QS5 Series Servo Driver

User Manual

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- **Voltage of power supply is AC220V~250V.**
- **The servo motor can not be connected to municipal power grid directly**

Servo motor can not be connected to municipal power grid directly; otherwise the motor will be damaged. Servo motor can not rotate without servo driver.

■Do not plug in or draw out of socket during electrification

Plugging in or drawing out of socket can be carried out after power down.

■Please carry out checking after 5 minutes after power down

Even the power is down, there is still electricity remaining in capacitors of servo driver. In order to prevent electric shock, test is carried out after a confirmed minute.

■Distance with other equipment is over 10mm

The transverse distance with other equipment shall over 10mm and vertical distance shall over 50mm for installation. Servo motor gives heat such that the installation shall in accordance with the layout that is favorable for heat emission, and it shall be installed in the environment free from influence of dewing, shock and impact.

■Anti-interference process and grounding

If there is interference on signal lines, vibration and abnormal operation may be caused.

Following stipulations shall be strictly complied:

a. Strong current signle and weak current signle shall be separated.
b. Wiring distance shall be shortened as most as possible.
c. servo motor and servo driver connect to GND through 100Ω resistance.
d. Don't used interference filter between motor and servo driver.

■Voltage withstand test shall be carried out under following conditions.

Voltage: AC1500Vrms, in 1 minute

Rupturing current: 100mA

Frequency: 50/60Hz

Charge point: between terminals of L1, L2, L3(R, S, T) and FG ⏚ terminal

(connection s between terminals shall be fastened)

■Leakage protector of instant response type shall be applied.

Leakage protector of instant response type or that appointed for PWM inverter shall be applied instead of leakage protector, don't used delaying type.

■It can not operate continuously under over loading.

■Servo motor can not be operated by on/off of power supply.

Frequently turn on/off power will accelerate ageing of inside components, such that operation of servo motor shall be controlled by command signals.

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Chapter I

Product Confirmation & Introduce Each Part

1. 1Confirmation up on Arrival of Product

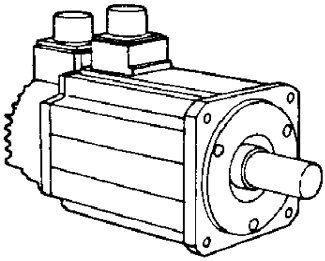
Up on receiving product, please confirm following items.

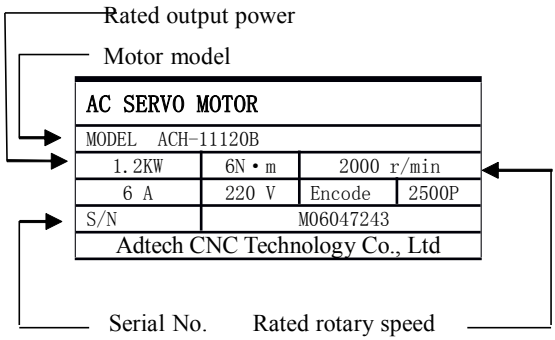
Confirm	Reference
If the arrival product matches the ordered model?	"Model" on nameplate of servo motor and servo driver can be referred for confirmation. (see following page)
If the rotary shaft of servo motor operates normally?	It can be turned softly by hand, but "motor with arrester" can not be turned.
If there is rupture?	Rupture caused by transportation can be examined by overall surface inspection.
If there is loose screw?	Screwdriver can be used to test if there is loose screw.

If unsatisfactory point is found in confirmation of above items, local distributor or service office of our company shall be contacted in time.

☞ Servo Motor

■Illustration of appearance and nameplate





■ Method for confirming model

ACH	09	075	D	/	S
AC－AC servo motor series	Pedestal No.	Output power	Rotary speed		Arrester
ACF：F eries	04－40	010－100W	A－1500		NULL－without arrester
ACH：H Series	06－60	020－200W	B－2000		S－DC99V arrestor
ACK：K Series	08－80	040－400W	C－2500		T－DC24V arrestor
ACS：S Series	09－90	055－550W	D－3000		
	11－110	075－750W	E－3500		
	13－130	120－1200W			
	15－150	150－1500W			
	18－180	180－1800W			
		200－2000W			
		230－2300W			
		260－2600W			
		350－3500W			
		550－5500W			

☞ Servo Driver

■ Illustration of appearance and nameplate

Model of servo driver

SERVO DRIVE		
MODEL	QS5AA030M	
INPUT	AC 200V 3 PHASE	50/60Hz 6~8A
OUTPUT	1.2KW~2.3KW	
S/N	Q06041023	
Adtech CNC Technology Co., Ltd		

Serial No.

Applicable motor capacity

Applicable Power supply

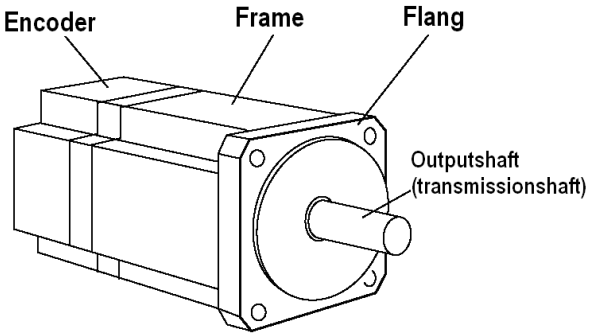
■Method for confirming model

QS5	AA	030	M
QS5—QS5 series	AS-S Series motor AH-H Series motor AM-M Series motor AA-ALL Series motor	Current 010—10A 015—15A 020—20A 030—30A 050—50A 075—75A 100—100A	control model B—position control M-position, speed or torque control

1.2 Name of Each Part of Product

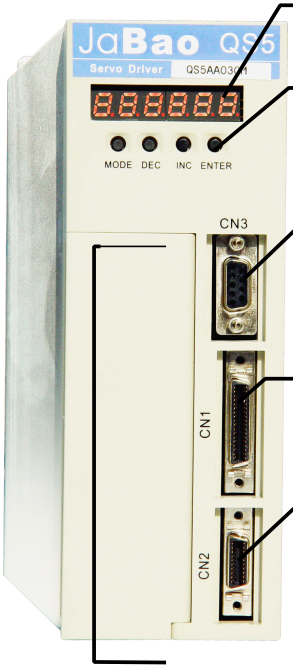
☞ Servo Motor

Name of each part of the servo motor without speed reducer and arrestor is shown in following illustration



☞ Servo Driver

QS5AA020M，QS5A030M，QS5AA050MName of each part of servo driver is shown in following illustration.



Display Panel

Display state, alarm and parameter input of servo

Buttons Panel

Used for setting parameters

Port for computer communication (CN3)

Used for communicating with computer

Port for signal input and output (CN1)

Port for command signal input or sequential signal input or output.

Port for encoder (CN2)

For connecting port of encoder on servo motor

Power supply terminal and servo motor connection terminal

Terminals for power input and connecting power lines of servo motor.

☞ Servo Driver

QS5AA015M Name of each part of servo driver is shown in following illustration.

Display Panel

Display state, alarm and parameter input of servo

Buttons Panel

Used for setting parameters

Power supply terminal

Terminals for power input

Port for signal input and output (CN1)

Port for command signal input or sequential signal input or output.

Port for encoder (CN2)

For connecting port of encoder on servo motor

servo motor connection terminal

connecting power lines of servo motor.

Chapter II

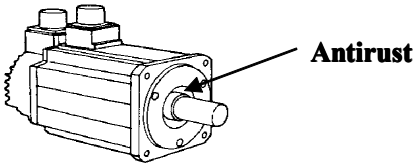
Installation

2.1 Servo Motor

Series servo motor can be installed horizontally or vertically. However, incorrect installation or abnormal installation position will shorten motor life or cause accident. Correct installation can be carried out in accordance with following precautions.

Precautions before installation：

There is antirust painted on shaft end of motor. Cloth dipped in thinner is used to wipe off antirust before installing motor. During wiping off antirust, thinner shall be prevented to contact other parts of servo motor.



2.1.1 Temperature for storage

Servo motor that is not electrified shall be stored in following range of temperature： -20 ～ +60 ℃

2.1.2 Site of installation

Series servo motor shall be installed in doors and meet following ambient conditions.

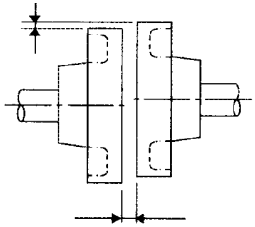
- There is no corrosive, inflammable or explosive gas；
- Good ventilation, dry and less dust；
- Range of ambient temperature 0 ～ 40 ℃；
- Relative humidity 26% ～ 80%RH, without dewing；
- Easy to overhaul and cleaning。

1. 2.1.3

2.1.3 Installation concentricity

Coupling shall be used at the time of connecting machine, and axes of servo motor shall be aligned with that of machine. While installing servo motor, requirement of concentricity tolerance in following picture shall be met.

Test at 4 points of a circle and differenc e of maximum and minimum shall less than 0.03mm. (Rotate together with coupling)



- Excessive concentricity warp will cause vibration which may harm bearings.
- While installing the coupling, motor shaft can not be hammered directly, otherwise the encoder on the other side of motor may be damaged.

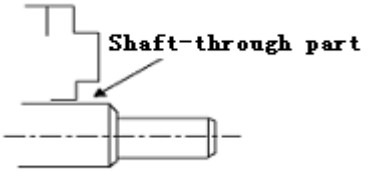
2.1.4 Installation direction

Alternative horizontal or vertical installation can be selected for ACH series servo motor

2.1.5 Measures for waterproof and oil proof

When motor is used on site with water or oil drops, special treatment shall be performed for protection. However, when shaft-through is needed to be sealed, motor with oil seal ring shall be specified.

Shaft-through refers to the clearance of extruding part at the end face of motor



2.1.6 Tightness of electrical wire

Electrical wires can not be bended or applied with strain.

Especially core wires of signal lines are 0.2 or 0.3 mm which is very thin, such that stretching can not be over tight at the time of wiring.

2.2 Servo Driver

QS5 series servo driver is servo driver of pedestal mounting type. Failure may occur if installation is wrong, such that following precautions shall be complied for correct installation.

2.2.1 Storage condition

Servo driver that is not electrified shall be stored in following range of temperature.：-20 ～ +85 ℃.

2.2.2 Installation site

Precaution regarding installation site is as followings

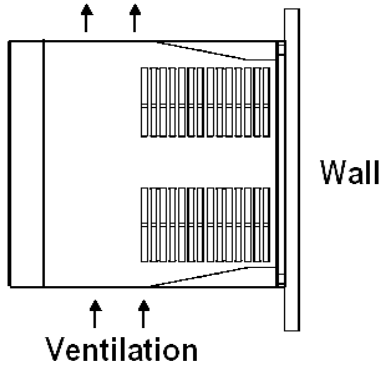
Condition	Installation Precaution
When installed in control cabinet	Size of control cabinet, configuration of servo driver and cooling method shall be designed when install in control cabinet so as to keep ambient temperature of servo driver under 55℃.
When installed close to heat source	For keeping ambient temperature of servo driver under 55℃, radiation and convection of heat source shall be controlled in order to prevent rise of temperature.
When installed close to vibration source	In order to prevent vibration is transmitted to servo driver, anti-prevention facilities shall be installed under installation surface of servo driver.
When installed in site with corrosive gas	When it is installed in site with corrosive gas, penetration of corrosive gas shall be prevented. Though there is no instant influence, failure of electric parts and relevant parts of contactor may be caused.
Others	It can not be installed in site with high temperature, humid, excessive dust and iron powder.

2.2.3 Installation direction

As shown in following illustration, installation direction shall parallel with wall.

Natural convection or fan is utilized to cool servo motor and install strictly

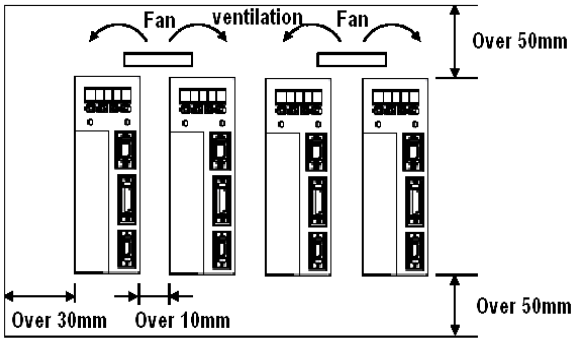
according to this direction. The fourth installation orifice is used to firmly fix servo driver on installation surface



2.2.4 Installation standard

Installation standard for installing in control cabinet in following illustration shall be strictly followed. This standard is applicable for side by side installation of multiple servo drivers.

Situation in control cabinet (hereinafter referred to “while side by side installation”)



■ Installation direction of servo driver

While installing, front face (operation panel) of servo motor shall face to operator and perpendicular to wall.

■ Cooling

In order to ensure cooling by fan or natural convection, sufficient space around servo motor shall be preserved as in the above illustration.

■ While side by side installation

As shown in above illustration, space over 10mm is preserved on both horizontal sides respectively and space over 50mm is preserved on both vertical sides respectively. In addition, fan for cooling shall be installed on servo driver. In order to prevent regional over heat in ambient temperature, temperature within control cabinet shall be kept even.

■ Ambient conditions within control cabinet

1. Ambient temperature of servo driver: 0 ~ 55 ℃
2. Humidity: below 90%RH
3. Vibration: 4.9m/s^2
4. Without freezing and dewing etc.
5. In order to ensure reliability of long term service, it shall be used in ambient temperature below 45℃.

Chapter III

Wiring

3. 1 Wiring of Main Circuit

While wiring, following precautions shall be abided.

attention

- Power lines and signal lines shall neither be threaded from identical tube nor banded. While wiring, distance between power lines and signal lines
- Strand wire and strand integrated shielding wire shall be used for signal lines and encoder (PG) feedback lines,
  With respect to length of wire, command input line can not exceed 3m and PG feedback line can not exceed 20m.
- Even power supply is OFF, there may be still high voltage remaining in servo driver, please do not touch power terminals for a while.
- Power supply shall not be frequently turned ON/OFF. If it is needed to turn ON/OFF power supply continuously, the frequency shall be controlled below 1 times/min
  Since there are capacitors in power supply of servo driver, there is large charging current flow (charge time 2.0s) at the time of turning ON power supply. Therefore, if power supply is frequently turned ON/OFF, performance of main circuit parts within servo driver will be degraded.

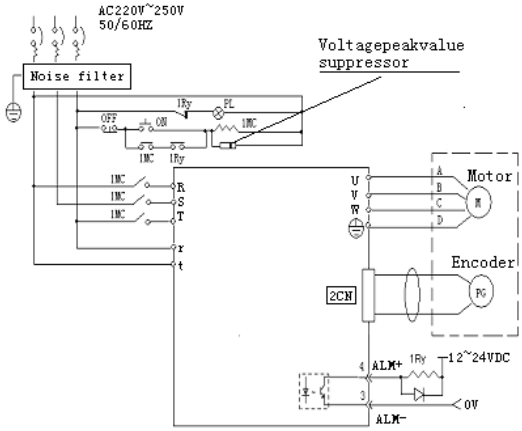
3.1.1 Name and function of main circuit terminal

mark	Function	Essential
R/S/T	Input terminals of main loop	Three phase AC220V~250V，50/60Hz
r，t	Input terminals of controlling power supply	Single phase AC220V~250V，50/60Hz
U/V/W	Motor connecting erminals	Connect with motor

⏚ PE	Grounding terminals	Connect with power supply grounding and motor grounding to carry out grounding treatment.
P,D	Regenerative unit connecting terminals	In normal condition, PD is not connected, when capacity of built-in regenerative resistance is not sufficient, outside regenerative resistance is connected between P-D.

3.1.2 Illustration typical main circuit wiring

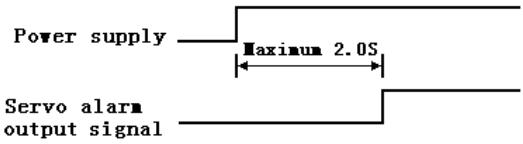
Illustration of typical wiring is as following.



3.1.3 Design of power ON sequence

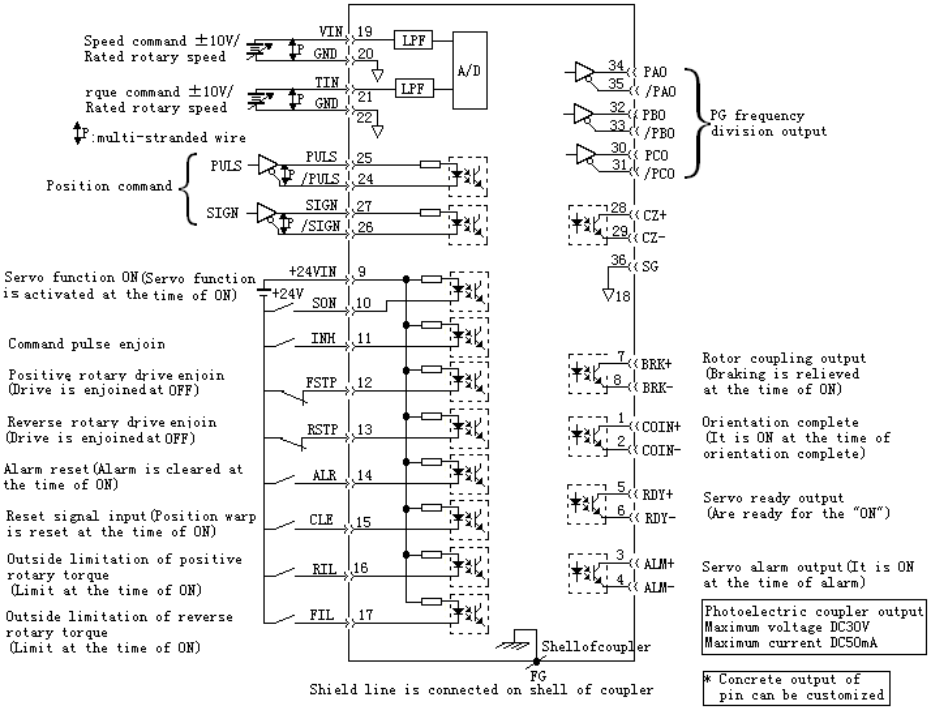
Following points shall be considered while designing power on sequence.

- Following designs shall be carried out for power ON state sequence: after giving "servo alarm" signal, power shall be in OFF state. (refer to above circuit diagram)
- Please press power ON button for over 2 seconds. After service driver is ON, maximum 2 seconds "servo alarm" signal will be gave, which is a necessary step for initial setup of servo driver.



3. 2 Input and Output Signal

3. 2. 1 Connection of input signal and output signal



3.2.2 Arrangement of terminals of coupler (CN1)

No.	Name	Description	No.	Name	Description
1	COIN+	Orientation complete signal	19	VIN	Speed command input
			20	GND	
3	ALM+	Alarm output	21	TIN	Torque command input
			22	GND	
5	RDY+	Servo ready to output	23		
			24	/PULS	Command pulse input
7	BRK+	Arrester output	25	PULS	
			26	/SIGN	Command signal input
9	+24V	24V power supply input, anode	27	SIGN	
10	SON	Servo ON input	28	CZ+	Programmable output
11	INH	Command pulse enjoin	29	CZ-	
12	FSTP	positive rotary over travel input	30	PCO+	PG frequency division output
13	RSTP	reverse rotary over travel input	31	PCO--	
14	ALR	Alarm clear input	32	PBO+	PG frequency division output
15	CLE	Reset signal input	33	PBO--	
16	RIL	Positive torque limit input	34	PAO+	PG frequency division output
17	FIL	Reverse torque limit input	35	PAO--	
18	GND	0V	36	FG	0V

- Idle terminal can not be used as relay.
- Shield line for cable for input/output signal shall be connected to shell of coupler.
- Servo driver lateral coupler is used to connect FG (frame grounding).

3.2.3 Names and their functions of input and output signals

■ Input signal

Signal Name	Pin No.	Function		Reference item
+24VIN	9	Control power input for sequence signal: +24V power supply is prepared by user Operable voltage range: +11V ～ +25V		4.2.4
SON	10	Servo ON input, control command is received in 50ms after taking effect		4.5.2
INH	11	Command pulse is enjoined.		
FSTP	12	Positive rotary drive is enjoined		4.1.2
RSTP	13	Reverse rotary drive is banned		
ALR	14	Alarm clearance: clear servo alarm state		4.5.1
CLR	15	Reset signal input: reset warp counter.		4.2.2
RIL	16	Positive rotary torque outside limitation input		4.1.3
FIL	17	Reverse rotary torque outside limitation input		4.1.3
VIN	19 20	Speed command input: ±10V.		4.2.1
TIN	21 22	Torque command input: ±10V.		4.2.8
CZ+ CZ-	28 29	Programmable output		4.2.2
/PULS PULS /SIGN SIGN	24 25 26 27	Command pulse input, photoelectric coupler insulation	Input mode *DIR + PU *CCW/CW pulse	4.2.2

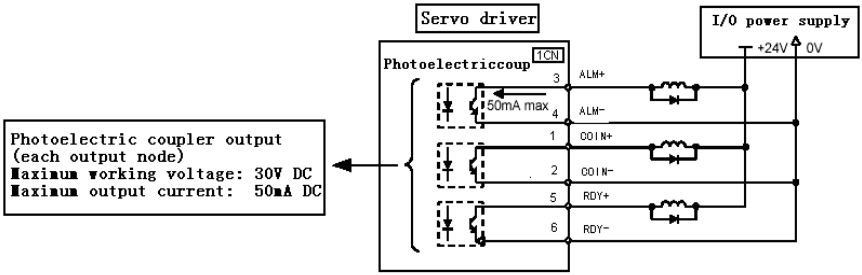
(Note) 1. The pin number with in () refers to signal grounding.

■ **Output signal**

Signal name	Pin No.	Function		Reference item
1 2	COIN- COIN+	Orientation complete signal output. When the value of position warp counter is in range of orientation, orientation complete output ON		
3 4	ALM+ ALM-	Alarm output		4.5.1
5 6	RDY+ RDY-	Servo is ready for output		
7 8	BRK+ BRK-	Arrester output		
PAO+ PAO- PBO+ PBO- PCO+ PCO-	34 35 32 33 30 31	A phase signal B phase signal C phase signal	2 phase pulse (A phase, B phase) transition encoder output signal and original point pulse (C phase) signal	4.2.3
FG	Shell	If shield line of cable for input and output signal is connected to shell of coupler, it can be connected to frame grounding line. (grounding line)		

3.2.4 Interface circuit

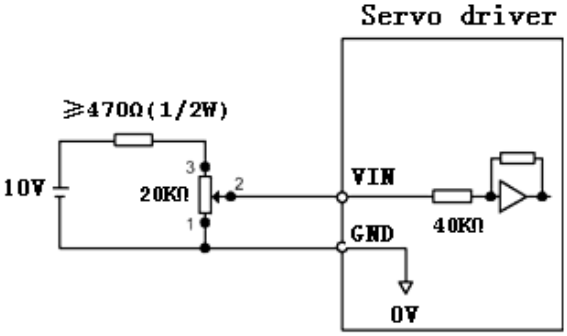
Connection illustration of input and output signal of servo driver with its upper equipment is shown as following.



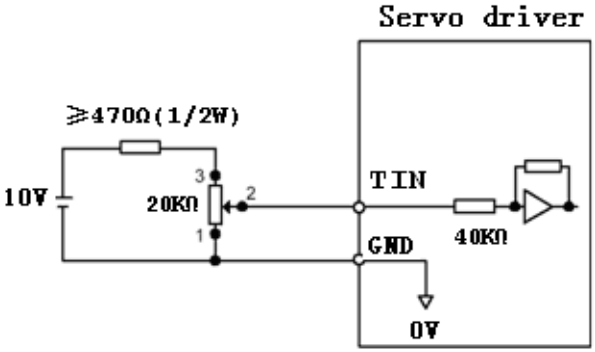
■ Port for analog command input

Analog signals are speed command signal and torque command signal, command input impedance is about 40kΩ and maximum allowable voltage for input signal is ±10V.

Speed command input port:

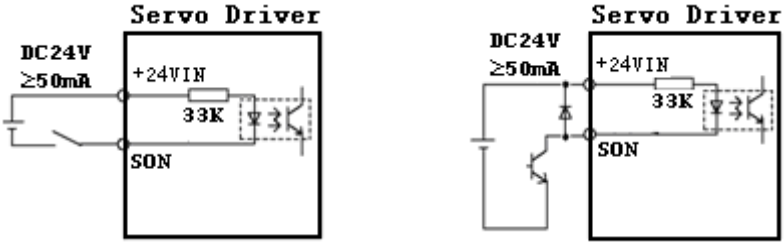


Torque command input port:



■ Interface for input circuit

Relay or open-collector transistor circuit is used for connection. Relay for slim current shall be selected while connecting by relay. If relay for slim current is not used, loose contact may be caused.

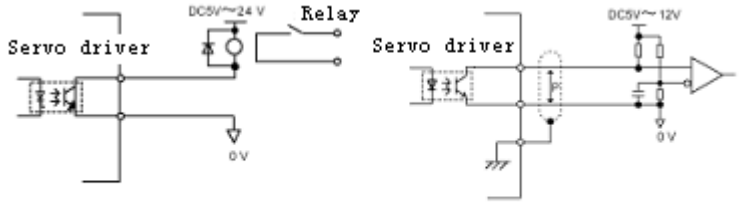


■ Interface for bus driver output circuit

Output signal (PAO, /PAO, PBO, /PBO) and original point pulse signal (PCO, /PCO) of two phases (A phase, B phase) of encoder is outputted by output circuit of bus driver. It is usually used when position control system is formed by upper equipment. Line receive circuit receiving is used for upper side equipment. Refer "wiring with encoder" for connection circuit illustration.

■ Interface for output circuit

Servo alarm and servo ready and output signal for other sequence consist of photoelectric coupler output circuit. Relay and lien receive circuit is used for connection.

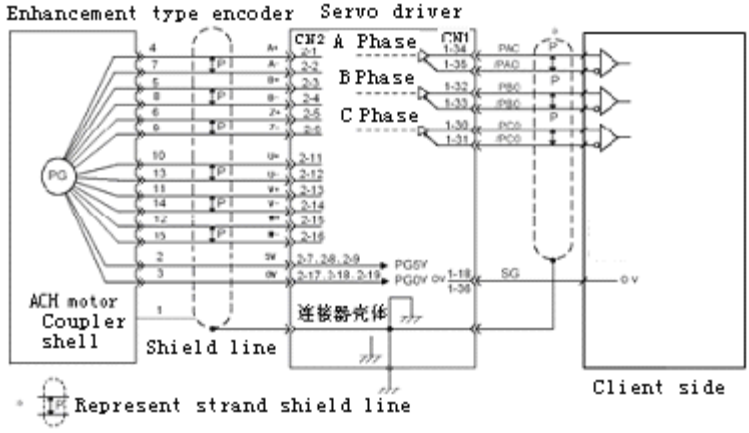


Note) Maximum allowable voltage and current capacity of photoelectric coupler is as following:
Voltage: DC30V (Max) Current: DC50Ma (Max)

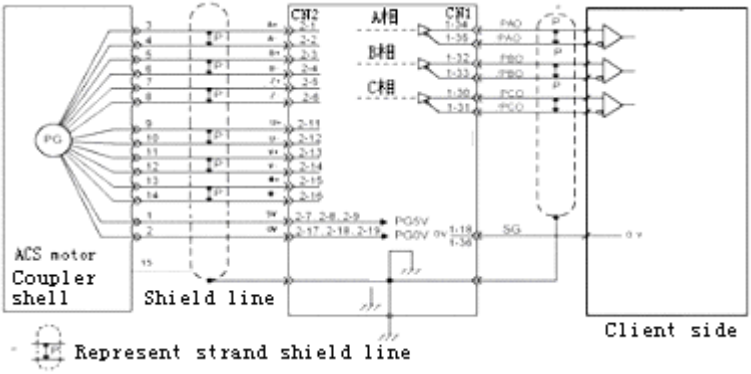
3.3 Wiring with Encoder

3.3.1 Connection with encoder (CN2) and processing output signal from servo driver

QS5+ACH motor:



QS5+ACS motor:



3.3.2 Terminal arrangement of coupler (CN2) for encoder

Terminal No.	Color code	Name	Description	Terminal No.	Color	Name	
1	Blue	A+	PG input A phase	11	Grass green	U+	PG input U phase
2	Pink	A-	PG input /A phase	12	Brown	U-	PG input /U phase
3	Yellow	B+	PG input B phase	13	Green	V+	PG input V phase
4	Purple	B-	PG input /B phase	14	Pink-purple	V-	PG input /V phase
5	White	C+	PG input C phase	15	Gray	W+	PG input W phase
6	Pink-green	C-	PG input /C phase	16	Pink-blue	W-	PG input /W phase
7	Red	5V	PG power supply+5V	17	Black (Orange)	0V	PG Power supply 0V
8				18			
9				19			
10	—	—	—	20	—	—	—

3.4 Wiring of Motor

3.4.1 Arrangement of terminals of connector for encoder (ACH motor)

Terminal No.	Color code	Description
1	**Shield line**	**FG**
2	Red	+5V（power supply）
3	Black (orange)	0V（power supply）
4	Blue	A channel output
5	Pink	/A channel output
6	Yellow	B channel output
7	Purple	/B channel output
8	White	C channel output
9	Pink green	/C channel output
10	Grass green	U channel output
11	Brown	/U channel output
12	Green	V channel output
13	Pink purple	/V channel output
14	Gray	W channel output
15	Pink blue	/W channel output
Terminal No.	**Color code**	**Description**
1	**Shield line**	**FG**
2	Red	+5V (power supply)
3	Black (orange)	0V (power supply)
4	Blue	A channel output
5	Pink	/A channel output
6	Yellow	B channel output
7	Purple	/B channel output
8	White	C channel output
9	Pink green	/C channel output

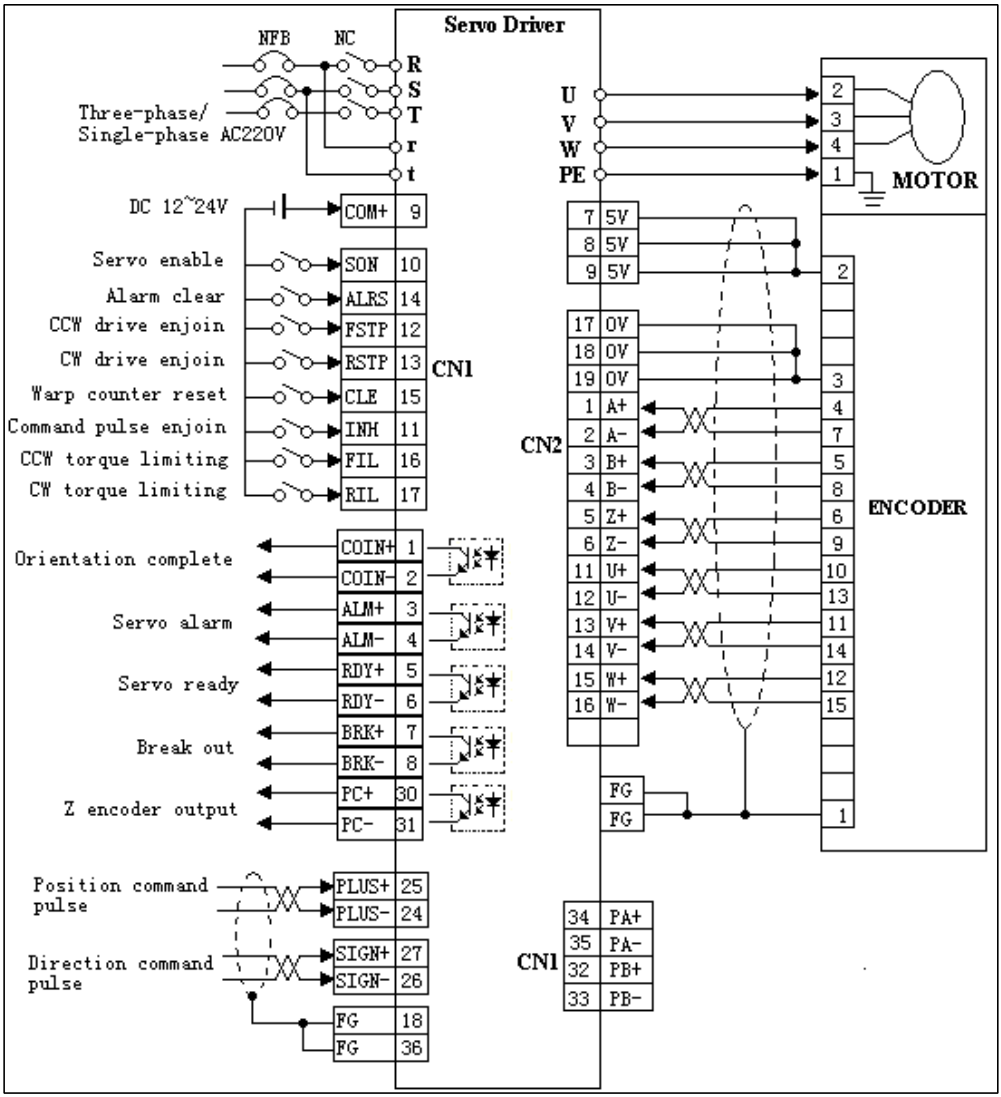
10	Grass green	U channel output
11	Brown	/U channel output
12	Green	V channel output
13	Pink purple	/V channel output
14	Gray	W channel output
15	Pink blue	/W channel output

3.4.2 Terminal arrangement of coupler for dynamic electricity (ACH motor)

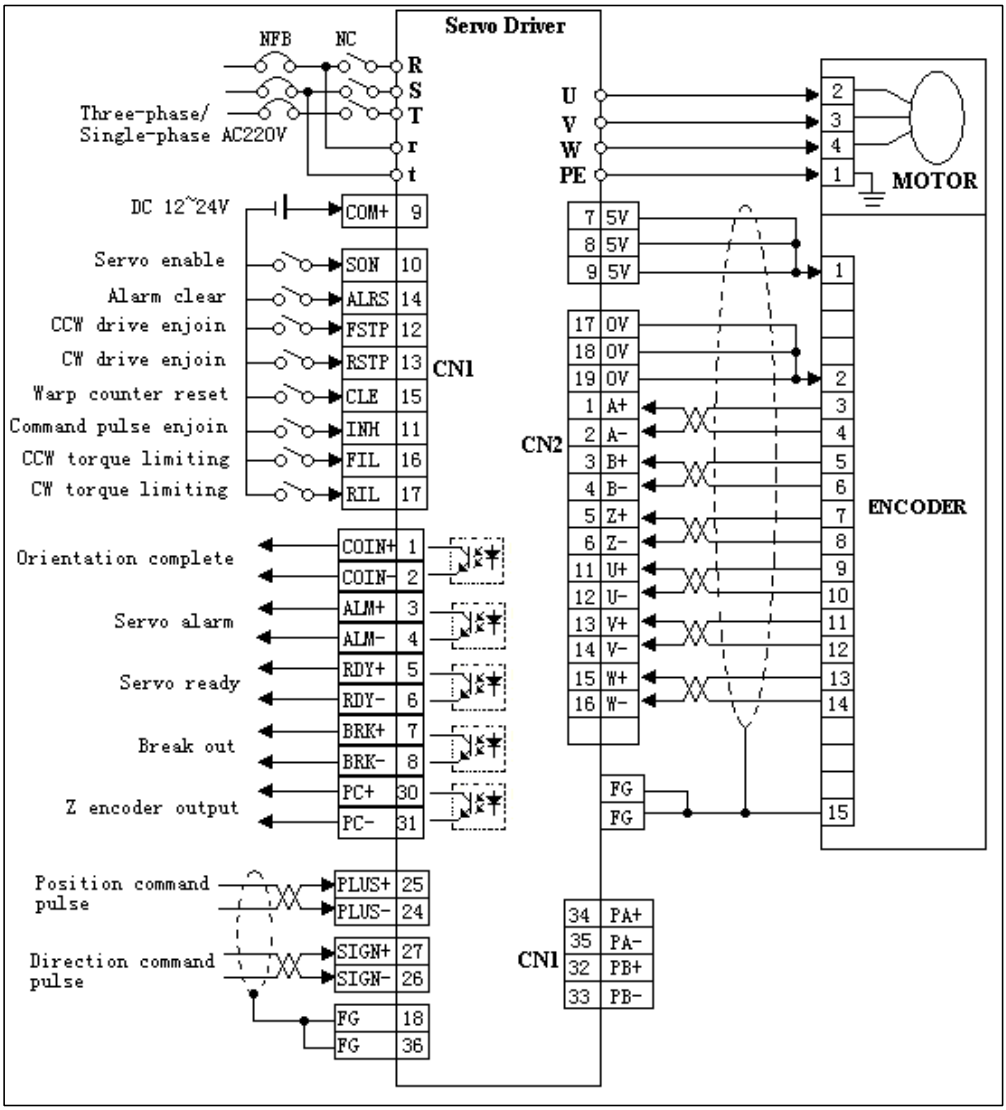
Terminal No.	Color code	Description
1	Blue	FG（Frame grounding）
2	Red	U Phase
3	Yellow	V Phase
4	Green	W Phase

3.5 **Standard Connection Illustration**

Following grounding is applicable for drivers of following model:
QS5AA015M/QS5AA020M/QS5AA030M/QS5AA050M



QS5+ACH motor(position)



QS5+ACS motor(position)

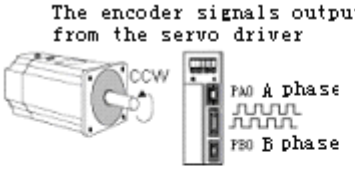
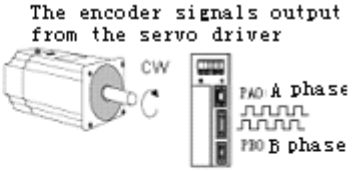
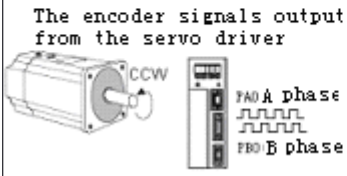
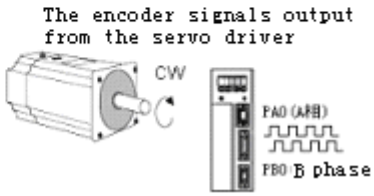
Chapter IV

Parameter Setting and Description of Functions

4. 1 Settings in respect of mechanism

4. 1. 1 Shifting of the rotating direction of the motor

The servo driver can reverse the rotating direction of the servo motor, namely the “Reversed Mode”, without changing the wiring of the servo motor. The standard setting is “Forward Direction”, namely “Rotating Counterclockwise” when observing from the loading side of the servo motor. The “Reversed Mode” only reverses the rotating direction of the motor, without any other change.

	Standard Setting	Reversed Mode
Forwarding Instruction		
Reversing Instruction		

■Setting Method of the "Reversed Mode"

Choose the rotating direction of the motor by setting the following parameters.

Parameter No.	Name and description	Unit	Range of setting	Ex-factory value
PA-10	**Choose the rotating direction** [0] The CCW direction is the forwarding direction when observing from the loading side of the motor. (Standard setting) [1] The CW direction is the forwarding direction when observing from the loading side of the motor. (Reversed mode)	—	1~2	1

When this parameter is altered, save and cut off the power supply, and then connect the power supply again so that the setting can be validated.

4.1.2 Overrange Setting

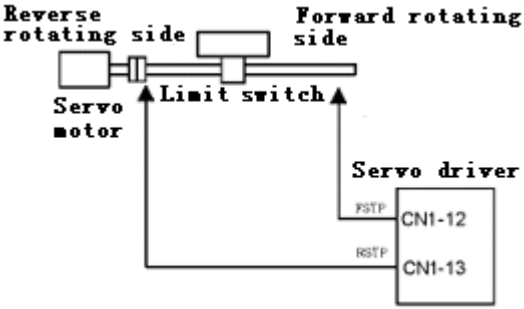
The overrange setting is a function to stop the movable part of the machine by force when is exceeds the moving range.

■Use the overrange function

In order to use the overrange function, please correctly connect the following input signals of the overrange limit switch to the corresponding pins of the CN1 connector of the servo driver.

→ **Input FSTP CN1-12**	Prohibit rotating the driver forwardly (the forward rotating side is overrange)
→ **Input RSTP CN1-13**	Prohibit rotating the driver reversely (the reverse rotating side is overrange)

In situations such as linear driving, in order to prevent damaging the machine, please do connect the limit switch according to the following figure.



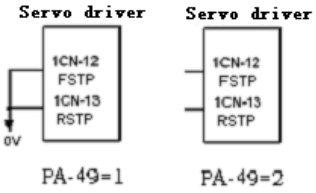
The status of the driver when the input signal is "ON/OFF" is shown in the following table.

Signal	Status	Input level	Explanation
FSTP	ON	CN1-12: "L" level	Allow rotating the driver forwardly. (Normal operation status).
	OFF	CN1-12: "H" level	Prohibit rotating the driver forwardly. (It can be rotated reversely).
RSTP	ON	CN1-13: "L" level	Allow rotating the driver reversely. (Normal operation status).
	OFF	CN1-13: "H" level	Prohibit rotating the driver reversely. (It can be rotated forwardly).

Note:

- When using the overrange function to stop the motor when controlling the position, there would be remnant pulses. The signals should be cleared in order to clear the remnant pulses.

When "FSTP" and "RSTP" are not used, the following short circuit wirings can be omitted.

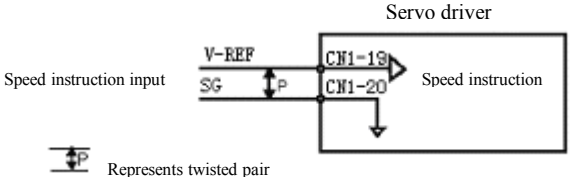


4. 2 Settings according with the supervisory device

4. 2. 1 Speed instruction

☞ Analog instruction

Input the speed instruction by using the following input signal "Speed Instruction Input". It is used for speed control (analog instruction).



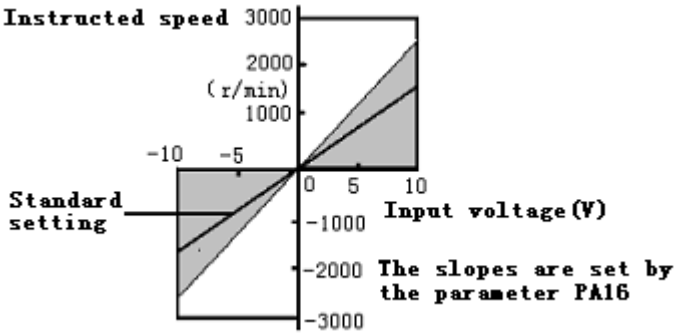
→ Input V-REF CN1- 19	Speed instruction input
→ Input SG CN1- 20	Signal grounding

According to V-REF and the ratio of 10V motor speed regulation:

V-REF/10V = Vo/Va;

Va: Motor rated speed, or set the maximum value of the actual situation;

Vo: Motor actual speed。



■Example of setting

Use parameter PA16 can alter the input range of the speed instruction.

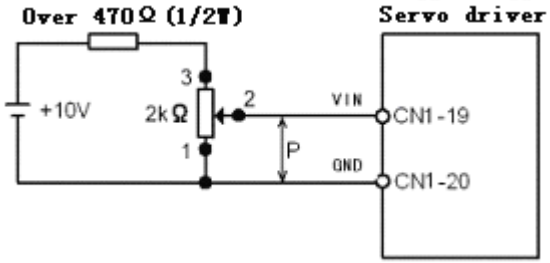
PA16=20: this setting means 10V is corresponding to the rated rotating speed (2000r/min).

The actual example is shown in the following table.

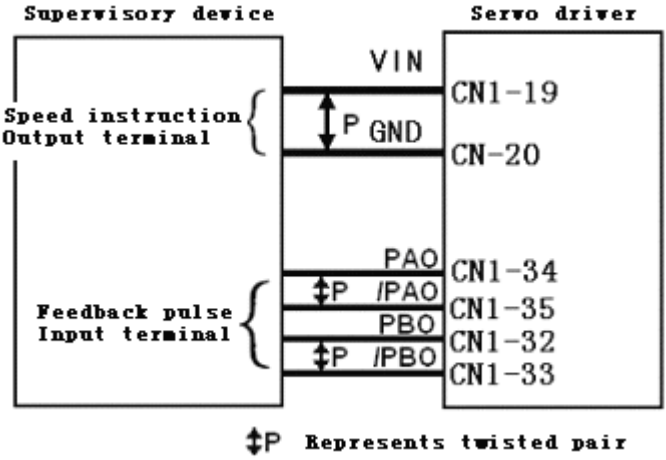
Speed instruction input	Rotating direction	rotate speed
+10V	Forward rotating	Rated rotating speed，2000r/min
+1V	Forward rotating	(1/10)rated rotating speed,200r/min
-3V	Reverse rotating	(3/10)rated rotating speed,600r/min

■Example of the input circuit

In order to prevent interference, please use stranded wires during wiring.



The use of programmable controllers and other upper position control devices when the VIN and GND connected to the upper device output terminals on the speed of command.



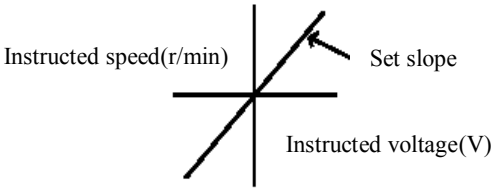
In this

situation, please adjust PA16 in reference to the specification of the output voltage.

Adjust the input gain of the speed instruction by setting the following parameter.

Parameter	Name and description	Unit	Range of setting	Ex-factory value
PA16	Speed instruction gain	(r/min)/V	0~100	24

Set the speed command input VIN (CN1-19) of the voltage range. Follow the upper device and external circuitry to set the output patterns. The factory has been adjusted to comply with the 10V input conditions, the rated speed settings.



Note

- The maximum permissible voltages are ±10VDC at the speed instruction input terminal (between CN1-19 and 20).

Choose one of the following four controlling methods:

Parameter	Name	Range	Ex-factory value	Usage
PA01	Choose the controlling method	1-5	1	Speed and torque control, position and IO control

☞ Parameter Instruction

The system runs with constant rotating speed and rotating direction set by PA13, PA17 or PA16 under speed control (parameter instruction) controlling mode (PA01=2).

Parameter	Name and description	Unit	Range of setting	Ex-factory value
PA13	The speed when the parameter instruction is running	R/min	0～2000	2000
PA17	The rotating direction when the		1～2	1

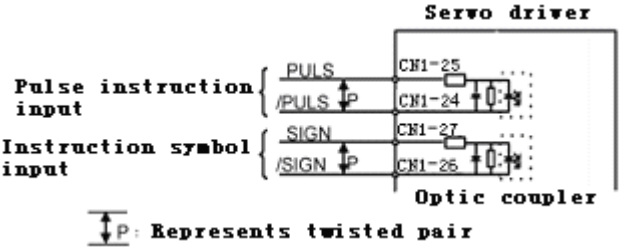
	parameter instruction is running 1：Forward；2：Reverse			

4.2.2 Position instruction

The position instruction has instruction pluse input, instruction symbol input and clear input methods. As there are many ways of usage, please set the optimal instrunction inputs in the established system.

■Pulse input instruction

Give movement instructions by the pulse input.



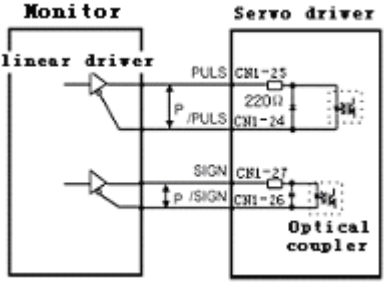
There are the following three controller output states according to the position instructions given by the pulse input.

- Linear driver output
- +12V collector open circuit output
- +5V collector open circuit output

Connection example 1 (linear driver output)

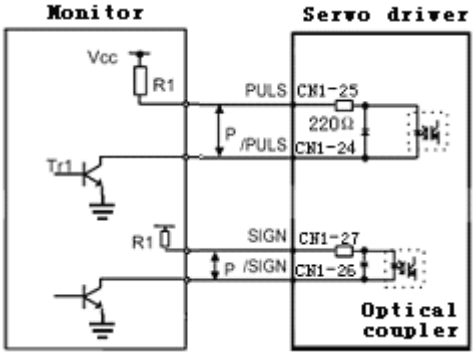
Suitable linear driver

SN75174 of TI company or substitute of MC3487



Connection example 2 (collector open circuit output)

Please set resistor R1 according to the input current value range required below.



Input current I 7~15mA

When Vcc is 12V, R1=1KΩ

When Vcc is 5V, R1=0Ω, Namely, direct access Vcc pin.

Note: When the collector starts to output, please pay attention to the signal logic, as shown in the following table.

Tr1：ON	Equivalent to “H” level input
Tr1：OFF	Equivalent to “L” level input

The inner power supply in the servo driver can be used. In that case, it is uninsulated to the 0V part of the servo unit.

■Choose the instruction pulse state

Use the following user’s constants to choose the “instruction pulse state” to be used.

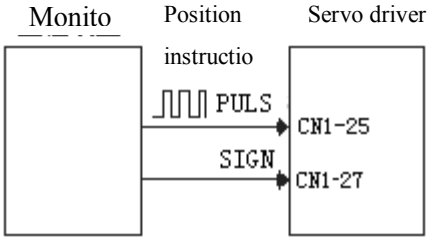
→Input PULS CN1- 25	Input instruction pulse
→Input /PULS CN1-24	Input instruction pulse
→Input SIGN CN1-27	Input instruction pulse
→Input /SIGN CN1-26	Input instruction pulse

The rotation angle of the motor is only in proportion to the input pulse.

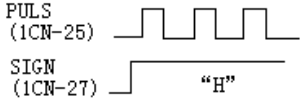
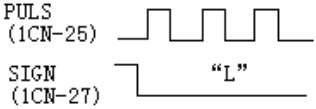
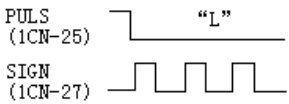
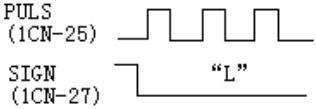
Use the following parameters “PA09, PA10” to choose the “Instruction pulse state”.

Parameter	Code	Name	Unit	Range	Ex-factory value
PA09		Input pulse type: [1]symbol+pulse [2]CW+CCW		1~2	1
PA10	--	Input symbol: [1]：SIGN not reversed [2]：SIGN reversed	--	1~2	1

Confirm the instruction pulse type sent from the supervisory device to the servo unit.



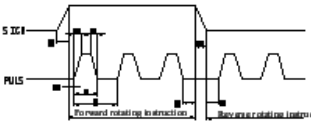
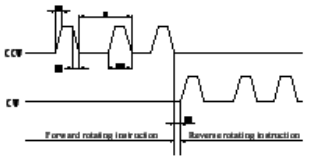
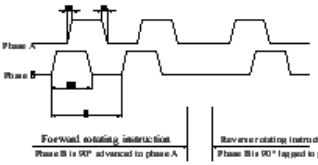
Choose the following instruction pulse types in reference to the specifications of the supervisory device.

PA09	Instruction type	Motor forward rotating instruction	Motor reverse rotating instruction
1	Sign-pulse sequence		
2	CW pulse-CCW puls		

Choose whether the input signal is to be reversed or not by setting the PA10

parameter according to the actual needs.

Time of the "instruction pulse input" signal

Instruction pulse signal type	Electric specifications	Remark
Sign+pulse sequence input (SIGN+PULS signal) Maximum instruction frequency: (200KPPS collector open circuit output)	 t1, t2≤0.1μs t3, t7≤0.1μs t4, t5, t6≥3μs τ≥0.1μs (τ/T)×100≤50%	Sign (SIGN) H=forward rotating instruction L=reverse rotating instruction
CW pulse+ CCW pulse Maximum instruction frequency: (200KPPS collector open circuit output)	 t1, t2≤0.1μs t3≥0.1μs τ≥0.1μs (τ/T)×100≤50%	
90°phase difference 2 phase pulse (Phase A+phase B) ×1 multiplication: 500kpps (200KPPS collector open circuit output) ×2 multiplication: 200kpps ×4 multiplication: 400kpps	 t1, t2≤0.1μs τ≥0.1μs (τ/T)×100≤50%	Shifting of the multiplication mode Setting through user's constant Pn-09

■Clear the content of deviation counter

The method of clearing the content of deviation counter is as follows:

→Input CLE CN1-15	Clear input

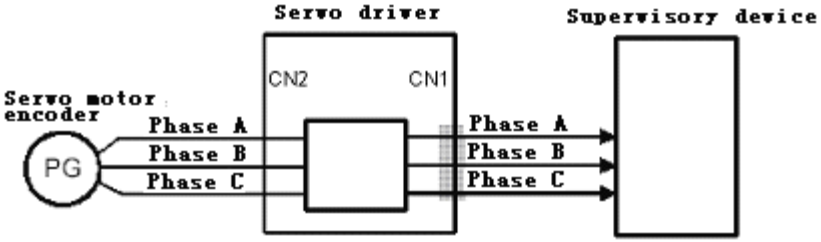
When CLE signal is in L level, clear the deviation counter:

- The internal deviation counter of the servo driver is "0".
- The position loop action is invalid

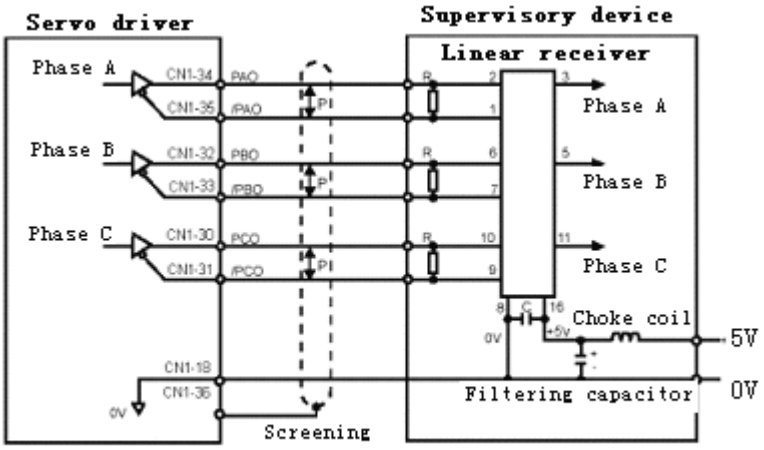
During position control, when the servo is turned OFF, there would be remnant pulses, so the remnant pulse signals should be cleared when connecting the power supply again.

4.2.3 Encoder Signal Output

The output of the encoder goes through internal frequency division in the servo driver and then is output to the outside for the supervisory device to configure the position controlling loop.



The output circuit is the bus driver output. Please conduct connection in reference to the following circuitry



■Output signal

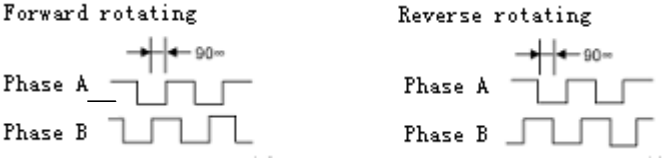
The output encoder signal.

Output → PAO CN1- 34	The encoder outputs phase A	Speed and torque control, position control
Output → /PAO CN1- 35	The encoder outputs phase /A	Speed and torque control, position control
Output → PBO CN1- 32	The encoder outputs phase B	Speed and torque control, position control
Output → /PBO CN1- 33	The encoder outputs phase /B	Speed and torque control, position control

Output → PCO CN1- 30	The encoder outputs phase C	Speed and torque control, position control
Output → /PCO CN1- 31	The encoder outputs phase /C	Speed and torque control, position control
Output → SG CN1- 18	Signal grounding	

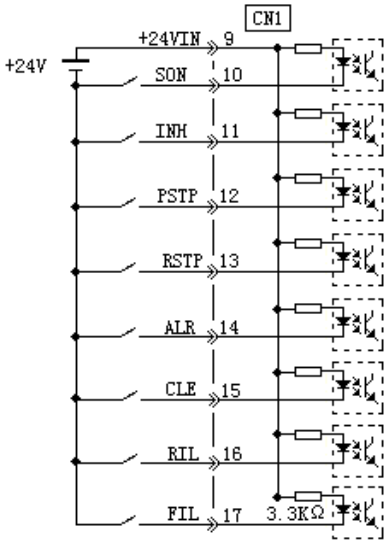
When using the supervisory device to configure the position loop and conduct position control, please do connect SG to the 0V part of the main control device.

The output signal shapes are shown in the following figure:



■Connection of the Input Signal

Please connect the sequential input signals according to the following method.



Note

Please prepare an external 24V I/O power supply, for the servo driver has no internal 24 power supply.

• External power supply specification: DC24V±1V，over 50mA.

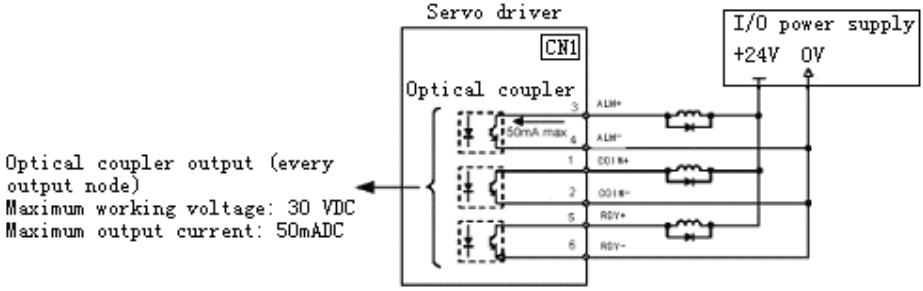
The same power supply is recommended to be used for the input and output circuits. Furthermore, the voltag range of the moveable +24V power supply of the sequenctial input circuit is +11V～+25V.

The +12 power supply can be used too, but bad contact would occur at the mechanical connecting points such as the relay when the current is very low.

Please use it after confirming the characteristics of the relay, etc.

→ Input +24VIN CN1- 9	External I/O power supply input

■Connection of the output signals of the nodes

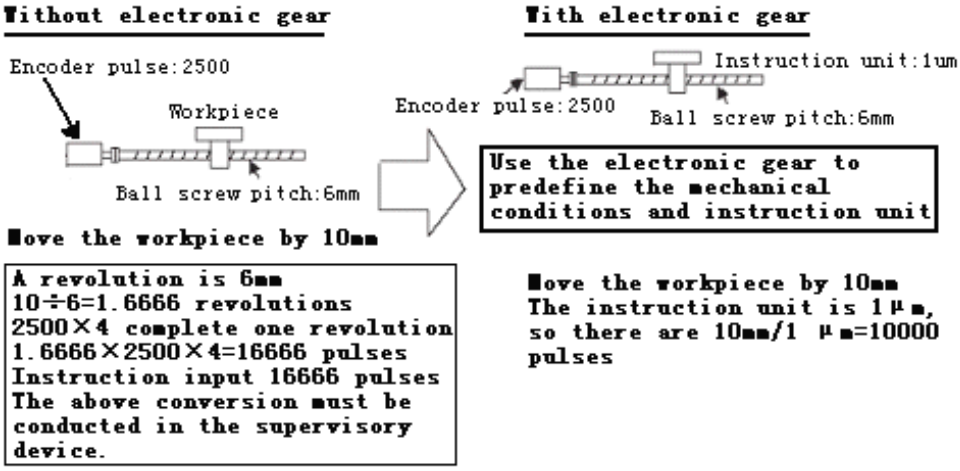


Note

Please prepare an external 24V I/O power supply, for the servo driver has no internal 24 power supply. The power supply is recommended to be the same as that of the input circuit.

4.2.4 Electronic gear

Use the “electronic gear: function to set the motor moving distance corresponding to the input instruction pulse to random values. The supervisory device which gives instruction pulses can be controlled without concerning the mechanical speed reducing ratio or the amount of encoder pulses.



■The setting method of the electronic gear

Calculate the electronic gear ratio (B/A) according to the following steps, and set this value in the user's parameters "PA18, PA19".

a. Confirm the type of the mechanism

Factors that are relevant to the electronic gear

- Speed reducing ratio
- Ball screw pitch
- Belt pulley radius

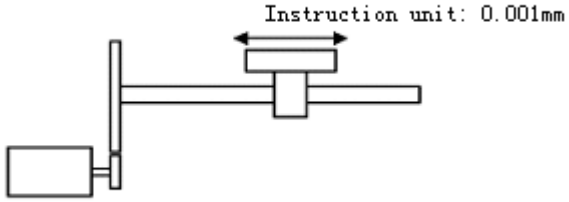
Confirm the amount of encoder pulses of the servo motor.

b. Decide the instruction unit

The instruction unit is the minimum position unit of the movement of load. (The minimum unit of the supervisory device's instructions).

- 0.01mm，0.001mm，0.1°，0.01 inch, input the instruction of 1 pulse, and move 1 instruction unit.
- When the instruction unit is 1 um, the amount of input instruction pulses is 50000, and the moving distance must be 50000×

The working table is moved with the instruction unit of 0.001mm



Please decide the instruction unit in view of the type of mechanism and positioning precision, etc.

1um=50mm

c. Use the instruction unit to calculate the moving distance of the bearing axle in one revolution.

The moving distance of the bearing axle in one revolution (instruction unit)= the moving distance of the bearing axle in one revolution/instruction unit

• When the ball screw pitch is 5mm, and the instruction unit is 0.001mm, then 5/0.001 = 5000 (instruction unit)

Ball screw	Swivel table	Belt pulley
Bearing axle, P, P: Pitch 1 revolution = P / Instruction unit	Bearing axle 1 revolution = 360° / Instruction unit	Bearing axle, πΔ, D: Diameter of the belt pulley 1 revolution = πD / Instruction unit

d. Calculate the electronic gear ratio (B/A)

The speed reducing ratio between the motor axle and bearing axle is n/m. (When the motor rotates m revolutions, the bearing axle rotates n revolutions.)

The electronic gear ratio (B/A)= amount of encoder pulses × 4 / moving distance of one revolution of the bearing axle×（m/n）

Note:

Please confirm whether the following conditions are met:

0.01≤electronic gear ratio (B/A)≤100

If the range is exceeded, the servo unit cannot act properly, and please alter the mechanism and the instruction unit.

e. Set as the user's constant

When the electronic gear ratio (B/A) is calculated, choose two integers smaller than "32767" for A and B, and set it as a user's constant.

The setting of the electronic gear ratio ends.

Parameter	Name	Unit	Range	Ex-factory value
PA19	Electronic gear A (denominator)	--	1~32767	1
PA18	Electronic B (numerator)	--	1~32767	1

Set the gear ratio of the electronic gear to cooperate with the setting of mechanical type.

Electronic gear ratio（B/A）= PA18 / PA19

- B = amount of encoder pulses × 4×rotate speed of the motor axle
- A = instruction unit (moving distance of the bearing axle in one revolution × rotate speed of the bearing axle

Furthermore, please pay attention to the following restriction of the set values.

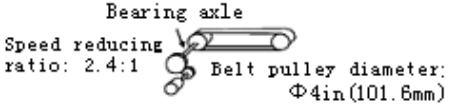
0.01≤ Electronic gear ratio（B/A）≤100

■Electronic gear setting example

The various settings of the loading mechanism are shown in the following example:

Belt pulley

Instruction unit: 0.0010in(0.0254mm)



Absolute encoder: 2500P/R

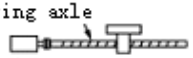
$$\text{Moving distance of the bearing axle in one revolution} = \frac{3.1416\times 4\text{in}}{0.0010\text{in}} = 12566$$

$$\text{Electronic gear ratio} = \left(\frac{B}{A}\right) = \frac{2500\times 4\times 2.4}{12566} = \frac{PA18}{PA19}$$

Set value	PA19	3142
	PA18	6000

Ball screw

Instruction unit: 0.00004 (0.0001mm)



Increment encoder: 2500P/R

Ball screw pitch: 0.24in(6mm)

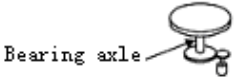
$$\text{Moving distance of the bearing axle in one revolution} = \frac{6\text{mm}}{0.0001\text{mm}} = 60000$$

$$\text{Electronic gear ratio} = \left(\frac{B}{A}\right) = \frac{2500\times 4\times 1}{60000} = \frac{PA18}{PA19}$$

Set value	PA19	6
	PA18	1

Round swivel table

Instruction unit: 0.1^0



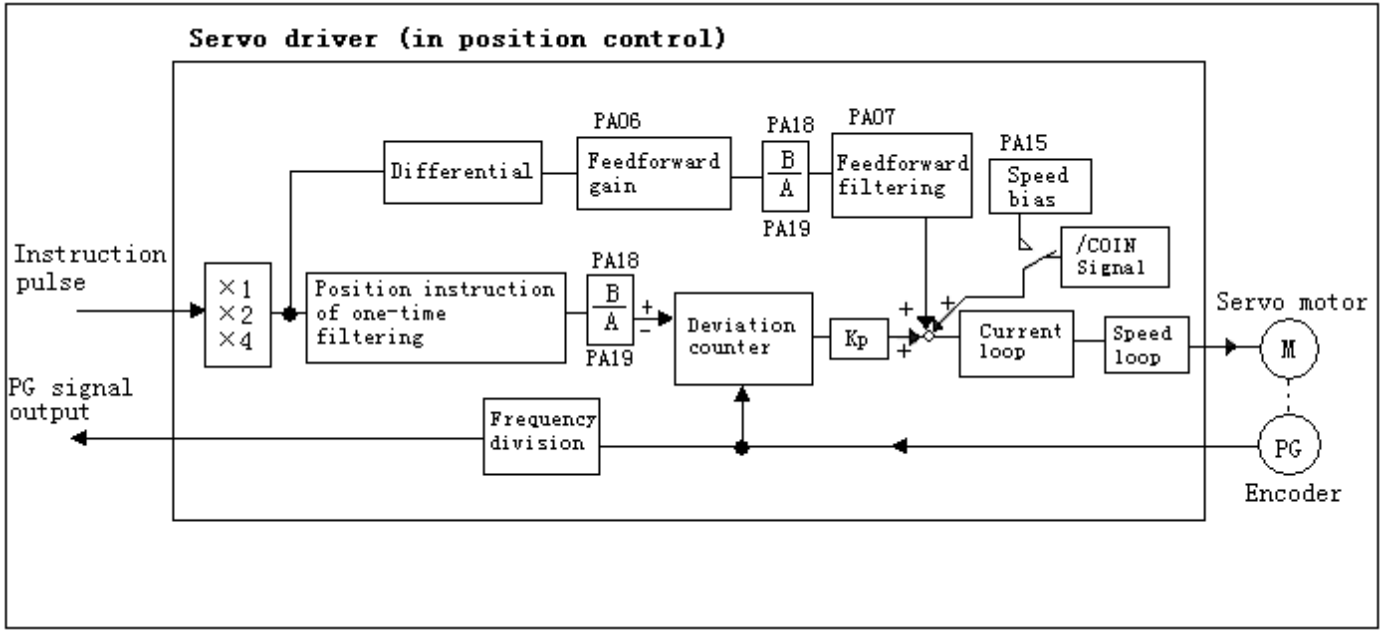
$$\text{Moving distance of the bearing axle in one revolution} = \frac{360^0}{0.1^0} = 3600$$

$$\text{Electronic gear ratio} = \left(\frac{B}{A}\right) = \frac{2500\times 4\times 3}{3600} = \frac{PA18}{PA19}$$

Set value	PA19	9
	PA18	75

■Block diagram of the control

The block diagram of the position control is shown in the following figure for your reference.



4.3 The parameter setting table

Table 4.1 The parameter table

Para No.	Parameter name	Application	Range of the parameter	Factory set	Unit	Additional remarks
PA-01	Control mode		1～5	1		You may select a mode of controlling the drivers using these parameters. 1. The mode of position control (QS5AA015B/20B/30B/20M/30M/50M); 2. Analog speed control (QS5AA020M/30M); 3. The mode of speed test run (QS5AA015B/20B/30B/20M/30M); 4. The mode of controlling JOG test run. (Optional); 5. I/O point control mode, ALR, CLE, INH to select one of the 8 speeds for PA51-58; Under the position control mode, the velocity command is inputted via the the input port' pins, and the velocity depends on the postive and negative levels (±10V); the speed test run control mode operates in the state of SPEEDTEST; the JOG test run control mode operates under JOGTEST
PA-02	Speed loop proportional constant (in Middle high-speed mode)		10～1000	200		The proportional constant for the velocity loop is used to set the velocity loop regulator's proportional gain. The higher value brings the higher gain that determines the higher stiffness of the system. The parameters are set based on the loading condition and the driver's default, and should be maximized when the system is not oscillating.
PA-03	Speed loop integral constant(in Middle high-speed mode)		10～1000	100		The integral constant for the velocity loop is used to set the velocity loop regulator's integration time constant. The higher set value brings the higher stiffness. The higher load inertia determines the higher set value. The parameters should be set based on t

						he loading condition and the driver's default, and maximized when the system is nonoscillating.
PA-04	Acceleration time constant		6～1530	6	ms	The acceleration time constant is used to set the motor's acceleration time ranging from 0rpm to 1000rpm.
PA-05	Deceleration time constant		6～1530	6	ms	The deceleration time constant is used to set the motor's deceleration time ranging from 0rpm to 1000rpm.
PA-06	Position loop gain	Position control	40～500	160		The position loop gain is used to set the position loop regulator's proportional gain. The higher value determines the higher gain, the higher stiffness and the shorter position delay at the same-frequency command pulse. Over high value may result in oscillation or overshoot.
PA-07	Position loop feedforward gain	Position control	0～100	10		The position loop feedforward gain is used to set the position loop feedforward's gain. The higher value determines the shorter position delay, and the lower value determines the slower response.
PA-08	Display power on	Position control	1～15	1		The default value is used to set the driver's information displayed at starting up.
PA-09	Position command pulse mode	Position control	1～2	1		The pulse mode selection is used to set the driver's default mode of the position loop pulse input. 1 is command pulse + direction, and 2 is CW and CCW dipulse system.
PA-10	The position co	Position	1～2	1		The position command pulse's negative direction is used for the motor'

	mmand pulse's negative direction	control				s negative direction.
PA-11	Over position warning level	Position control	1～3000	900	*10pulse	The over position warning level is used to set the over position pulse regime under the mode of position control. If the motor's actual follow error is higher than the value, and PA12＝1, the driver will give Err-9 warning.

No.	Parameter name	Application	Range of the parameter	Factory set	Unit	Additional remarks
PA-12	Over position warning select	Position control	1～2	1		Disengage the position error warning select. The over position warning select does not actuate the driver's warning while the parameter is set to 2 or 11.
PA-13	The motor's maximum speed		0～3000	2000	Rpm	The maximum speed is used to set the driving system's max running speed. The speed is independent of the direction.
PA-14	Velocity command low pass filter	Analog control	4～10	8		Under the mode of analog velocity control (PA=2), the velocity command low pass filter
PA-15	Analog velocity command Zero adjustment	Analog control	3000～-3000	60		Command zero adjustment of the analog velocity input.
PA-16	Velocity command gain/torque command gain	Analog control	1～100	24		This is used to set the proportional relations between the input analog voltage and the actucal running velocity (Mode 2); or set the proportio

						nal relations between the input analog voltage and the motor's actual torque (Mode 6).
PA-17	Velocity command negative direction	Analog control	1～2	2		Control the motor's negative direction in the analog velocity control.
PA-18	Electronic gear 1	Position control	1～32767	1		The electronic gear 1 is used to set the ratio of the position command pulse's frequency dividing and frequency multiplication with PA-19. Under the mode of the position control, it provides easy connection with control systems by setting PA-18 and PA-19 to achieve better resolution, viz. angle-pulse relations.
PA-19	Electronic gear 2	Position control	1～32767	1		The electronic gear 2 is used with PA-18.
PA-20	Over load parameter		1.0～3.0	2.0		The over load parameter is used to limit the maximum torque of the motor operation under the modes of position and velocity, namely the overload factor.
PA-21	The maximum velocity under the torque control mode		10~25	20		The motor's max velocity under the torque control mode
PA-22	Position command low pass filter	Position control	0～200	120		Under the mode of position control (PA1=1), the velocity command low pass filter
PA-23	Encoder alarm On/Off		1~2	1		The encoder alarm On/Off is used to engage alarm of No. 30 when PA23 is set to 1 or to disengage alarm of No. 30 when PA23 is set to 2.
PA-24	Inter parameter					The velocity loop integral constant at ultra low speed (F<10), usually P

						A24 = PA40; (The parameter is unavailable under the position control mode)
PA-25	Inter parameter					
PA-26	Standby					

Parameter No.	Parameter name	Range of the parameter	Factory set	Unit	Additional remarks
PA-27	Enable singal on/off and alarm level selection	0~3	0		The enable singal On/Off and alarm level selection The first digit number is used to turn on/off the enable signal: 0 represents outer Enable, and 1 represents inter Enable. The second digit number is used to select the alarm signal output level: 0 activates Low, and 1 activates High When PA27 is set to 0: The outer enable signal is activated, with active Low for alarm signal output. When PA27 is set to 1: The inter enable signal is activated, with active High for alarm signal output. When PA27 is set to 2: The outer enable signal is activated, with active High for alarm signal output. When PA27 is set to 3: The inter enable signal is activated, with active High for alarm signal output.
PA-28	Position complete scale	0~3000	10	Pulse	The position complete scale provides the information depending on which the drive

					r can determine whether the position is completed under the position control mode. If the afterpulse's value of the position error counter is lower than that of the parameter, the driver determines the position is completed. The position completion signal COIN ON appears, or else COIN OFF.
PA-29	Current loop proportional constant	50～5000	2400		Usually, the current loop proportional constant cannot be edited by a client.
PA－30	Current loop integral constant	300~2000	1500		Usually, the current loop integral constant cannot be edited by a client.
PA－31	Inter parameter				
PA-32	Velocity loop proportional gain addition value	0~100	13		The addition value of the velocity loop proportional gain can be regulated to change the stability of low velocity, but over low value may make the motor creeping.
PA-33	The motor's rated current	0~9.0	6.5	Amp.	The motor's rated current
PA-34	Standby				
PA-35	Motor modes	1~18			The motor mode: PA35 = 3: ACH, the motor with four pairs of 2500 lines PA35 = 5-14: ACS, the motor with two pairs of 2500 lines PA35 = 17: ACM, the motor with four pairs of 2500 lines Others: The manufacturer reserves the rest motor modes
PA-36	The minimal velocity loop proportional constant (low	1~500	100		The minimal value of the velocity loop's proportional constant can be regulated to change the stability of low velocity, but over low value may make the motor

	velocity)				creeping.
PA-37	Variable rate of the velocity loop integral constant	0~100	10		The variable rate of velocity loop integral constant can be regulated to change the stability of low velocity, but over low value may make the motor creeping.
PA-38	The correspondence between the motor and IPM module	1~5000	20B:601 30B:1202		The correspondence between the motor and IPM module QS5AA015M，QS5AA020M：PA38=3874/PA33 QS5AA030M：PA38=7748/PA33 QS5AA050M：PA38=10874/PA33
PA-39	The electric current loop integral constant (low velocity)	1~5000	1		The electric current loop integral constant (low velocity), PA39 = (1/10~1/3); (Under position control mode, PA39 = 1)
PA-40	The minimal velocity loop integral constant (low velocity)	1~1000	50		The minimal velocity loop integral constant can be regulated to change the stability of low velocity, but over low value may make the motor creeping.
PA-41	Delete the historical alarm log	1/2	1		1: save the historical alarm log; 2: delete the historical log;
PA-44	Position mode, the percentage of torque setting	5-100	5		Position control mode, torque Rated torque to reach the percentage of the module after the COIN + and COIN-output a 100ms turn-off pulse (normal for the conduction).
PA-45	Position mode, the output torque alarm	10-100	10		Position control mode, the percentage of torque to reach the module rated torque output of 47, after the alarm.
PA-43	The electric current loop's maximum current parameter	1000-8190	8190		Over high running torque coefficient may be cause to the current alarm;
PA-49	Overrun-prevention level	1/2	1		1: active High; 2: active Low
PA-50	Servo is ready for output state	1/2	1		RDY for output state before the servo is ON.

	(RDY)				1: RDY for high output; 2: RDY for low output
PA-51	Outer velocity control V1	-3000 - 3000	0	RPM	The velocity (ALR, CLE, INH) = (0, 0, 0)
PA-52	Outer velocity control V2	-3000 - 3000	0	RPM	The velocity (ALR, CLE, INH) = (0, 0, 1)
PA-53	Outer velocity control V3	-3000 - 3000	0	RPM	The velocity (ALR, CLE, INH) = (0, 1, 0)
PA-54	Outer velocity control V4	-3000 - 3000	0	RPM	The velocity (ALR, CLE, INH) = (0, 1, 1)
PA-55	Outer velocity control V5	-3000 - 3000	0	RPM	The velocity (ALR, CLE, INH) = (0, 0, 0)
PA-56	Outer velocity control V6	-3000 - 3000	0	RPM	The velocity (ALR, CLE, INH) = (1, 0, 1)
PA-57	Outer velocity control V7	-3000 - 3000	0	RPM	The velocity (ALR, CLE, INH) = (1, 1, 0)
PA-58	Outer velocity control V8	-3000 - 3000	0	RPM	The velocity (ALR, CLE, INH) = (1, 1, 1)
PA-59	ALR definition	1/2	1		1: ALR is defined as deletion of alarm; 2: ALR is defined as selection of velocity
PA-60	Torque gain				0: adopt the outer analog to control the torque output; non 0 values: output the torque's preset value (the torque value is independent of the outer analog).

4.4 Fast position

4.4.1 Settings for servo gain

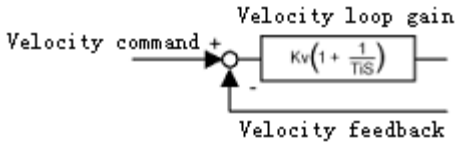
■ Settings for velocity loop gain

As a velocity loop gain constant, the following parameters are set as required.

Parameter	Item	Unit	Setting range	Factory set
PA02	Velocity loop gain (K_v)		10~1000	200
PA03	Velocity loop integration time constant (T_i)		10~1000	100

The table gives the velocity loop gain and integration time constant for the servo driver.

Higher velocity loop gain or lower velocity loop integration time constant can better facilitate control of the quick responsive velocity, but is subject to the mechanical features.



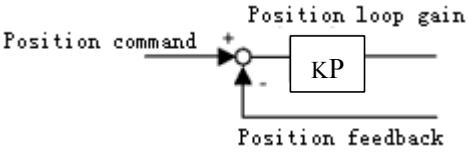
■Settings for position loop gain

As a position loop gain constant, the following parameters are set as required.

Parameter	Item	Unit	Setting range	Factory set
PA006	Position loop gain (kp)	1/s	40~500	160

The table gives the position loop gain.

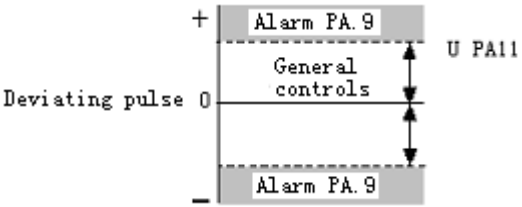
Higher position loop gain can better facilitate quick responsive and low-deviation position control, but is subject to the mechanical properties.



The gain is also active in QS5 servo driver at zero clamping

Parameter	Item	Unit	Setting range	Factory set
PA11	Overflow value setting for the deviometer	Command unit	1～3000	1000

Set the deviating pulse for the deviating pulse overflow alarm (alarm 9).

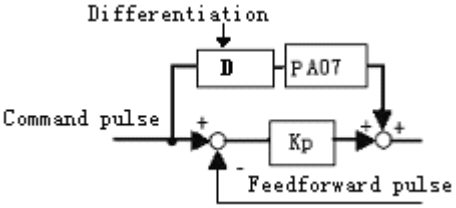


■Feedforward

Set the user constants as below. The positioning time may be shortened through "feedforward control".

Parameter	Item	Unit	Setting range	Factory set
PA07	Position feedforward gain		0~100	10

In the servo unit, feedforward compensation for the position control is given to shortern the positioning time. But over high value may be cause to the motor oscillation. 80% or lower is recommended for the conventional motors.



Chapter V

How to use the panel manipulator

5. 1 Button definition

The buttons are defined as below:
MODE for Exit; DEC for Decrease;
INC for Increase; ENTER for Confirmation

5. 2 Keyboarding

The driver panel comprises 6 digital LEDs and 4 buttons for display of the system's states and parameters. The button functions are given as follows:

INC: Increase the serial number and the numerical value, or move forwards.
DEC: Decrease the serial number and the numerical value, or move backwards.
MODE: Return to the previous menu, or cancel operation.
Enter: Access the next menu, or input validation.

【Note】 In operation, repeat the operation by pressing and holding INC and DEC. The longer holding time causes the faster repetition.

- 6 digital LEDs can display all states and information of the system. All LEDs flashing is alarm for system failure.
- Multilevel menu is adopted. The first-level menue is used to display alarm or monitor the default parameter; the second-level menu provides five operation modes; the third-level menu is the function menu for each operation mode. The Diagram 5 gives the main menu's operating flow:
- The system can automatically detect the operating status and conditions at powering on. Any exception causes warning message; if the system is in working order, the user-customized value is

displayed (Refer to Parameter Specification PA-18). Pressing button Enter engages the main menu's operation mode through the first-level menu.

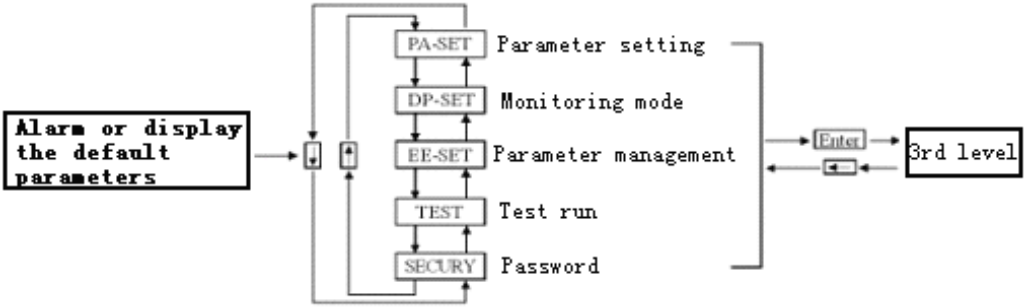
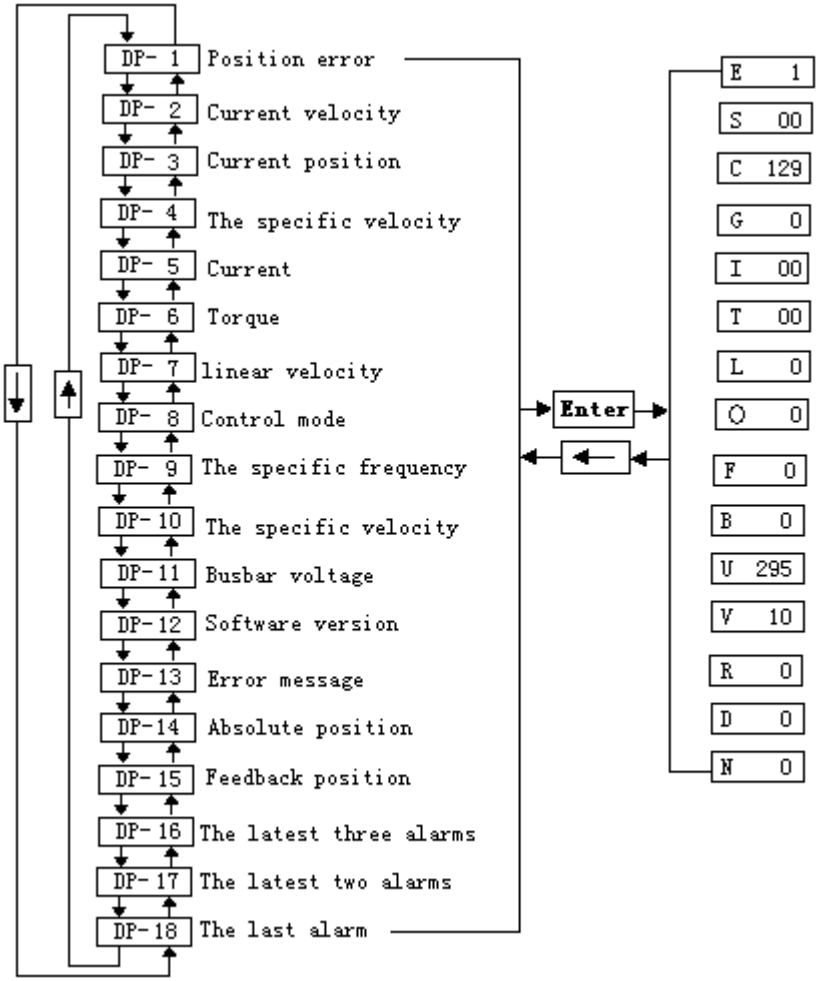


Diagram 5-1 Mode selection

5. 3Monitoring mode

Select "DP- SET" on the 1st level menue, and access the monitoring mode by pressing button Enter (See Diagram 6-2). There are 15 display modes. User may select one of them using button INC and DEC, and press Enter again to engage a specific display mode.



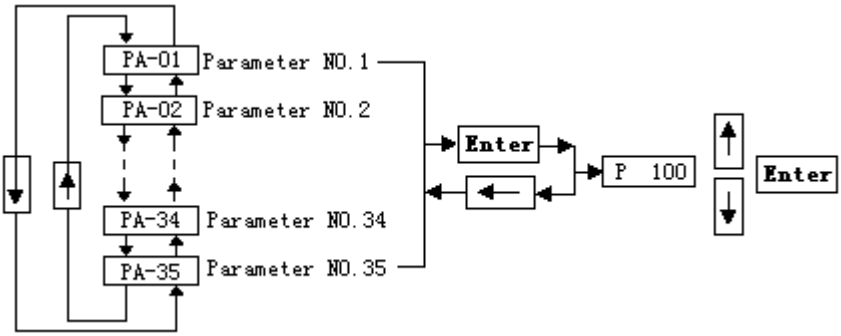
5-2 Diagram of the monitoring mode

5. 4Parameter setting

【Note1】 User must enter the correct user password on "S1-COD" under SECURY before set parameters, and then confirm it by pressing Enter. Then ,the parameter setting is effective immediately. Any error setting can the unit in improper operation that may result in accident.

【Note 2】 To avoid accident, never change the parameters 4, 5 (acceleration and deceleration time), 20 (torque limitation and positive direction)!

Select "PA- SET" on the 2nd menu, and press Enter to engage parameter setting mode (See Diagram 6-3). Select the parameter number using INC or DEC, and have the parameter value displayed by pressing Enter. Then, the parameter value can be changed using INC or DEC. Pressing INC or DEC once increases or decreases the parameter by 1. Pressing and holding button INC or DEC uninterruptedly increases or decreases the parameter. Upon change in the parameter value, letter "P" flashing on the leftmost LED, and pressing button Enter makes the change effective. At this point, "P" is displayed normally, and a new value is effective immediately in control. INC or DEC is also used to resume change of the parameter, and pressing MODE returns to Preferences after the parameter is changed. If any value is to be revised, pressing MODE cancels the previous operation to restore the parameter, and returns to Preferences.



5-3 Diagram of parameter setting

5. 5Parameter management

【 Note1 】 If no write operation to the changed parameter is executed, the parameter set will be lost by power off.

【Note2】 Before parameter management, user must enter its correct password on the password menue (See 6.6) for EEPROM operation. (On the standard configuration, the password is inoperative)

The parameter management is used to process memory and EEPROM. Select "EE-SET" on the first level, and engage the parameter management mode by pressing Enter. See Diagram 6-4. First of all, engage selecting operation mode that comprises 3 sub modes. User may select one of them by using INC or DEC.

In parameter write-in operation, select "EE-rt", and then press Enter. At this point, "EE-NO" is displayed, and leftmost letter "E" is flashing. Next, select "EE-YES" by pressing INC or DEC. Then "E" displays normally. Finally, pressing Enter again has "E" displayed for 4 seconds. This indicates that the parameter is writen in EEPROM. After write-in operation, "FINISH" is displayed. Then, pressing MODE returns to the operating mode selection.

"EE-rt" parameter write-in: write the parameter in the memory into the EEPROM parameter block. The parameter in the memory is changed due to change in the parameter by user, and restored to the original value upon next power on. If user wants to save the changed parameter value on permanent basis, the parameter write-in operation is required. Write the parameter in the memory into EEPROM parameters.

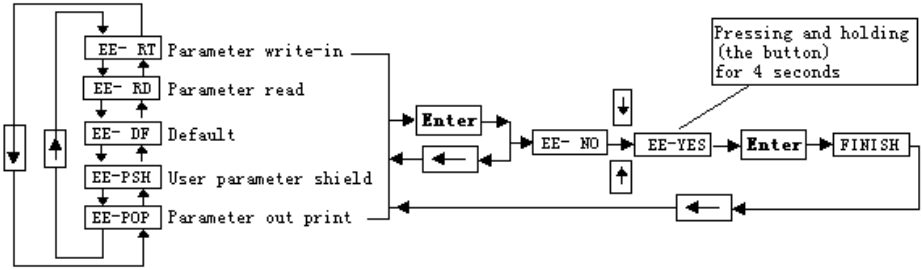
"EE-rd" parameter read: read the EEPROM parameter data in the memory. Read automatically executes once power on. At the beginning the parameter value in the memory is different from that in EEPROM parameters. But user can change the parameter value in the memory through change of parameter. When user need revise the parameter or the parameter changes by accident, user may restore it by executing parameter Read to read the parameter data into the memory again.

"EE-df" default: read all parameter's default values into the memory, and write them into EEPROM parameters. The default parameter will be effective upon next power on. When the parameter is changed by accident, and fails, this

operation can restore all parameters to the factory set. Different driver has different default values. So, the correct type of driver (Parameter No. 1) must be ensured for the default parameter.

♀ "EE-psh" user parameter shield is designed to protect the motor's parameter. For example, when user is satisfied with the previous-changed parameter, she/he can save such parameter into EEPROM on permanent basis by this operation (Note: only one group of data can be saved. After execution of this operation, the previous-saved parameter will be overwriten).

♀"EE-pop" user parameter out print: the operation is designed to restore user's parameter with "EE-PSH" (directly import the data from EEPROM into a working space). If user does not save the working parameter, execution of "EE-pop" such as Restart will empty the working space, and "EE-DF" must be executed to reset values.



5-4 Diagram of parameter management

5.6 Test run

【Note1】 Velocity and JOG test run on a no-load motor is recommended in order to prevent accident;

【Note2】 During test run, driver SON (Servo Enable) must be operative, with inactive CCW and CW drive inhibit feature;

Note 3: During speed test run, user can keep the system key scroll repeating at a constant speed by pressing and holding INC or DEC (for protection of the motor).

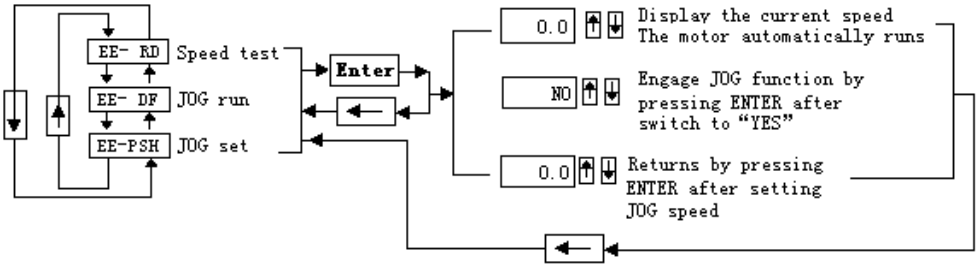
Select "TEST" on the first level, and engage test run mode by pressing Enter. The test run includes speed test run "SPDTST", JOG value set "JOGSET" and JOG test run "JOGTST". User may select them by pressing INC or DEC, and then

go to settings by pressing Enter.

"SPDTST" speed test run: the unit of value is R/MIN. The system engages velocity control mode, and the velocity command is sent by INC (Increasing) and DEC (decreasing). The motor runs at the specified speed. When the speed is positive value, the motor corotates; when the speed is negative, the motor counter rotates.

"JOGSET" speed setting under JOG mode: the unit of value is R/MIN, and the initial value is "0.0". User may set a velocity as required by using INC (Increasing) and DEC (decreasing). A positive value drives the moter to corotate; a negative value drives the motor to counter rotates.

"JOGTST" JOG run: user can engage JOG mode by pressing Enter. The initial value displayed is "NO". Pressing INC or DEC switches it to "YES", and then pressing Enter each time makes the motor run once at the speed preset on "JOGSET". Pressing and holding Enter, the motor uninterruptedly runs at such speed until the button is not ressed.



5-5 Diagram of test run

Chapter VI

Error or alarm and processing

【Note1】 Servo drives and motors at least 5 minutes after power failure in order to touch the drive and motor to prevent electric shocks and burns.

【Note2】 Resume the driver only when the trouble is removed in accordance with the alarm codes after the fault alarm is raised;

【Note3】 Before restoration alarm, make sure that SON (Servo Enable) signal is inoperative in order to prevent the motor from failure by sudden start.

Where the error alarm is raised, Err-xx flashes on the first level before the parameter is operated. xx is alarm code. If the menu is in operation, the displayed information flashes. Press and hold EXIT until Err-xx is displayed.

Where the alarm is raised, please do not use the unit until the fault is cleared.

6.1Alarm definition table

Alarm definition table

code	Alarm definition	Information
--	Normal	
3	Main circuit overvoltage	The main circuit's supply voltage is over high
4	Main circuit undervoltage	The main circuit's supply voltage is too low
6	The motor overspeed	The motor speed is over high
8	The input pulse frequency is over high	The specific frequency for the position loop is higher than the set value
9	Position error	The position error is out of the setting range
11	Overcurrent protection	The load current is over high
14	write-in EEPROM error	Error occurs in write-in EEPROM

15	FPGA configuration error	Error occurs with configuring FPGA parameters
17	Overload protection	Servo driver and motor are over loaded
20	EEPROM read error	Error occurs with reading EEPROM parameters
23	Braking fault	Braking circuit fault
25	Encoder UVW error	There is overall high or low level with UVW signal
27	IPM alarm	IPM undervoltage or overcurrent protection
30	Encoder fault	Disconnection or open-phase in the encoder
32	Overrun protection	Overrun protection alarm
47	Torque Protection	Set the torque is greater than the percentage of

6.2 Alarm processing

☞ Alarm processing

code	definition	Running status	Cause	Processing method
3	Main circuit overvoltage	Occur with connection to the control power supply	1) Circuit board fault	1) Replace servo driver
		Occur with connection to the primary power supply	1) The main circuit's supply voltage is over high 2) The supply voltage waveform is not normal	1) Inspect your EPS
		Occur with the motor running	1) Disconnect the braking resistor wire	1) Rewiring
			1) The braking transistor is spoiled 2) The inter braking resistor is spoiled	1) Replace the servo driver

			1) Short capacity of the braking loop	1) Lower the start-and-stop frequency 2) Increase the acceleration/deceleration time constant 3) Lower the torque limitation 4) Decrease the load inertia 5) Repace with higher-power driver and motor
4	Main circuit undervoltage	Occur with connection to the primary power supply	1) Circuit board fault 2) The power supply safety failure 3) Soft startups circuit fault 4) The rectifier is spoiled	1)Replace the servo driver
			1) Low supply voltage 2) Power failure for 20mS or longer	1) Inspect the power supply
		Occur with the motor running	1) Short power supply 2) Transient power down	1) Inspect the power supply
			1) Overheating radiator	1) Inspect the loading condition
6	The motor overspeeds		1) The encoder wiring error	1) Inspect the connection
			1) The encoder is spoiled	1) Replace the motor
			1) Bad encoder's cable	1) Replace the cable
			1) Overlong encoder's cable causes low power supply voltage	1) Shorten the cable 2) Adopt multi-cord line for relevance power supply
8	The input pulse frequency is over high	Occur with connection to the control power or the motor running	1) Dot circuit board fault	1) Replace the servo driver
			1) Overhigh frequency	1) Lower the control frequency

9	The position deviation overflows		1) The motor is mechanically stuck 2) Exceptional Input Order pulse	1) Inspect the loaded mechanical parts 2) Inspect the command pulse 3) Make sure that the motor rotates by the command pulse
11	Overcurrent		1) Driver U, V and W short circuit	1) Inspect the connection
			1) Imperfect earth	1) Correct the grounding
			1) The motor's insulation deterioration	1) Replace the motor
			1) The driver is spoiled	1) Replace the driver
			1) The input electronic gear ratio is over high	1) Correct the setting
			1) The encoder fault	1) Replace the servomotor
			1) Bad encoder's cable	1) Replace the encoder's cable
			1) Instable servo system causes overshoot	1) Reset the gain 2) Decrease the load moment of inertia ratio if the gain cannot be set to a proper value
14	Write-in EEROM error		1) The chip or circuit board is spoiled	1) Replace the servo driver
15	FPGA configuration error		1) The chip or circuit board is spoiled	1) Replace the servo driver
17	Excess load	Occur with connection to the control power supply	1) Circuit board fault	1) Replace the servo driver

		Occur with the motor running	1) Higher than the rated torque	1) Inspect the load 2) Set the frequency lower 3) Set the torque limitation lower 4) Repace with a higher-power driver and motor
			1) Keep the brake idle	1) Inspect the brake
			1) The motor unsteadily oscillates	1) Adjust the gain 2) Increase the acceleration/deceleration time constant 3) Decrease the load inertia
			1) One-phase disconnection in U, V and W 2）The encoder wiring error	1) Inspect the connection
20	Read EEPROM error		1) The chip or circuit board is spoiled	1) Replace the servo driver
23	Braking fault	Occurs with connection to the control power supply	1) Circuit board fault	1) Replace the servo driver
		Occur with the motor running	1) Disconnect the braking resistor wire	1) Rewiring
			1) The braking transistor is spoiled 2) The inter braking resistor is spoiled	1) Replace the servo driver

			1) Short capacity of the braking loop	1) Set the start-and-stop frequency lower 2) Increase the acceleration/deceleration time constant 3) Set the torque limitation lower 4) Decrease the load inertia 5）Repace with a higher power driver and motor
			1) The main circuit's supply voltage is over high	1)Inspect the main power supply
25	Encoder UVW error		1) The encoder is spoiled 2) The encoder wiring error 3) Bad earth	1) Replace the motor 2) Inspect the connection 3) Correct the grounding
27	IPM alarm		1) The voltage is too low 2) The motor's current is over high	1) Inspect AC input 2) Decrease the acceleration 3) Replace the motor
30	Encoder fault		1. The encoder is spoiled 2. The encoder wiring error	1) Replace the motor 2) Inspect the cable
32	Overrun protection		1. Overrun tact switch	1) Inspect the state of overrun switch

Chapter VII

Debugging Method

7.1 Position Control Debugging Method

1) Set the PA35 parameter and make the servo driver match with the servo motor in the condition that the motor is not wired firstly.
2) The position loop gain PA6 and position loop feed-forward coefficient PA7 need not be modified and the default value can be used in general condition, for that the rigidity of position loop is adequate.
3) The user shall modify the PA33 parameter according to the rated current of matching motor. This parameter will influence the over-current protection value, overloading protection value and PA38 value.
4) Calculation of PA38:

   QS5015M: PA38=3874/PA33;

   QS5020M: PA38=3874/PA33;

   QS5030M: PA38=7748/PA33;

   QS5050M: PA38=10874/PA33;

   The result will be input into the AC servo driver after being integared according to the above formula, and it will become effective after electrifying again.
5) Set the PA18 and PA19 electronic gear ratio based on the actual transmission ratio. The user is suggested to set the electronic gear

ratio into the AC servo driver rather than the step motor.

6) Rigidity Adjustment:

In general, the user just need adjust several ratio constants such as PA2, PA36, PA32 and PA29. The integral constants such as PA3, PA37, PA40 and PA30 need not adjust. The rigidity adjustment can usually be implemented in 3 steps:

①Firstly make the motor run several cycles per minute and use the micrometer or cent meter to test whether the move of worktable is equal or use the hand to feel whether the running of motor is stable, and then mainly the speed loop ratio gain PA36 shall be adjusted. Larger the motor is, heavier the loading is and tighter the assembly is, bigger the PA36 is, or the crawl or Err-17 overloading protection will occur. If PA36 is too big and the rigidity is too strong, the worktable will have the obvious hi-frequency vibration, and then the PA36 shall be decreased.

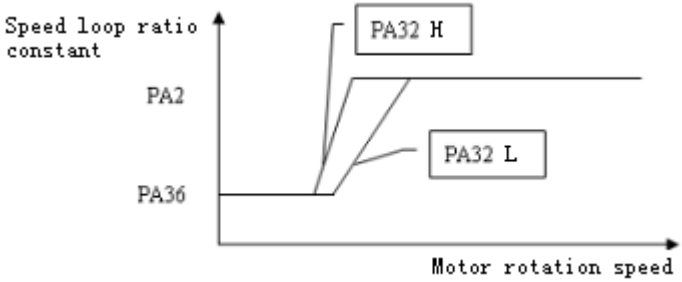
②Make the motor run over 10 cycles per minute after the low speed is adjusted, and then adjust the value of PA2 to make the worktable run with equal speed and without any noise. If it fails, please decrease the value of PA29! In general:

PA2=PA36*(1.2~2)

③ Make the motor run within 10 cycles per minute after the above 2 steps are adjusted; if the vibration is great, please decrease the value of PA32; if it crawls, please increase the value of PA32 to increase the rigidity.

The relation between the speed loop ratio constant PA2, PA36 and PA32 is as shown in the following figure:

Note: The relation between the speed loop integral constant PA3, PA37 and PA40 is similar to this figure.



1. If you hope that the servo motor can be locked once being electrified or does not use the external enable signal, please set PA27 as 1 or 3;

The options of enable signal of the first control motor of PA27: 0: external enable; 1: internal enable.

The options of the second control alarm signal output level of PA27: 0: effective in low level; 1: effective in high level.

2. If the equipment does not earth reliably or locates at the occasion with transducer and the Err-30 alarm of driver occurs frequently, it is suggested to set PA23 as 2 to shield the occurrence of coder alarm.
3. The powerful wire such as the 380V input wire in the electricity box, the U, V and W output wire of transducer and the U, V and W output wire of AC servo shall keep away from the signal wire of AC servo and even can not bind together with it, or there will be powerful interference to influence the normal work of AC servo.

Special Note: The PA38 shall be changed when changing PA33 because

the rated current is different when configuring the motor with different power.

7.2 Simulation Control Debugging Method

1) Set the corresponding PA35 parameter for different motor.
2) The user shall modify the PA33 parameter according to the rated current of matching motor. This parameter will influence the over-current protection value, overloading protection value and PA38 value.
3) Calculation of PA38（It is suggested to change this value when the rated current is changed）:

   QS5015M: PA38=3874/PA33;

   QS5020M: PA38=3874/PA33;

   QS5030M: PA38=7748/PA33;

   QS5050M: PA38=10874/PA33;

   The result will be input into the AC servo driver after being integared according to the above formula, and it will become effective after electrifying again.
4) Set the PA1 as 2 and the servo in speed mode, then the position control parameters such as PA6, PA7, PA18 and PA19 will be ineffective.
5) Zero-adjustment PA15: The servo and system shall be linked correctly at first; adjust the value of PA15 to make the motor still and the follow error of system in several impulses when the system is in zero speed in the condition that the motor is unloading.

6) Rigidity Adjustment:

a. Definition of relevant parameters:

PA14: the speed feedback lowpass coefficient, generally PA14=8~10 （ this coefficient is ineffective in the position control）;

PA24: the speed loop integral constant in superlow speed （ F<10 ） , generally PA24=PA40 （ this coefficient is ineffective in the position control）;

PA39: the current loop integral constant in low speed, PA39=（1/10~1/3）PA30（PA39=1 in the position control）;

b. The low speed rigidity can be increased by increasing PA24, PA36, PA39 or PA40; the PA36 is mainly increased in general condition.

c. The middle and high speed rigidity can be increased by increasing PA2, PA3, PA32 or PA37; the PA2 is mainly increased in general condition.

PA2=(1.2~1.5)*PA36

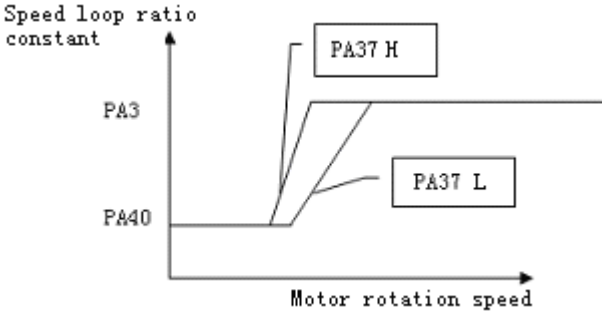
PA3>PA40;

PA32=13~30;

PA37=10~20;

The relation between the speed loop integral constant PA2, PA36 and PA32 is as shown as the following figure.

Note: The relation between the speed loop integral constant PA3, PA37 and PA40 is similar to this figure.



1) If you hope that the servo motor can be locked once being electrified or does not use the external enable signal, please set PA27 as 1 or 3;

   The options of enable signal of the first control motor of PA27: 0: external enable; 1: internal enable.

   The options of the second control alarm signal output level of PA27: 0: effective in low level; 1: effective in high level.

2) If the equipment does not earth reliably or locates at the occasion with transducer and the Err-30 alarm of driver occurs frequently, it is suggested to set PA23 as 2 to shield the occurrence of coder alarm.

3) The powerful wire such as the 380V input wire in the electricity box, the U, V and W output wire of transducer and the U, V and W output wire of AC servo shall keep away from the signal wire of AC servo and even can not bind together with it, or there will be powerful interference to influence the normal work of AC servo.

Chapter VIII

Electrifying and Running

【Note 1】 The driver and motor must earth reliably, and the PE terminal must link with the earthing terminal of equipment reliably.

【Note 2】 It is suggested that the driver power be supplied through the isolation transformer and source filter to guarantee the security and anti-jamming capacity.

【Note 3】 The power can be connected after the wire connection is checked and confirmed inerrably.

【Note 4】 An urgent stopping circuit must be connected to guarantee that the power can be stopped immediately upon the default.

【Note 5】 It must confirm that the default has been solved and the SON signal is ineffective before the restart after the driver default alarms.

【Note 6】 The driver and motor can not touch within 5 minutes after cutting the power to avoid electric shock.

【Note 7】 The temperature may increase after the driver and motor have run for a period of time to avoid burning.

8.1 Power Connection

Please refer to figure 8-1 for the power connection, and the power shall be connected according to the following sequence:

a. Connect the power into the primary circuit power input terminal

through the electromagnetic contactor（the terminal R, S and T shall be connected for 3-phase power, and the terminal R and S shall be connected for single-phase power）.

b. The power r and t controlling the circuit shall be connected before or when connecting the primary circuit power. If only the power controlling the circuit is connected, the servo shall prepare for the signal（SRDY）OFF.

c. 1.5 seconds will be delayed after the primary circuit power is connected, and servo shall prepare for the signal（SRDY）ON, and then the servo enable signal（SON）can be accepted. If the servo enable is checked to be effective, then the driver output is effective and the motor inspiring is in the running status; if the servo enable is checked to be ineffective or alarming, then the base circuit will be cut and the motor is in the free status.

d. The base circuit will be connected after about 1.5 seconds after the servo enable and power are connected at the same time.

a. The soft start circuit and energy-consumed braking circuit may be damaged if connecting and cutting the power frequently; the frequency of connection/cut shall be limited to 5 times/hour and 30 times/ day at best. If the driver or motor is overheated, then the power can be connected again after 30 minutes' cooling after ordering the default causes.

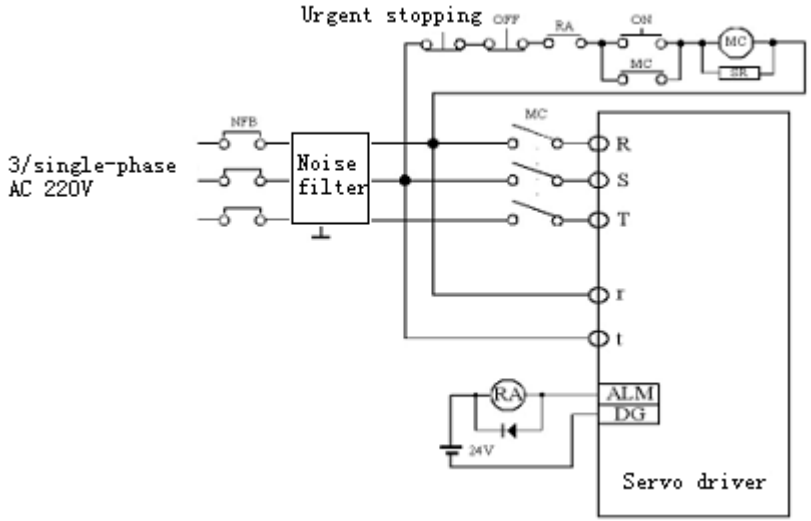


Figure 8-1 Power Connection Chart

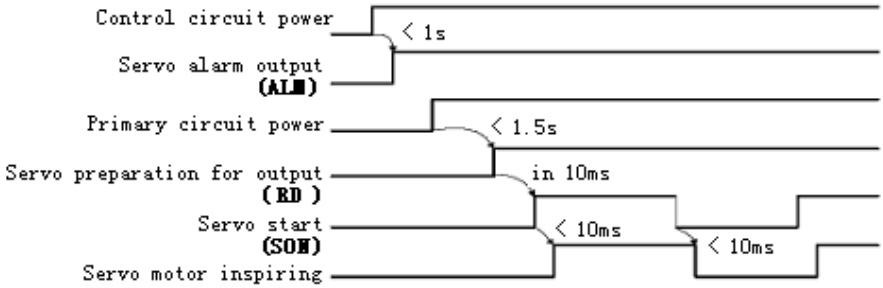


Figure 8-2 Power Connection Sequence Chart

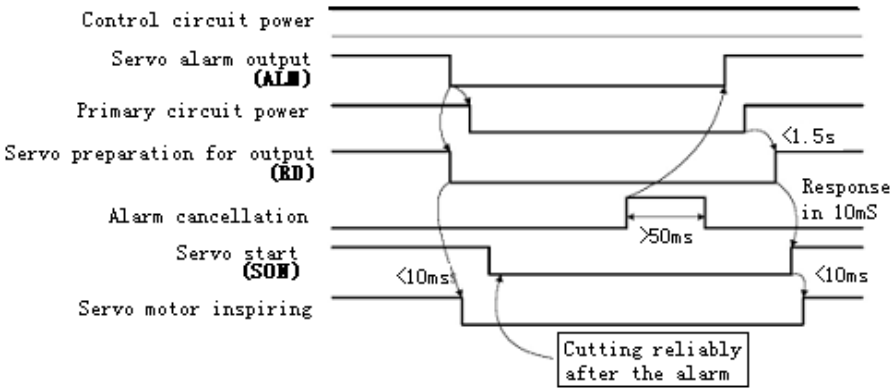


Figure 8-3 Alarm Sequence Chart

8.2 Trial Running

1） Inspection before Running

The following items shall be inspected before the electrifying after the installation and wire connection:

a. Whether the wire between the power terminal and TB wire is correct and reliable? Whether the input voltage is correct?

b. Whether the power wire or motor wire is in short circuit or earthed?

c. Whether the control signal terminal has been connected correctly? Whether the power polarity and capacity is correct?

d. Whether the driver and motor are fastened firmly?

e. Whether the motor axes is connecting with the loading?

2） Electrifying and Trail Running

※ Trail Running Mode

a. Connect CN2 and make the input control signal: servo enable（SON）OFF.

b. Connect the control circuit power（the primary circuit power need not

be connected temporarily）, the display light of driver will shine; if there is the alarm, please check the wire.

c. Set the control mode option （parameter PA_1） as the speed trail running mode（set the parameter as 3）.

d. Connect the primary circuit power.

e. Make the servo enable （SON）ON after confirming there is no alarm or any abnormal condition, and then the motor inspiring is in the zero speed status.

f. Enter into the speed trail running operation status by pressing the button; the prompt of speed trial running is “S”, and the numerical value unit is R/MIN, the system is in the speed control mode, and the speed instruction shall be provided by the button; the speed instruction can be changed by the button **INC** and **DEC**, and the motor will run in the given speed.

※ JOG Running

a. Connect CN2 and make the input control signal: servo enable（SON） OFF.

b. Connect the control circuit power（the primary circuit power need not be connected temporarily）, the display light of driver will shine; if there is the alarm, please check the wire.

c. Set the control mode option （parameter PA_1） as the jog running mode（set the parameter as 4）.

d. Connect the primary circuit power.

e. Make the servo enable （SON）ON after confirming there is no alarm

or any abnormal condition, and then the motor inspiring is in the zero speed status.

f. Enter into the jog running operation status by pressing the button; the prompt of jog running is "J", and the numerical value unit is R/MIN, the system is in the speed control mode, and the speed and direction shall be determined by the parameter No. 21; the motor will run according to the speed and direction determined by the parameter No. 21 by pressing **INC**, and the motor will run in the given speed and adverse direction by pressing **DEC**.

※ Position Mode Running

a. Connect CN2 and make the input control signal: servo enable（SON）OFF.

b. Connect the control circuit power（the primary circuit power need not be connected temporarily）, the display light of driver will shine; if there is the alarm, please check the wire.

c. Set the control mode option （parameter PA_1） as the jog running mode（set the parameter as 1）; set the parameter PA_9 and the proper electronic gear ratio （PA_18, PA_19） according to the controller output mode.

d. Connect the primary circuit power.

e. Make the servo enable （SON）ON after confirming there is no alarm or any abnormal condition, and then the motor inspiring is in the zero speed status.

f. Operate the position controller to output the signal to the driver CN2-

6, 18, 7 and 19, so that the motor can run according to the instruction.

8.3 Adjustement

【Note 1】 The wrong parameter setting may lead to the equipment default and accident; confirm the correctness of parameter before the start.

【Note 2】 It is suggested to make the loading debugging after making the unloading debugging.

1）Basic Gain Adjustment

※ Speed Control

a. The value of speed ratio gain（parameter PA_2）shall be set as large as possible in the condition without vibration. In general, the value of speed ratio gain shall be set larger if the loading inertia is larger.

b. The value of speed integral time constant（parameter PA_3）shall be set as large as possible according to the given condition. If the value of speed integral time constant is set to be too large, the response speed will be increased, but the vibration is easy to occur, so that the value shall be set as large as possible in the condition without vibration. If the value of speed integral time constant is set to be too small, the speed change will be large when the loading is changed. In general, the value of speed integral time constant shall be set to be smaller if the loading inertia is larger.

※ Position Control

a. Set the proper speed ratio gain and speed integral time constant according to the above method.

b. Set the position feedforward gain（parameter PA_7）to be 10%.

c. The position ratio gain （parameter PA_6） shall be set as large as possible in the stable scope. If the value of position ratio gain is set to be too large, the tracking feature of position instruction is better and the lagged error is small, but the vibration is easy to occur when stopping the orientation.

d. If the requirement of position tracking feature is especially high, the value of position feedforward gain can be increased, but the over-shooting may occur if the value of position feedforward gain is too large.

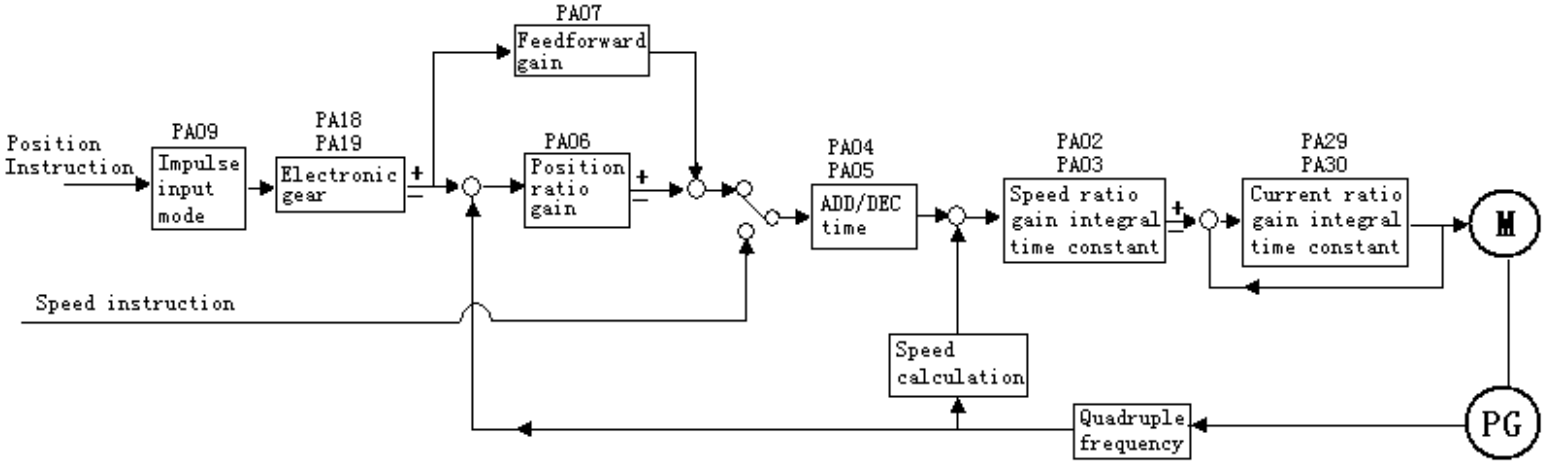
[Note 1] The system will be in the stable status when the value of position ratio gain is set to be small, while the position tracking feature will become worse and the lagged error will become larger; the acceleration and deceleration time constant（parameter PA_4, PA_5）can be increased to avoid over-shooting in order to use the high position ratio gain.

[Note 2] The value of acceleration and deceleration time constant（parameter PA_4, PA_5）can be increased to avoid over-shooting if the system is instable when increasing the value of position feedforward gain.

[Note 3] The setting value of position ratio gain can refer to the following table:

Rigidity	Low rigidity	Middle rigidity	High rigidity
Position ratio gain	40～60/S	60～100/S	100～200/S

2) **Basic Paramter Adjustment Chart**



3）Position Resolution and Electronic Gear Setting

The position resolution（a impulse stroke）is determined by the servo motor stroke per circle ΔS and the coder feedback impulse per circle P_t, and it can be shown in the following formula:

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

In the formula,

Δl: An impulse stroke（mm）;

ΔS: Servo motor stroke per circle（mm/circle）;

P_t: Coder feedback impulse per circle（impulse/circle）.

There is the quadruple frequency circuit in the system, so that $P_t=4\times C$, in which C is the lines per circle of coder. In this system, C=2500 lines/circle, therefore P_t=10000 impulses/circle.

The instruction impulse can be transferred to the position control impulse by multiplying the electronic gear ratio G, therefore an instruction impulse stroke can be denoted as:

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

In the formula,

$$G = \frac{\text{Instruction impulse divider numerator}}{\text{Instruction impulse divider denominator}}$$

4）Start and Stop Feature Adjustment

The start and stop feature of servo system, i.e. the acceleration and deceleration time is determined by the loading inertia and start and stop frequency, and it is also limited by the servo driver and servo motor performance. The frequent

start/stop, short acceleration/deceleration time and large loading will lead to the overheating of driver and motor and the over-current alarm of primary circuit, and it must be adjusted based on the actual condition.

a. Loading inertia and start/stop frequency

It shall be confirmed whether it is in the allowable frequency range in advance when used in the high frequency start/stop occasion. The allowable frequency range may be different with the motor type, capacity, loading inertia and motor rotation speed. The start/stop frequency and recommended acceleration/deceleration time（parameter PA-4, PA-5）allowed by the servo motor is as follows in the condition that the loading inertia is m times of motor inertia:

Loading inertia times	Allowable start/stop frequency
m≤3	＞100 times/ minute: the acceleration/ deceleration time is 100mS or even less.
m≤5	60-100 times/ minute: the acceleration/ deceleration time is 150mS or even less.
m＞5	＜60 times/ minute: the acceleration/ deceleration time is over 150mS.

b. Influence of servo motor

The start/stop frequency and acceleration/deceleration time allowed by different types of servo motors are different with the loading condition, running time, loading ratio, environment temperature and other factors, please refer to the motor instruction and make the adjustment based on the given condition to avoid the alarm or use life

decrease due to the overheating.

c. Adjustment method

The common loading inertia shall be within 5 times of motor rotor inertia; the over-current or striking abnormity may be usually resulted in the deceleration when being used in the large loading inertia, and then the following processing method can be adopted:

- Increase the acceleration/deceleration time; the time can be set a little larger, and then be decreased to the proper value gradually;
- Decrease the internal torque limitation value to reduce the current limitation value;
- Decrease the max rotation speed of motor;
- Replace with the motor with larger power and inertia.