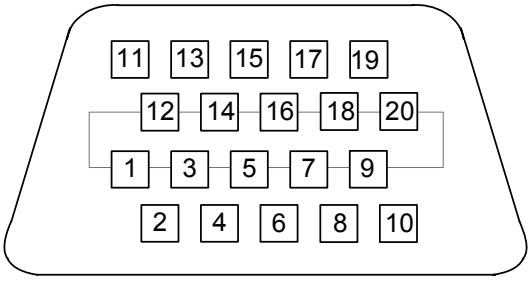


Fig 3-13 CN3 drawing (welded side)

Pin No.	Name	Meaning	Pin No.	Name	Meaning
1	SCZ＋	2nd position incremental encoder signal	11	BAT3V6	Absolute encoder battery supply
2	SCZ－		12	0V	
3	SCB＋		13	NC	
4	SCB－		14	NC	
5	SCA＋		15	NC	
6	SCA－		16	NC	
7	SCSL－	2nd position absolute encoder feedback signal	17	NC	
8	SCSL＋		18	NC	
9	SCMA－		19	0V	Encoder power (-)
10	SCMA＋		20	5V	Encoder power (+)

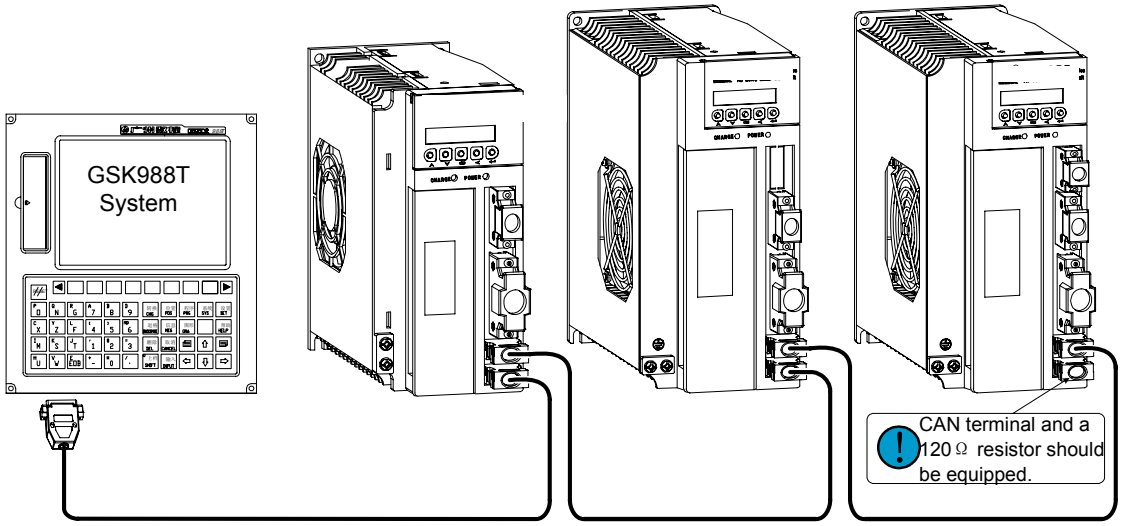
The feedback signal interface (spindle encoder) of GS Series servo unit 2nd position encoder can be connected to incremental encoder or absolute encoder. The connection method can be

referred to CN3 and CN2 respectively.

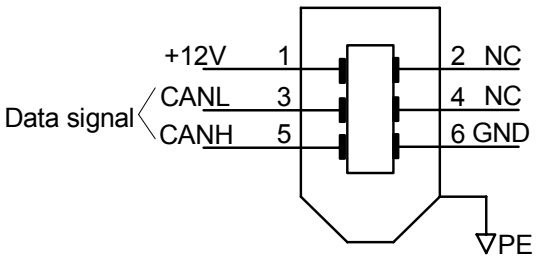
3.5 GSK-CAN Communication

The GS Series MDR servo unit has the GSK-CAN communication function. The interface CN4 or CN5 is connected to GSK-CAN interface to realize the real-time communication. Through GSK-CAN, the following function can be controlled by CNC system: parameter management of servo unit (including parameter saving, modification, backup, etc.), monitoring of servo unit position, speed, current, temperature and I/O status.

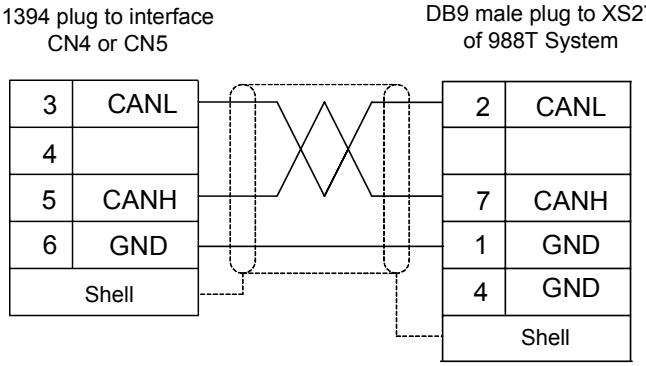
- The connection between CNC and servo unit is shown in following figure:



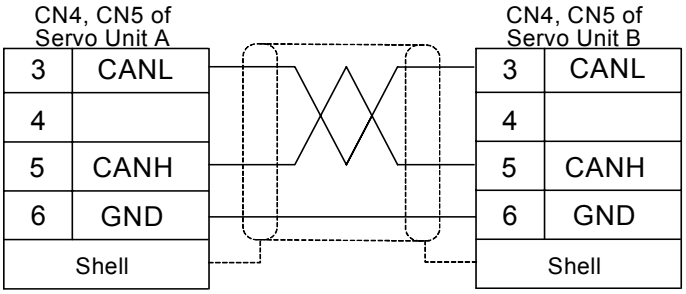
- GSK-CAN bus interface CN4, CN5 adopts IEEE1394 interface; the connectivity diagram is:



- The connection diagram of GSK988T CNC system and servo unit:

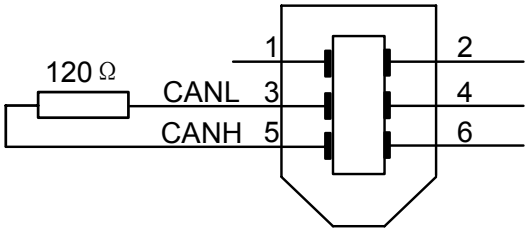


- The diagram of communication connection between servo units:



- GSK-CAN terminals:

At the end of GSK-CAN link bus, a terminal is needed. A 120Ω resistor is internally connected at CANL and CANH signal terminals of 1394 interface.



- Relevant parameters should to be set after the connection:

Relevant Parameter	Name	Unit	Range	Default Value	Applicable Mode
PA155	GSK-CAN communication baudrate selection		1～4	1	P, S
	PA155=1: baudrate is set to 500k; PA155=2: baudrate is set to 600k; PA155=3: baudrate is set to 800k; PA155=4: baudrate is set to 1M.				
PA156	Slave number of servo unit		1～5	1	P, S
	There may more than one servo unit be connected to the CNC system, therefore, corresponding servo axis number should be set for CNC control and the servo axis number cannot be repeated. Note: The slave number of servo unit which is connected to GSK-CAN communication bus must be set and cannot be repeated.				

3.6 Connection in Different Working Mode

3.6.1 Connection in Speed Mode

- D-SUB servo unit connection in speed mode

The input power of GS4□□□ Series spindle servo unit and motor cooling fan should adopt 3N～50/60Hz 440V.

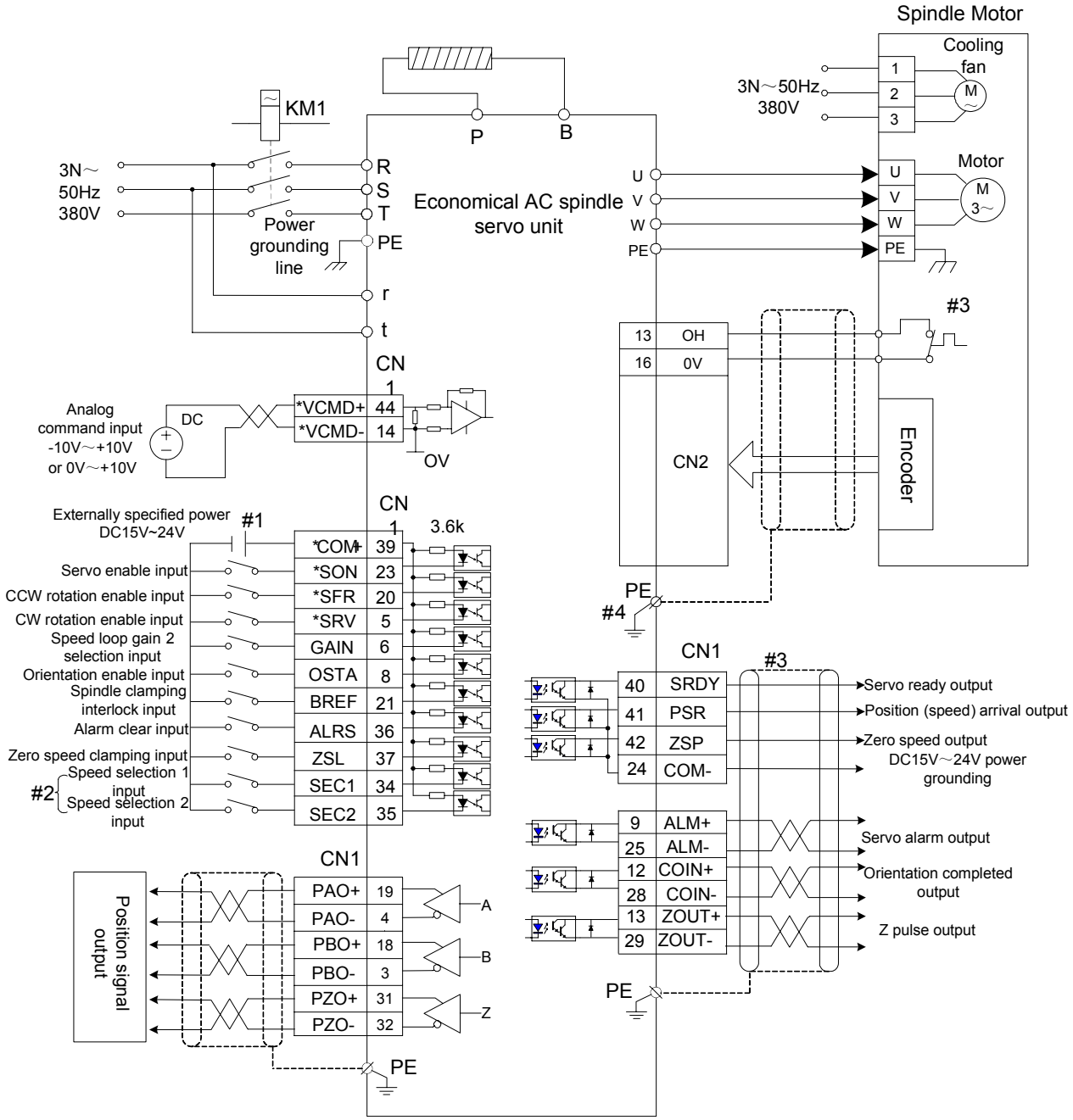


Fig. 3-14 (a) Connection in speed mode

The signals with "*" are the ones that need to be connected.

#1: The minimum power of externally specified DC 15V~24V switching power supply should not be less than 35W.

#2: In speed mode, when PA4=1 and PA6=2, the SEC1, SEC2 are taken as internal speed selection signal.

#3: OH is not connected when there is no temperature sensor in the servo motor.

#4: The metal shells of CN1 and CN2 are connected to PE of servo unit, and can be taken as the welding point of shielding wire.

- MDR servo unit connection in speed mode

The input power of GS4□□□ Series spindle servo unit and motor cooling fan should adopt 3N～50/60Hz 440V.

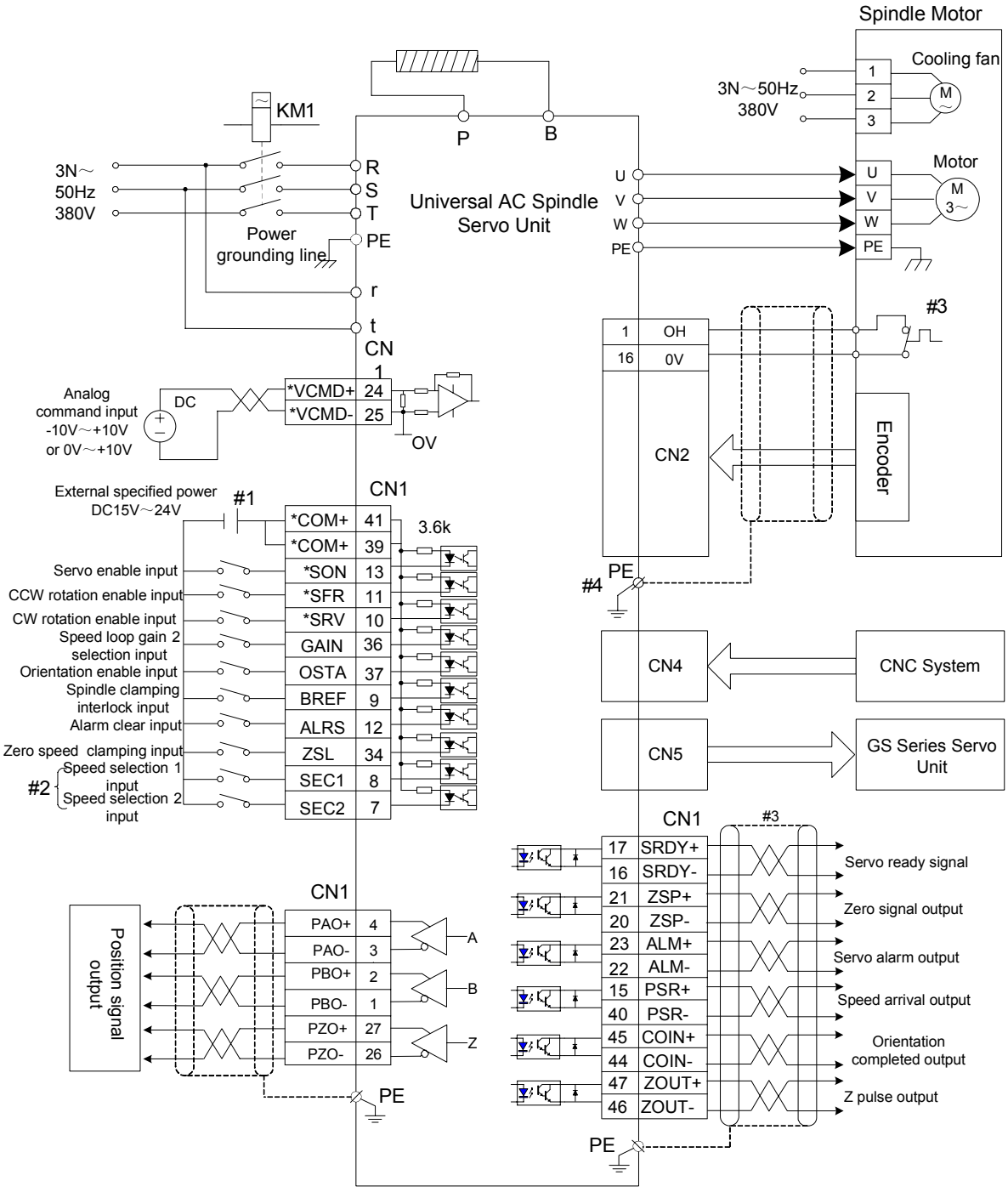


Fig. 3-14 (b) Connection in speed mode

The signals with "*" are the ones that need to be connected.

#1: The minimum power of externally specified DC 15V~24V switching power supply should not be less than 35W.

#2: In speed mode, when PA4=1 and PA6=2, the SEC1, SEC2 are taken as internal speed selection signal.

#3: OH is not connected when there is no temperature sensor in the servo motor.

#4: The metal shells of CN1 and CN2 are connected to PE of servo unit, and can be taken as the welding point of shielding wire.

3.6.2 Connection in Position Mode

- D-SUB servo unit connection in position mode

The input power of GS4□□□ Series spindle servo unit and motor cooling fan should adopt 3N～50/60Hz 440V.

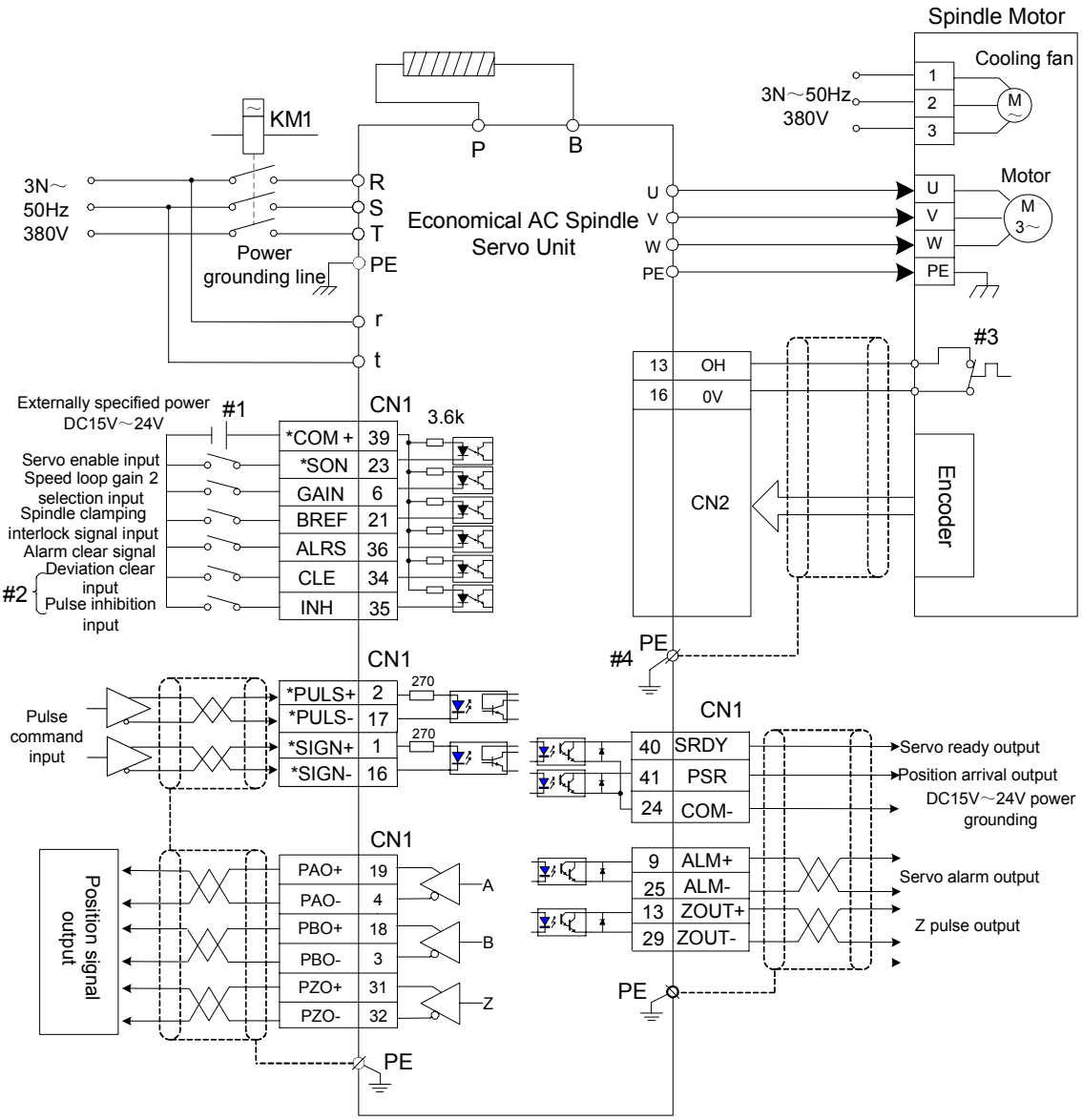


Fig. 3-15 (a) Connection in position mode

The signals with "*" are the ones that need to be connected.

#1: The minimum power of external DC 15V~24V switching power supply should not be less than 35W.

#2: In speed mode, CN1-34 is the position deviation clear signal (CLE), and CN1-35 is the pulse command inhibition signal (INH).

#3: OH is not connected when there is no temperature sensor in the servo motor.

#4: The metal shells of CN1 and CN2 are connected to PE of servo unit, and can be taken as the welding point of shielding wire.

- MDR servo unit connection in position mode

The input power of GS4□□□ Series spindle servo unit and motor cooling fan should adopt 3N～50/60Hz 440V.

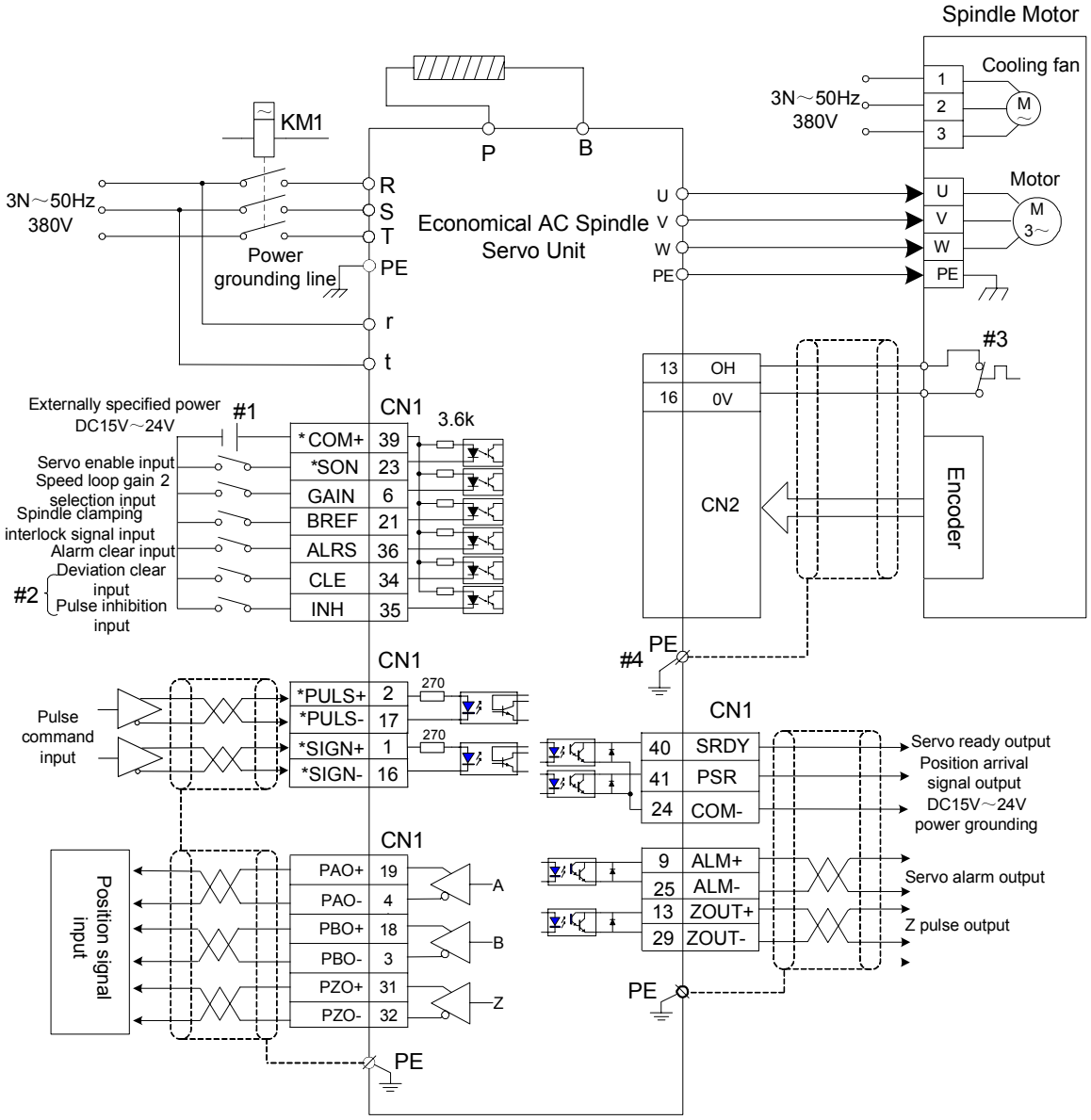


Fig. 3-15 (b) Connection in position mode

The signals with "*" are the ones that need to be connected.

#1: The minimum power of external DC 15V~24V switching power supply should not be less than 35W.

#2: In speed mode, CN1-8 is the position deviation clear signal (CLE), and CN1-7 is the pulse command inhibition signal (INH).

#3: OH is not connected when there is no temperature sensor in the servo motor.

#4: The metal shells of CN1 and CN2 are connected to PE of servo unit, and can be taken

as the welding point of shielding wire.

3.6.3 Connection in Speed/Position Mode

- D-SUB servo unit connection in speed/position mode

The input power of GS4□□□ Series spindle servo unit and motor cooling fan should adopt 3N～50/60Hz 440V.

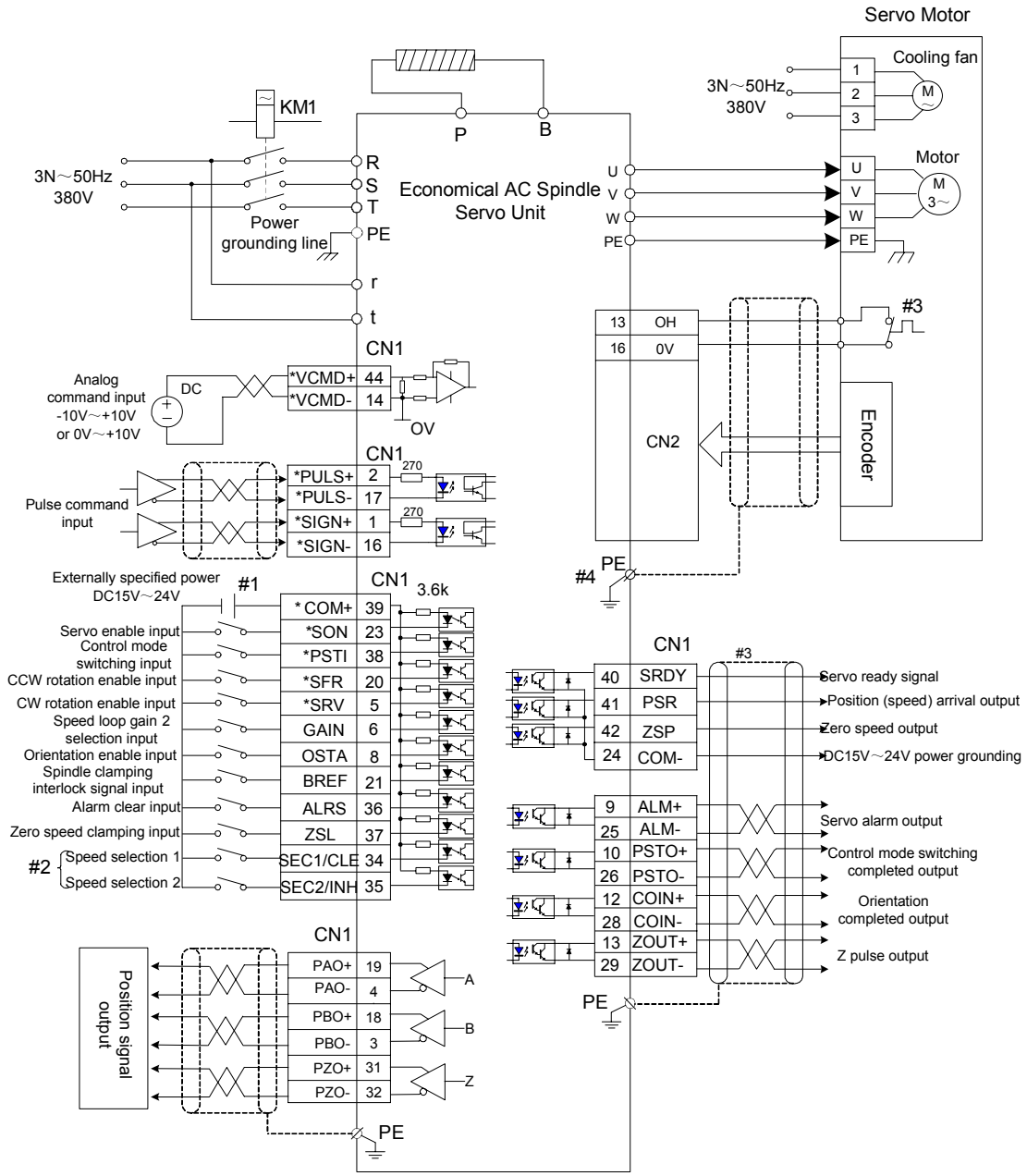


Fig. 3-16 (a) Connection in speed/position mode

The signals with "*" are the ones that need to be connected.

#1: The minimum power of external DC 15V~24V switching power supply should not be less than 35W.

#2: In position mode, CN1-34 is the position deviation clear signal (CLE), and CN1-35 is the pulse command inhibition signal (INH). In speed mode, CN1-34 is the speed selection 1 signal (SEC1), and CN1-35 is the speed selection 2 signal (SEC2).

#3: OH is not connected when there is no temperature sensor in the servo motor.

#4: The metal shells of CN1 and CN2 are connected to PE of servo unit, and can be taken as the welding point of shielding wire.

- MDR servo unit connection in speed/position mode

The input power of GS4□□□ Series spindle servo unit and motor cooling fan should adopt 3N～50/60Hz 440V.

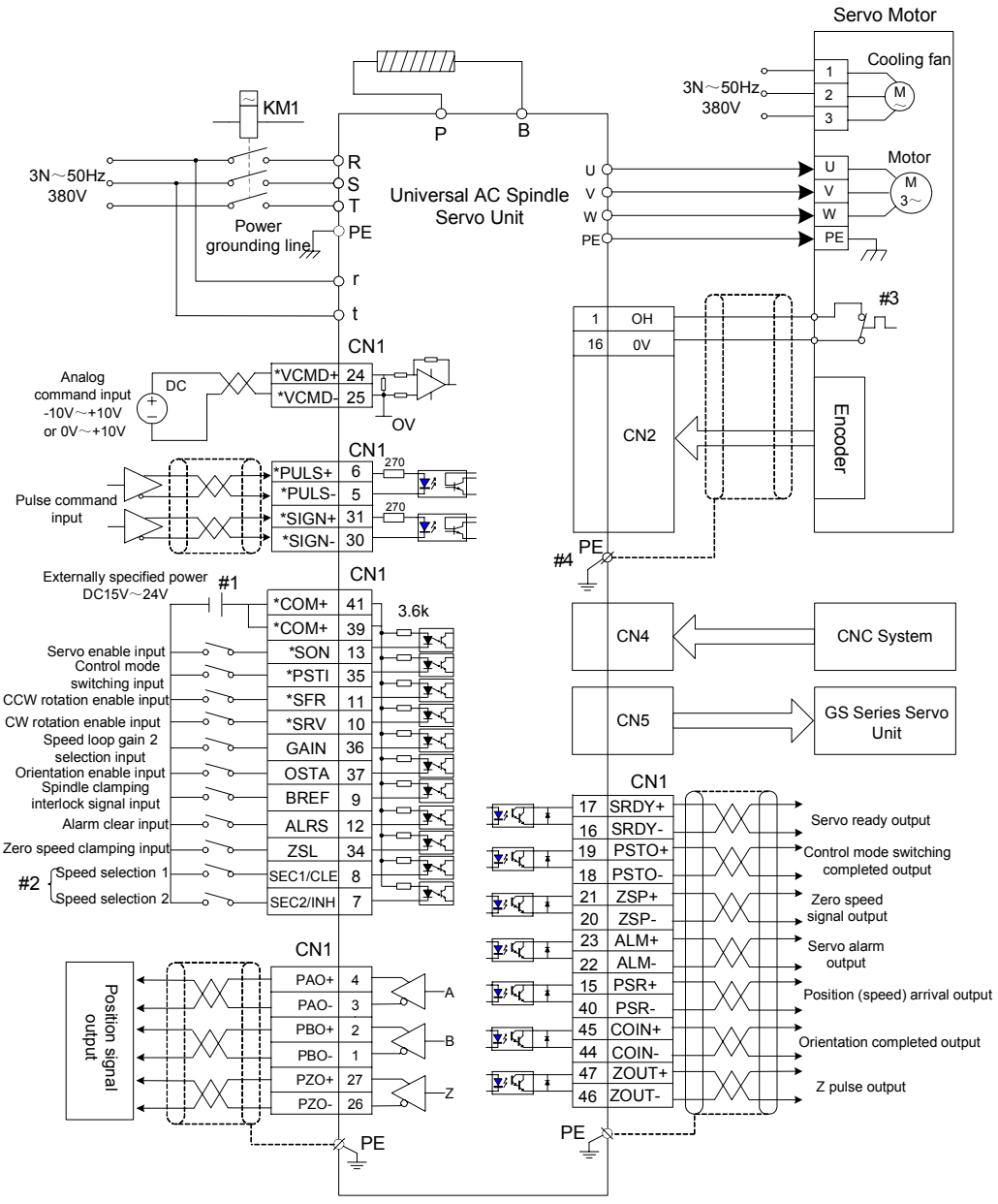


Fig. 3-16 (b) Connection in speed/position mode

The signals with "*" are the ones that need to be connected.

#1: The minimum power of external DC 15V~24V switching power supply should not be less than 35W.

#2: In position mode, CN1-8 is the position deviation clear signal (CLE), and CN1-7 is the pulse command inhibition signal (INH). In speed mode, CN1-8 is the speed selection 1 signal (SEC1), and CN1-7 is the speed selection 2 signal (SEC2).

#3: OH is not connected when there is no temperature sensor in the servo motor.

#4: The metal shells of CN1 and CN2 are connected to PE of servo unit, and can be taken

as the welding point of shielding wire.

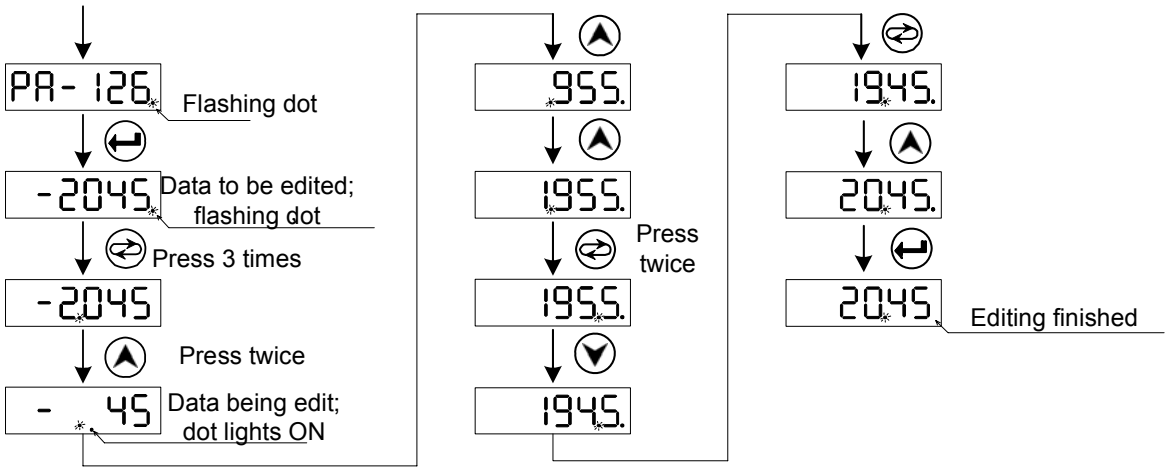
CHAPTER IV DISPLAY AND OPERATION

4.1 Operation Panel

- The functions of components on the servo unit panel are described in Section 1.2.2.
- The functions of keys are listed below:

Key	Name	Description
	Up	1. Increase the parameter No. and value; 2. Page up in secondary menu; 3. Increase the motor running speed in manual mode; 4. Activate CCW rotation in JOG mode;
	Down	1. Decrease the parameter No. and value; 2. Page down in secondary menu; 3. Decrease the motor running speed in manual mode; 4. Activate CW rotation in JOG mode;
	Move	1. Select the digit of parameter No. to be edited; 2. Select the digit of parameter value to be edited;
	Return	Return to previous menu or cancel the operation;
	Enter	Go to sub-menu or confirm the data setting;

Take key for example: how it changes the value of parameter PA126 from -2045 to 2045.

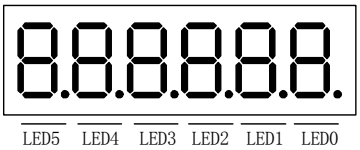


1. For step 4, pressing ▲ once is to add 1000 based on -45 (-45+1000＝955) rather than change -45 to 1045. This is the calculation result of servo unit.

2. The dot on the right bottom of the LED keeps lighting ON when the data is being edit, and it becomes flashing after ↵ is pressed, indicating the validation of the data. If ◄ is pressed before the dot flashes, the parameter setting is invalid.

4.2 Display Menu

The monitoring window of GS Series Products adopts LED display.



When LED5, LED4 is flashing, it means the servo unit is in alarm state.

The primary menu includes contents about monitoring, parameter setting, parameter management, manual running, JOG running. The selection and operations are shown below:

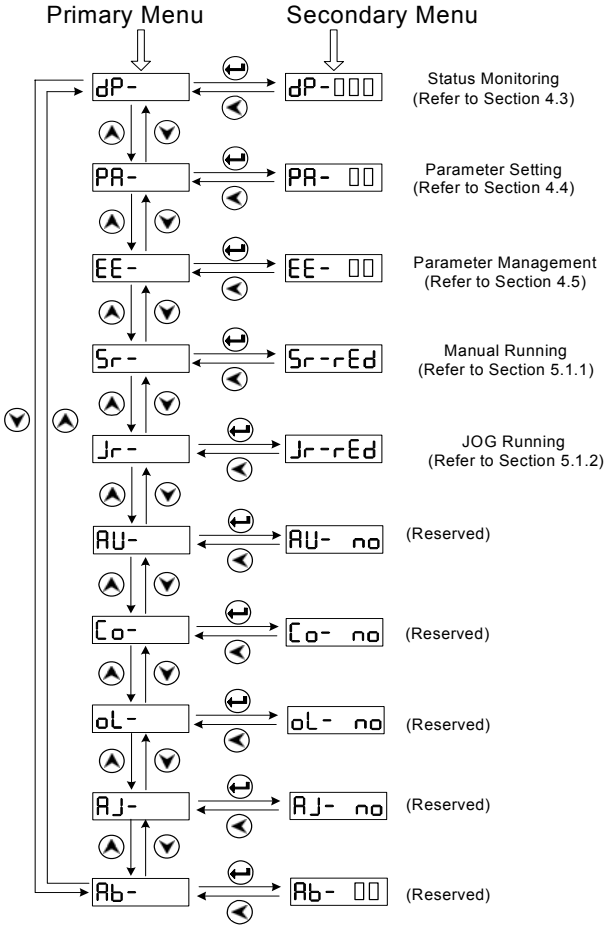
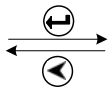
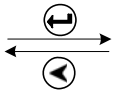


Fig. 4.1 Menu Operation

4.3 Status Monitoring

dP- is the status monitoring menu. Different kinds of status can be selected in this menu. The value of PA03 which selects the initial monitoring status after power-on can be set.

Parameter Value	Initial Status	Operation	Monitored Data	Description
PA3=0	dP-SPd		r 1000	Motor rotation speed is 1000r/min【1】
PA3=1	dP-PoS		P45806	Current motor position low-order 5 digits (pulse) 【2】
PA3=2	dP-PoS.		P. 18	Current motor position high-order 5 digits (×10000 pulse)
PA3=3	dP-CPo		C45810	Current motor position low-order 5 digits (pulse) 【2】
PA3=4	dP-CPo.		C. 18	Current motor position high-order 5 digits (×10000 pulse)
PA3=5	dP-EPo		E 213	Position deviation low-order 5 digits (pulse) 【2】
PA3=6	dP-EPo.		E. 0	Position deviation high-order 5 digits (×10000 pulse)
PA3=7	dP-I		I 2.3	The current of motor is 2.3A.
PA3=8	dP-ouC		n 1000	The speed corresponding to analog command is 1000r/min.
PA3=9	dP- CS		r 210	The speed command is 210r/min.
PA3=10	dP-Fr9		F 283.8	The position command pulse frequency is 283.8KHZ.
PA3=11	dP- Ct		t 20	20% of torque command value
PA3=12	dP-tr9		t 70	70% of rated torque
PA3=13	dP-tEP		C 32	The temperature of radiator is 32℃
PA3=14	dP- tH		C 55	The temperature of servo motor is 55℃.
PA3=15	dP-dC		dC 540	The DC bus voltage is 540V.
PA3=16	dP-Err		Err- 9	Error No. 9
PA3=17	dP-rn		rn- on	Running 【3】
PA3=18	dP-Cod		Cod 0	*Reserved*
PA3=19	dP-In		In'''''11	Input terminal status 【4】
PA3=20	dP-oUt		oUt'''''	Output terminal status 【4】
PA3=21	dP-PLd		C4128	*Reserved*
PA3=22	dP-CPL		uEr 1.03	Hardware version No.
PA3=23	dP-dSP		uEr 1.01	Software version No.

Parameter Value	Initial Status	Operation	Monitored Data	Description
PA3=24	dP-SPo		H 2577	The absolute position low-order digits of the 2nd position encoder are 2577 【5】
PA3=25	dP-SPo.		H 6.	The absolute position high-order digits of the 2nd position encoder is 6 【5】
PA3=26	dP-APo		H 3256	The absolute position low-order digits of the 1st position encoder are 3256 【5】
PA3=27	dP-APo.		H 6.	The absolute position high-order digits of the 1st position encoder is 6 【5】
PA3=28	dP-SAS			*Reserved*
PA3=29	dP-SAS.			*Reserved*
PA3=30	dP-HAS			*Reserved*
PA3=31	dP-HAS.			*Reserved*
PA3=32	dP-AbS			*Reserved*
PA3=33	dP-AbS.			*Reserved*
PA3=34	dP-HbS			*Reserved*
PA3=35	dP-HbS.			*Reserved*

Note:【1】【2】【3】【4】【5】in the table above represent the following:

【1】r 1000.0 "r" represents the motor rotation code; 1000 represents the rotation speed in CCW direction; if the direction is CW, the displayed speed will be negative (- 1000.0).

【2】The position value of encoder feedback is composed of POS**.** (high-order 5 digits) + POS (low-order 5 digits).

For example: P. 18 × 100000 + P45806 =1845806 pulses;

Likewise, the position command pulse value is composed of CPO**.** (high-order 5 digits) + CPO (low-order 5 digits).

For example: C. 18 × 100000 + C45810 =1845810 pulses;

The relationship between CPO and POS is: (when position deviation EPO is 0)

$$\text{P.□□□□□} \times 100000 + \text{P□□□□□} = \frac{\text{PA29}}{\text{PA30}} \left(\text{C.□□□□□} \times 100000 + \text{C□□□□□} \right)$$

Likewise, the position deviation is composed of EPO**.** (high-order 5 digits) + EPO (low-order 5 digits).

For example: E. 0 × 100000 + E 4 =4 pulses

One rotation of the motor causes the change of displayed POS value be "encoder line number×4" pulses. One pulse corresponds to the minimum angular displacement of servo motor (360°/'encoder line number×4').

【3】Running status display

rn- on : The main circuit of servo unit has been charged and enabled.

rn-oFF : The main circuit of servo unit is not charged.

rn- CH : The main circuit of servo unit has been charged but not enabled.

【4】Refer to Section 3.3.4 for input terminal status and Section 3.3.5 for output terminal status.

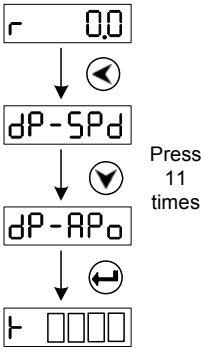
【5】The initial position of Z pulse is taken as zero-point position. dP-APo and dP-SPo display the relative pulse between zero-point signal and zero-point position output by motor encoder and the 2nd position encoder respectively. If the two encoder line numbers are 1024, then, the displayed value range is 0～4095. The value is used for the setting of pre-position for spindle orientation. When the encoder is absolute type or reluctance type, and the position to be displayed is beyond the displayed value range, high-order or low-order digits are used.

When the orientation is performed, the pre-position should be set according to the value displayed on dP-APo or dP-SPo (Refer to Section 6.5.1).

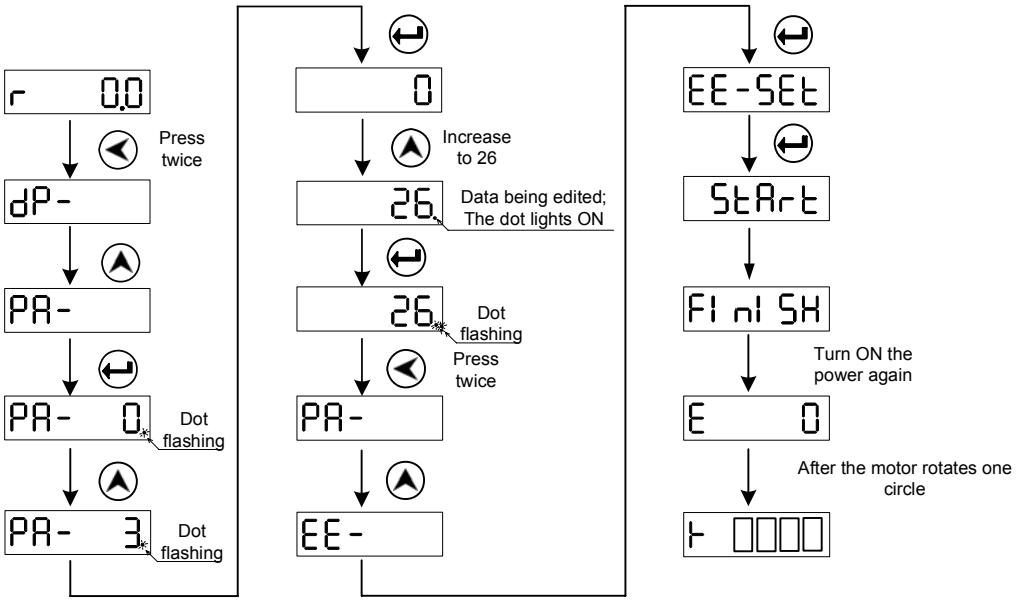
Method of bringing up status monitoring menu:

Example: There are two ways to bring up the status monitoring menu under dP-APo :

(1). Select the status monitoring menu directly.



(2). Select the status monitoring menu through parameters.



- In method 1, [F 0000] indicates that the servo unit has detected the Z pulse, and the displayed value is accurate.
- In method 2, [E 0] indicates that the servo did not detect the Z pulse yet, the displayed value is a random value and cannot be taken as reference value. After the motor rotates one circle, [F 0000] is displayed.

4.4 Parameter Setting

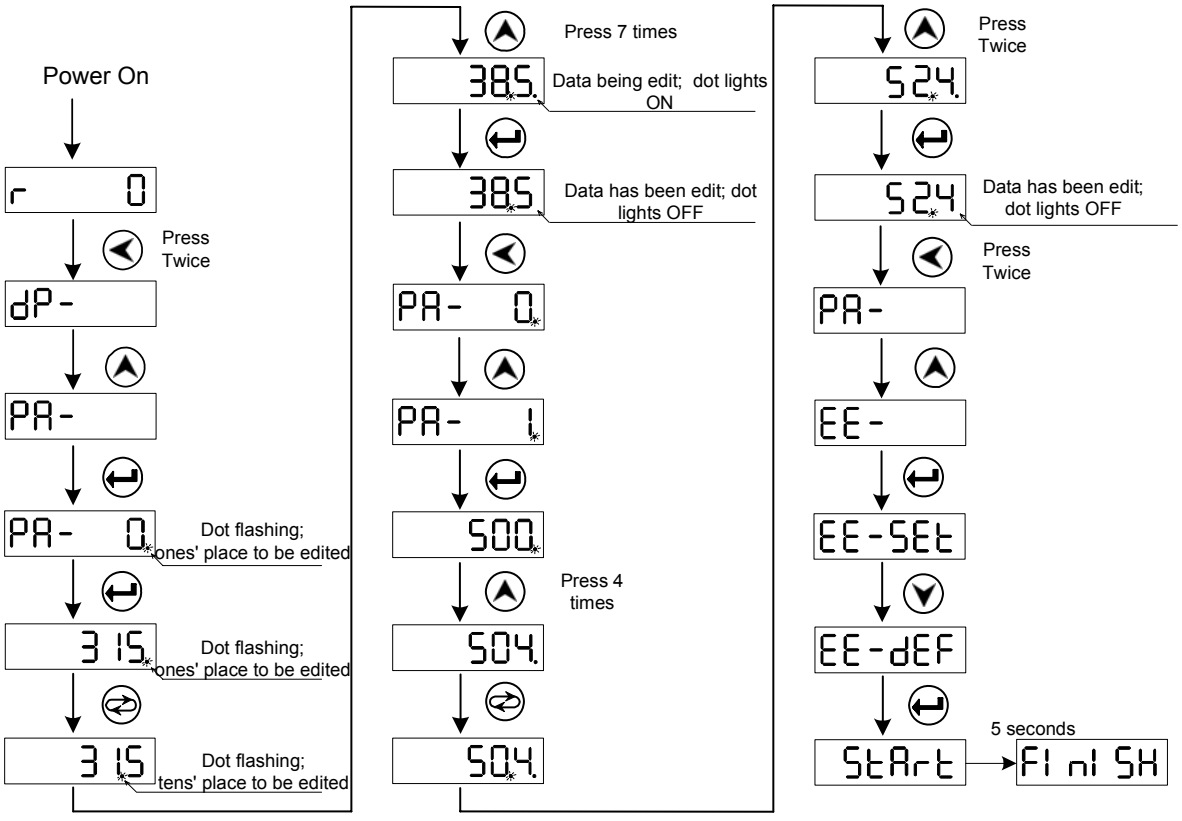
The values after parameter initialization are initial values; the values after parameter recovery are default values.

- **Restore the motor default parameter:**

Relevant Parameter	Name	Unit	Range	Default Value	Applicable Mode
PA0=315	Parameter modifying password		0～9999	315	P, S
	When PA0=315, parameters except PA1, PA2 can be modified.				
PA1	Motor model code		500～530	0	P, S

For example, how to set the default parameter of ZJY208—7.5—B5:

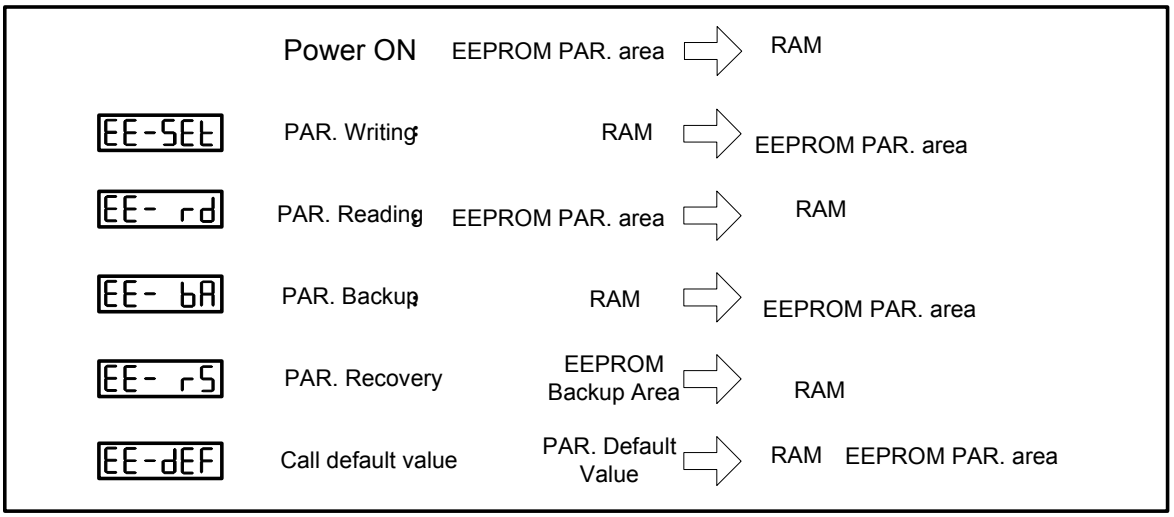
The model code is 524 (refer to Appendix A), set PA1 to 524.



- 385 is the special password for setting motor default value. PA1 can be modified only when PA0=385.
- Whether the default parameter is applicable to the used motor or not can be known from the value of PA1. If there is no corresponding motor model code, the motor may not run normally.
- The modification is valid after key ↵ is pressed; if key ◄ rather than ↵ is pressed, the parameter value will recover to the one of pre-modification.

4.5 Parameter Management

This section detailedly describes the operations of parameter writing, reading, backup, recovery and calling the default value. The data storage relationship is shown as follows:



- **EE－SEt Parameter Writing**

It means storing the parameter in RAM to EEPROM parameter area. Since the modified parameter is valid only in RAM and will become the original value after power-on, the parameter writing function can store the modified parameter forever. The modified parameter will be stored in EEPROM parameter area and can be used after power-on.

- **EE－rd Parameter reading**

It means reading the data in EEPROM parameter area into RAM. During this process, the power will be turned ON automatically. At first, the parameter value in RAM is the same with the one in EEPROM parameter area; after modification, the value in RAM will be changed. When the modified parameter does not meet the need or is disrupted, the parameter reading can be performed: read the data in EEPROM parameter area into RAM to recover the original parameters.

- **EE－bA Parameter backup**

In case of wrong parameter modification, parameters are backed up in EEPROM backup area so that user can call the original parameter if needed. Parameter backup should be done as soon as commissioning has been performed.

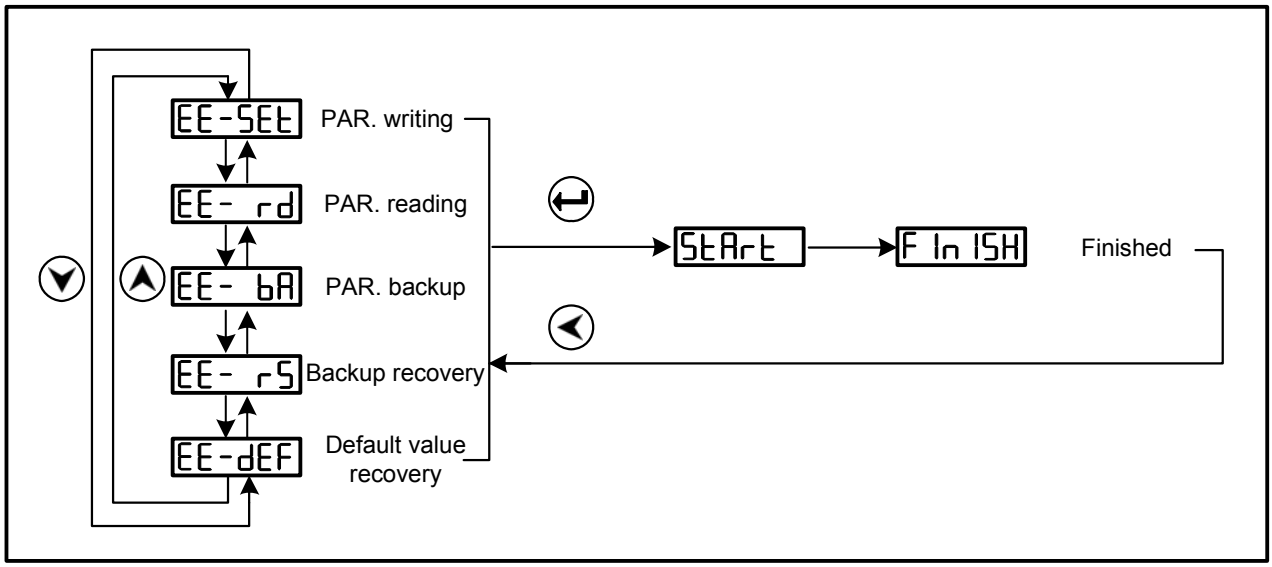
- **EE－rs Recovery**

Read the parameters in EEPROM backup area into the RAM. The parameters need to be stored; otherwise, they will become original parameters after power-on.

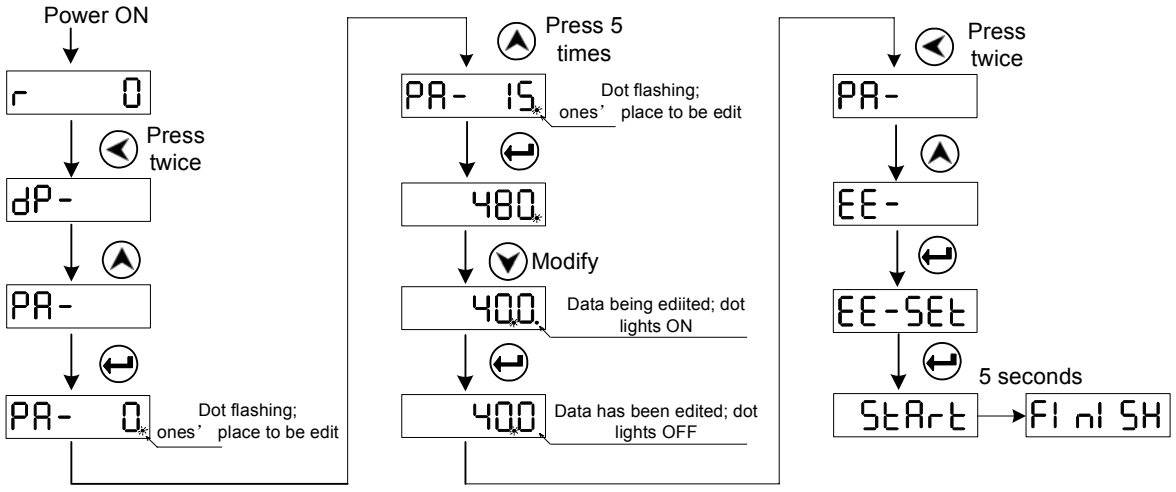
- **EE－dEF Call default value**

It means the default value which is related to a certain model of motor will be read into RAM and written into EEPROM parameter area. It will become the default value after power-on (refer to Section 4.4 for parameter setting).

The operation of parameter management:



Take parameter writing for example:



CHAPTER V GENERAL COMMISSIONING

Commissioning of servo unit is described in this chapter according to the working mode listed below:

Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA4	Working mode selection		0～10	1	P, S
	PA4=0: Position mode; Digital pulses determine the rotation direction and angle. The servo unit makes the rotor work with the determined direction and angle. In position mode, the rotation angle (position) and speed are controllable. PA4=1: Speed mode; The rotation direction and speed are determined by the analog voltage. The servo unit makes the rotor work with the determined direction and speed. This mode not only improves the motor response capability, but also enhances the capability of anti-disturbance. PA4=3: Speed/Position mode; In this mode, when the input point PSTI (speed/position switch) is OFF, the servo unit will be in speed mode after being enabled; when the PSTI is ON, orientation is performed first, after PSTO (speed/position status) signal is output, the servo unit is switched to position mode. PA4=9: Manual mode It is operated in Sr- menu. Acceleration/deceleration can be performed through keys ▲ or ▼. PA4=10: JOG mode; It is operated in Jr- menu. The motor works at the JOG speed set by parameter PA124. CCW/ CW rotation can be selected through keys ▲ or ▼.				

Usually, the following four steps are needed before a new servo unit runs.

Correct Connection ⇒ Parameter Setting ⇒ General Commissioning ⇒ Functionality Testing

In this chapter, the first three steps are described in details for quick commissioning. For detailed information about individual functions, please refer to Chapter 6 Functionality Testing.

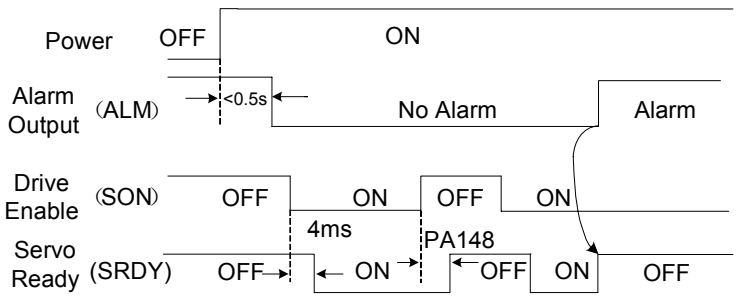
5.1 Running in Manual/JOG Mode

- When the servo unit is used for the first time, it is advised to perform manual or JOG running without load, thus ensuring the servo unit and motor can work normally after transportation, vibration and installation.
- On the condition that the drive unit is working normally without load, it is necessary to carry out commissioning in speed mode or position mode after CN1 control signal is connected.
- The drive unit can run with load after signal connection, parameter setting and motor running are proved to be normal.

The servo unit and motor should be connected according to Section 3.2.1 Connection Diagram of Servo Unit Main Circuit before performing manual or JOG running, and the motor should be disconnected to load. After connection, the following items should be checked before power-on.

Item	Method
Whether the specification of the servo unit and motor are appropriate.	Refer to the User Manual for the details of the servo unit and nameplate of the motor.
Whether correct circuit breaker, contactor and isolation transformer are connected.	Refer to Appendix B for the selection of Peripheral Equipments.
Whether the connection between R, ST, T, P, B1, B and U, V, W, PE are correct.	Check the power circuit and measure it with universal meter if necessary.
Whether the motor encoder feedback signal lines are connected correctly.	Refer to Section 3.4.
Whether the screws of main circuit terminals are tightened.	Check if the screw is loose with screw driver.

Turn ON the power after checking the above items. The power sequence is shown as follows:



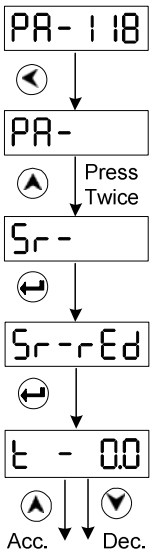
Caution! When the servo unit works for the first time, bring up the motor current monitoring window after power-on. When the SON is ON, check whether the motor current exceeds the rated current; if it does, turn OFF the SON, and then check the connection and parameter setting of the servo unit; otherwise, the motor may be damaged.

5.1.1 Manual Running

After the servo unit is power-on, in normal condition, r 0.0 will be displayed; if the servo unit is faulty, Er.r-□□ will be displayed. The remedies for faults are described in Chapter 8.

Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA4	Working mode selection		0～10	0	P, S
PA118	Internal enable		0～1	0	P, S

The procedures of manual running (PA4=9):



1. r 0.0 is displayed after power-on. It is the monitoring window of motor running speed.
2. Check PA1 first; if it is not set correctly (see Appendix A), call the default parameter corresponding to servo motor in the servo unit (see Section 4.4).
3. Set PA4 to 9 to select the manual running mode.
4. Set PA118 to 1 to turn ON Internal enable (set PA118 to 0 to turn OFF). (make sure the motor rotation is safe)
5. Proceed to the manual running according to the left figure (parameter setting is omitted).
6. Press down ▲, the motor starts acceleration, and the speed maintains after loose the key; press down ▲, the motor starts deceleration, and it starts acceleration in opposite direction after the speed decreases to 0.

During manual running, if Sr-rEd is displayed on the monitoring window, and it becomes no-Enb after pressing “Enter”, indicating that there is no enable signal from the servo unit, please set PA118 to 1; if Sr-rEd is displayed on the monitoring window, and it becomes no-PA4 after pressing “Enter”, indicating that the working mode of servo unit is

wrong, please set PA4 to 9.

During manual running, if abnormalities such as vibration and noise occur on the motor, adjust the speed loop parameters such as PA15, PA16, and PA18 etc. The adjustment method is shown in Section 6.1.

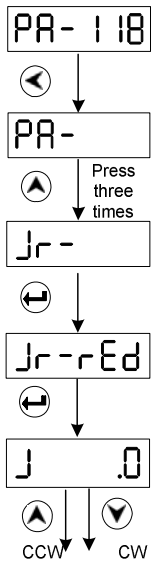
5.1.2 JOG Running

After the servo unit is power-on, in normal condition, r 0.0 will be displayed; if the servo unit is faulty, Err-□□ will be displayed. The remedies for faults are described in Chapter 8.

Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA4	Working mode selection		0～10	0	P, S
PA124	JOG running speed	r/min	-6000～6000	300	S
PA118	Internal enable		0～1	0	P, S

As with manual running, JOG running is operated through the operation panel.

The procedures of JOG running (PA4=10) are:



1. r 0.0 is displayed after power-on; it shows the motor running speed.

2. Check PA1 first; if it is not set correctly (see Appendix A), call the default parameter corresponding to servo motor in the servo unit (see Section 4.4).

3. Set PA4=10 to select the JOG running mode;
   Set PA124 to 500; the JOG running speed is 500r/min.

4. Set PA118 to 1 to turn ON Internal enable (set PA118 to 0 to turn OFF). (make sure the motor rotation is safe)

5. Proceed to the manual running according to the left figure (parameter setting is omitted).

6. Press down ▲, the motor starts acceleration, and the speed maintains after loose the key; press down ▲, the motor starts deceleration, and it starts acceleration in opposite direction after the speed decreases to 0.

During manual running, if Jr-rEd is displayed on the monitoring window, and it becomes no-Enb after pressing “Enter”, indicating that there is no enable signal from the

servo unit, please set PA118 to 1; if Jr-rEd is displayed on the monitoring window, and it becomes no-PA4 after pressing “Enter”, indicating that the working mode of servo unit is wrong, please set PA4 to 10.

During manual running, if abnormalities such as vibration and noise occur on the motor, adjust the speed loop parameters such as PA15, PA16, and PA18 etc. The adjustment method is shown in Section 6.1.

5.2 Running in Speed Mode

5.2.1 Analog Speed Command

①. Connection should be done according to Section 3.6.1 (A) Connection Diagram. Note that the following input signal should be connected.

Input Signal	D-SUB Interface	MDR Interface	Function
*COM+	CN1-39	CN1-39	Common port of input point is the input port of control power.
*VCMD+ *VCMD-	CN1-44 CN1-14	CN1-24 CN1-25	Analog voltage command input
*SON	CN1-23	CN1-13	Servo enable signal
*SFR	CN1-20	CN1-11	PA6=1, CCW rotation enable input; PA6=0, enable permit signal;
*SRV	CN1-5	CN1-10	PA6=1, CW rotation enable input; PA6=0, invalid;

②. After connection, maintain all the input signals OFF, then, turn ON the power and set the essential parameters.

Parameter	Description
PA4=1	Select speed mode;
PA6=0	Select the external analog voltage -10V～+10V
PA52=6000	The motor speed corresponding to default analog voltage (10V) is 6000r/min.
	If PA52=5000, then 10V corresponds to 5000r/min, 5V corresponds to 2500r/min, 1V corresponds to 500r/min.

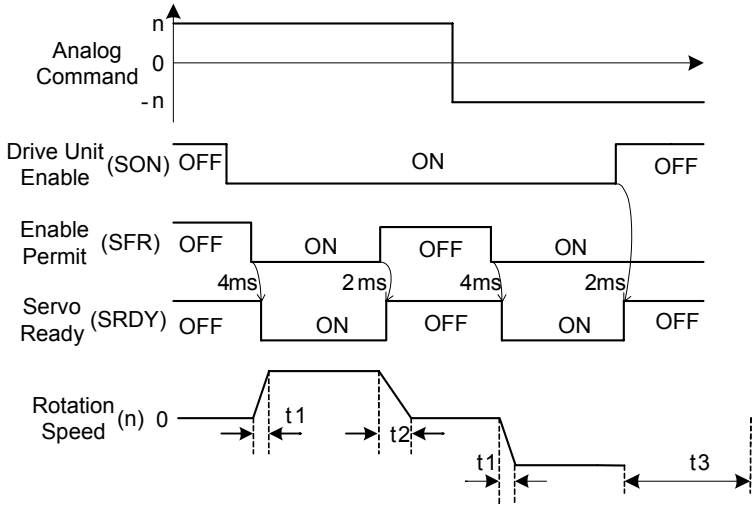
<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>PA51</td><td>
<table>
<tr><td rowspan="3">PA6=0</td><td colspan="2">The external analog voltage range is －10V～＋10V;</td></tr>
<tr><td>PA51=0</td><td>Voltage command is positive, motor performs CCW rotation;
Voltage command is negative, motor performs CW rotation;</td></tr>
<tr><td>PA51=1</td><td>Voltage command is positive, motor performs CW rotation;
Voltage command is negative, motor performs CCW rotation.</td></tr>
<tr><td rowspan="3">PA6=1</td><td colspan="2">The external analog voltage range is 0V～＋10V;</td></tr>
<tr><td>PA51=0</td><td>SFR is ON, motor performs CCW rotation;
SRV is ON, motor performs CW rotation;</td></tr>
<tr><td>PA51=1</td><td>SFR is ON, motor performs CW rotation;
SRV is ON, motor performs CCW rotation;</td></tr>
</table>
</td></tr>
</table>

③General Commissioning

1. After the parameter setting is completed, parameter writing can be enabled (refer to EE-SEt Instruction in Section 4.5 Parameter Management).

2. Specify a small analog command value and turn ON signals SON and SFR (or SRV), the motor will run as commanded.

If PA6=0, the motor can be energized only when both SON and SFR are ON. SFR is enable permit signal.



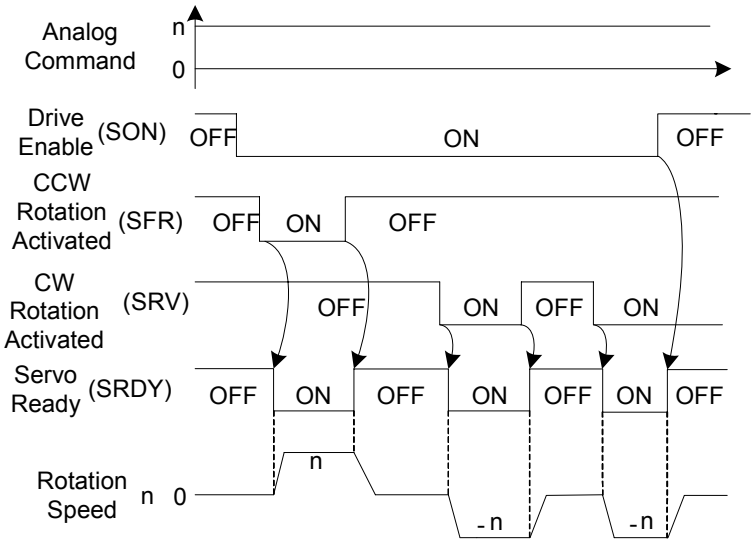
Motor running sequence when PA6=0

➢ To ensure stable start and stop of the motor, appropriate acceleration time (t1=PA57) and deceleration time (t2=PA58) are needed to be set. When the load inertia

is large, the time should be increased accordingly in case of alarm Err-2.

➢ In the figure above, t3 represents the process of motor coasting to stop when PA119=0. Refer to PA119 for details.

When PA6=1and SON is ON, the motor is not energized until SFR (or SRV) is ON.



Motor running sequence when PA6=1

The motor current is displayed on dP-I. Normally, the current value would not exceed the rated current. When the SON signal is invalid, analog command (represented by rotation speed) can be known on dP-ouC; if it is in normal state, the displayed value equals to the rotation speed when SON signal is ON.

3. Increase the analog voltage to slowly raise the motor running speed; meanwhile, monitor the motor running to see whether any vibration and noise exist, whether the speed is steady and whether the current exceeds the rated value or not.

4. When the motor runs normally with the speed from zero to positive maximum or from zero to negative maximum, other actions can be performed.

During the running in analog command speed mode, some abnormalities and remedies are listed as follows:

No.	Abnormality	Remedy
1	No data is displayed on monitoring window dP-ouC after the analog command is specified.	Check the command system and control line.
2	Data is only displayed on dP-ouC, not on dP-SPd after the servo is enabled, that means a speed is commanded but the motor does not work.	Check the parameter setting or check the enable signal line. It is convenient to check I/O according to the contents displayed on dP- In (refer to Section 3.3.4 Digital Input Point).

3	Motor rotation directions are not inconsistent.	Refer to Section 6.2 for the rotation direction switching.
4	Abnormalities such as vibration and noise occur on the motor; motor shaft vibrates during orientation.	1. Check the shielding line connection. 2. Refer to Section 6.1 for the basic performance parameter setting.
5	The motor rotates in single direction;	1. Check the mode of command source and the setting of PA6. 2. Check whether the analog command input line is connected in reverse.
6	A slight drift exists in the motor even 0V is commanded.	Refer to Section 6.5.2 to adjust the "drift amount".

5.2.2 Internal Speed Command

①. Connection should be done according to Section 3.6.1 Connection Diagram. Note that the following input signal should be connected.

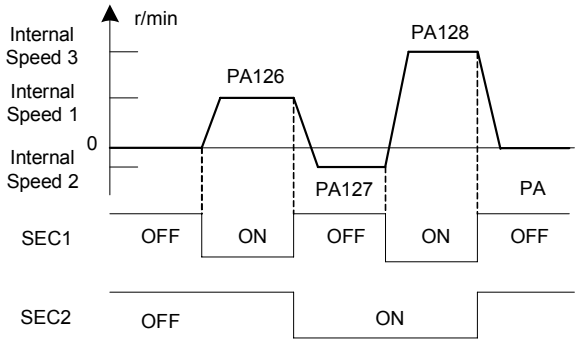
Input Signal	D-SUB Interface	MDR Interface	Function
*COM+	CN1-39	CN1-39	Common port of input point is the input port of control power.
*SON	CN1-23	CN1-13	Servo enable signal; enable the motor alone
*SEC1	CN1-34	CN1-8	Speed selection 1
*SEC2	CN1-35	CN1-7	Speed selection 2

②. After connection, all the input signals maintain OFF, then, turn ON the power and set the essential parameters.

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>PA4=1</td><td>Speed mode selection</td></tr>
<tr><td>PA6=2</td><td>Select internal command</td></tr>
<tr><td>PA126
～
PA128</td><td>
<table>
<tr><td rowspan="2">Default Value</td><td rowspan="2">Running Speed</td><td colspan="2">I/O Status</td></tr>
<tr><td>SEC1</td><td>SEC2</td></tr>
<tr><td></td><td>0 r/min</td><td>OFF</td><td>OFF</td></tr>
<tr><td>PA126＝1000</td><td>Internal speed 1</td><td>ON</td><td>OFF</td></tr>
<tr><td>PA127＝-500</td><td>Internal speed 2</td><td>OFF</td><td>ON</td></tr>
<tr><td>PA128＝2000</td><td>Internal speed 3</td><td>ON</td><td>ON</td></tr>
</table>
</td></tr>
</table>

③General Commissioning

1. After the parameter setting is completed, parameter writing can be enabled (refer to EE-SEt Instruction in Section 4.5 Parameter Management).
2. Turn ON signals SON, the motor will be energized and maintains at zero speed; then turn ON signal SEC1, the motor will run at the “internal speed 1”; the default motor speed is 1000r/min. motor current can be monitored on dP-I; normally, the displayed current is 0.2 times of the rated current.
3. Turn ON signals SEC1, SEC2 by sequence, so that the motor can run at three different internal speeds. Meanwhile, monitor the motor running to see whether any vibration and noise exist, whether the speed is steady and whether the current exceeds the rated value or not.



4. When the motor works normally at three internal speeds, other actions can be performed. The abnormalities and remedies are described as follows:

No.	Abnormality	Remedy
1	Motor rotation directions are inconsistent;	Refer to Section 6.2 for the rotation direction switching.
2	Abnormalities such as vibration and noise occur on the motor; motor shaft vibrates during orientation.	Refer to Section 6.1 for the basic performance parameter commissioning.
3	The status of input signal is not consistent with the motor rotation direction.	Check dP- In to see if the input signal is correct (refer to Section 3.4.4 for digital input points).

5.3 Running in Position Mode

①. Connection should be done according to Section 3.6.2 Connection Diagram. Note that the following input signal should be connected.

Input Signal	D-SUB	MDR	Function
*COM+	CN1-39	CN1-39	Input point common port is control power input port

*SON	CN1-23	CN1-13	Servo enable signal
*PULS+ *PULS-	CN1-2 CN1-17	CN1-6 CN1-5	Position command input; the input mode is : PA5=0: Pulse + direction; PA5=1: CCW pulse+CW pulse; PA5=2: AB phase of orthogonal pulse;
*SIGN+ *SIGN-	CN1-1 CN1-16	CN1-31 CN1-30	

②. After connection, all the input signals maintain OFF, then, turn ON the power and set the essential parameters.

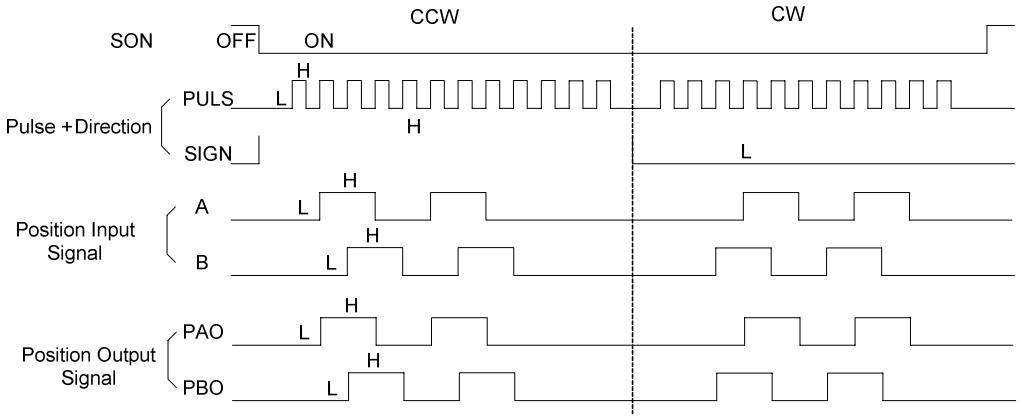
Parameter	Description
PA4=0	Select position mode
PA5	Selection pulse mode of position command; PA5=0: Pulse + direction; PA5=1: CCW pulse+CW pulse PA5=2: AB phase of orthogonal pulse; (Refer to Section 3.3.3 for position command input.)
PA28	Position command direction reversed; PA28=0: “Standard Mode” of position command; PA28=1: “Reverse Mode” of position command; (See Section 6.2).
PA29 PA30	Position command electronic gear ratio: PA29 pulse command frequency multiplication coefficient; PA30 pulse command frequency division coefficient; The electronic gear ratio formula is : $S = \frac{I}{\delta} \cdot \frac{CR}{CD} \cdot \frac{PA29}{PA30} \cdot \frac{L}{4C} \cdot \frac{ZD}{ZM}$ (Refer to Section 6.4.1 for details.)

③. General Commissioning

1. After the parameter setting is completed, parameter writing can be enabled (refer to EE-SEt Instruction in Section 4.5 Parameter Management).

2. Turn ON signals SON, the motor will be energized and maintains at zero speed; specify the position pulse with low frequency, and then the motor can start running. Motor current can be monitored on dP-I; normally, the displayed current will not exceed the rated current. When PA29 and PA30 are set to 1, command pulse number can be read on dP-CPo after the execution of some commands. The pulse number should be in accordance with the displayed pulse number on dP-PoS. When the gear ratio is not 1:1, the pulse number should multiply the gear ratio.

The following figure is an example of driving the motor by pulse+direction commands.



3. Increase the analog command value to slowly raise the motor running speed; meanwhile, monitor the motor running to see whether any vibration and noise exist, whether the speed is steady and whether the current exceeds the rated value or not.

4. When the motor runs normally at the rated speed, and the pulse number on dP-CPo equals to the pulse number on dP-PoS, other actions can be performed.

The possible abnormalities and remedies are shown as follows:

No.	Abnormality	Remedy
1	No data is displayed on dP-ouC, and the motor does not work after being enabled.	Check the connection and the PC.
2	There are data displayed on dP-CPo, but the motor does not work.	Check the enable signal and parameter setting.
3	Motor rotation directions are not inconsistent.	Refer to Section 6.2 for the rotation direction switching.
4	Abnormalities such as vibration and noise occur on the motor; motor shaft vibrates during orientation.	Refer to Section 6.1 for the basic performance parameter setting.
5	The motor rotates in single direction;	Check the mode of command source and the setting of PA5.
6	The data displayed on dP-CPo are not consistent with the pulse number of command source.	1. Check the shielding condition of signal line. 2. Keep the motor far away from interference source.

5.4 Running in Speed/Position Mode

①. Connection should be done according to Section 3.6.3 Connection Diagram. Note that the following input signal should be connected.

Input Signal	D-SUB	MDR	Function
*COM+	CN1-39	CN1-39	Input point common port is the control power input port.
*VCMD+ *VCMD-	CN1-44 CN1-14	CN1-24 CN1-25	Analog voltage command input point.
*SON	CN1-23	CN1-13	Servo enable signal.

*SFR	CN1-20	CN1-11	PA6=1, CCW rotation enable input signal; PA6=0, drive unit enable permit signal;
*SRV	CN1-5	CN1-10	PA6=1, CW rotation enable input; PA6=0, invalid.
*PSTI	CN1-38	CN1-35	Speed/potion switching (valid when PA4=3).
*PSTO+ *PSTO-	CN1-10 CN1-26	CN1-19 CN1-18	Speed/position status output (valid when PA4=3).
*PULS+ *PULS-	CN1-2 CN1-17	CN1-6 CN1-5	Position command input; the input mode is : 1. Pulse + direction; 2. CCW pulse+CW pulse 3. AB phase of orthogonal pulse
*SIGN+ *SIGN-	CN1-1 CN1-16	CN1-31 CN1-30	

②. After connection, all the input signals maintain OFF, then, turn ON the power and set the essential parameters.

<table>
<tr><th>Parameter</th><th colspan="3">Description</th></tr>
<tr><td>PA4=3</td><td colspan="3">Select speed/position mode</td></tr>
<tr><td rowspan="8">PA6</td><td colspan="3">Speed command selection: PA6=0: －10V～＋10V analog voltage;
PA6=1: 0～＋10V analog voltage;
PA6=2: internal speed;</td></tr>
<tr><td rowspan="5">PA6=0</td><td colspan="2">The external analog voltage is －10V～＋10V;</td></tr>
<tr><td>PA51=0</td><td>When the voltage command is positive, motor performs CCW rotation;
When the voltage command is negative, motor performs CW rotation;</td></tr>
<tr><td>PA51=1</td><td>When the voltage command is positive, motor performs CW rotation;
When the voltage command is negative, motor performs CCW rotation;</td></tr>
<tr><td rowspan="3">PA6=1</td><td colspan="2">External analog voltage is 0～＋10V.</td></tr>
<tr><td>PA51=0</td><td>When SFR is ON, motor performs CCW rotation;
When SFV is ON, motor performs CW rotation;</td></tr>
<tr><td>PA51=1</td><td>When SFR is ON, motor performs CW rotation;
When SFV is ON, motor performs CCW rotation;</td></tr>
<tr><td rowspan="2">PA28</td><td colspan="3">Position command direction reversed;</td></tr>
<tr><td colspan="3">PA28=0: “Standard Mode” of position command;
PA28=1: “Reverse Mode” of position command; (See Section 6.2).</td></tr>
<tr><td rowspan="3">PA29
PA30</td><td colspan="3">Position command electronic gear ratio: PA29 is the pulse command frequency multiplication coefficient;
PA30 is the pulse command frequency division coefficient.</td></tr>
<tr><td colspan="3">The electronic gear ratio formula is :</td></tr>
</table>

	$S = \frac{I}{\delta} \cdot \frac{CR}{CD} \cdot \frac{PA29}{PA30} \cdot \frac{L}{4C} \cdot \frac{ZD}{ZM}$ (Refer to Section 6.4.1 for details.)
PA89	Select the transition mode switching from position mode to speed mode.
	In speed/position mode, it selects the transition mode switching from position mode to speed mode. PA89=0: When VP is OFF, switch to speed mode after the execution of position commands. PA89=1: When VP is OFF, switch to speed mode no matter whether the position commands are completed.

Parameter	Description
PA90 PA91	Reference point position in speed/position switching mode
	When switching from speed mode to position mode, the servo unit will work at the speed set by PA99, and stops at the reference point set by PA90, PA91, then, waits for position commands. (Refer to Section 6.5.1 for orientation process.)
PA99	Orientation speed
	When the spindle motor performs orientation, it rotates at the orientation speed at first; then, after the Z pulse of encoder is acquired, the spindle motor rotates to the orientation position.

③. General Commissioning

1. After the parameter setting is completed, parameter writing can be enabled (refer to EE-SEt Instruction in Section 4.5 Parameter Management).

2. Speed/position switching. Input according to the status of PSTI:

PSTI is ON; the servo unit is in position mode;

PSTI is OFF; the servo unit is in speed mode;

The switching process is:

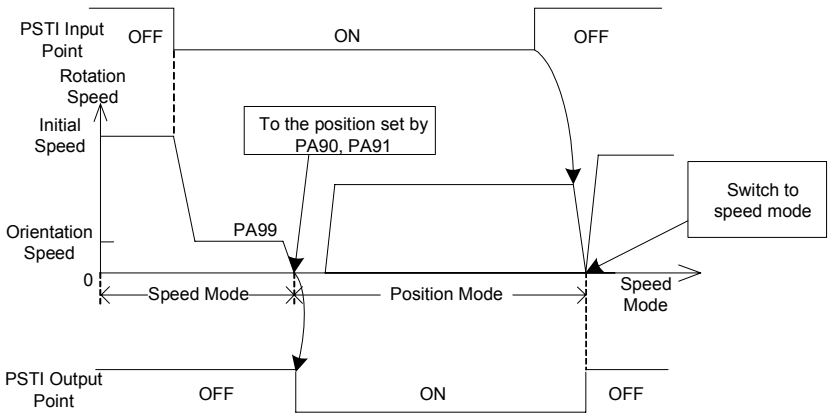


Fig. 5-4-1 Switching process when PA89=0

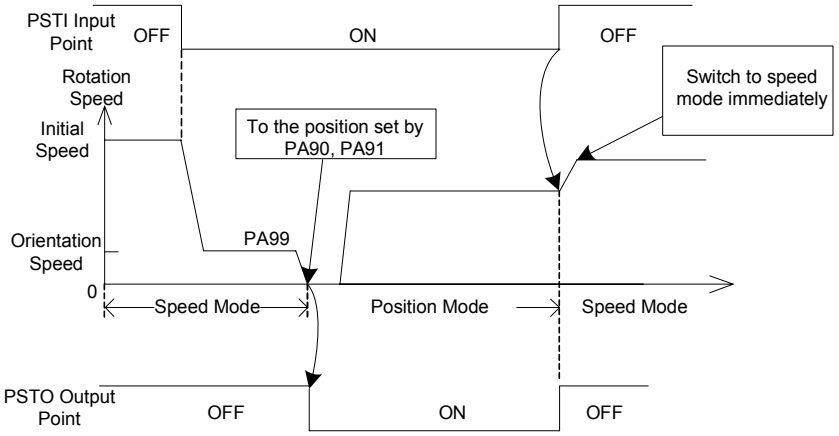
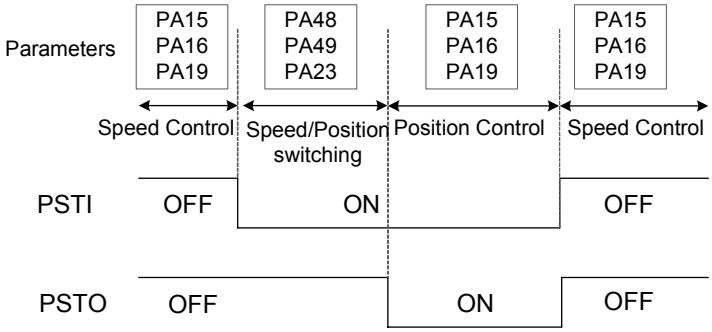


Fig. 5-4-2 Switching process when PA89=1

3. The default status of PSTI signal is OFF. Commissioning should be performed in speed mode at first. The procedures are described in Section 5.2.1 General Commissioning.
4. When the motor works normally in speed mode, switch to position mode directly, and turn ON signal PSTI. The sequence is in Figure 5.4.1 or 5.4.2 signals PSTO+ and PSTO- conduct. Then, perform commissioning according to Section 5.3.

1. In the speed/position switching process, speed loop gain 1 (PA15, PA16), position loop gain 1 (PA19), speed loop gain 3 (PA48, PA49), position loop gain 3 (PA23) are used. Shown as follows:



2. The abnormalities during the running in speed/position mode can be handled according to the remedies in speed mode and position mode.

CHAPTER VI FUNCTIONALITY TESTING

6.1 Instruction for Basic Performance Parameters Setting

Caution The following is the parameter setting diagram. Parameters are needed to be adjusted according to this diagram due to different motors or loading states, for the purpose of achieving optimum working state of spindle motor. However, excessive adjustment may lead to unstable running of the servo unit.

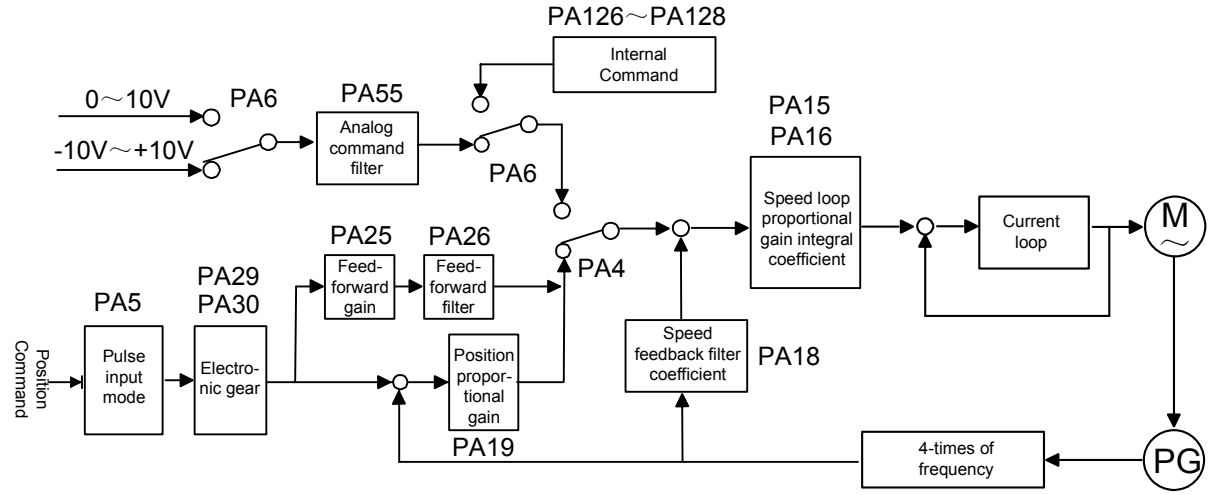


Fig 6-1 Parameter setting diagram

User needs to tune out the default parameters according to corresponding model code in appendix A at first. If some abnormalities such as vibration, noise occur, the basic performance parameters are needed to be adjusted. Generally, speed loop parameters should be prior to the position loop parameter.

6.1.1 Setting Methods

- PA15 (Speed loop proportional gain) :

Larger speed loop proportional gain corresponds to higher servo rigidity. However, excessive proportional gain may lead to vibration during motor start or stop (abnormal noise is produced), and smaller proportional gain may lead to slower response. It is advised to reduce or increase the proportional gain value by 50 each time on the basis of default value to obtain the desired result. Please note that the value range is 500 to 2000.

- PA16 (Speed loop integral coefficient) :

Larger speed loop integral coefficient corresponds to faster system response. However, excessive coefficient may lead to instability or even vibration; smaller coefficient may lead to slower response or even cause the weakening of integral action and inability to reduce the steady-state error. For example, when the orientation function is performed, the orientation axis keeps vibrating (motor vibration), or the orientation fails. In this case, the setting value of PA16 needs to be reduced. It is advised to reduce or increase the coefficient by 1 each time on the basis of default value to obtain the

desired result. Please note that the value range is 1 to 20.

The proportional gain and integral coefficient of speed loop should be adjusted in proportion according to exact servo motor and load status. Generally, when the load inertia is large, the setting value should be smaller accordingly. On the condition that no vibration occurs, the two parameters should be set as large as possible.

The following Figure 6-2 is the response curve for step command input of a motor with a certain inertial load.

Curve 1 represents the speed step input curve when PA16 is 0. The motor characteristic is soft, and the dynamic response is slow; great steady-state error exists.

Curve 2 represents the speed step input curve when the PA15, PA16 is set properly. The motor rigidity is appropriate, and the dynamic response is fast.

Curve 3 represents the speed step input curve when PA15 setting value is small and PA16 setting value is large. The instantaneous overshoot is the largest and vibration will be generated.

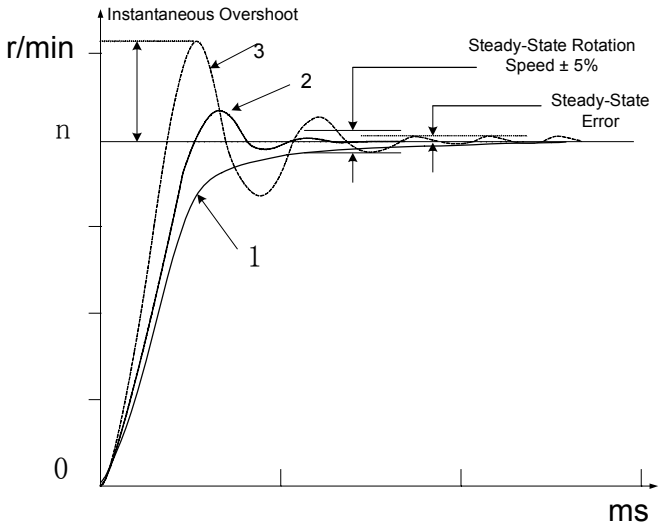


Fig. 6-2 Response curve for step command input

- PA18 (Speed feedback filter coefficient) :

Larger speed feedback filter coefficient corresponds to faster speed feedback response. However, excessive coefficient may lead to great electromagnetic sound; smaller coefficient may lead to slower speed feedback response or even speed fluctuation and vibration. It is advised to reduce or increase the coefficient by 50 each time on the basis of default value to obtain the desired result. Please note that the minimum value of PA 18 should not smaller than 50.

- PA19 (Position loop proportional gain) :

Servo unit position loop adopts P adjustment. In position mode and when orientation function is performed, the position close-loop control takes effect.

The larger position loop proportional gain corresponds to faster response to position commands, and higher rigidity. However, excessive proportional gain may lead to position overshoot which will cause vibration; while smaller proportional gain may lead to slower response and greater following error. It is advised to reduce or increase the proportional gain by 5 each time on the basis of default value. Please note that the setting value of PA19 is 25 to 60.

- PA25 (Position loop feedforward gain), PA26 (Position loop feedforward filter coefficient):

The speed loop is adjusted by the speed information of position command. The greater the setting value is, the smaller the following error is; however, excessive setting value may lead to instantaneous overshoot and vibration.

PA26 performs smooth processing to position command feedforward control. The larger the setting value is, the faster the response to step speed command will be, which will suppress the position overshoot and vibration during speed jump. Smaller value will cause poor effect of feedforward control during speed jump and less vibration.

Generally, PA25 (position feedforward gain), PA26 (position loop feedforward filter coefficient) can be unused.

- PA55 (Analog command filter coefficient) :

The smaller the value is, the stronger the anti-interference capability is. However, when the value is too small, the response to speed command will be slow; when the value is too large, the response to speed command will be fast but the anti-interference capability will be poor. It is advised to reduce or increase the value by 50 each time on the basis of default value to obtain the desired result. Please note that the minimum setting valve of PA55 should not be less than 50.

6.1.2 Three Gains of Closed-Loop Control

There are three different speed loop rigidities and position loop rigidities available according to different application circumstances. Shown as follows:

GAIN is OFF OSTA is OFF	Speed loop gain 1 (PA15), integral time coefficient 1 (PA16) are valid; Position loop gain 1 (PA19) is valid;	Applicable to the common speed control or position control mode;	Modest rigidity
GAIN is ON	Speed loop gain 2 (PA45), integral time coefficient 2 (PA46) are valid; Position loop gain 1 (PA19) is valid;	Applicable to rigid tapping state;	Strong rigidity
OSTA is ON	Speed loop gain 3 (PA48), integral time coefficient (PA49) are valid; Position loop gain 3 (PA23) is valid;	Applicable to orientation state;	Weak rigidity
PSTI is ON and PSTO is OFF	Speed loop gain 3 (PA48), integral time coefficient (PA49) are valid; Position loop gain 3 (PA23) is valid;	Applicable to speed/position switching state;	Modest rigidity

Note: When PSTI is valid, refer to Section 5.4 for the parameter selection of speed loop gain and position loop gain.

- **Application of rigid tapping**

Rigid tapping belongs to thread machining under position loop control, which requires high servo rigidity, fast response to commands and small following error; therefore, during rigid tapping, high servo speed loop proportional gain is needed to be set. Since vibration will easily occur during the high-rigid motor running, the motor rotation speed is usually set below 2000r/min. But for universal

spindle machining, the motor runs at high speed and does not require high rigidity, thus universal spindle machining and rigid tapping require two different speed loop gains.

Through the selection of input signal GAIN (ON or OFF) and the setting of parameter PA45, PA46, PA53, different rigidities can be applied to different machining.

PA53 is valid when GAIN is ON; its function is the same with PA52 (see Section 5.2.1 Analog Voltage Command)

- **Application of orientation**

As with the speed/position switching process, the orientation function is performed with the same rigidity as the one in speed control. When the spindle inertia is large or the transmission mechanism bears big clearance, spindle vibration will easily occur after orientation. In such case, lower down the motor rigidity, specially the speed loop integral so as to ensure that the motor stops at a designated position steady and rapidly.

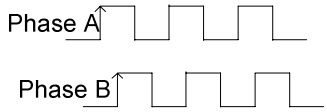
Through the selection of input signal OSTA (ON or OFF) and the setting of parameter PA48, PA49, different rigidities can be applied to different machining.

6.2 Switching of Motor Rotation Directions

- Standard Setting :

1. When all the servo unit parameters apply default value;

2. When the A, B phase relationship of encoder input signal (or the 2nd position feedback input signal) is:



For speed mode or position mode, the relationship between command and motor rotation direction complies with the standard setting.

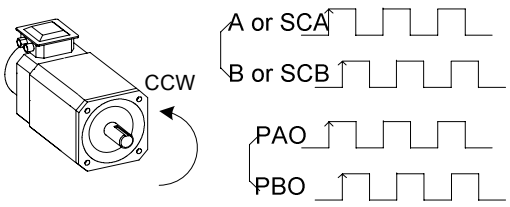
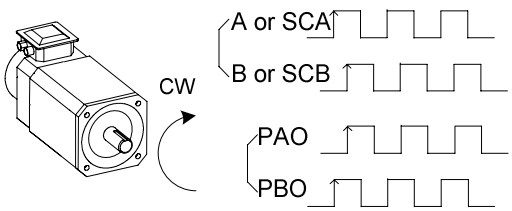
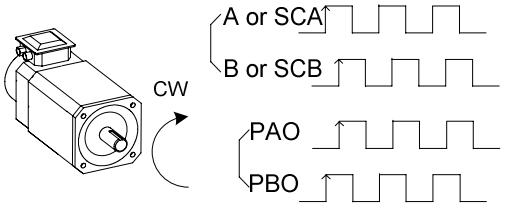
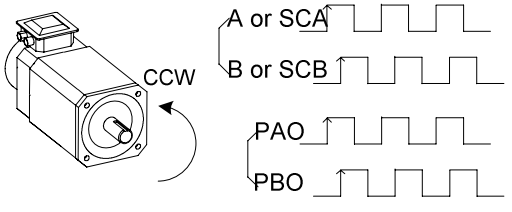
- Reverse Rotation Mode:

On the condition that no servo motor line distribution is changed, the “Reverse Rotation Mode” is to reverse the rotation direction of the motor.

1, Position mode:

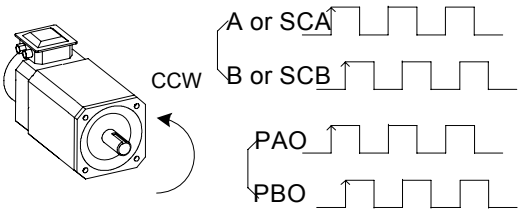
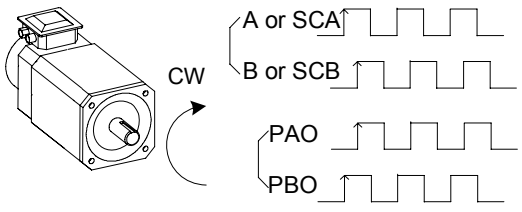
Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA28	Position command direction reversed		0～1	0	P
	PA28＝0: maintains the original direction; PA28＝1: Reverses the input pulse command;				

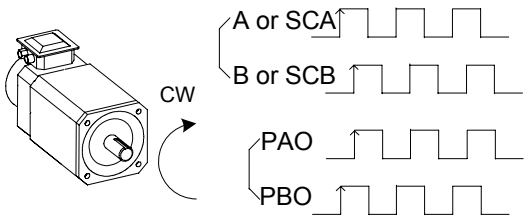
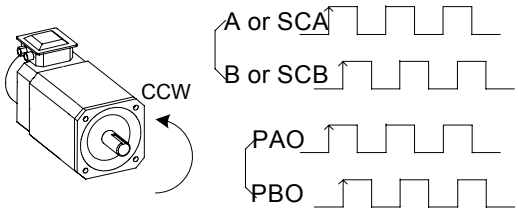
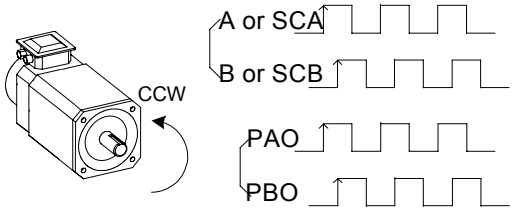
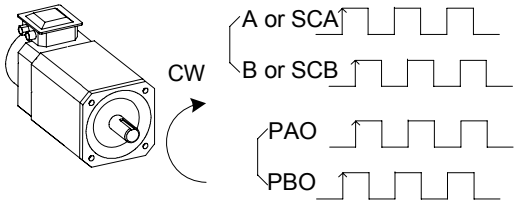
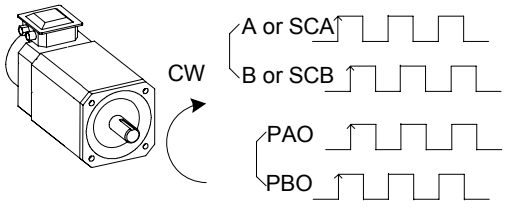
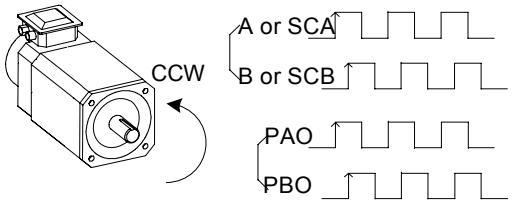
Command	Standard Setting (PA28=0)	Reverse Rotation Mode (PA28=1)

CCW	 The rotation speed displayed on LED is positive.	 The rotation speed displayed on LED is negative.
CW	 The rotation speed displayed on LED is negative.	 The rotation speed displayed on LED is positive.

2. Speed mode:

Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA51	Analog command reversed/ CCW, CW rotation starting reversed		0～1	0	S
	①. when the analog voltage is －10V～10V (PA6=0): PA51=0, analog command is positive, motor performs CCW rotation; analog command is negative, motor performs CW rotation; PA51=1, analog command is positive, motor performs CW rotation; analog command is negative, motor performs CCW rotation. ②. when analog voltage is 0~10V (PA6=1): PA51=0, CCW rotation signal enables CCW rotation; CW rotation signal enables CW rotation; PA51=1, CCW rotation signal enables CW rotation; CW rotation signal enables CCW rotation;				

Command	Standard Setting (PA51=0)	Reverse Rotation Mode (PA51=1)
SFR (PA6=1)	 The rotation speed displayed on LED is positive.	 The rotation speed displayed on LED is negative.

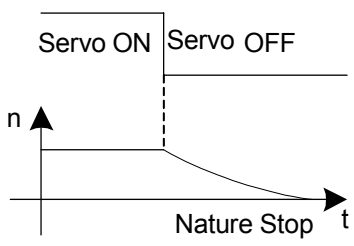
SRV (PA6=1)	 The rotation speed displayed on LED is negative.	 The rotation speed displayed on LED is positive.
Positive Voltage (PA6=0)	 The rotation speed displayed on LED is positive.	 The rotation speed displayed on LED is negative.
Negative Voltage (PA6=0)	 The rotation speed displayed on LED is negative.	 The rotation speed displayed on LED is positive.

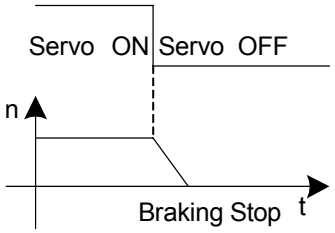
6.3 Braking Stop

During servo unit running, when the enable signal is OFF, PA119 selects whether the motor is stopped by brake or by mechanical friction.

Braking stop is a usual way to stop servo motor. The brake can consume the energy which is generated during motor stop. On the other hand, the reversed torque imposed on motor by servo unit can stop the motor in a very short time.

Nature stop is to stop the motor by mechanical friction. When the servo unit turns OFF the power of motor, the motor gradually stops by mechanical friction against motor rotation inertia.

<table>
<tr><th>Relevant Parameter</th><th>Name</th><th>Parameter Range</th><th>Default Value</th><th>Applicable Mode</th></tr>
<tr><td rowspan="2">PA119</td><td colspan="4">Stop mode selection</td><td>0～1</td><td>1</td><td>P, S</td></tr>
<tr><td colspan="5"><table>
<tr><td>PA119=0</td><td>Nature stop</td><td>  </td></tr>
</table></td></tr>
</table>

		PA119=1	Braking stop (stop duration is set by PA58)		

6.4 Testing in Position Mode

6.4.1 Electronic Gear Ratio of Position Command

"Electronic gear function" is a concept relative to mechanical speed-changing gear. When it is applied, the mechanical deceleration ratio and encoder line number can be ignored. It can set the motor rotation amount which corresponds to input command to arbitrary value.

Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA29	Position pulse command frequency multiplication coefficient		1～32767	1	P
PA30	Position pulse command frequency-division coefficient		1～32767	1	P

Through the setting of PA29, PA30, it is easy to match with different kinds of pulse source so as to obtain the ideal control resolution (i.e. mm/pulse).

Electronic gear ratio G=PA29/PA30

Load speed=Command pulse speed×G×Mechanical deceleration ratio

Load min. displacement= Minimum command pulse stroke × G × Mechanical deceleration ratio

When G is not 1, the result of gear ratio calculation may contain remainder, which means position deviation exists. The maximum deviation is the minimum rotation amount of the motor (minimum resolution).

The electronic gear ratio is G:

$$S = \frac{I}{\delta}\cdot\frac{CR}{CD}\cdot\frac{PA29}{PA30}\cdot\frac{L}{4C}\cdot\frac{ZD}{ZM}$$

$$\Rightarrow \quad G = \frac{PA29}{PA30} = \frac{4C}{L}\cdot\frac{ZM}{ZD}\cdot\frac{\delta}{I}\cdot\frac{CD}{CR}\cdot S$$

Range $\frac{1}{50} \le G \le 50$ is recommended;

C: Motor encoder line number;

L: Screw lead (mm);

ZM: Number of gear teeth on the screw side (applicable when deceleration box is applied);

ZD: Number of gear teeth on the motor side;

δ: Minimum output command unit (mm/pulse);

I: Commanded displacement（mm）;

S: Actual displacement（mm）;

CR: PC command frequency multiplication coefficient;

CD: PC command frequency division coefficient;

$$G = \frac{PA29}{PA30} = \frac{4\times1024}{6} \times 0.0005 = \frac{128}{375}$$

【Example】: For system 980TDb, motor is connected directly with X axis screw. The screw lead is 6mm, encoder line number is 1024, regardless the command frequency multiplication coefficient and frequency division coefficient, how to calculate the electronic gear ratio of servo unit?

Solution: Since the motor is connected directly with X axis, then ZM: ZD=1; usually, S=1, the commanded displacement equals to the actual displacement; the minimum output command unit of X axis is δ＝0.0005mm (radius programming), then:

$$G = \frac{PA29}{PA30} = \frac{4\times1024}{6} \times 0.0005 = \frac{128}{375}$$

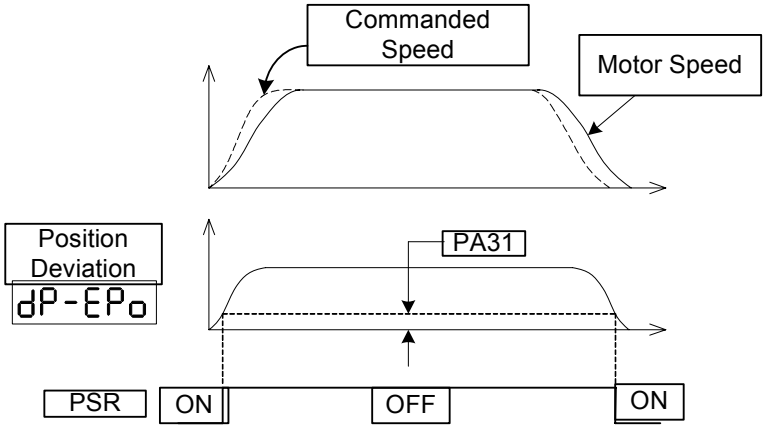
PA29 is 128, PA30 is 375.

6.4.2 Position Arrival Signal

PSR is position arrival signal in position mode.

When the remaining pulse in position deviation counter is less than or equal to the setting value of PA31, it is regarded that the position has been reached, and the output optical coupler of this signal conducts.

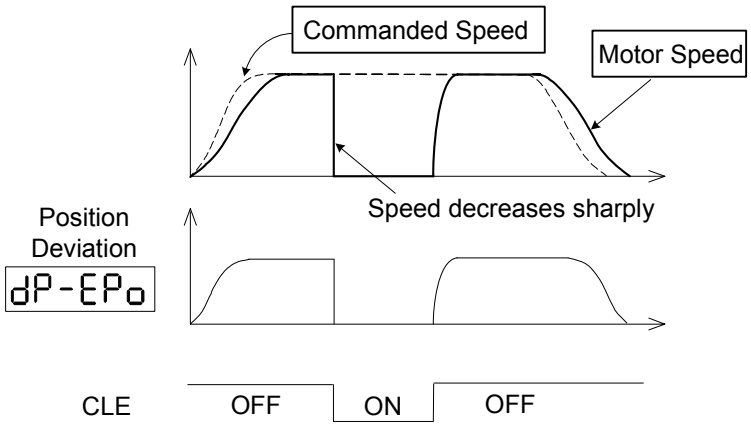
Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA31	Position arrival range	Pulse	0～30000	20	P
	When the remaining pulse in position deviation counter (DP-EPO in display menu) is less than or equal to the setting value of PA31, it is regarded that the position has been reached, and the position arrival signal PSR is ON, otherwise, it is OFF.				



Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA32	Position deviation range	×100 Pulse	0～999	400	P
	In position mode, when the value of position deviation counter exceeds the setting value of PA32, servo unit issues an alarm. (See Section 8.2 Err-4 for remedy).				

6.4.3 Position Deviation Clear

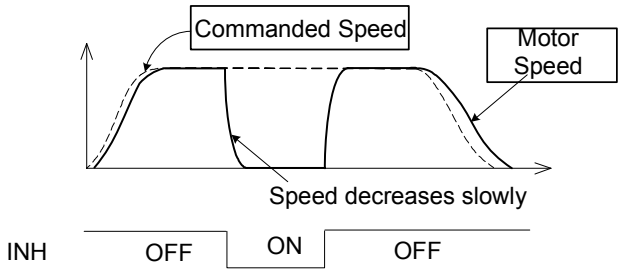
In position mode, the input point is position deviation clear signal (CLE); it is SEC1 in speed mode. When it is ON in position mode, the remaining pulse in position deviation counter is cleared, i.e. position following error is cleared.



In the figure above, when the position deviation clear is ON, the position following error is zero, which means there is no command in servo unit, and the motor speed decreases to 0.

6.4.4 Pulse Command Inhibition

In position mode, this input point is pulse command inhibition signal (INH); it is SEC2 in speed mode. When it is ON in position mode, the servo unit inhibits the receival of pulse command.



In the figure above, when the pulse command inhibition is ON, the position command is set to 0. The remaining pulse commands in the deviation counter are cleared after being executed, and then the speed decreases to 0. Comparing to the speed in position deviation clear, the speed drops slowly.

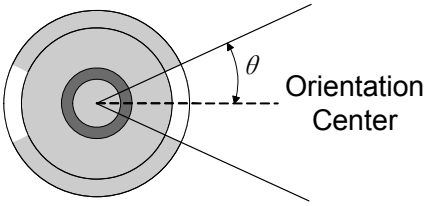
6.5 Testing in Speed Mode

6.5.1 Orientation Function

Orientation function: for the requirements of changing and measuring tools, it is necessary to perform orientation according to the feedback signal of motor encoder or the 2nd position encoder to precisely stop and maintains at the pre-stop position (the stop position of motor rotating shaft or spindle). Orientation includes single-point orientation and multi-point orientation.

Orientation precision: The maximum orientation deviation angle θ is used to indicate the orientation precision, shown as follows:

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



The orientation precision is ±θ.

C: Position feedback encoder line number;

4C: Orientation encoder pulse number after the frequency multiplying 4.

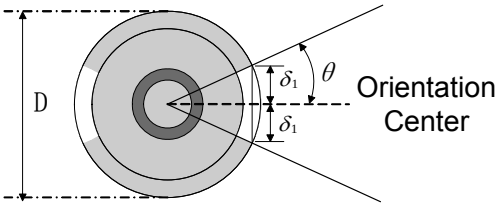
Therefore, when incremental encoder with 1024 line number is selected, the orientation precision is ±0.088°.

During actual orientation, being affected by mechanical transmission error, usually the orientation error is $\pm\frac{180°}{C}$.

During the orientation application, the arc length or chord length of the orientation axis which is connected to spindle motor can also be used to represent orientation precision. For example, in turning machine, external directional drilling on workpiece of round shape, and tool setting with the spindle in milling machine, the orientation precision not only related to motor (or spindle) encoder line

number, but also related to diameter. The formula is shown as follows:

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

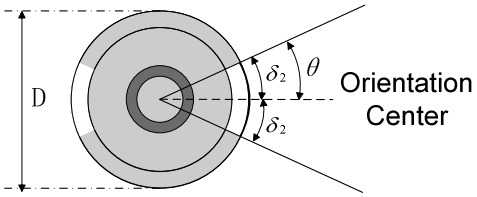


D: Orientation circle diameter

δ_1: Orientation precision represented by chord length

It can also be calculated by:

Formula 3—— $\delta_2 = \frac{\pi D}{4C}$



δ_2: Orientation precision represented by arc length

It is known from formula 2 and 3 that the orientation precision can be described as $\pm\delta_1$ or $\pm\delta_2$.

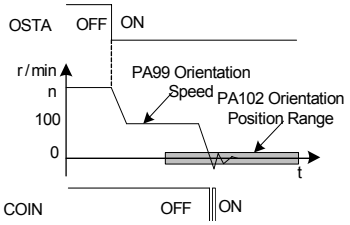
Example:

In the right figure, to drill a circular workpiece with 200 diameters, the orientation deviation should not be larger than 50μm, how much the line number of the encoder should be to meet the requirement?

Solution: To meet the requirement that the orientation deviation should not be larger than 50μm, the drive unit should ensure $\Delta\delta$ ≤25μm. By formula 3, we can conclude that:

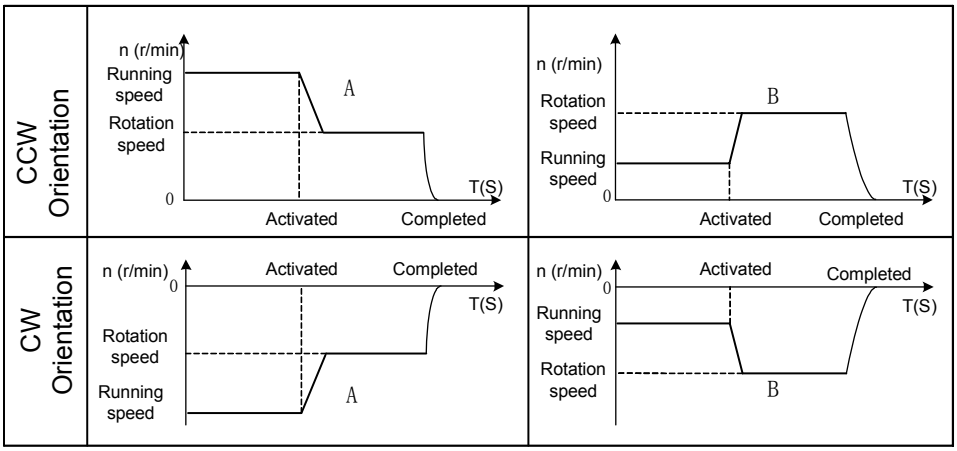
$$\Delta\delta \geq \frac{\pi D}{4C} \quad \Rightarrow \quad C \geq \frac{\pi D}{4\Delta\delta}$$

Then: C ≥ 6280; therefore, the encoder line number should be larger than or equal to 6280.

Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA99	Orientation speed	r/min	5～1000	100	S
PA102	Orientation position range	Pulse	0～100	2	S
	After the orientation function is activated, the position loop control is enabled. The motor rotates at the orientation speed and stops at the orientation position. However, a slight vibration may occur to the motor due to close-loop adjustment. If the vibration difference is within the orientation position range, it is assumed that the orientation is completed, then signal COIN is output, optical coupler conducts.  If this range is set too small, the orientation completed signal may be unstable due to motor				

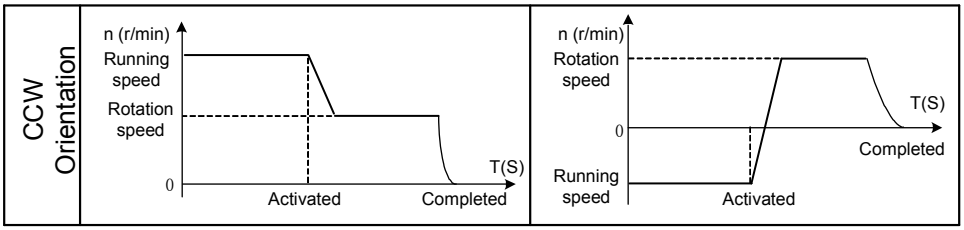
Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
	vibration, which may lead to the failure of orientation.				
PA100	Orientation direction selection	0～2	0		S

When PA100=0, motor CCW corresponds to the same orientation direction; motor CW corresponds to the same orientation direction;

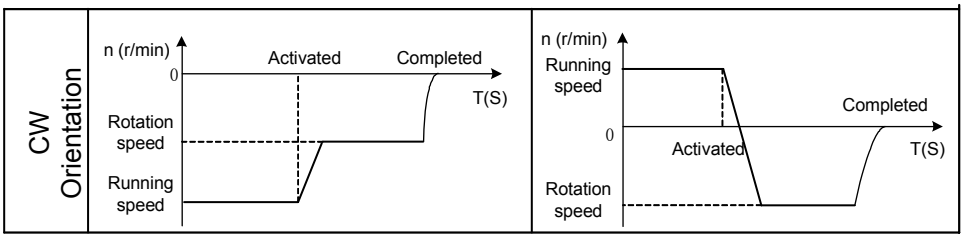


Note: Curve A means that when the running speed is larger than the orientation speed, motor decelerates to the orientation speed, and then decelerates to 0 after finding the orientation position, thus, orientation is completed. Likewise, curve B means that when the running speed is less than the orientation speed, the motor accelerates to the orientation speed, and then decelerates to 0 after finding the orientation position, thus orientation is completed.

When PA100=1, motor performs orientation in CCW direction at the orientation speed regardless the running direction.



When PA100=2, motor performs orientation in CW direction at the orientation speed regardless the running direction.



PA103, PA105, PA107, PA109.	Orientation position 1~4		0～30000	0	S

Parameters	Running Speed	I/O Status	
		SEC1（PA239=1）	SEC2（PA239=1）

Relevant Parameter	Name		Unit	Parameter Range	Default Value	Applicable Mode
	PA103	Orientation position 1		OFF		OFF
	PA105	Orientation position 2		ON		OFF
	PA107	Orientation position 3		OFF		ON
	PA109	Orientation position 4		ON		ON

The orientation position selection input point is not given by servo unit default value, i.e. orientation position 2, 3 and 4 are not selectable. Only single-point orientation can be performed. When multi-point orientation is needed, please contact technical personal of GSK.

- **When the motor encoder signal is taken as position feedback signal, the orientation process is shown as follows:**

1. Bring up monitoring menu dP-APo after power on; press ↵, E 0000 will be displayed. Symbol "E" indicates that the motor rotating shaft is at an uncertain position, and the value cannot be regarded as reference value.

2. The motor shaft should rotate at least one circle, then correct orientation position will be displayed after servo unit detects the Z pulse signal of encoder, and dP-APo will be changed to F 0000, indicating the current displayed position is correct.

The motor shaft can be rotated manually when the motor is not enabled, or by a low-speed command after it is enabled.

3. Make sure that the spindle servo unit enable is OFF, then, adjust the motor shaft or the connected spindle to a pre-set orientation point, and record the position displayed on dP-APo into parameter PA103 and dP-APo. into PA104. These two parameter values are the orientation positions.

4. Turn ON signal SON (in analog command speed mode, turn ON signal SFR at the same time), then, make sure the orientation signal OSTA keeps ON no matter whether the motor is running or not. The motor runs at the speed set by PA99, and stops at the orientation position after finding it. Meanwhile, the output optical coupler of orientation completed signal COIN conducts.

5. CNC system commands tool changing after receiving COIN. The orientation signal should be ON all the time during the process of tool changing. Other operations can be performed after this signal is OFF.

- **When the 2nd position input signal is taken as position feedback signal, the process is similar to the contents described above except the first 3 steps:**

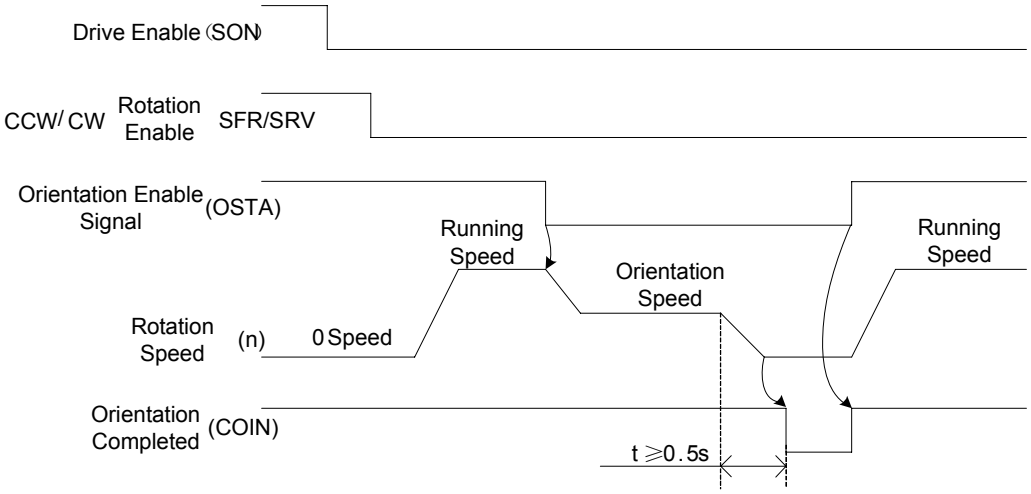
1. Bring up monitoring menu dP-SPo after power on; press ↵, E □□□□ will be displayed. Symbol “E” indicates that the motor rotating shaft is at an uncertain position, and the value cannot be regarded as reference value.

2. The motor shaft should rotate at least one circle, then correct orientation position will be displayed after servo unit detects the 2nd encoder position automatically, and dP-SPo will be changed to H □□□□, indicating the current displayed position is correct.

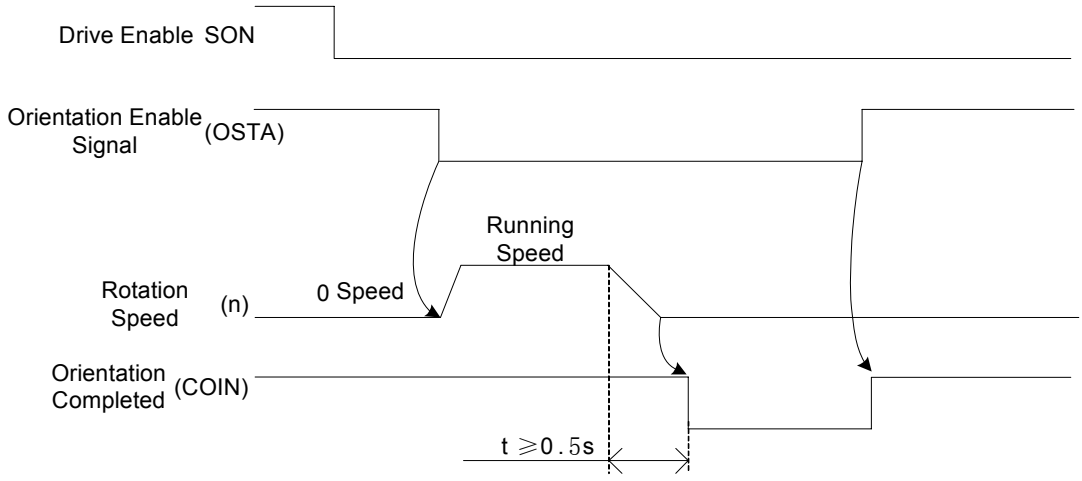
3. Make sure that the spindle servo unit enable is OFF, then, adjust the spindle to the orientation point, and record the position displayed on dP-SPo into parameter PA103 This parameter value is the orientation positions 1.

The whole orientation process sequence diagram is shown as follows:

- Spindle orientation sequence A (motor is running)

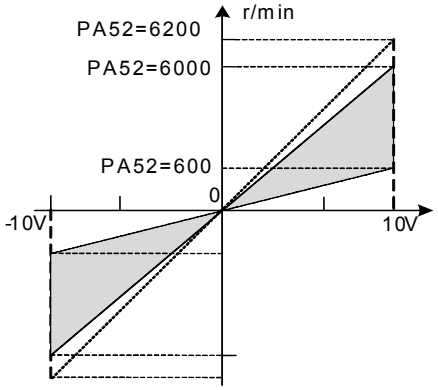
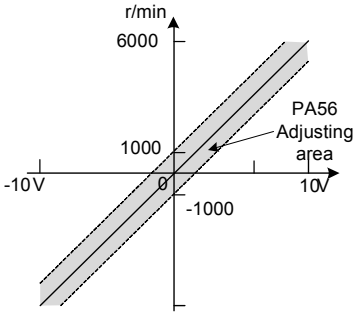


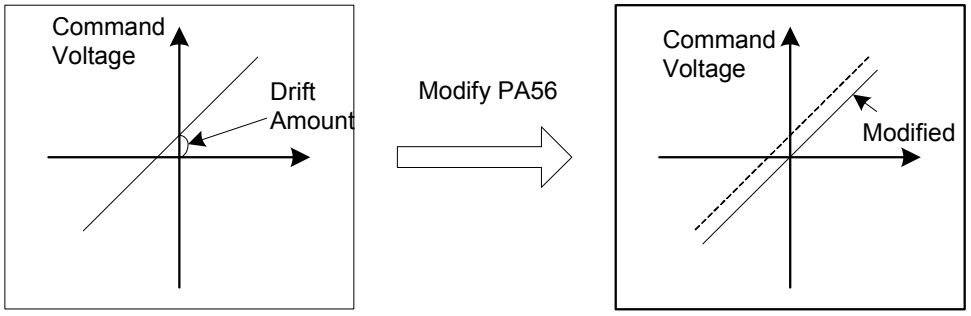
- Spindle orientation sequence A (motor is in free state or zero speed)



6.5.2 Adjustment of Analog Commands

The following three parameters are needed to be adjusted when the commanded speed is different with the actual rotation speed:

<table>
<tr><th>Relevant Parameter</th><th>Name</th><th>Parameter Range</th><th>Default Value</th><th>Applicable Mode</th></tr>
<tr><td rowspan="2">PA52</td><td>Servo analog command gain 1</td><td>0～15500</td><td>6000</td><td>S</td></tr>
<tr><td colspan="4">Set the voltage range of input command VCMD; the default setting is 10V corresponding to 6000r/min.
For example: if PA52=5000,
10V corresponds to 5000r/min,
5V corresponds to 2500r/min,
1V corresponds to 500r/min,
 
</td></tr>
<tr><td rowspan="2">PA56</td><td>Analog command zero-drift compensation</td><td>-1000～1000</td><td>0</td><td>S</td></tr>
<tr><td colspan="4">When the command voltage is 0V, the motor still rotates at slowest. This is due to the slight “drift” of the PC or external command voltage. If zero-drift phenomenon occurs on a motor, modify the drift value to 0V in PA56.
 

 
</td></tr>
</table>

The recommended adjustment sequence is:

1. Set the value of PA52; usually it is the maximum rotation speed of the motor.

2. Modify PA 56, change the “drift amount” to 0V to stop the motor.

3. Specify several speed commands respectively, such as 1000r/min, 3000r/min, 6000r/min, then, modify PA52 to decrease the difference according to the speed displayed on LED.

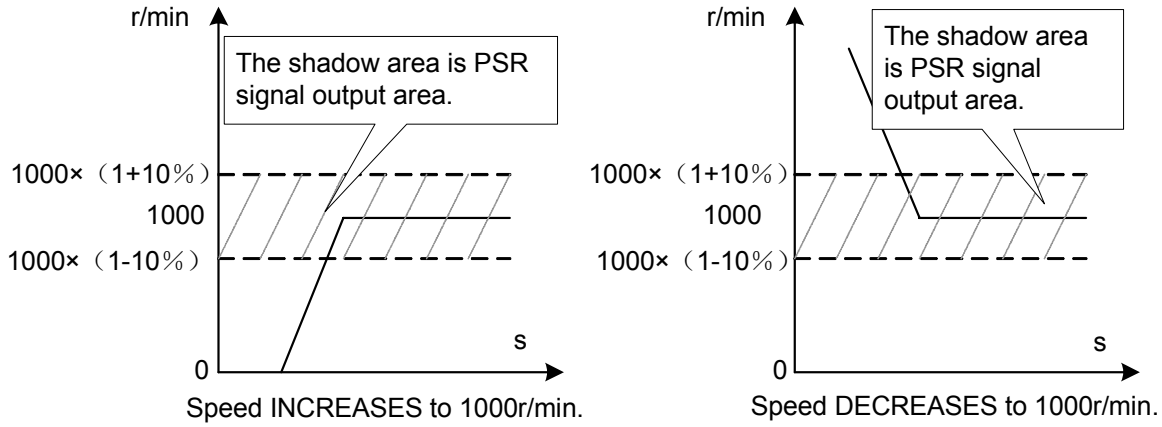
6.5.3 Speed Arrival Signal

PSR is speed arrival signal in speed mode.

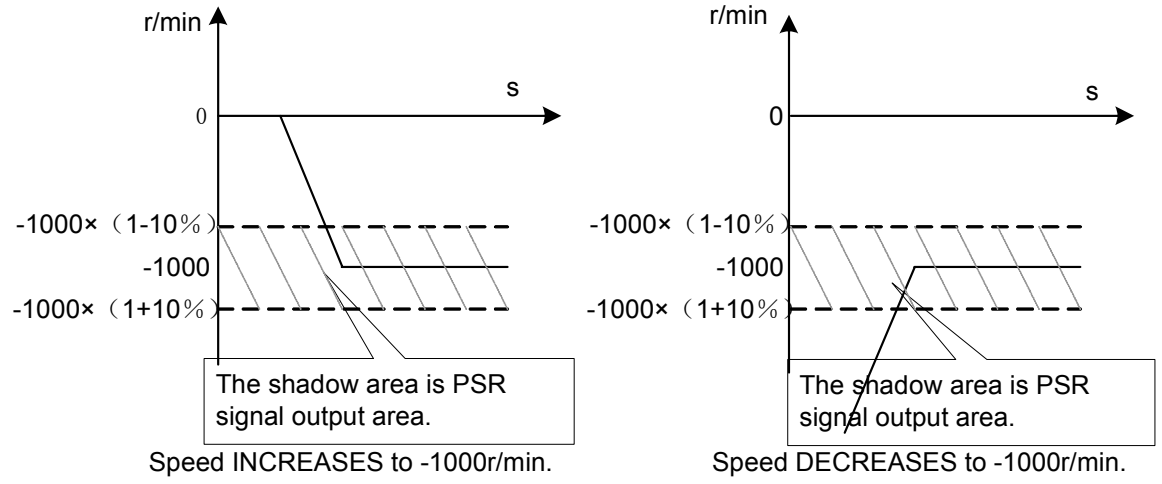
When actual speed=［commanded speed ×（100－PA61）%～commanded speed×（100＋PA61）%］, the output optical coupler of this signal conducts.

Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA61	Speed arrival range	%	1～100	10	S

For example: when PA61 is set to 10, it means 10% of commanded speed. When the commanded speed is 1000r/min, and the actual speed is increased or decreased to 900r/min～1100r/min, the speed arrival signal PSR is output, shown as follows:



The following figure shows the status when commanded speed is -1000r/min.



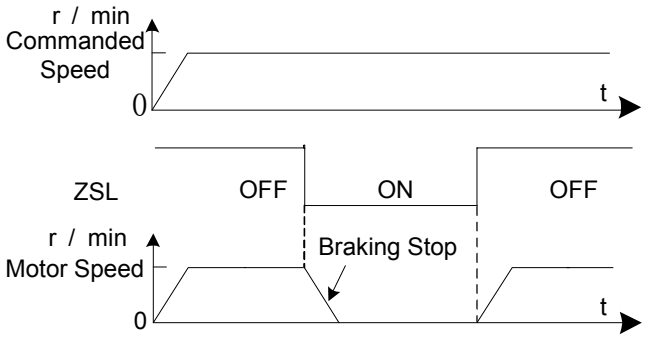
6.5.4 Zero Speed Clamp

When the analog voltage command is used to control servo unit, if the motor is needed to be stopped and become locked status even if the command voltage is not 0V, “Zero Speed Clamp” function can be used.

There are two ways to implement this function:

A. ZSL zero speed clamp input point control

In speed mode, when the analog voltage is not 0V (or the internal digital command is not 0 r/min), turn ON the ZSL, the motor will become locked status.

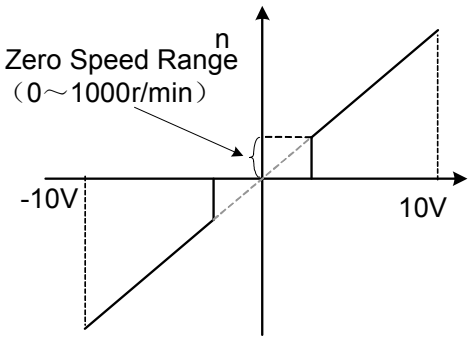


B. PA60 zero speed range control

Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA60	Analog command zero speed range	r/min	0～1000	0	S

① When the motor rotation speed corresponding to analog command voltage is less than or equal to the setting value, the motor shaft is clamped at zero speed.

② This range is absolute value and suitable for both positive and negative analog command voltage.



6.5.5 Speed Command Electronic Gear Ratio

"Speed Command Electronic Gear Ratio" function is to convert analog command value into the maximum command voltage (10V) by the setting of parameters, regardless the maximum command voltage given by PC.

Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA63	Analog command frequency-multiplication coefficient		1～32767	1	S
PA64	Analog command frequency-division coefficient		1～32767	1	S

Note: The recommended range for these two parameters are: 1~100.

Through the setting of PA63, PA64, it is easy to match with all kinds of analog voltage. When the given command voltage is not 10V, it can be changed into 10V through the setting of PA63, PA64.

【Example】: When the given analog voltage is 6V, how to set PA63 and PA64?

$$\frac{PA63}{PA64} = \frac{10V}{6V}, \text{ so } \frac{PA63}{PA64} = \frac{5}{3}.$$

Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA52	Motor rotation speed corresponding to 10V analog voltage	r/min	0～15500	6000	S

When the transmission ratio between motor axis and load axis is not 1:1, it is easy to know the setting of PA52 if maximum rotation speed of load axis corresponding to 10V is given.

【Example】: When the maximum spindle speed is 3000r/min, and the transmission ratio is 3:5, how to set PA52?

Solution: $PA52 = \frac{ZD}{ZM} \times$ Max. spindle speed

ZM: Number of gear teeth on the spindle side;

ZD: Number of gear teeth on the motor side;

Then,

$$PA52 = \frac{5}{3} \times 3000 = 5000$$

Therefore, PA52 should be set to 5000r/min.

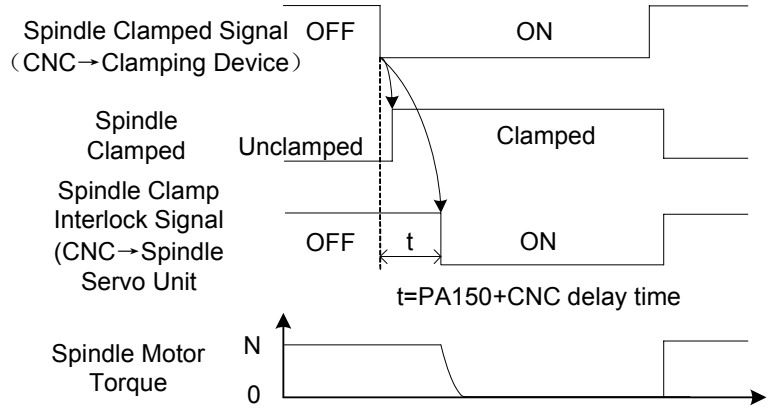
6.6 Spindle Clamp Interlock Signal (BREF)

Nowadays, to perform drilling and tapping on the external circle of a workpiece, a mechanical spindle clamp device is installed on spindle to ensure the precision and stability. Since the clamping force and spindle motor torque is contrary, it is necessary to use servo unit to reduce the motor torque when spindle is clamped. As for GS Series Spindle Servo Unit, signal BREF can be used to reduce the motor torque.

Relevant Parameter	Name	Unit	Parameter Range	Default Value	Applicable Mode
PA150	Spindle clamp interlock delay time	ms	0～32000	0	S, P
	Set the delay time for reducing motor torque after the spindle is clamped.				

Generally, PA150 setting value is 0. PA150 is set to other value only when parameter for clamping interlock delay time is not set in CNC system. The delay time is used because motor torque should be reduced after the spindle is completely clamped by mechanical device. Only in this way, can the spindle offset be avoided during clamping.

The following figure is the clamping sequence controlled by CNC.



After the machining is completed, the spindle clamp device releases. Turn OFF BREF signal, spindle will enter to position mode, and the spindle remains in the position when being clamped. If there is a slight drift when the clamping device releases, the spindle position will be back to the position when spindle is clamped after the BREF turns to OFF.

CHAPTER VII PARAMETERS

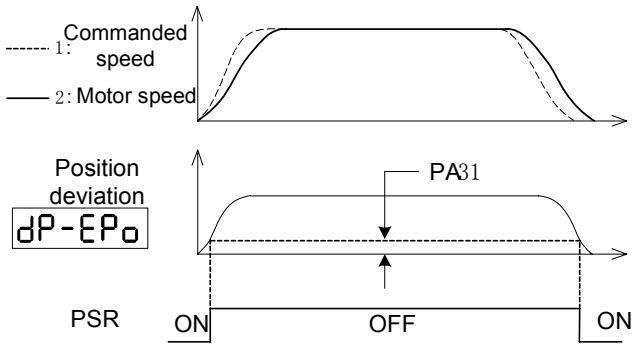
7.1 Parameter List

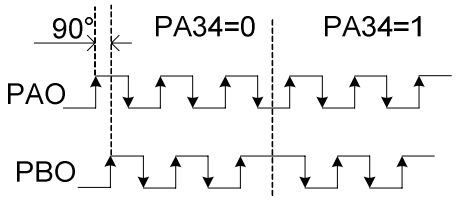
P: Position Control Mode S: Speed Control Mode

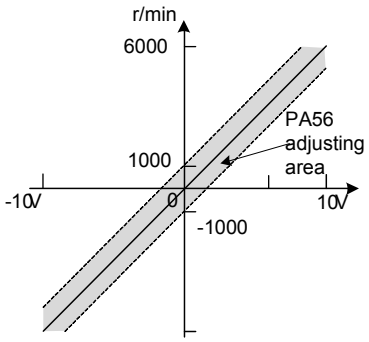
<table>
<tr><th>Relevant Parameter</th><th>Name</th><th>Range</th><th>Default Value</th><th>Unit</th><th>Applicable Mode</th></tr>
<tr><td rowspan="2">PA0</td><td>Password</td><td>0～9999</td><td>315</td><td></td><td>P, S</td></tr>
<tr><td colspan="5">When PA=315, parameters other than PA1, PA2 are modifiable; To modify PA1, it is needed to set PA0 to 385.</td></tr>
<tr><td rowspan="2">★PA1</td><td>Motor model code</td><td>500~530</td><td>500</td><td></td><td>P,S</td></tr>
<tr><td colspan="5">Set the model code of the drive motor according to Motor Model Code List (see APPENDIX A for details), then the default values of the motor can be restored.
The exfactory parameter is correctly set already. Do not modify this default value in general condition.</td></tr>
<tr><td rowspan="2">※PA3</td><td>Monitoring setting at initialization</td><td>0~35</td><td>0</td><td></td><td>P, S</td></tr>
<tr><td colspan="5">
<table>
<tr><th>Parameter Value</th><th>Monitoring setting at initialization</th><th>Instruction</th><th>Parameter Value</th><th>Monitoring setting at initialization</th><th>Instruction</th></tr>
<tr><td>PA3=0</td><td>dP-SPd</td><td>Motor speed</td><td>PA3=18</td><td>dP-Cod</td><td>Encoder feedback signal</td></tr>
<tr><td>PA3=1</td><td>dP-PoS</td><td>Current motor position low-order 5 digits (pulse)</td><td>PA3=19</td><td>dP-In</td><td>Input terminal status</td></tr>
<tr><td>PA3=2</td><td>dP-PoS.</td><td>Current motor position high-order 5 digits ×100000 (pulse)</td><td>PA3=20</td><td>dP-oUt</td><td>Output terminal status</td></tr>
<tr><td>PA3=3</td><td>dP-CPo</td><td>Position command low-order 5 digits (pulse)</td><td>PA3=21</td><td>dP-PLd</td><td>Reserved</td></tr>
<tr><td>PA3=4</td><td>dP-CPo.</td><td>Position command high-order 5 digits ×100000 (pulse)</td><td>PA3=22</td><td>dP-CPL</td><td>Hardware version No.</td></tr>
<tr><td>PA3=5</td><td>dP-EPo</td><td>Position deviation low-order 5 digits (pulse)</td><td>PA3=23</td><td>dP-dSP</td><td>Software version No.</td></tr>
<tr><td>PA3=6</td><td>dP-EPo.</td><td>Position deviation high-order 5 digits ×100000 (pulse)</td><td>PA3=24</td><td>dP-SPo</td><td>Absolute position low order digits of the 2nd encoder</td></tr>
<tr><td>PA3=7</td><td>dP-I</td><td>Motor current</td><td>PA3=25</td><td>dP-SPo.</td><td>Absolute position high order digits of the 2nd encoder</td></tr>
</table>
</td></tr>
</table>

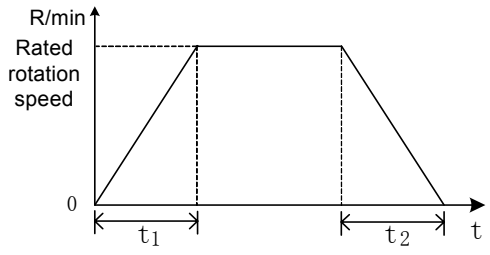
Relevant Parameter	Name		Range		Default Value	Unit	Applicable Mode
	PA3=8	dP-ouC	Rotation speed corresponding to analog command	PA3=26	dP-APo		Absolute position low order digits of the 1st encoder
	PA3=9	dP- CS	Speed command	PA3=27	dP-APo.		Absolute position high order digits of the 1st encoder
	PA3=10	dP-Fr9	Position command pulse frequency	PA3=28	dP-SAS		Reserved
	PA3=11	dP- Ct	Torque command	PA3=29	dP-SAS.		Reserved
	PA3=12	dP-tr9	Motor torque	PA3=30	dP-HAS		Reserved
	PA3=13	dP-tEP	Radiator temperature	PA3=31	dP-HAS.		Reserved
	PA3=14	dP- tH	Servo motor temperature	PA3=32	dP-Ab5		Reserved
	PA3=15	dP-dC	DC bus voltage	PA3=33	dP-Ab5.		Reserved
	PA3=16	dP-Err	Alarm display	PA3=34	dP-Hb5		Reserved
	PA3=17	dP-rn	Servo unit working status	PA3=35	dP-Hb5.		Reserved
PA4	Working mode selection		0~10		1		P, S
	PA4=0: Position mode; Digital pulses determine the rotation direction and angle. The servo unit makes the rotor rotate in the determined direction and at specified angle. In position mode, the rotation angle (position) and speed are controllable. PA4=1: Speed mode; The rotation direction and speed are determined by the analog voltage or parameters. The servo unit makes the rotor rotate in the determined direction and speed. This mode not only improves the motor response capability, but also enhances the capability of anti-disturbance. PA4=2: *（Reserved）* PA4=3: Speed/position; To switch between speed and position control through input signal. PA4=4: *（Reserved）* PA4=5: *（Reserved）* PA4=6: *（Reserved）* PA4=7: *（Reserved）* PA4=8: *（Reserved）* PA4=9: Manual mode It is operated in Sr— menu. Acceleration/deceleration can be performed through keys ▲ or ▼. PA4=10: JOG mode; It is operated in Jr—menu. The motor works at the JOG speed set by parameter. CCW/ CW rotation can be selected through keys ▲ or ▼.						
PA5	Position command mode selection		0~2		0		P, S
	PA5=0: Pulse + Direction						

Relevant Parameter	Name	Range	Default Value	Unit	Applicable Mode
	PA5=1: CCW/CW PA5=2: two-phase orthogonal input （Refer to Section 3.4.2 Input Command Instructions for details）				
PA6	Speed command mode selection	0~2	0		P, S
	PA6=0: －10V～＋10V analog voltage (Refer to Section 3.4.2 Input Command Instructions for details); PA6=1: 0～＋10V analog voltage (Refer to Section 3.4.2 Input Command Instructions for details); PA6=2: Internal speed (Refer to Section 3.4.2 Input Command Instructions for details);				
PA11	Communication mode selection	0~6	0		P
	PA11=0: No communication PA11=1: GSK-CAN communication PA11=2: GSK—LINK (Reserved) PA11=3: Ethercat (Reserved) PA11=4: (Reserved) PA11=5: (Reserved) PA11=6: RS232 (Reserved)				
★PA15	Speed loop proportional gain 1	10~3000	700	Hz	P,S
	The bigger the speed loop proportional gain, the greater the servo rigidity is. However, excessive value may easily lead to vibration (abnormal sound in the motor) during motor start or stop. The smaller the value is the slower response is. A recommended way for adjusting is to perform coarse adjustment at first (increase or decrease the default value by 50), then make fine adjustment (increase or decrease the value by 5), till the motor runs steadily.				
★PA16	Speed loop integral time coefficient 1	1~3000	2		P,S
	The greater the speed loop integral time constant value is, the quicker the system responds. However, excessive value may lead to instability of the system, or even cause vibration. Smaller value results in slower response, so, set the value as great as possible on condition that no vibration is generated. A recommended way for adjusting is to perform coarse adjustment at first (increase or decrease the default value by 5), then make fine adjustment (increase or decrease the value by 1), till the motor runs steadily.				
★PA17	Current command low pass filter (reserved)		0		P,S
	It is used to limit the current command belt, and avoid current rush and vibration. Set the value as great as possible on condition that on vibration is generated.				
★PA18	Speed feedback filter coefficient	50~1000	100		P,S
	The greater the speed feedback filter coefficient is, the quicker the speed feedback responds. However, excessive value may lead to electromagnetic noise. Smaller value results in slower response, larger speed fluctuation, or even vibration. A recommended way for adjusting is to perform coarse adjustment at first (increase or decrease the default value by 50), then make fine adjustment (increase or decrease the value by 10), till the motor runs steadily.				
★PA19	Position loop proportional gain 1	20~1000	40		P
	The greater the position loop proportional gain is, the quicker the response is and the greater the rigidity is. However, excessive value may lead to vibration during the motor start or stop. Smaller				

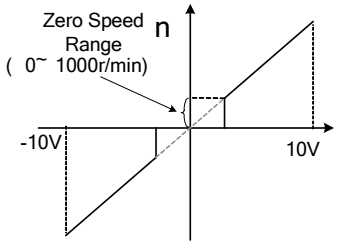
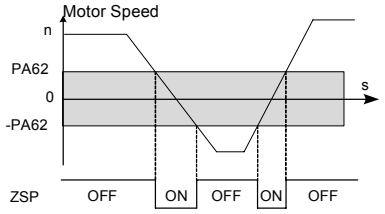
<table>
<tr><th>Relevant Parameter</th><th>Name</th><th>Range</th><th>Default Value</th><th>Unit</th><th>Applicable Mode</th></tr>
<tr><td></td><td colspan="5">value results in slower response and greater following error.
A recommended way for adjusting is to perform coarse adjustment at first (increase or decrease the default value by 10), then make fine adjustment (increase or decrease the value by 2), till the motor runs steadily.</td></tr>
<tr><td rowspan="2">PA23</td><td>Position loop proportional gain 3</td><td>20~1000</td><td>36</td><td></td><td>P</td></tr>
<tr><td colspan="5">When signal OSTA or PSTI is ON, parameter PA23 is enabled and PA19 is disabled.
The adjustment method is the same with PA19. The greater the position loop proportional gain is, the quicker the response is and the greater the rigidity is. However, excessive value may lead to vibration during the motor start or stop. Smaller value results in slower response and greater following error.</td></tr>
<tr><td rowspan="2">PA25</td><td>Position loop feedforward gain</td><td>0~100</td><td>0</td><td>%</td><td>P</td></tr>
<tr><td colspan="5">Position loop feedforward gain is to adjust the speed loop according to the speed information of position command. The greater the value is, the quicker the response is, and the smaller the following error is. However, excessive setting value may lead to instantaneous overshoot and vibration. When PA25 is set to 0, the position feedforward function is invalid.</td></tr>
<tr><td rowspan="2">PA26</td><td>Position loop feedforward filter coefficient</td><td>1~1200</td><td>300</td><td>Hz</td><td>P</td></tr>
<tr><td colspan="5">Position loop feedforward filter coefficient is used in the smoothing process of position command feedforward control. The greater the value is, the quicker the step response is, which will suppress the overshoot and vibration caused by sudden speed change. It is valid when PA25 is not set to 0.</td></tr>
<tr><td rowspan="2">PA28</td><td>Position command direction reversed</td><td>0~1</td><td>0</td><td>0</td><td>P</td></tr>
<tr><td colspan="5">PA28＝0: remains the original commanded direction;
PA28＝1: the input pulse direction is reversed.</td></tr>
<tr><td rowspan="2">PA29</td><td>Numerate of electronic gear ratio</td><td>1~32767</td><td>1</td><td></td><td>P</td></tr>
<tr><td colspan="5">（Refer to Section 6.4.1 Electronic Gear Ratio for details）</td></tr>
<tr><td rowspan="2">PA30</td><td>Denominator of electronic gear ratio</td><td>1~32767</td><td>1</td><td></td><td>P</td></tr>
<tr><td colspan="5">（Refer to Section 6.4.1 Electronic Gear Ratio for details）</td></tr>
<tr><td rowspan="2">PA31</td><td>Position arrival range</td><td>0~30000</td><td>20</td><td>Pulse</td><td></td></tr>
<tr><td colspan="5">When the position following error (displayed as DP-EPO in the menu) is less than or equal to the setting value of PA31, it means the position is reached, and position arrival signal COIN outputs ON, otherwise, COIN outputs OFF.
 
</td></tr>
<tr><td rowspan="2">PA32</td><td>Position deviation range</td><td>0~999</td><td>400</td><td>×100 pulse</td><td>P</td></tr>
<tr><td colspan="5">In position model, when the position following error exceeds the value set by parameter PA32, an alarm is generated. （Refer to Section 8.2 Err-4 for remedy）</td></tr>
</table>

Relevant Parameter	Name	Range	Default Value	Unit	Applicable Mode
PA33	Position feedback output	0~1	0		P, S
	PA33=0, select the motor encoder signal as the position output signal; PA33=1, select the 2nd position input signal as the position output signal. If the CN3 does not connect with the 2nd position encoder feedback signal at this time, Err-24 occurs.				
PA34	Position feedback output inverted	0~1	0	%	P, S
	PA34=0: maintain the original PAO, PBO phase relationship of CN1 position feedback output signal; PA34=1: invert the relationship between phases PA, PB of position feedback output signal. Shown is the following figure:  				
PA35	Line numbers for position feedback output (reserved)		0		
★PA45	Speed loop proportional gain 2	10~3000	700	Hz	S
	It is valid when GAIN is ON and its functions are the same with PA15. Usually, it is used for rigid tapping.				
★PA46	Speed loop integral time coefficient 2	1~3000	5		S
	It is valid when GAIN is ON and its functions are the same with PA16. Usually, it is used for rigid tapping.				
★PA48	Speed loop proportional gain 3	10~3000	690	Hz	S
	It is valid when OSTA（or PSTI）is ON and its functions are the same with PA15. Usually, it is used for spindle orientation.				
★PA49	Speed loop integral time coefficient 3	1~3000	1		S
	It is valid when OSTA（or PSTI）is ON and its functions are the same with PA16. Usually, it is used for spindle orientation.				
PA51	When the analog speed command is valid, the motor rotation direction is reversed	0~1	0		S
	When external analog voltage range is -10V~10V (PA6=0): PA51=0: Positive voltage corresponds to motor CCW rotation, negative voltage corresponds to motor CW rotation. PA51=1: Negative voltage corresponds to motor CCW rotation, positive voltage corresponds to motor CW rotation. When external analog voltage range is 0V~10V (PA6=1): PA51=0: SFR is ON, motor performs CCW rotation, SRV is ON, motor performs CW rotation; PA51=1: SFR is ON, motor performs CW rotation, SRV is ON, motor performs CCW rotation.				
★PA52	Servo analog command gain 1	0~15500	6000	r/min	S

<table>
<tr><th>Relevant Parameter</th><th>Name</th><th>Range</th><th>Default Value</th><th>Unit</th><th>Applicable Mode</th></tr>
<tr><td></td><td colspan="5">Set the motor rotation speed corresponding to 10V analog voltage. When the rated rotation speed corresponding to 10V is 6000r/min, this value is set to 6000.</td></tr>
<tr><td rowspan="2">★PA53</td><td>Servo analog command gain 2</td><td>0~15500</td><td>6000</td><td>r/min</td><td>S</td></tr>
<tr><td colspan="5">It is valid when GAIN is ON.
Set the motor rotation speed corresponding to 10V analog voltage. When the rated rotation speed corresponding to 10V is6000r/min, this value is set to 6000.</td></tr>
<tr><td rowspan="2">★PA54</td><td>Maximum speed limit</td><td>0~15500</td><td>6000</td><td>r/min</td><td>P, S</td></tr>
<tr><td colspan="5">The maximum speed of motor is limited by PA54.</td></tr>
<tr><td rowspan="2">PA55</td><td>Analog speed command filter coefficient</td><td>1~600</td><td>100</td><td></td><td>S</td></tr>
<tr><td colspan="5">The smaller the analog command filter coefficient value is, the stronger the anti-disturbance capability is. However, when the value is too small, the response to the speed command will be slower; the greater the value is, the weaker the anti-disturbance capability is, and the quicker the response is.</td></tr>
<tr><td rowspan="2">PA56</td><td>Analog command zero-drift compensation</td><td>-1000~1000</td><td>0</td><td>r/min</td><td></td></tr>
<tr><td colspan="5"> 

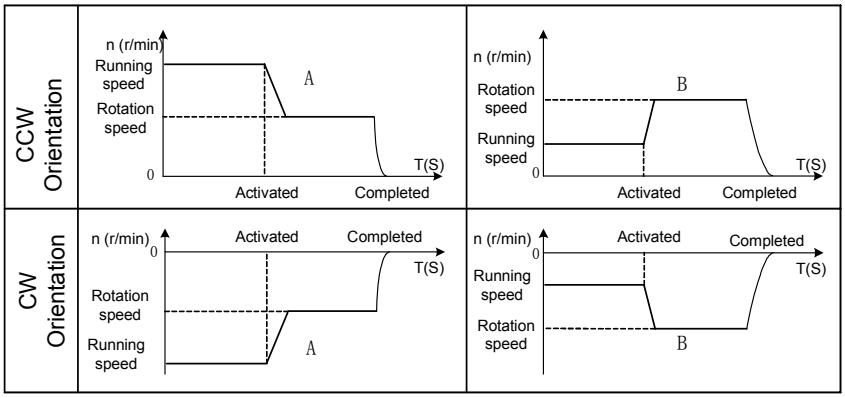
Sometimes, when the command voltage is 0V, the motor still rotates at slowest. This is due to the slight “drift” of the PC or external command voltage. If zero-drift phenomenon occurs on a motor, modify the drift value to 0V in PA56.</td></tr>
<tr><td rowspan="2">★PA57</td><td>Linear acceleration time constant</td><td>1~10000</td><td>50</td><td>ms</td><td>S</td></tr>
<tr><td colspan="5"> 

Acceleration/deceleration time constant is valid only in speed mode.
Acceleration time is the time from zero speed to rated speed (t1 in the figure)
Deceleration time is the time from rated speed to zero speed (t2 in the figure)
The actual acceleration time=commanded speed/rated rotation speed×PA57;
The actual deceleration time=commanded speed/rated rotation speed×PA58;
Note: When the time is set too small, the actual acceleration/deceleration will be affected by the servo capacity, and the time will be longer than the setting value.</td></tr>
<tr><td>★PA58</td><td>Linear deceleration time constant (see PA57 for details)</td><td>0~10000</td><td>100</td><td>ms</td><td>S</td></tr>
</table>

<table>
<tr><th>Relevant Parameter</th><th>Name</th><th>Range</th><th>Default Value</th><th>Unit</th><th>Applicable Mode</th></tr>
<tr><td>PA59</td><td>S acceleration/deceleration time constant (reserved)</td><td></td><td>0</td><td></td><td></td></tr>
<tr><td rowspan="2">PA60</td><td>Analog command zero speed range</td><td>0～1000</td><td>0</td><td>r/min</td><td>S</td></tr>
<tr><td colspan="5">When the rotation speed corresponding to analog command voltage is less than or equal to the setting values in this range, the rotation speed is fixed at zero speed.
This range is absolute value and suitable for both positive and negative analog command voltage.
  </td></tr>
<tr><td rowspan="2">PA61</td><td>Valid range of speed arrival</td><td>1～100</td><td>10</td><td>%</td><td>S</td></tr>
<tr><td colspan="5">In speed mode, when the actual speed=［commanded speed ×（100－PA61）%～ commanded speed×（100＋PA61）%］, corresponding optical coupler conducts when signal PSR is output. (see Section 6.5.3 for details)</td></tr>
<tr><td rowspan="2">PA62</td><td>Valid range of zero speed output</td><td>0~100</td><td>10</td><td>r/min</td><td>P, S</td></tr>
<tr><td colspan="5">When the actual rotation speed is less than or equal to the valid rang, corresponding optical coupler conducts when signal ZSP is output.
  </td></tr>
<tr><td>PA63</td><td>Analog command multiplying ratio (see PA64)</td><td>1～32767</td><td>1</td><td></td><td>S</td></tr>
<tr><td rowspan="2">PA64</td><td>Analog command frequency division ratio</td><td>1～32767</td><td>1</td><td></td><td>S</td></tr>
<tr><td colspan="5">Through the setting of PA63, PA64, it would be easily to match with various analog command voltage sources. For example, if the given maximum command voltage for the PC is not 10V, it could be converted to 10V through the setting of PA63, PA64.
For example: the maximum command voltage is 6V
Then: $\frac{PA63}{PA64} \times 6V = 10V$, which lead to: $\frac{PA63}{PA64} = \frac{5}{3}$.</td></tr>
<tr><td>PA65</td><td>Speed feedback input selection (reserved)</td><td>0～1</td><td>0</td><td></td><td></td></tr>
<tr><td rowspan="2">PA89</td><td>Switching method between position mode and speed mode</td><td>0～1</td><td>0</td><td></td><td>P/S</td></tr>
<tr><td colspan="5">In speed/position mode, the process of switching between position mode to speed mode is:
PA89=0: When PSTI signal is OFF, switch to speed mode after the completion of position commands.
PA89=1: When PSTI signal is OFF, switch to speed mode no matter the position commands are completed or not.</td></tr>
<tr><td>PA90</td><td>Low-order digits of speed/position switching reference point (see PA91)</td><td>0～30000</td><td>0</td><td></td><td>P/S</td></tr>
<tr><td rowspan="2">PA91</td><td>High-order digits of speed/position switching reference point</td><td>0～30000</td><td>0</td><td></td><td>P/S</td></tr>
<tr><td colspan="5">When the servo unit is switched from the speed control mode to position control mode, it rotates at the speed set by PA99 and stops at the reference point set by PA90, PA91, then waits for position command.　(for more details, please refer to Section 5.4 speed/position mode)</td></tr>
</table>

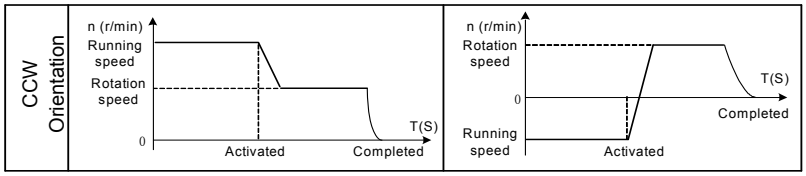
Relevant Parameter	Name	Range	Default Value	Unit	Applicable Mode
PA92	Position arrival range in switching mode (reserved)		0		
※PA97	Position feedback input signal selection	0～1	1		P, S
	PA97=1: Select motor encoder signal as the position feedback input signal PA97=0: Select the 2nd position input signal as the position feedback input signal. However, if the CN3 is not connected to the 2nd position encoder feedback signal port, Err-24 will occur.				
PA98	Second position encoder line numbers	100~8000	1024		P, S
PA99	Orientation speed	10～1000	100	r/min	S
	When the spindle motor performs orientation, it rotates at this speed, and then to the orientation position after the acquisition of encoder Z pulse.				
PA100	Orientation direction selection	0～2	0		S

When PA100=0, motor CCW corresponds to the same orientation direction; motor CW corresponds to the same orientation direction;

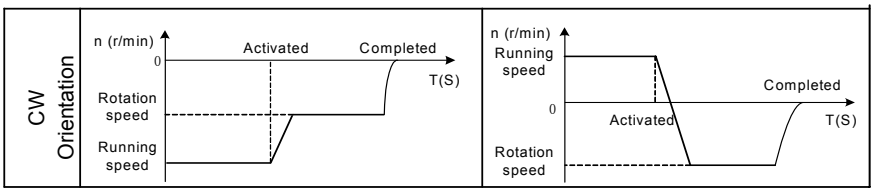


Note: Curve A means that when the running speed is larger than the orientation speed, motor decelerates to the orientation speed, and then decelerates to 0 after finding the orientation position, thus, orientation is completed. Likewise, curve B means that when the running speed is less than the orientation speed, the motor accelerates to the orientation speed, and then decelerates to 0 after finding the orientation position, thus orientation is completed.

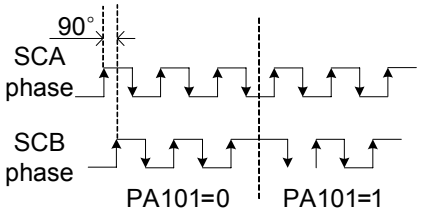
When PA100=1, motor performs orientation in CCW direction at the orientation speed regardless the running direction.

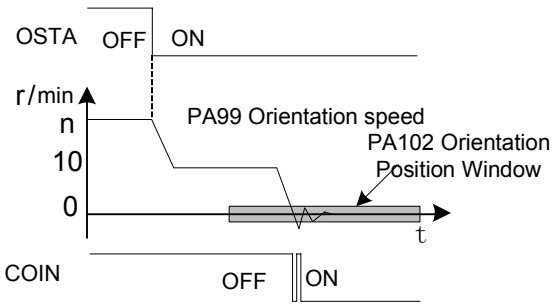


When PA100=2, motor performs orientation in CW direction at the orientation speed regardless the running direction.



Relevant Parameter	Name	Range	Default Value	Unit	Applicable Mode
PA101	Second position feedback input signal inverted	0～1	0		P, S
	PA101=0: Maintains the phase relationship between SCA and SCB of the second position input signal. PA101=1: inverts the SCA, SCB phase relationship				
PA102	Orientation position window	0～100	2	pulse	S
	After the orientation function is activated, the position loop control is enabled. The motor rotates at the orientation speed and stops at the orientation position. However, a slight vibration may occur on the motor due to close-loop adjustment. If the vibration difference is within the orientation window, it is assumed that the orientation is completed, then signal COIN (CN1-21) is output, optical coupler conducts.				
PA103 ～ PA110	Low-order digits of orientation position	0~30000	0	Pulse	S
	High-order digits of orientation position	0~30000	0	Pulse	S
	Set four orientation positions. If the position value does not exceed the low-order digits, high-order digits are not necessary to set. When the orientation is performed according to motor encoder signal, the low-order/high-order digits are set according to DP-APO; when the orientation is performed according to the second encoder signal, the low-order/high-order digits are set according to DP-SPO.				





If this range is set too small, the orientation completed signal may be unstable due to motor vibration, which may lead to the failure of orientation.

Orientation position parameter	Running speed	SEC1	SEC2
PA103	Low-order of orientation position 1	OFF	OFF
PA104	High-order of orientation position 1		
PA105	Low-order of orientation position 2	ON	OFF
PA106	High-order of orientation position 2		
PA107	Low-order of orientation position 3	OFF	ON
PA108	High-order of orientation position 3		

<table>
<tr><th>Relevant Parameter</th><th>Name</th><th>Range</th><th>Default Value</th><th>Unit</th><th>Applicable Mode</th></tr>
<tr><td></td><td colspan="5"><table>
<tr><td>PA109</td><td>Low-order of orientation position 4</td><td rowspan="2">ON</td><td rowspan="2">ON</td></tr>
<tr><td>PA110</td><td>High-order of orientation position 4</td></tr>
</table></td></tr>
<tr><td rowspan="2">PA118</td><td>Internal compulsive enable</td><td>0～1</td><td>0</td><td></td><td>P, S</td></tr>
<tr><td colspan="5">In case there is no SON input signal, the motor is enabled in servo unit compulsively.
PA118=0: The motor is enabled only when the external input signal SON is on.
PA118=1: The motor is enabled in the servo unit compulsively; signal SON is not needed.</td></tr>
<tr><td rowspan="2">PA119</td><td>Stop mode selection</td><td>0～1</td><td>1</td><td></td><td>P, S</td></tr>
<tr><td colspan="5">PA119=0: The motor stops naturally by mechanical friction;
PA119＝1: motor stops by brake (stop time is set by PA58);</td></tr>
<tr><td rowspan="2">PA120</td><td>Motor enable range</td><td>0～32000</td><td>10</td><td></td><td>P, S</td></tr>
<tr><td colspan="5">When the motor rotation speed is less than the setting range, the servo unit disables the motor, and the motor is in static state.</td></tr>
<tr><td rowspan="2">※PA121</td><td>Maximum speed selection</td><td>1～5</td><td>2</td><td></td><td>P, S</td></tr>
<tr><td colspan="5">PA121=1: The maximum speed is within the range 0～3100 r/min;
PA121=2: The maximum speed is within the range 0～6200 r/min;
PA121=3: The maximum speed is within the range 0～9300 r/min;
PA121=4: The maximum speed is within the range 0～12400 r/min;
PA121=5: The maximum speed is within the range 0～15500 r/min;</td></tr>
<tr><td rowspan="2">PA122</td><td>Alarm output inverted</td><td>0～1</td><td>0</td><td></td><td>P, S</td></tr>
<tr><td colspan="5">PA122=0: When a servo unit alarm is generated, ALM signal is output and optical coupler conducts.
PA122=1: When a servo unit alarm is generated, ALM signal is output and optical coupler does not conduct.</td></tr>
<tr><td rowspan="2">PA123</td><td>Refresh frequency of current display</td><td>2～100</td><td>15</td><td></td><td>P, S</td></tr>
<tr><td colspan="5">It sets the refresh frequency of motor current display dP-1; the larger the setting value is, more real the displayed current will be. However, the current value may vary from time to time, it is hard to read the exact value.</td></tr>
<tr><td rowspan="2">PA124</td><td>JOG running speed</td><td>－6000～6000</td><td>300</td><td>r/min</td><td>S</td></tr>
<tr><td colspan="5">It sets the running speed in JOG mode. The running mode is set by PA4.</td></tr>
<tr><td rowspan="2">PA126
～PA128</td><td>Inner speed 1~3</td><td>-20000~20000</td><td>1000</td><td>r/min</td><td>S</td></tr>
<tr><td colspan="5"><table>
<tr><td rowspan="2">Default value of digit command</td><td rowspan="2">Running speed</td><td colspan="2">Select the I/O state of speed</td></tr>
<tr><td>SEC1</td><td>SEC2</td></tr>
<tr><td></td><td>0 r/min</td><td>OFF</td><td>OFF</td></tr>
<tr><td>PA126＝1000</td><td>Inner speed 1</td><td>ON</td><td>OFF</td></tr>
<tr><td>PA127＝-500</td><td>Inner speed 2</td><td>OFF</td><td>ON</td></tr>
<tr><td>PA128＝2000</td><td>Inner speed 3</td><td>ON</td><td>ON</td></tr>
</table></td></tr>
<tr><td rowspan="2">PA137</td><td>Validity of position excess error</td><td>0～1</td><td>1</td><td></td><td>P</td></tr>
<tr><td colspan="5">PA137=0: Does not check for position excess-error alarm;</td></tr>
</table>

Relevant Parameter	Name	Range	Default Value	Unit	Applicable Mode
	PA137=1: Checks for position excess-error alarm				
PA139	Validity of open-phase alarm	0～1	1		P, S
	PA139=0: Does not check for input power R, S, T open-phase alarm; PA139=1: Checks for input power R, S, T open-phase alarm.				
PA140	Validity of under-voltage alarm	0～1	1		P, S
	PA140=0: Does not check for DC bus under-voltage alarm; PA140=1: Checks for DC bus under-voltage alarm.				
PA141	Validity of encoder alarm	0～1	1		P, S
	PA141=0: Does not check for CN2 encoder fault; PA141=1: Checks for CN2 encoder fault.				
PA142	Validity of charging failure alarm	0～1	1		P, S
	PA142=0: Does not check for input power charging failure; PA142=1: Checks for input power charging failure;				
PA143	Braking duration	10～32000	800	0.1ms	
	Factory-set parameter! Do not change it!				
PA145	Overload duration	6000～32000	12050	0.1ms	
	Factory-set parameter! Do not change it!				
PA146	Speed regulator saturation overtime alarm	0～32000	3000	5ms	
	Factory-set parameter! Do not change it!				
PA150	Delay time of spindle interlock clamping	0～32000	0	ms	
	It sets the delay time after spindle being clamped and motor torque being reduced.				
PA151	Digit input filtering time	0～200	3	ms	
	It sets the filtering time for digit signal of CN1 interface. When a signal width is less than the one set by PA151, the servo unit leaves it untreated.				
PA155	GSK-CAN communication baudrate selection	1～4	1		P,S
	PA155=1: baudrate is set to 500k; PA155=2: baudrate is set to 600k; PA155=3: baudrate is set to 800k; PA155=4: baudrate is set to 1M.				
PA156	GSK-CAN servo axis numbers	1～5	5		P,S
	There are more than one servo unit that has built up serial port communication with CNC; therefore, setting a servo axis number corresponding to CNC system makes it easy to control a servo unit. Do not set a repeat servo axis number for the same CNC system.				

The default setting of parameters marked with '★' is related to the motor model; therefore, the default value varies with motors.

Parameters marked with '※' should be saved after modification and only be valid after power-on.

CHAPTER VIII ABNORMALITIES AND REMEDIES

Caution

1. When the servo unit or motor is needed to be dismantled for inspection or maintenance, please contact our technical personnel or operate under guidance of professionals.

2. Once an abnormality occurs in servo unit, inspection or maintenance can only be done after cutting off the power for more than 5min till the “CHARGE” light is off to avoid residual voltage.

8.1 Remedies for Normal Faults

8.1.1 Speed Mode

Abnormality	Possible Reason	Inspection and Remedy
In analog command speed mode, the motor does not work when a speed command is specified.	1. The spindle servo unit is in alarm state.	Clear the alarm or turn ON the power.
	2. Wrong working mode or wrong command mode is selected.	Check the setting of PA4 and PA6.
	3. No enable signal is input.	Check whether the SON connection is correct. Check dP- In to see whether the enable signal is connected, or set PA118 to 1, to enable the motor compulsively.
	4. No SFR or SRV signal;	Check the correctness of SFR or SRV connection, or check dP- In to see whether the enable signal is connected.
	5. No 24V for the I/O connection line.	Check whether the GND and COM+ ends are 24V with a universal meter.
The spindle motor can only run at low speed rather than at high speed;	1. PC command failure;	Check dP-uoC to see whether the analog command is correct.
	2. Motor default parameter error;	Refer to APPENDIX A MOTOR MODEL LIST, and check the setting of PA1. If the parameter is set incorrectly, restore the default value.
	3.Inappropriate PA52 setting;	Increase the setting value of PA52.
	4. Motor encoder fault;	Check whether orientation can be performed precisely by spindle motor.
In analog command speed mode, motor rotates in single direction	1. The command voltage is 0~10V, and the PA6 is set to 0 by mistake, therefore, the motor cannot perform counterotation.	Set the PA6 to 1; when SFR is ON, motor performs CCW rotation; when SRV is ON, motor performs CW rotation;

Abnormality	Possible Reason	Inspection and Remedy
	2. Command voltage is 0~10V, PA6 is set to 1, but the signal SFR or SRV is invalid;	Check the input state of SFR or SRV through dP- In , and examine the signal connection to find out the reason.
	3. The command voltage is 0~10V, but the signal lines VCMD+ and VCMD- are connected in reverse.	When signal lines VCMD+ and VCMD- are connected in reverse, the motor rotates in single direction and the speed is uncontrollable. Turn off the power immediately to check the signal lines.
Large vibration occurs when the motor is running. (no load connected)	1. Improper speed loop gain setting	Restore the motor default parameter or manually set the PA15, PA16, PA18 according to Section 6.1.1.
	2. Incorrect shielding line connection	Connect the line according to the connection diagram in speed mode described in Section 3.3.2.
	3. Dynamic balance connected to motor shaft is poor.	Perform dry run without load, if the vibration disappears, then, re-adjust the dynamic balance.
Big vibration when motor is started and stopped.	The load inertia is large.	Reduce the speed loop integral time or lower down the motor rotation speed.
The temperature of servo unit or motor is too high;	1. Mechanical fault;	Disconnect the motor shaft and mechanical device for motor dry run. Usually, the no-load current is 0.2 times of the rated current. If the no-load current is proved to be normal, the problem may lie in large friction or running obstruction, or may be the servo device model is smaller than needed.
	2. The motor or servo unit is not grounded, which leads to interference to the servo unit, instability and high temperature of the motor.	Refer to Chapter 3 for details about grounding.
Err-27 occurs during motor running;	Phase sequence error of the connection between servo unit and motor U, V, W wires.	Exchange any two of the phases. For example: the U port of servo unit is connected to V port of motor; V port of servo unit is connected to U port of motor.
Alarms Err-2, Err-19 or Err-18 occurs.	A brake is not connected to the servo unit or the brake resistance is too large.	Change a suitable braking resistor.

Abnormality	Possible Reason	Inspection and Remedy
Motor braking cannot be stopped.	Parameter PA119 is set wrong; Large load inertia; no appropriate acceleration/deceleration time is set.	Set parameter PA119 to 1. Adjust the setting value of PA57, PA58 by increasing 100 each time, till the abnormality is eliminated.

8.1.2 Position Mode

Abnormality	Possible Reason	Inspection and Remedy
In position mode, when a pulse command is specified, the motor does not work.	1. The servo unit is in alarm state.	Clear the alarm or re-power on.
	2. Wrong working mode or command mode is selected.	Check the setting of PA4, PA5.
	3. No enable signal is input.	Check whether the SON connection is correct. Check dP- In to see whether the enable signal is connected, or set PA118 1, to enable the motor compulsively.
	4. 24V for the I/O connection line.	Check whether the GND and COM+ ends are 24V with a universal meter.
The spindle motor can only run at low speed rather than at high speed;	1. Command failure;	Check dP-uoC to see whether the analog command is correct.
	2. Electric gear ratio setting error.	Refer to Section 6.4.1 for the electric gear ratio calculation.
Large motor running vibration	Inappropriate setting of speed loop proportional gain and integral coefficient. (PA15, PA16) Inappropriate setting of position loop proportional gain. (PA19)	Restore the motor default parameter or manually modify the parameter according to Section 6.1.1 (PA15, PA16, PA19).
Inaccurate position control	1. Electric gear ratio setting error;	Correct the electronic gear ratio according to Section 6.4.1.
	2. External interference causes the received pulses inaccurate.	When the command pulses are less than pulses displayed on dP-CPo, it means there is external interference. A. Use difference circuit as far as possible; B. Connect the shielding line correctly. C. Keep far away from the interference source. D. Add first-order RC circuit for wave filtering.

	3. When the pulse command is input (the drive unit is connected to single end), the current-limit resistance is not connected in series correctly.	Refer to the position command wiring diagram in Section 3.3.3.
	4. Machine connection failure	When the command pulses equal to the pulses displayed on dP-CPo (the pulses after electronic gear ratio calculation), it means the system controlled side is normal. Check whether the machine connection is loose or faulty.
The motor hunts greatly during start or stop.	The load inertia is great. The acceleration/deceleration time corresponding to PC commands are too small.	Increase the acceleration/deceleration time for smooth start or stop, or reduce the position loop proportion gain.

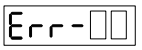
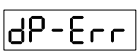
8.1.3 Others

Abnormality	Inspection	Possible Reason
1. No display	Fault still exists after unplugging CN1, CN2, and CN3 connectors.	A. Power voltage failure; B, Servo unit failure;
	Fault disappears after unplugging CN1 or CN2, or CN3 connectors.	Short circuit of signal line;
2. “POWER” indicator on the panel does not light up.	Fault still exists after unplugging CN1, CN2, CN3 connectors.	A. Power voltage failure; B, Servo unit failure;
	Fault still exists after unplugging CN1 or CN2, or CN3 connectors.	Short circuit of signal line;
3. Power breaker trips out after power-on.	It is normal after re-power-on.	The charging current of DC capacitor in the servo unit is too large. It would return to normal state after switching on the breaker one or two times
	The breaker still trips out after re-powering on for two or three times. Check the connection of main circuit.	A. short circuit occurs on servo unit. B. The main circuit is connected wrong, or short circuit occurs on the brake resistance lead or motor U, V, W grounding wires.
4. Servo unit enable is ON, but the motor is	Check whether alarm message exists in the servo unit monitoring window.	Clear the alarm according to Section 8.2.

<table>
<tr><th>Abnormality</th><th>Inspection</th><th>Possible Reason</th></tr>
<tr><td>in free state and not energized.</td><td>Check dP- In to see whether the SON signal is connected or whether the SFR (or SRV) is connected in analog command speed mode.</td><td>I/O signal line connection error;</td></tr>
<tr><td rowspan="5">5. Servo unit enable is ON, and the motor has performed excitation, but the motor does not work.</td><td>1. Check dP- 1; the current exceeds the rated one, and orientation can be performed accurately after load-off.</td><td>The fault may caused by short circuit or mechanical stall. An alarm will be generated. Refer Section 8.2 for details.</td></tr>
<tr><td>2. Check dP- 1; the current exceeds the rated one, and orientation CANNOT be performed accurately after load-off.</td><td>Motor encoder failure.</td></tr>
<tr><td>3. Check dP- 1;, the current does not exceed the rate one.</td><td>A. Wrong working mode is selected (refer to chapter 5 for correct setting);
B. The input command is not received (refer to chapter 5 for the correct command signal lines);
C. The parameter PA180 is set too small;</td></tr>
<tr><td colspan="2"><table>
<tr><th>No.</th><th>Name</th><th>Range</th><th>Unit</th><th>Default Value</th></tr>
<tr><td>PA180</td><td>Maximum drive capacity</td><td>0～300</td><td>%</td><td>300</td></tr>
<tr><td></td><td colspan="4">1. The setting value is represented by the percentage of motor rated current. For example, value 300 means the overload current is 3 times of the rated current.
2. This parameter value limits the maximum output torque of the motor.</td></tr>
</table></td></tr>
<tr><td>4. Check dP- 1, no current is found.</td><td>Servo unit failure;</td></tr>
<tr><td rowspan="2">6. The motor is running unstably and the speed fluctuation is large.</td><td>The motor is running stably in manual mode.</td><td>Strong interference occurs to input command. Keep the motor far away from the interference source and properly lay the shielding lines.</td></tr>
<tr><td>In manual mode, the motor is running unstably, and the speed fluctuation is large.</td><td>A. Motor encoder fault; change the motor.
B. Parameter setting error. Re-set the motor default parameter, especially the</td></tr>
</table>

Abnormality	Inspection	Possible Reason
		encoder line number and the number of magnetic poles.
Obvious vibration occurs during motor start or stop.	1. Check whether the acceleration/deceleration time during motor start/stop is too short. 2. Check whether the parameters of speed loop and position loop proportional gain is set too large.	Large load inertia;
8. The spindle motor is overheated.	1, Check the heat radiation fan.	The fan is broken or the fan power is connected incorrectly.
	2. Check the ventilation duct;	The ventilation duct is blocked.
	3. Check the ambient temperature;	The ambient temperature is too high; improve or increase heat radiation device.
	4. Check the load status;	The motor is overload; reduce the load.
	5. Check the model code parameter.	The motor default parameter is wrong.
9. Abnormal noise exists in the spindle motor.	1. Check the parameter of speed loop and position loop.	The motor default parameter is wrong.
	2. Check whether there is strong interference to analog command or position command.	The input command is disturbed. Keep the motor far away from the interference source and properly lay the shielding wires.
	3. Release the load to see whether the load is blocked.	The load is blocked or out of shape.
	4. Stop the motor when it runs at high speed; the abnormal noise still exists;	A. Screw in the motor is loose. B. Motor internal failure;
10. The motor still runs even when the speed command is 0V.	Check the parameter PA56 (analog command zero-drift compensation).	Proper zero-drift compensation is not performed.

8.2 Alarms and Remedies

The servo unit is provided with multiple protection functions. When a fault is detected after power-on, the servo will stop the motor, and  will be displayed on the operation panel. The alarm code can also be checked under menu  . This Section also offers remedies for troubleshooting.

Alarm No.	Meaning	Main Reason	Remedy
Err-1	Spindle motor speed exceeds the setting value of parameter PA54.	1. The encoder feedback signal is abnormal;	Check the motor or the 2nd position encoder and its signal connection status.
		2. In speed control mode, the acceleration/deceleration time constant is set too small, which leads to excessive velocity overshoot value.	Increase the setting value of PA57 or PA58.
		3. Parameter PA54 (peak speed limit) is set too small;	Set PA54 correctly according to the motor nameplate.
		4. Control panel fault;	Change the servo unit.
Err-2	Main circuit DC bus voltage is excessive.	1. Braking resistor is disconnected or damaged.	Check braking resistor and its connection.
		2, Braking resistor is unmatched (resistance value is excessive) Note: Smaller resistance means greater current, which will easily cause damage to the braking pipe of the braking circuit.	A, Change to a new braking resistor whose resistance is matched with the power. B, Reduce the ON/OFF frequency according to actual usage. C. Modify PA57, PA58 according to the actual using conditions.
		3, Power supply voltage is instable;	Check the power supply.
		4. Internal braking circuit is damaged.	Change the drive unit.
Err-3	Main circuit DC bus voltage is too low	1. The input power capacity is insufficient, which leads to low voltage.	Check the power capacity and electrical control cabinet.
		2. If it occurs when the power is turned ON, it means the servo unit control panel is faulty.	Change the servo unit.
Err-4	The value in position deviation counter exceeds the setting value (refer to the range set by parameter PA32); (When PA137=0, detects the position deviation alarm, when PA137=1, does not detects the position deviation alarm)	1. The pulse command frequency is too high or the electronic gear ratio is too large.	Check the command frequency of principal PC; check the electronic gear ratio set by PA29/PA30.
		2. The load inertia is excessive or the drive unit torque is insufficient.	A, Check the setting of motor capacity limit (PA180). B, Improve the drive unit and motor power. C, Lighten the load.
		3. Motor encoder fault or wrong encoder line number.	A, Check the motor encoder and its connection. B, Check the setting of PA1.
		4. In position mode, the motor U, V, W phase sequence is wrong, accompanying alarm Err-12 or Err-27.	Exchange any two of the phase.

Alarm No.	Meaning	Main Reason	Remedy
		5. PA98 is set incorrectly when the 2nd position encoder is used, and the feedback signal is abnormal.	Check the setting of PA98.
		6. The position loop or speed loop gain setting is too small (refer to parameter PA15, PA16, PA19).	Adjust the speed loop or position loop gain.
		7. The valid range of position deviation is set too small.	Set the PA32 correctly.
Err-6	Speed amplifier saturation failure	1. The motor cannot follow the speed command for a long running time due to insufficient torque or excessive load.	A. Check whether PA1 is set correctly and restore the motor default parameter. B. Check mechanical device to see whether they are blocked or not.
		2. The motor or the encoder is abnormal.	Change the spindle servo motor.
Err-8	Position deviation counter overflow	1. The electronic gear ratio of position command is set too large.	Check the setting of PA29, PA30.
		2. The input command pulse is abnormal.	Check the PC command pulse frequency.
Err-9	The motor encoder signal feedback is abnormal.	1. Motor encoder signal line is poorly or wrong connected.	Check the connector and signal line welding condition.
		2. The motor encoder signal feedback cable is too long, causing lower signal voltage.	Shorten the cable length within 30m.
		3. The motor encoder is damaged.	Change the motor or encoder.
		4. Servo unit control panel is faulty.	Change the servo unit.
Err-11	Servo unit internal IPM module failure	1. It occurs when the power is ON, and the drive unit is not enabled. It cannot be removed after power-on. A, drive unit failure B, Short circuit occurs when braking resistor terminal is grounding	Remedy for reason A is to change to a new drive unit. Remedy for reason B is to check the correct the braking resistor connection.
		2. It occurs when the power is ON, and the drive unit is not enabled. It is removed after re-power-on.	It may be caused by external interference or poor grounding. Check the grounding status and interference source.
		3. It occurs when the power is turned ON, and the drive unit is enabled. It cannot be removed after power-on. A. short circuit occurs among motor power line U, V, W, or between U, V, W and PE.	The remedy for reason A is to change the motor line or the motor. The remedy for reasons B is to change the drive unit.

Alarm No.	Meaning	Main Reason	Remedy
		B. Drive unit IPM module is damaged.	
		4. It occurs when the motor is starting or stopping and it can be removed after re-power-on. A. The default parameter of the motor set by drive unit is wrong. B. Then load inertia is too large; the commanded accelerated speed is too large during starting or stopping.	The remedy for reason A is to restore the motor default parameter (refer to Section 4.4). The remedy for reason B is to increase the acceleration/ deceleration time, lower down the accelerated speed or load inertia.
Err-12	Motor overload alarm;	1. Overcurrent alarm;	Reduce the load.
		2. Parameter setting error. The motor may be running accompanying vibration or abnormal noise;	Readjust the parameters concerning motor performance (PA15, PA16, PA18, PA19).
		3. PA1 is set wrong, which leads to incorrect encoder line number.	Re-set PA1 according to the motor model code.
		4. U, V, W wire connection error. The phenomena after power-on are similar to the description in Err-27.	Exchange any two of the phases.
Err-16	Overload alarm during motor running;	The motor is running with overload for a long time (longer than the time in Err-12).	A. Reduce the load; B. Change a drive of greater power.
Err-17	Braking time is too long	1. The input power voltage is excessive for a long time.	Apply a power which meets the working needs of servo unit.
		2. The braking resistance is too large. The energy cannot be released during braking, causing the rise of internal DC voltage.	Change a correct braking resistor.
Err-18	The DC bus voltage is excessive, but there is no braking feedback.	1. Braking circuit fault;	Change a servo unit.
Err-19	The DC bus voltage is insufficient, but there is a braking feedback.	1. Braking circuit fault;	Change the servo unit.
Err-20	EEPROM alarm occurs in the servo unit after power-on.	1. Servo unit fails to read the data in EEPROM when power-on.	Refer to Section 4.4 for details to restore the motor default parameter.
		2. EERPOM chip or circuit panel fault;	Change the servo unit.
Err-21	Input power R, S, T open-phase alarm;	1. A phase of input power line is OFF, or the power is open-phase;	A. Check the input power line and re-connect it. B. Check the input three-phase power.

Alarm No.	Meaning	Main Reason	Remedy
		2. The input circuit of servo unit power is faulty.	Change the servo unit.
Err-23	Excessive current error;	1. Current detection circuit failure; 2. Current sensor is damaged. 3. Control power voltage failure;	Change the servo unit.
Err-24	The 2nd position input signal which detects the CN3 interface is abnormal.	1 PA97 is set to 0 when there is no 2nd position encoder feedback signal;	Set PA97 to 1.
		2. Spindle encoder feedback signal is abnormal (the same reason described in Err-9).	Check the 2nd position encoder signal connection, welding and plug connection status.
Err-25	Servo unit orientation failure	1. Z pulse signal cannot be detected.	Check the feedback signal connection;
		2. Due to large load inertia, the corresponding parameter setting is set improperly or the gain setting is too large.	Check the motor model code PA1 or relevant gain parameters PA15, PA16, PA18, PA19 (Section 6.1).
		3. The A/B phase sequence of spindle encoder signal is different from that of the motor encoder signal when the 2nd position input signal is applied for orientation.	Modify parameter PA101 to set consistent phase sequence. Refer to PA101 for details.
Err-26	Servo unit radiator overheat alarm	1. The temperature is too high or the radiation fan is damaged.	After the servo unit being cut off and cooled down, check the radiation fan and ventilation duct, and reduce the load.
		2. Temperature detection switch or circuit is damaged.	Change the servo unit.
Err-27	U, V, W wire connection error	U, V, W phase sequence error;	Exchange any of the two phases.
Err-28	Software upgrading parameter error	Parameters are not modified and saved after the software recording or upgrading.	Restore the default parameters and re-power on after the parameters are saved.
Err-29	Parameter error detected after power-on	Conflict occurs when software upgrading.	Re-write the parameter and turn on the power again.
Err-30	Excessive AC input voltage alarm	The three-phase AC power input voltage exceeds 110% of the rated voltage.	Adjust the grid voltage or increase some power-stabilizing devices such as AC reactor, AC filter.
Err-33	The main circuit voltage is abnormal at power-on	1. The input power voltage is too low or the fluctuation is too large at the moment of power-on.	Check the input power.

Alarm No.	Meaning	Main Reason	Remedy
		2. Rectifier is damaged or the soft-start circuit is faulty.	Change the servo unit.
Err-34	Excessive pulse electronic gear ratio	The setting of gear ratio is inappropriate.	Re-set parameter PA29/PA30 correctly.
Err-36	Three-phase main power failure	1. three-phase main power is OFF	Check the main power; make sure the power can be input regularly.
		2. Three-phase main power detection circuit is faulty.	Change the servo unit.
Err-37	Alarm occurs when the temperature of radiator is below -30℃.	The environmental temperature is too low.	Improve the environmental temperature.
Err-38	Alarm occurs when the temperature is higher than 75℃.	1. The motor overload running for a long time.	Reduce the load.
		2. The environmental temperature is too high.	Improve the ventilation condition.
		3. The drive unit is damaged.	Change the drive unit.

8.3 Inspection and Maintenance

Caution

- Do NOT use resistance meter or the like to make insulation inspection to the servo unit, otherwise, the servo unit may be damaged!
- Do NOT dismantle or repair the servo unit by yourself!
- Change the encoder backup battery half-yearly!
- Make sure that the average load rate of drive is below 80%.

Category	Item	Period	Daily Maintenance
Electric Cabinet Environment	Abnormal odor	Every day	Properly eliminate the odor in time. If it is caused by aging equipment, make a replacement.
	Dust, vapor and oil	Once every month	Remove it with dry clean cloth or filtered high-pressure air gun.
	Power cable, connection terminals	Once every half-year	When the external insulation layer and insulation joints are damaged or aging, make a replacement soon; tighten the loose connection terminals with screw driver.
Servo Unit	Radiation fan	Once every week	Check whether the wind speed and ventilation amount is normal, and whether the abnormal heating exists. Change the fan if any.
	Dirt retention on cooling plate	Once every month	Remove it with dry clean cloth or filtered high-pressure air gun.

	Loose screw	Once every half-year	Tighten the terminal strip, connector, and installation screw with screw driver.
Spindle Motor	Noise, vibration	Every day	When the noise or vibration is obviously greater than usual, check the machine connection and repair it.
	Radiation fan	Once every week	Check whether the wind speed and ventilation amount is normal, and whether the abnormal heating exists. Change the fan if any.
	Dust, vapor and oil	Once every month	Remove it with dry clean cloth or filtered high-pressure air gun.
	Measure the insulation resistance	Once every half-year	Measure it with a 500V resistance meter. When the resistance is below 10 MΩ, please contact our technical personnel.
	Motor and load connection	Once every half-year	Check the device wear status, connection and sundries with proper tools.

APPENDIX A Model Code Parameters and Feed Servo Motors Table

Model Code (set by PA01)	Spindle motor models, technical specifications
500	GM7101-4SB6□, 3.7kW, 6000r/min, 0.02kg.m^2
501	GM7103-4SB6□, 5.5kW, 6000r/min, 0.02kg.m^2
502	GM7105-4SB6□, 7.5kW, 6000r/min, 0.032kg.m^2
503	GM7131-4SB6□, 11kW, 6000r/min, 0.076kg.m^2
504	GM7103-4SC6□, 7.5kW, 9000r/min, 0.02kg.m^2
505	GM7100-4SB6□, 2.2kW, 6000r/min, 0.015kg.m^2
506	GM7109-4SB6□, 11kW, 6000r/min, 0.037kg.m^2
509	YPNC-50-2.2-B, 2.2kW,380V, 6000r/min, 5.1A, 14 N·m
510	YPNC-50-3.7-B, 3.7kW,380V, 6000r/min, 8.0A, 24 N·m
511	YPNC-50-5.5-B, 5.5kW,380V, 6000r/min, 11.8A, 36 N·m
512	YPNC-50-7.5-B, 7.5kW,380V, 6000r/min, 16.0A, 49 N·m
513	YPNC-50-11-B, 11kW, 380V, 6000r/min, 21.3A, 72 N·m
514	YPNC-5015-B, 15kW, 380V, 6000r/min, 33.0A, 98 N·m
515	ZJY208-5.5AM-B5（B3） 16.2A 380V
516	ZJY265-7.5AM-B3 21.0A 380V
517	ZJY182-1.5BH-B35 7.3A 380V
518	ZJY182-2.2BH-B35 7.5A 380V
519	ZJY182-3.7BH-B35 15.5A 380V
520	ZJY208-2.2B-B5（B3） 6.3A 380V
521	ZJY208-2.2B-B5（B3） 9.3A 380V
522	ZJY208-3.7B-B5（B3） 8.9A 380V
523	ZJY208-5.5B-B5（B3） 13.7A 380V
524	ZJY208-7.5B-B5（B3） 18.4A 380V
525	ZJY265-7.5BM-B5（B3） 18A 380V
526	ZJY265-11BM-B5（B3） 26A 380V
527	ZJY265-15BM-B5（B3） 35A 380V
528	ZJY265-15AM-B5（B3） 48.3A 380V
529	ZJY265-22BM-B5（B3） 58A 380V
530	ZJY265-18.5BM-B5（B3） 48.7A 380V
543	ZJY208-2.2AM-B5（B3） 6.7A 380V
544	ZJY208-3.7AM-B5（B3） 10.2A 380V
546	ZJY265-11AM-B5（B3） 31A 380V

APPENDIX B Peripheral Equipments

B.1 Circuit Breaker and Contactor (essential)

Circuit breaker and contactor should be installed between input power and spindle servo unit. They are not just the power switch of servo unit but also a protection method for the power.

Circuit breaker is a protection switch which can cut off the faulty circuit automatically. It can protect the circuit in case of overload, short circuit or undervoltage. Servo unit has a capability of 150% overload in 30min, to fully exert the servo unit overload capability, it is advised to choose the power distribution protection circuit breaker.

AC contactor is to control the ON/OFF of the drive unit through electric protection circuit. It can cut off the power once a system fault is detected, to prevent the fault from expanding.

The following technical data table is for your consideration.

Motor Power (kW)	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22
Rated current of circuit breaker (A)	25	25	25	32	32	50	63	80	100
Rated current of contactor (A)	9	9	12	18	25	32	50	50	63

B.2 Three-phase AC filter (recommended)

Three-phase AC filter is a passive low-pass filter. The frequency range is 10kHz～30MHz. It is used to suppress the high-frequency noise from the power end of servo unit. When other equipments are interfered by this noise, the three-phase AC filter is recommended.

The following technical data table is for your consideration.

Motor Power (kw)	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22
Rated current (A)	10	10	20	20	30	40	50	50	60
Rated Voltage (V)	380/440	380/440	380/440	380/440	380/440	380/440	380/440	380/440	380/440
Inductance (mH)	≈2.8	≈2.8	≈1.6	≈1.6	≈0.9	≈1.1	≈0.6	≈0.6	≈0.4
Leakage current (Ma)	≤2	≤2	≤2	≤2	≤2	≤2	≤3	≤3	≤3

Cautions for filter installation:

Make sure the metal shell of the filter and electric cabinet is well connected and grounded.

There should be a certain distance between filter input and output lines (parallel connection is forbidden) in case that the effectiveness of the filter is reduced.

The filter should be installed at the entrance of power line to the device, and the filter input line in

the cabinet should be as short as possible, so as to lower down the radiation interference.

B.3 AC Reactor (recommended)

AC reactor is connected to power input end to suppress the high-order harmonic wave of input power. It can prevent the interference from power grid and reduce the harmonic wave pollution to the grid. It is recommended in the following conditions:

1. The power of matched motor is larger than 15kW.
2. The degree of unbalance of three-phase power voltage is larger than 3%.
3. Thyristor converter, non-linear load, electric arc furnace and capacitor compensation device which adjusts the power factors through switch are on the same power supply system.
4. The power factor of the input side needs to be changed.

The following technical data table is for your consideration.

Output Power	Three-phase AC Line Reactor		
	Rated Working Voltage	Rated Current	Inductance Range
1.5 kW	Three-phase AC 380V (or 440V) /50Hz	8A～10 A	1.0 mH～2.5 mH
2.2 kW	Three-phase AC 380V(or 440V) /50Hz	8A～10 A	1.0 mH～2.5 mH
3.7 kW	Three-phase AC 380V(or 440V) /50Hz	9A～10 A	1. mH ～2.5 mH
5.5 kW	Three-phase AC 380V(or 440V) /50Hz	13A～15 A	1.0 mH～1.5 mH
7.5 kW	Three-phase AC 380V(or 440V) /50Hz	18A～20 A	0.8 mH～1.2 mH
11 kW	Three-phase AC 380V(or 440V) /50Hz	24A～30 A	0.5 mH～0.8 mH
15 kW	Three-phase AC 380V(or 440V) /50Hz	34A～40 A	0.4 mH～0.6 mH
18.5 kW	Three-phase AC 380V(or 440V) /50Hz	40A～50A	0.4 mH～0.5 mH
22 kW	Three-phase AC 380V(or 440V) /50Hz	50A～60 A	0.35 mH～0.4mH

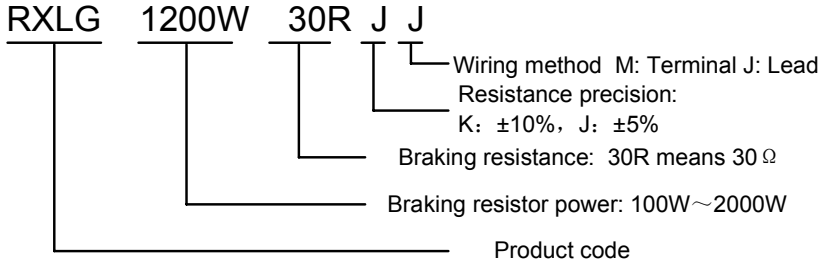
APPENDIX C BRAKING RESISTOR SELECTION

①, Configuration of braking resistor

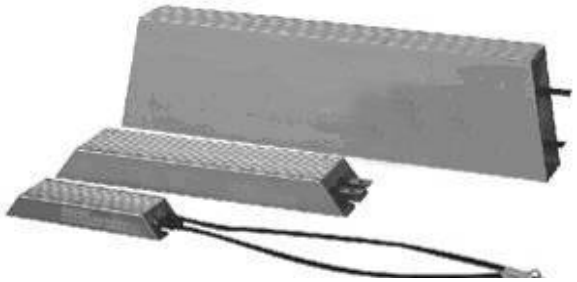
Spindle Motor Model	Spindle Servo Unit Model	Large, middle inertia application (such as turning machine)		Small inertia application (such as milling machine)	
		Specification	Model (Product Identification Code)	Specification	Model (Product Identification Code)
ZJY182－1.5BH ZJY182－2.2BH ZJY208－2.2AM	GS3048Y GS4048Y	500W/47Ω	RXLG500W47RJJ	500W/47Ω	RXLG500W47RJJ
ZJY208－2.2B （Exclusive use）	GS3048Y GS4048Y	800W/30Ω	RXLG800W30RJM	500W/30Ω	RXLG500W30RJJ
ZJY182－3.7BH ZJY208－3.7AM ZJY208－3.7B ZJY208－5.5B	GS3050Y GS4050Y	1200W/30Ω	RXLG1200W30RJM	800W/30Ω	RXLG800W30RJM
ZJY208－5.5AM ZJY208－7.5B ZJY265－7.5BM	GS3075Y GS4075Y	1500W/30Ω	RXLG1500W30RJM	1200W/30Ω	RXLG1200W30RJM
ZJY265－7.5AM ZJY265－11BM	GS3100Y GS4100Y	(1200W/30Ω)//2*	RXLG1200W30RJM	(800W/30Ω)//2*	RXLG800W30RJM
ZJY265－11AM	GS3148Y GS4148Y	(1200W/30Ω)//2*	RXLG1200W30RJM	(800W/30Ω)//2*	RXLG800W30RJM
ZJY265－15AM ZJY265－15BM ZJY265－18.5BM	GS3150Y GS4150Y	(1500W/22Ω)//2*	RXLG1500W22RJM	(1200W/30Ω)//2*	RXLG1200W30RJM

Note: "//2*" represents that two braking resistors with the same model should be connected in parallel in servo unit.

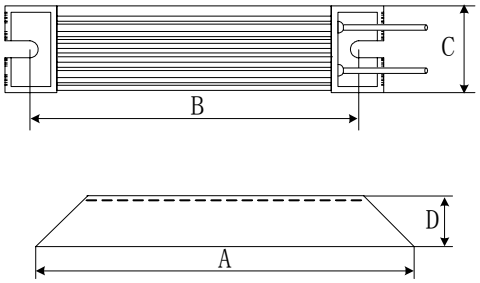
②, Braking resistor model instruction:



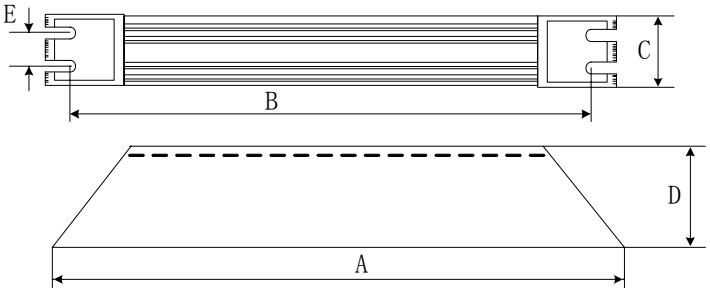
③, Appearance:



④, Braking resistor dimension:



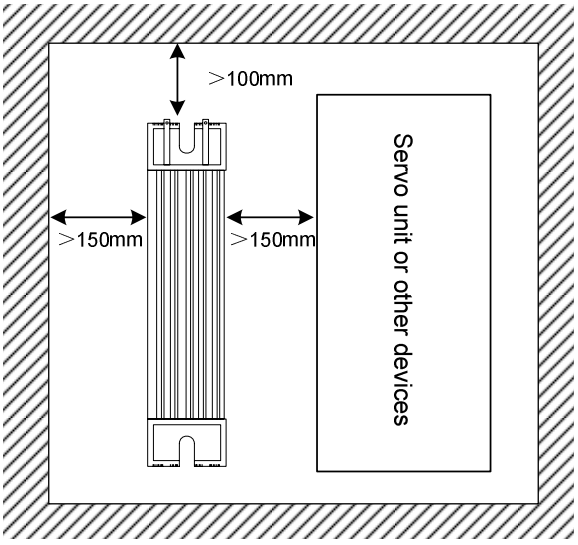
Bore dimension 5.5 mm



Bore dimension 5.5mm

Code	Power (W)	Appearance	Dimension (mm)					Wiring (mm^2)	Lead Length (mm)	Terminal
			A	B	C	D	E			
RXLG	500	Fig.1-9-1	335	323	60	30	/	2.5	1000	M5
RXLG	800		400	388	61	59	/	2.5	1000	M5
RXLG	1200	Fig.1-9-2	450	438	50	107	30	2.5	1000	M5
RXLG	1500		485	473	50	107	30	2.5	1000	M5

⑤, Braking resistor installation space



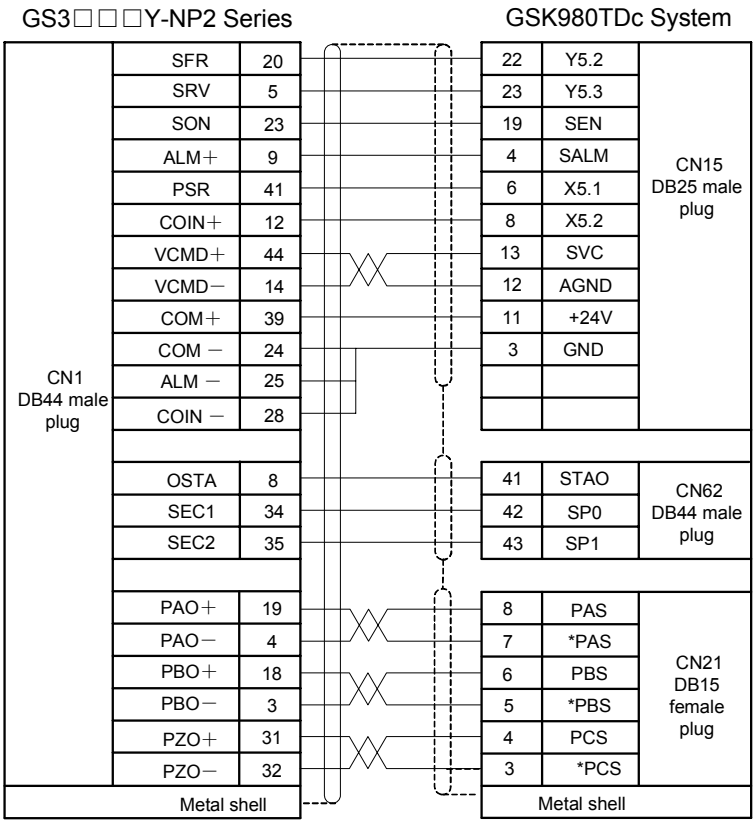
Caution

1. When the servo is turned ON or is running, high voltage and temperature exists on the surface of braking resistor, Do NOT touch it!
2. Please install a protection cover!
3. The temperature of braking resistor with aluminum case drops relatively slowly. Inspection and maintenance can be done only after the servo unit is cut OFF for 10 min, and the braking resistor surface temperature decrease to the room temperature.

APPENDIX D CONNECTION DIAGRAMS BETWEEN SPINDLE SERVO UNIT AND CNC SYSTEM

D.1 Connection between Servo Unit and GSK980TDc

1. For D-SUB servo unit in spindle speed control mode:



The major servo parameters are set as follows:

PAR. Setting	Meaning	PAR. Setting	Meaning
PA4=1	Speed control mode	PA6=1	External analog command 0~10V is valid.
PA51=0 or 1	When the analog command is valid, the motor rotation direction is reversed.	PA99=100	Set the orientation speed to 100r/min
PA103=orientation position 1	Set the 1st orientation position	PA105=orientation position 2	Set the 2nd orientation position
PA107=orientation position 3	Set the 3rd orientation position	PA109=orientation position 4	Set the 4th orientation position

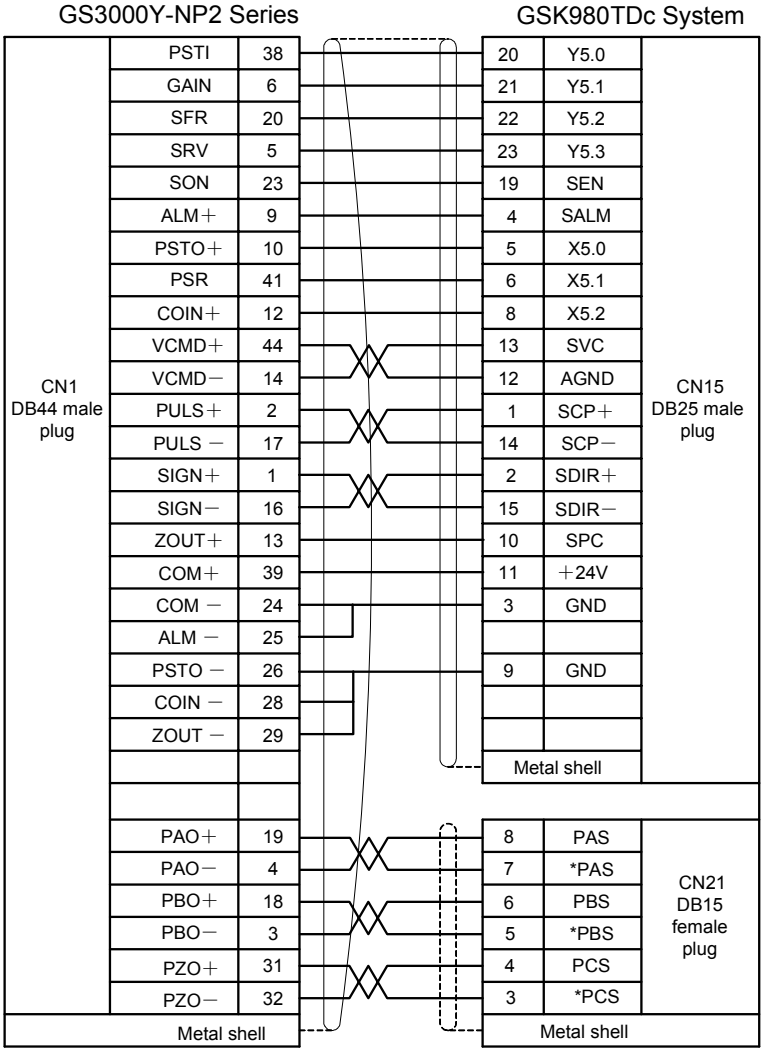
1. Single-point orientation is the default setting (PA103 is valid) in GS□□□Y-NP2 Series; Four-point orientation is supported.

2. SEC1, SEC2 are the default internal speed selection functions. If four-point orientation

is necessary, set PA239=1, PA240=2 and set SEC1, SEC2 as the orientation selection functions.

3. Refer to Section 6.5.1 for the details of orientation function.

2. For D-SUB servo unit in spindle speed/position control mode (Cs axis function):

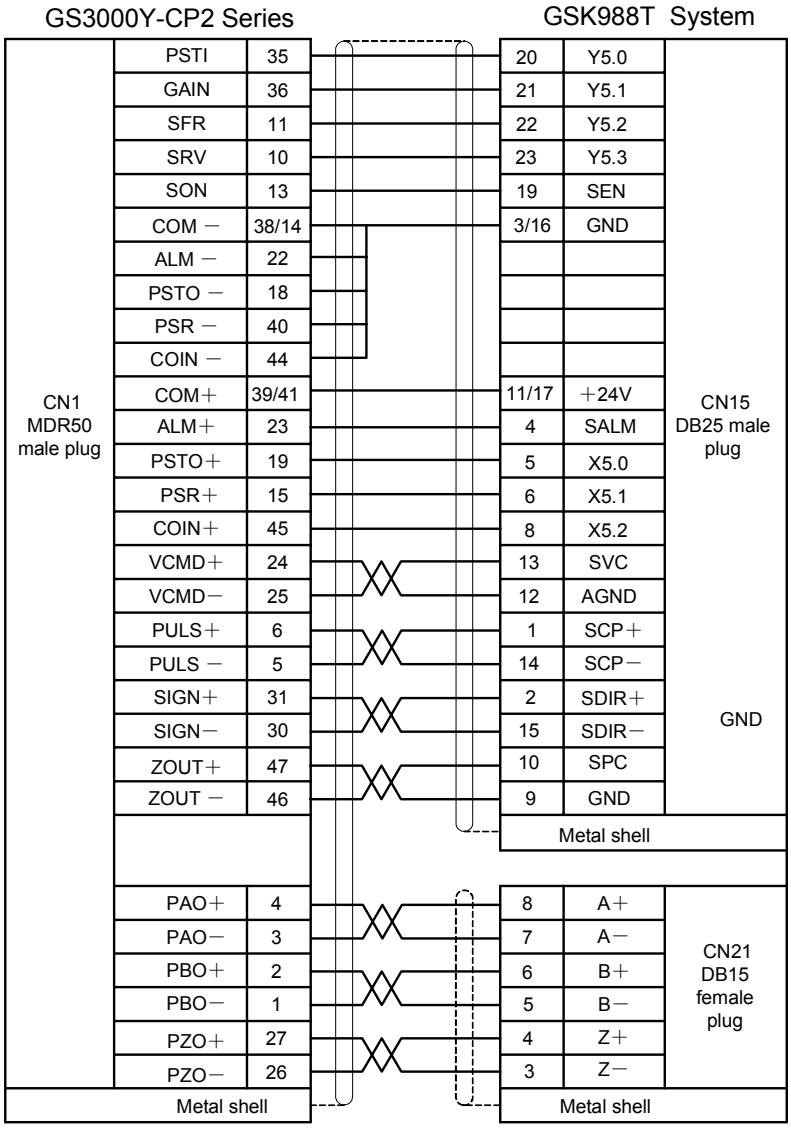


The major servo parameters are set as follows:

PAR. Setting	Meaning	PAR. Setting	Meaning
PA4=3	Set to speed/position control mode	PA5=0	Set the position command mode as pulse+direction
PA6=1	Set the external analog command 0~10V is valid	PA28=0 or 1	Position command direction is reversed
PA51=0 or 1	When the analog speed command is valid, the motor rotation direction is reversed.	PA90=reference point in position control mode	Reference point for speed/position switching
PA99=100	Set the orientation speed to 100r/min		

D.2 Connection between Servo Unit and GSK988T

1. For MDR servo unit in spindle speed/position control mode (Cs axis function):



The major servo parameters are set as follows:

PAR. Setting	Meaning	PAR. Setting	Meaning
PA4=3	Set to speed/position control mode	PA5=2	Set A/B phase orthorgonal pulse as the position command mode
PA6=1	Set the external analog command 0~10V are valid	PA28=0 or 1	Position command direction is reversed
PA51=0 or 1	When the analog speed command is valid, the motor rotation direction is reversed	PA90=reference point in position control mode	Reference point for speed/position switching
PA99=100	Set the orientation speed to 100r/min		