

HSD2 Series Servo Drive User Manual



HNC Electric Limited

Thank you for purchasing our HSD2 AC servo drives.

This manual provides the related information about product installation, wiring, inspection and operation of our AC servo drive. Before using the product, please read through this manual carefully in order to ensure the correct use of the product.

This manual includes:

- Installation of AC servo drives
- Configuration and wiring
- Parameter settings
- Control functions and adjusting methods of AC servo drives
- Trial run steps
- Troubleshooting

This manual is intended for the personnel with the following qualifications:

- Installation or wiring personnel
- Operating or programming personnel
- Troubleshooting personnel

Important Precautions

Before using the product, please read this user manual thoroughly to ensure correct use and place this manual in a safe place for a quick reference whenever is needed. In addition, please pay your attention to the following precautions accordingly:

No water, corrosive and inflammable gas are allowed in the installation environment.

Ensure that the drive is correctly connected to a ground. The grounding method must comply with the electrical standard of the country.

Do not connect a commercial power supply to the U,V,W terminals of drives, it may damage the drive.

Do not disconnect servo drive, motor or change the wiring when power is ON

Do not touch the heat sink of the drive before connecting to the power and operation.

If you have any inquiries, please contact your local distributor or our customer service center.

Preface

Please read and follow the following NOTES before using the product:

1. HSD2 series driver is designed to apply with AC 220V power input. Do not connect this product with AC 380V power, it's possible to damage the drive or cause personnel injury.
2. Please refer to this user manual, set the correct motor parameters PA1,so as to ensure proper parameters match between servo drive and motor.
3. Do not turn the power on and off too often, if continuous power on and off is needed, please add break resistor. Please follow the user manual or contact our technical support, use the correct break resistor for the driver.
4. Please set the right Electronic Gear Ratio parameter PA12, PA13.
5. Please set the right pulse command input parameter PA14.
6. When you finished the parameters setting of PA1,PA14, PA35, please re-power the drive to activate and save the modified settings.
7. Please use stranded wires and multi-core shielded-pair wires for making the encoder cable. The total length should not exceed 15meters.
8. Please use shielded wires to make control cable as well, and the max length of the control cable is 15meters, otherwise it may cause pulse lose.

Safety Precautions

Installation

- ◆ It is not allowed to expose the product with the environment which contains water, corrosive gas, inflammable gas, etc. Otherwise it may result in electric shock, fire or personal injury.
- ◆ Do not apply the product to the environment of direct sunlight, dust, salt and metal powder, etc.
- ◆ It is prohibited to apply this product to the place which contains oil and pharmaceuticals, etc.


Wiring

- ◆ Please connect the ground terminals to a class-3 ground system (Under 100 Ω), poor grounding may result in electric shock or fire.
- ◆ The HSD2 series AC servo drive is applicable for AC 220V single-phase or three-phase power. Please do not connect the product to AC 380V power. Otherwise it's may lead to possible drive damage..



- ◆ Do not connect the three-phase source to the output terminal U, V and W. Or it is possible to cause personnel injury or fire, or damage the drive.
- ◆ Please tighten the screws of the power, wire terminals & connectors of the motor and drive, otherwise it may result in damage, fire or personnel injury.
- ◆ In order to prevent any danger, it is strongly recommended to follow the specifications outlined in this manual when wiring.

Operation

- ◆ Before the operation, please change the parameter setting value according to the requirement, if it is not properly adjusted to the correct setting value, it may cause equipment out of control, or lead to malfunction of the machine.
- 
- ◆ Do not touch or approach any rotating parts (e.g. Heat sink) during operation, it may cause serious personnel injury.
 - ◆ Do not remove /disconnect the operation panel while the drive is

connected to the power supply, otherwise, it is possible to cause electric shock.



- ◆ Do not disassemble the servo drive as this may cause electric shock or personnel injury.
- ◆ Do not connect or disconnect wires or connectors while power is on, otherwise it may cause electric shock or personnel injury.
- ◆ The high voltage may still remain in the servo drive when the power is off, please wait for at least 10 minutes (after power is off) before touching or performing any inspections.

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Chapter 1 Product Description

1.1 HSD2 Series Servo Drives

HSD2 series drives include five different models: HSD2-020, HSD2-030, HSD2-050, HSD2-065 and HSD2-030A.

Except for HSD2-030A, which has a barrier screw secure terminal, the rest of above mentioned models have pinhole type power terminals (P / D / C, R / S / T, r / t, U / V / W / PE)

CN1, CN2, CN3 are signal connectors.

Please refer to the power level table (1-1) for each HSD2 series servo drives:

Table 1-1 Power level of HSD2 series drivers

TYPE	IPM (A)	POWER LEVEL (kw)
HSD2-020	20	1.0
HSD2-030	30	1.5
HSD2-050	50	2.5
HSD2-065	65	3.5
HSD2-030A	30	1.5

1.2 Appearance

The appearance of HSD2-030, HSD2-050, HSD2-065 are the same. They have designed with P / D / C, R / S / T / r / t terminals and CN1, CN2, CN3 connectors..

HSD2-020 doesn't have P / D / C terminals and CN3 connector..

The power terminal of HSD2-030A differs from the rest of four models, it has not equipped with P / D / C ports additionally.

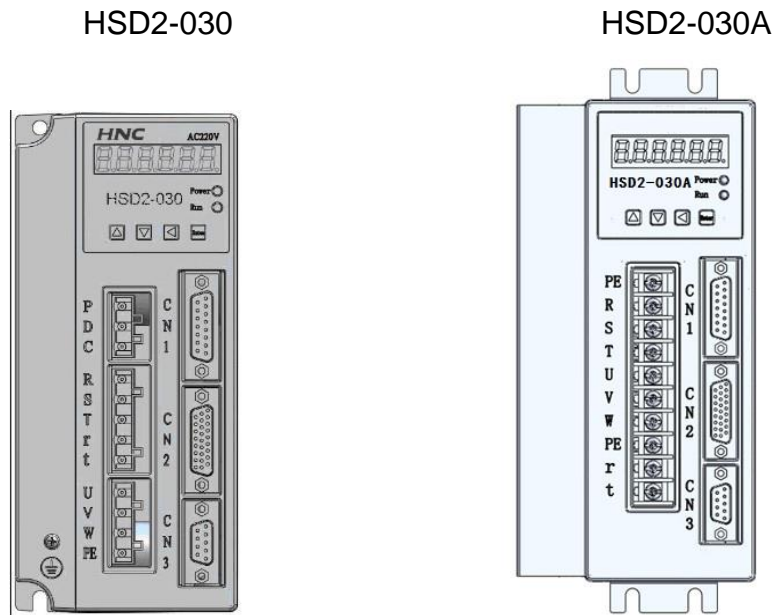


Figure 1-1 appearance of HSD2

1.3 Explanation of Each Power Terminals

1.3.1 P / D / C terminals

1. P / D / C are the wiring terminals of brake resistor.
2. It is prohibited to connect P and C directly, this will damage the drive.
3. When P and D is connected, it means the inner brake resistor is effective, the default setting is P and D being connected.
4. If an extra brake resistor is needed, it will be connected between P and C.
5. If P and D is connected, an extra external brake resistor is connected between P and C, both the internal and external resistors are working on a parallel basis.

1.3.2 R / S / T terminals

R / S / T are the three phased AC 220V power supply connection terminals, no phase sequence requirement.

Do not connect AC 380V power supply to the R/S/T terminals, otherwise it will damage the drive and cause personnel injury.

1.3.3 R / T terminals

R/T are the power supply terminals for the control system of the servo drive, AC 220V power supply is required in this case.

It will cause damages to the drive if you connect AC 380V power supply to these two terminals.

1.3.4 U / V / W / PE terminals

U / V / W / PE are the power output terminals of the drive, they can be connected to the corresponding ports of the servo motor.

The power cable is generally supplied by the manufacturer, if you need to make the power cable by yourself, please make sure you use the right shielded wire and ensure a correct connection of U / V / W / PE terminals to avoid losing control of the drive.

Please follow up the instructions from table 2-3 and table 2-4.

1.3.5 CN1 connector

CN1 is the encoder signal interface, it's used to receive position signals from servo motor.

Only incremental encoder is applicable to our HSD2 series servo drive.

Incremental encoder has 6 signals: U V W A B Z, adopting differential output for each signal. The encoder resolution is 2500 PPR, please find the detailed definitions from table 3-1.

1.3.6 CN2 connector

CN2 is the control signal interface, detailed definitions, please refer to table 3-2.

1.3.7 CN3 connector

CN3 is the communication interface, it is a reserved port at the time being.

Chapter 2 Installation & Wiring

In this chapter, you will find the related information and cautions for storage, installation environment, wiring of HSD2 series servo drive.

1. If the driver is severely damaged during transportation, please do not power on the drive, contact the supplier for further actions.
2. Do not connect AC 380V power supply to R/S/T terminals.
3. Please ensure PE port is properly connected and earthed.

2.1 Pre-check Before Installation

After receiving the AC servo drive, please check for the following:

Ensure that the product is what you have ordered.

Please check the nameplate to identify if the product you received is what you've ordered from the supplier. (You can refer to Section 1.1 and 1.3 for more details about the model explanation).

Check the appearance to see if there is any damage.

Please inspect the product carefully to see whether or not there is any damage during transportation or shipping. Turn the motor shaft by hand, a smooth rotation indicates a good motor. However, a servo motor with an electromagnetic brake can not be rotated manually.

Check the screws

Ensure that all necessary screws are tightened and secured.

If any items are damaged, please inform the distributor whom you purchased the product from or your local sales representative.

2.2 Product Size

Product size of HSD2 series servo drives, please refer to Figure 2-1 and table 2-1.

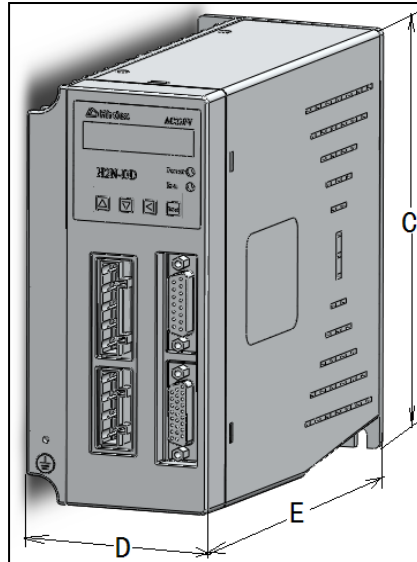


Figure 2-1 Dimensions sketch

Table 2-1 size details of HSD2 series drives

Type	C(mm)	D (mm)	E(mm)	Heat sink depth(mm)
HSD2-020	170	77	172	16
HSD2-030	185	82	182	21
HSD2-050	200	92	186	31
HSD2-065	215	105	207	29.5
HSD2-030A	195	97	155	34

2.3 Size Data for Installation

Please refer to the installation size from Figure 2-2 and Table 2-2.

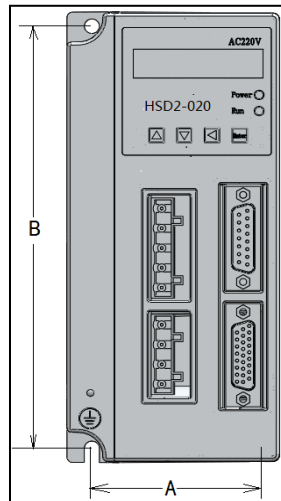


Figure 2-2 installation size sketch

Table 2-2 installation size data for HSD2 series drives

Installation size data		
Type	A(mm)	B(mm)
HSD2-020	60	160
HSD2-030	65	175
HSD2-050	75	189.3
HSD2-065	88	203.5
HSD2-030A	25	208

2.4 Installation Environment

The operating temperature for the HSD2 series servo drive is ranging from 0°C (32°F) to 55°C (131°F). If the ambient temperature of servo drive is higher than 45°C, please install the drive in a well-ventilated location and do not block the ventilation holes. The ambient temperature of servo drive for long-term reliability should be under 45°C (113°F).

If you need to install the servo drive and motor in a confined space, please ensure sufficient space around the units and make sure the ventilation status and size of the confined space won't cause overheating of the product. In addition, please also pay

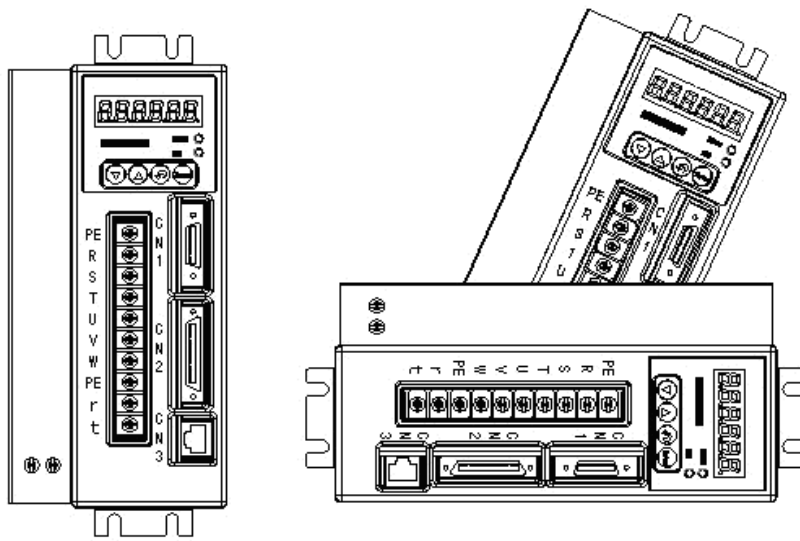
your attention to the following cautions:

1. The ambient humidity should be less than 80%, without condensing.
2. Please keep the servo drive or motor away from the heat-radiating equipment or in direct sunlight.
3. Do not install the drive or motor in a location subjected to the environment which contains water, corrosive gas or liquid, dust or oily dust, floating dust, metallic particles.
4. Do not mount the servo drive or motor in the places where it will be subjected to high levels of electromagnetic radiation.
5. Do not mount the servo drive or motor in a location where temperature and humidity will exceed specification.
6. Do not mount the servo drive or motor in a location where vibration and shock will exceed specification.
7. The mounted position vibration should be less than 0.5G.

2.5 Installation Procedure & Minimum Clearances

Incorrect installation may result in a drive malfunction or premature failure of the drive. Please follow the guidelines in this manual when installing the servo drive.

1. The servo drive should not be tilted or upside down. Please mount the drive perpendicular to the wall or in the control panel, otherwise malfunction and damage will occur.
2. The servo drive should be mounted in the control panel with a cooling fan, to enhance air circulation and cooling.
3. In order to ensure the drive is well ventilated, ensure that the all ventilation holes are not obstructed and sufficient free space is given to the servo drive. To define the free space, please refer to the section “Minimum Spacing”.
4. Please tighten the screws for securing drive or motor. Otherwise it may result in product damage or personnel injury.
5. As the drive conducts heat away via the mounting, the mounting plane or surface should not bring heat into the drive from external sources.



Correct

Incorrect

Figure2-3 The correct direction for mounting

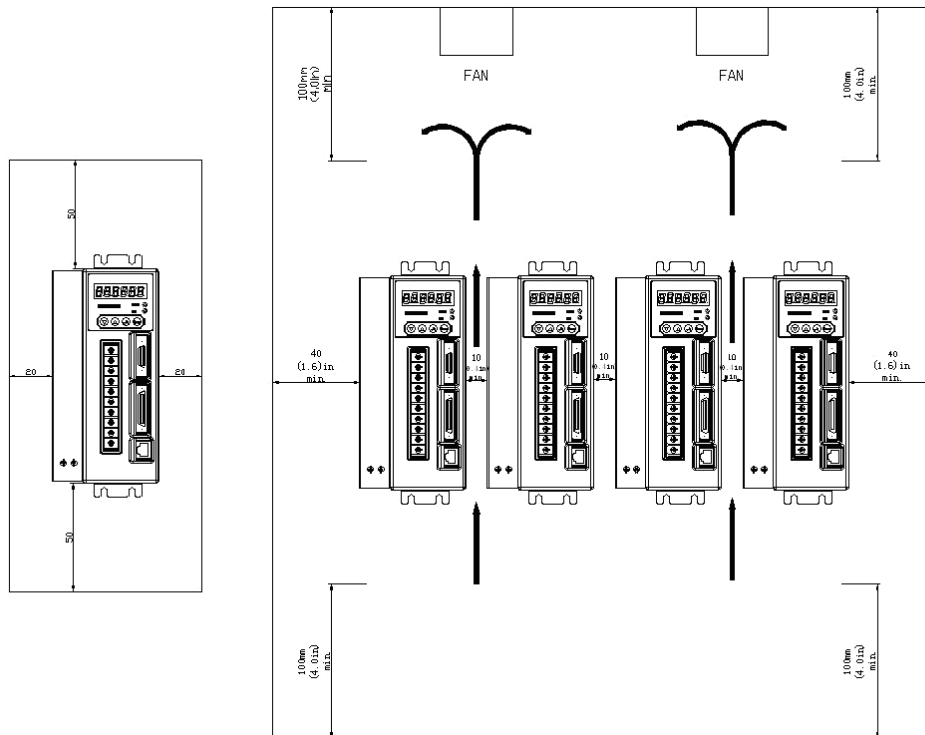


Figure 2-4 Installation Minimum Spacing

In order to increase ventilation to avoid ambient temperature being exceed to specification, please install a fan. A minimum spacing of two inches must be maintained above and below the drive for ventilation and heat dissipation. Additional space may be necessary for wiring and cable connections. When installing two or more drives next to each other, please follow the spacing diagram from the above Figure 2-4.

2.6 Connection Terminals

Please select the connecting terminals carefully and follow the instructions from table 2-3 and 2-4.

Table 2-3 Definition and function of the terminals

Terminal Identification	Terminal Description	Descriptions										
R、S、T	Main circuit terminal	Used to connect three-phase AC main circuit power depending on connecting servo drive model.										
R、t	Control circuit terminal	Used to connect single-phase AC control circuit power. (Control circuit uses the same voltage as the main circuit.)										
U、V、W、PE	Servo motor output	Used to connect servo motor <table border="1" data-bbox="804 992 1278 1361"> <thead> <tr> <th>Terminal symbol</th> <th>Wire colour</th> </tr> </thead> <tbody> <tr> <td>U</td> <td>Brown</td> </tr> <tr> <td>V</td> <td>Black</td> </tr> <tr> <td>W</td> <td>Grey</td> </tr> <tr> <td>PE</td> <td>Yellow and green</td> </tr> </tbody> </table>	Terminal symbol	Wire colour	U	Brown	V	Black	W	Grey	PE	Yellow and green
Terminal symbol	Wire colour											
U	Brown											
V	Black											
W	Grey											
PE	Yellow and green											
PE	Ground terminal	Used to connect with the grounding wires of power supply and servo motor.										
CN1	Encoder connector	Used to connect with the encoder of servo motor. Please refer to section 3.2 for more details.										
CN2	I/O connector	Used to connect with external controllers. Please refer to section 3.3 for more details.										
CN3	Communication connector (Reserved)	Connect with personal computer (PC or laptop).										

Table 2-4 Cable specifications for the terminals

Terminal Identification	Terminal Description	Cable specification
R、S、T	Main circuit terminal	1.5~2.5mm ²
r、t	Control circuit terminal	0.75~1 mm ²
U、V、W	Servo motor output	1.5~2.5 mm ²
PE	Ground terminal	1.5~2.5 mm ²
CN1	Encoder connector	≥0.14 mm ² , 7 pair shielded twisted-pair cable
CN2	I/O connector	≥0.14 mm ² , shielded twisted-pair cable

Wiring Cautions

Please read and follow up the below wiring precautions while performing wire connections with the servo drive and servo motor.

1. Please ensure that the wiring of the main power supply terminal R/S/T and control power supply terminal R/T are properly selected and connected, power specification is correct.

2. Please use shielded twisted-pair cables for wiring to voltage coupling and eliminate electrical noise and interference.

3. Please ensure a correct connection for U, V, W terminals, or it may not be able to start the motor or cause galloping.

4. The ground terminal of the servo motor should be connect with the PE of the servo drive properly and ensure a single point grounding. The grounding cable requires to be coarse as well.

5. As a residual hazardous voltage may remain inside the drive, please do not touch any of the terminals (R, S, T, & U, V ,W) or the cables connected to them after the power has just been turned off. Wait for at least 10 minutes until the charging light is off

before you take any further actions with the drive.

6. With regards to the I/O signal cable, please use the recommended cable or similar shield cable. The total length of I/O signal cable shouldn't exceed 3 meters, while encoder cable should be less than 15 meters. Please use a twisted-shield signal wire with grounding conductor for the encoder cable (CN1) and the position feedback signal connector (CN2). The wire length shouldn't exceed 20meters. If it exceeds 20m, please choose a bigger wire diameter (double the existing one) of signal cable to reduce the signal fading.

7. The shield of shielded twisted-pair cables (encoder cable) should be connected to the SHIELD end (ground terminal) of the servo drive.

8. The cables which connected to R, S, T and U, V, W terminals should be placed in separate conduits from the encoder or other signal cables. Separate them by at least 30cm.

9. Please ensure the diode connecting direction of signal output relay is correct, otherwise it may lead to malfunction of the drive.

10. Please install a non fuse type circuit breaker (NFB) to achieve external power cut offs when the servo drive is in a malfunction status.

11. Shut down the power supply if the servo drive is not being used for a long term.

12. Definition of rotating directions: face the motor shaft, the counter-clockwise direction is defined as the CCW. And the clockwise direction of rotation is defined as the CW. Generally, we refer the CCW as the positive direction, while CW as negative direction.

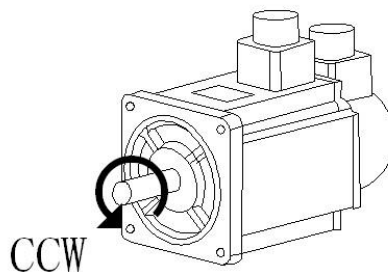


Figure 2-5 Definition of rotating directions

Chapter 3 Signal Interface And Wiring

CN1, CN2, CN3 are the signal interfaces of the servo drive, while CN3 is the communication port, (reserved).

This chapter provides the definitions and standard wiring/connections for the three ports.

3.1 Overview

1. CN1 is an encoder connector, used for receiving position signals from servo motor.
2. HSD2 series servo drive is only applicable with incremental optical encoder(resolution 2500ppr)
3. Incremental optical encoder includes 6 signals: U V W A B Z respectively. It adopts differential encoder signal output(15-line output generally).
4. CN2 is the I/O connector, used to receive control signal from the controller, and output the feedback signal to the controller by return.
5. Control signal generally include pulse command signal: PULS+, PULS-, and direction signal: SIGN+, SIGN-, analog speed command signal :AS+, AS-, drive signal: SON etc.
6. The feedback signal include encoder signal: A+, A-, B+, B-, Z+, Z-, Z ;signal OC, output signal :CZ, servo drive alarm signal: ALM+, ALM-, etc.

3.2 CN1 Encoder Connector

3.2.1 CN1 connector view and layout

CN1 is the encoder connector for the motor, which named as DB26M. Please refer to the layout from the below Figure 3-1.

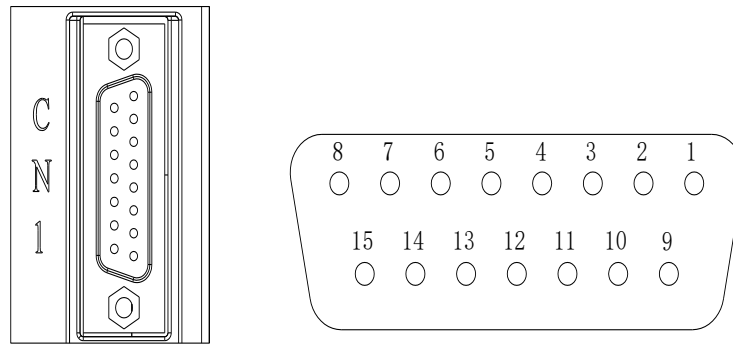


Figure 3-1 The view and layout of the CN1 encoder connector interface

3.2.2 Signal definition for CN1

Table 3-1 Signal definition for CN1

PIN No.	Identification	Description
1	A+	Encoder signal A+
9	A-	Encoder signal A-
2	B+	Encoder signal B+
10	B-	Encoder signal B+
3	Z+	Encoder signal Z+
11	Z-	Encoder signal Z+
14	U+	Encoder signal U+
6	U-	Encoder signal U-
13	V+	Encoder signal V+
5	V-	Encoder signal V-
4	W+	Encoder signal W+
12	W-	Encoder signal W-
7	+5V	Power supply 5V
8	GND	GND for power supply
15	PE	Shielded wire

3.3 CN2 Connector View and Layout

CN2 is the signal I/O connector, please refer to the view and layout from the below Figure 3-2.

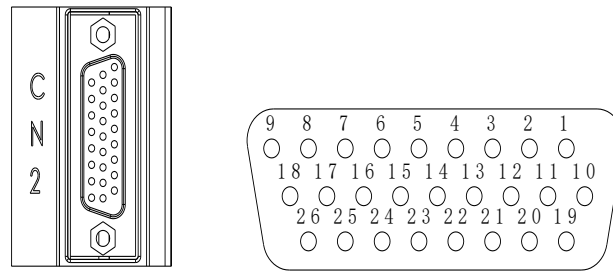


Figure 3-2 The view and layout of the CN2 I/O connector

3.4 Signal Definition of CN2 Connector

Table 3-2 CN2 Signal definition

Terminal No.	Terminal Identification	Description
19	OA+	Encoder signal output A, B, Z (Line-driver output). The motor encoder signals are available through these terminals.
10	OA-	
11	OB+	
1	OB-	
2	OZ+	
12	OZ-	
4	CZ	Encoder signal Z open-collector output.
6	DGND	Encoder digital signal ground
16	COM+	power input (DC 12-24V) positive end
14	SON	Servo drive enable signal input terminal: SON ON: enable the drive. SON OFF: drive disabled and the motor is in free status. Note 1: The motor must be still before enabling the drive. Note 2: Any other command should be inputted after the SON on signal for 50ms
17	ZCLAMP/ CLE/SC1	In the speed control model when PA22=1 the input terminal is defined as the zero speed clamping function. When PA4=0 the terminal is defined as deviation zero reset function The input terminal is defined as the speed command selection SC1 in the speed control model (PA4=1) when the parameter PA22=0

8	SC2	The input terminal is defined as the speed command selection in the speed control model when PA4=1 and PA22=0. Used to select the different internal speed through the combination of SC1 and SC2. SC1 OFF, SC2 OFF: internal speed 1. SC1 ON, SC2 OFF: internal speed 2. SC1 OFF, SC2 ON: internal speed 3. SC1 ON, SC2 ON : internal speed 4.
7	ALRS	Clear alarm signal
23	DOCOM	I/O signal output ground
21	ALM	Servo Alarm signal
22	BRK	Break release
20	COIN	In the position control mode (PA4=0), COIN is activated when the position error is equal and below the setting value of PA16. In the speed control mode (PA=1), COIN will be activated when the drive has detected the motor has reached the Target Rotation Speed setting as defined in parameter PA28.
13	AS+	Motor speed command: -10V~+10V, corresponds to -3000~+3000 r/min command and the input impedance is 10KΩ
3	AS-	
5,15	AGND	analog signal ground
26	PULS+	Position Pulse Input
18	PULS-	
24	SIGN+	Position Sign Input
25	SIGN-	
9	PE	Shielding earth cable

3.5 I/O Interface

3.5.1 Digital signal input interface

Digital signal input interface circuit is generally composed by optocouplers, switches, relays, open-collector transistors or other components as shown in the following diagram(3-3).

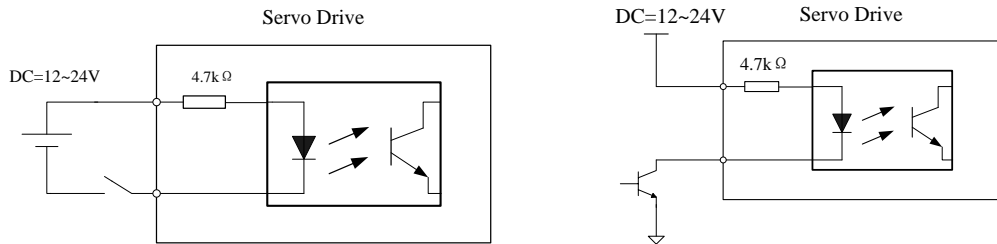


Diagram 3-3 Digital signal input interface circuit type 1

1. The voltage of the external power is DC12~24V and available current should be 100mA at least.
2. Ensure that the polarity of the power is correct, otherwise it will damage the drive.

3.5.2 Digital signal output interface

The digital signal output interface circuit is connected with optocoupler or optocoupler and relays together, achieve the transferring of the isolated digital signal.

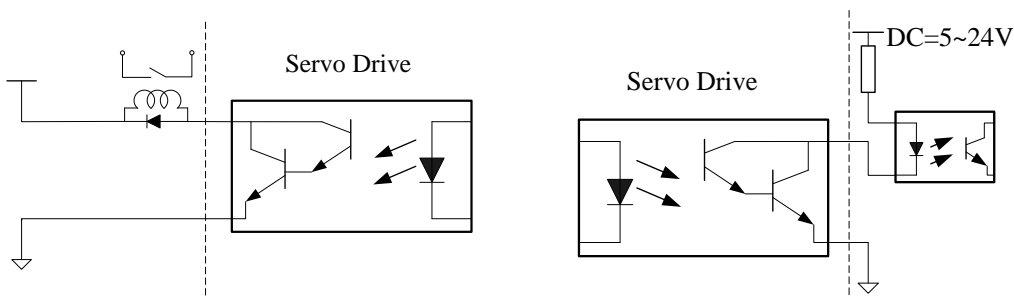


Diagram 3-4 Digital signal output interface circuit type 2

1. The voltage of the external power is DC5~24V.
2. The output form of optocoupler is open-collector, the max current is 50mA and the external max DC voltage is 25V.
3. When inductive components (i.e relays) are on load, please parallel fly-wheel diode at each end of the component, ensure the correct connection of the polarity, otherwise, it may damage the drive.

3.5.3 Pulse command input interface

The drive can run two different types of pulse inputs: Line-drive input and Open-collector input. The maximum input frequency of line-drive input is 500Kpps, with strong anti-jamming capability, while the Open-collector input type is 200Kpps. In order to ensure reliable signal transition, the Line-drive input circuit is recommended.

1. Diagram for Line-drive input circuit

In the Line-drive mode, AM26LS31, MC3487 or RS422 is used in the Line-drive output circuit of the host controller.

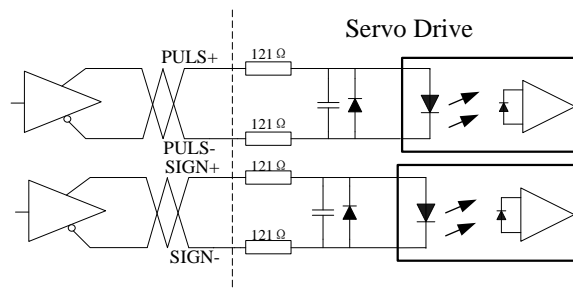


Diagram 3-5 Pulse input interface circuit type 3 (Line-drive input circuit)

2. Diagram for Open-collector input circuit

The source of pulse input is open-collector PNP equipment which applies the external power of the servo drive. Please pay attention to the power polarity, incorrect connection may damage the drive.

By adopting the open-collector input circuit, it reduces the motion frequency, the driving current of the circuit is between 10~15mA, users can calculate the resistance value of R according to the power supply voltage.

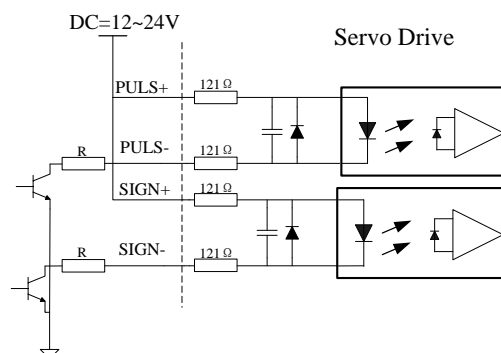


Diagram 3-6 Pulse input interface circuit type 3 (Open-collector input circuit)

3.5.4 Analog signal input interface

There are two different input circuit types of analog signal: differential input mode

and single-ended input mode. It is recommended to use the differential input circuit as it can inhibit the common-mode interference.

The valid voltage range of analog input command in speed and torque mode is $-10\text{V}\sim+10\text{V}$, and the input impedance is $10\text{k}\Omega$. The command value can be set via relevant parameters. The zero drift of the analog signal could be compensated by adjusting the parameters.

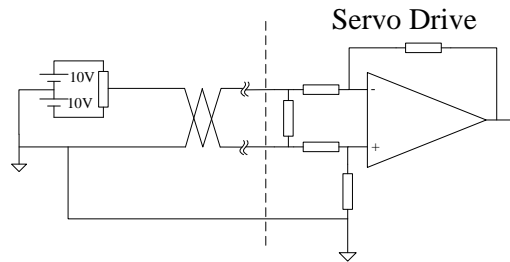


Diagram3-7 Analog signal input interface circuit type 4 (differential input mode)

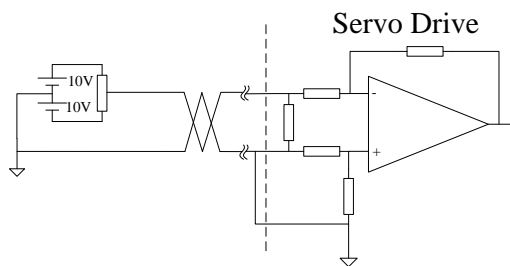


Diagram3-8 Analog signal input interface circuit type 4 (single-ended input mode)

1. Three connecting wires are needed in differential input mode, but only two connecting wires required in single-ended input mode.(The wires mentioned here means the wire from the analog generator.)

Note: under the single ended input mode, the short-circuit is not pre-designed inside of the servo drive in order to avoid the potential interference. Users need to create the short-circuit for CN2 side.

2. The voltage of the signal should not exceed the specified range ($-10\text{V}\sim+10\text{V}$) or it may damage the drive.

3. This interface is a non-isolated input interface, so the shielded cable is recommended to reduce the noise interference.

3.5.5 Encoder signal output interface

The servo drive output the motor encoder feedback position signals by Line-drive transmitter chip AM26LS31 to the controller signal input end. The user could receive the encoder A, B and Z phase signals by two types: Line-drive receiver chip and the

high-speed optocoupler.

The host controller receives the encoder signals by Line-drive receiver chip. Please refer to the wiring diagram from the below Diagram 3-9

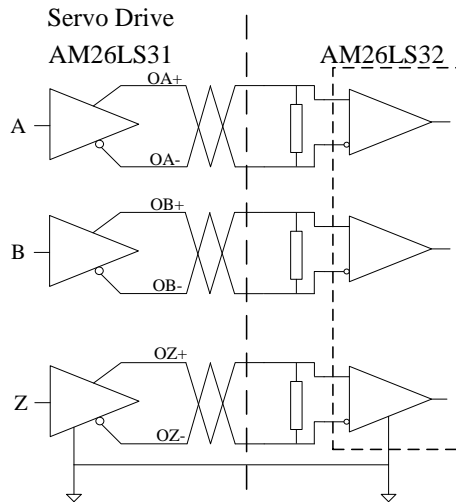


Diagram 3-9 Encoder position signals output interface circuit type 5 (Line-drive)

The value of the resistance is $220\Omega \sim 470\Omega$, and the command ground (GND) of the encoder should connect with the signal ground of the host controller.

When the host controller is receiving the signal by high speed optocoupler, series resistor is required to be added at the input end of host controller, resistance value is 220Ω approx. Detailed circuit please refer to the below Diagram 3-10.

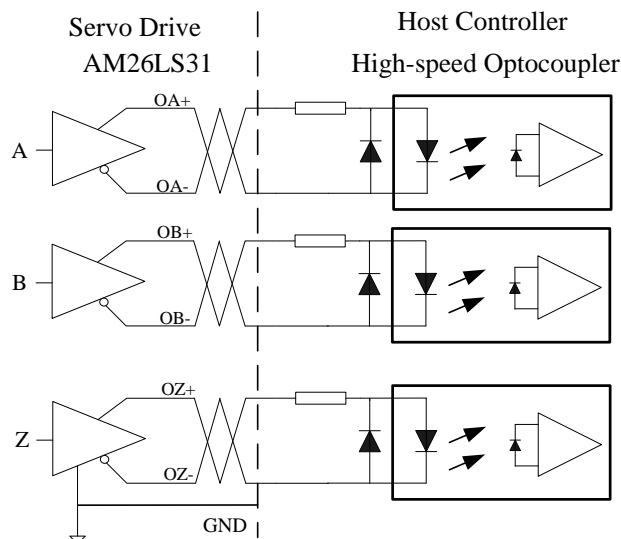


Diagram 3-10 Encoder position signals output interface circuit type 5 (optocoupler)

3.5.6 Encoder open-collector Z-pulse output interface

The drive transmit encoder zero position signal Z to the host controller via open-collector output interface mode. The width of the zero position pulse is narrow, therefore the high-speed optocoupler is recommended as the receiver. This interface is a non-isolated input interface, the maximum current is 50mA and the maximum voltage is 30V. The specific interface circuit is shown as the following.

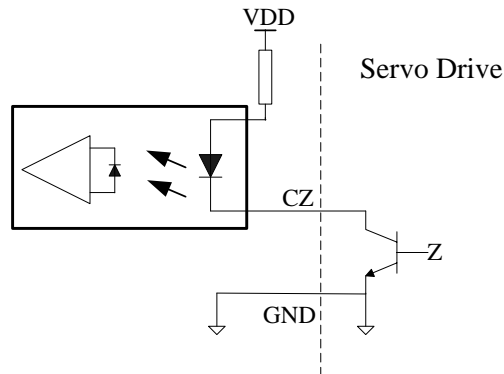


Diagram 3-11 Encoder Open-collector Z-pulse output interface circuit type 6

3.5.7 Encoder feedback signal input interface

The servo drive adopts AM26LS32 or equivalent IC encoder to receive the feedback signal, the detailed circuit please refer to the below Diagram 3-12.

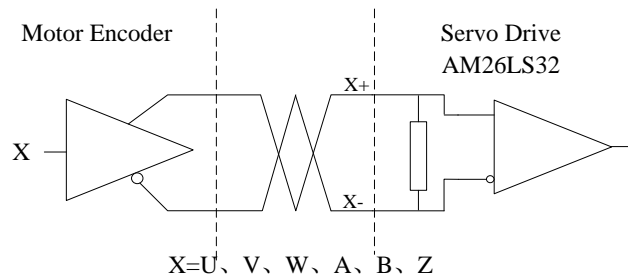


Diagram 3-12 Encoder feedback signal input interface circuit type 7

3.6 Standard Connection Example

3.6.1 Position control mode

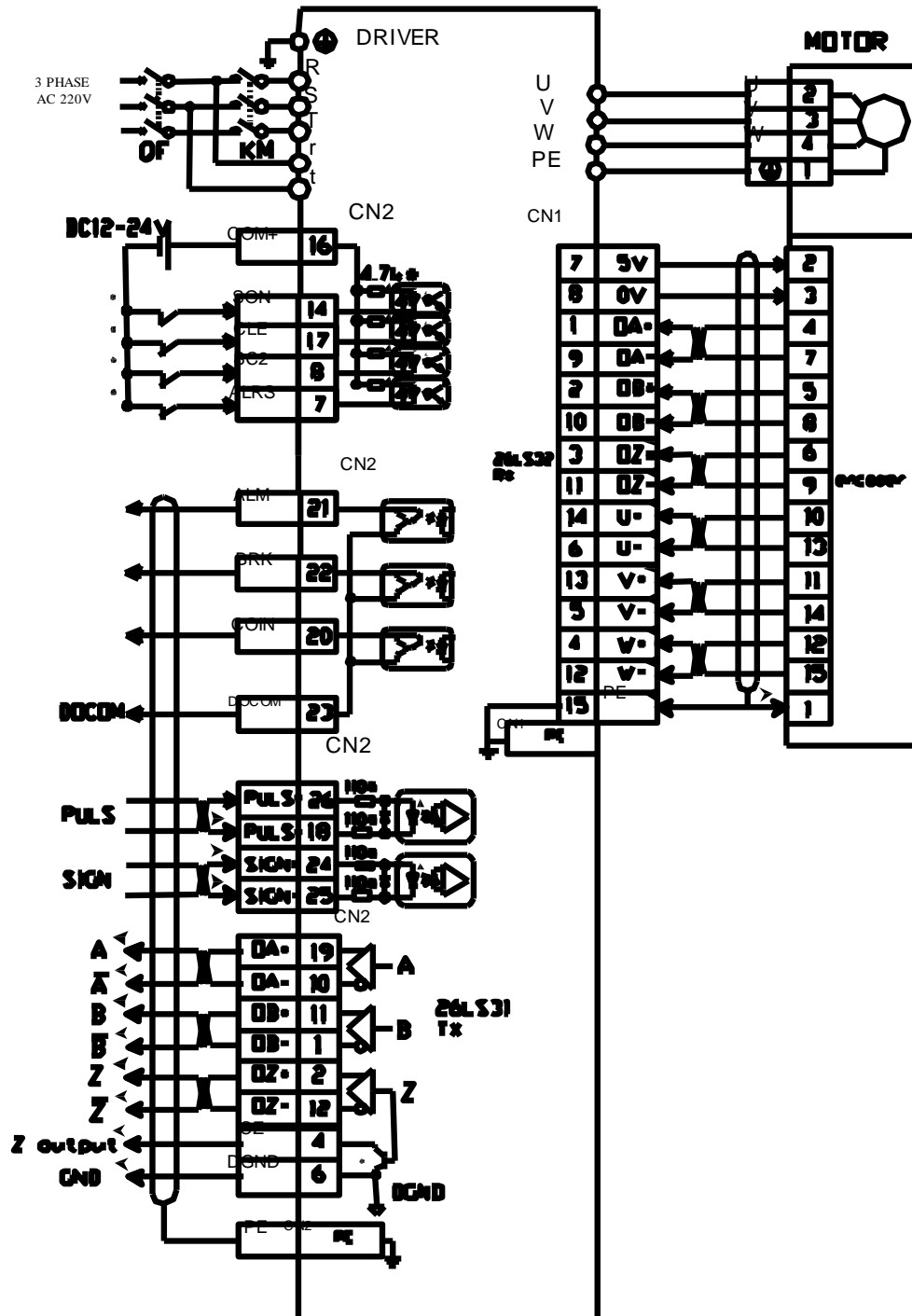
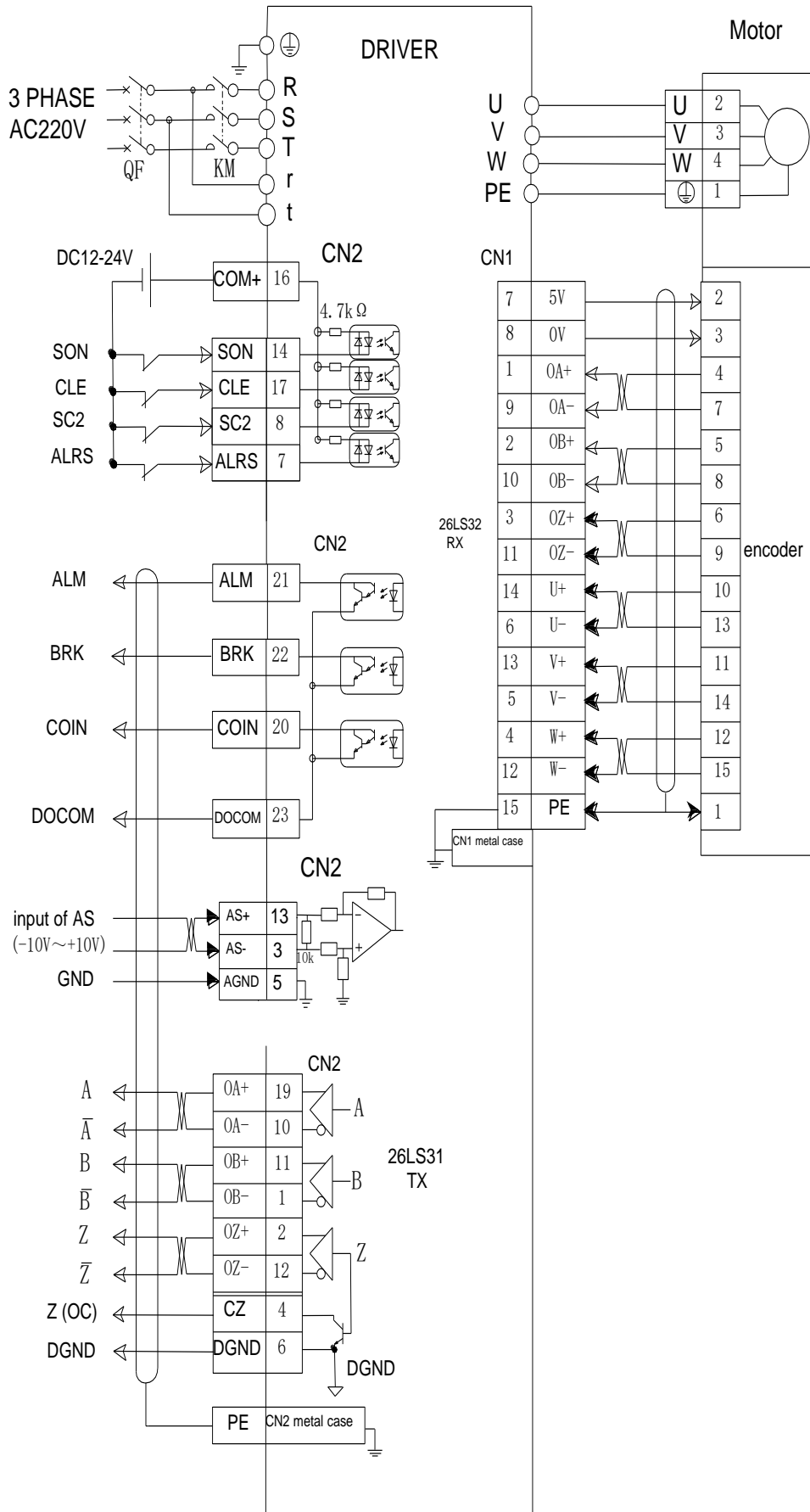


Diagram 3-13 position control mode

3.6.2 Speed / torque control mode



Chapter 4 Panel Display & Operation

This chapter describes the panel status and basic operations of the digital keypad.

4.1 Panel Description

The operation panel is composed by an LED display panel, and 4 functional keypads, for the use of displaying current status of the drive, and setting parameters etc. Please refer the key functions from Table 4-1 and overview of the panel from Figure 4-1

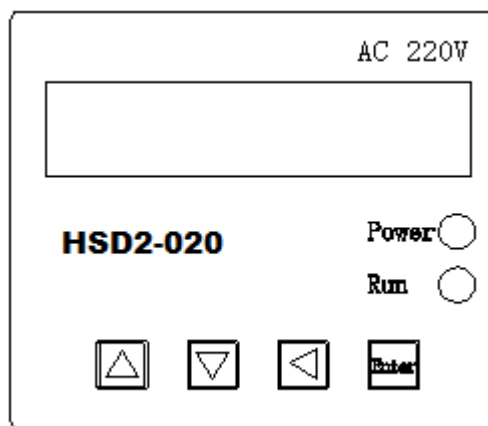


Figure 4-1 Display Panel overview

Table 4-1 Function descriptions

Symbol	Name	Function
Power	Power supply	The LED light indicates the control power is applied to the circuit.
Run	Running status	The LED light indicates the main power is applied to the circuit and the drive is OK to be started.
▲	Up key	Pressing the Up and Down key can scroll through and change monitor codes, parameter groups and various parameter settings.
▼	Down key	
◀	Return key	Pressing the Return key can exit the menu or cancel the operation or the settings.
Enter	Set	Pressing the Set key can enter the menu or save the operation /the parameter settings.

Note :The 6 segment LED display is blinking means there is a failure or alarm.

4.2 Main Menu

As the first layer of the operation panel, the main menu consists six sections. You can use the Up and Down key to change the content of the main menu display and press the Set key to enter the secondary menu, you can also press the Return key to quit the secondary menu and back to the main menu.

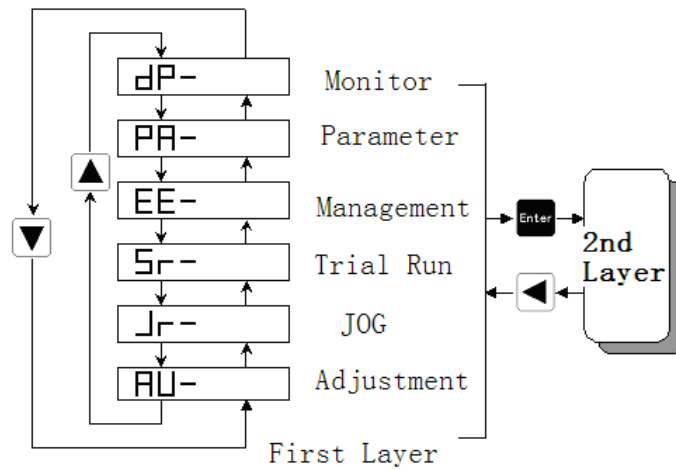


Figure 4-2 Flowchart for the main menu of the operational processes

4.3 Monitoring Display (DP--)

Press the Up and the Down key to find the monitor display from the main menu. When “dp-” is displayed, please press the Set key to enter the monitor mode. There are 19 kinds status for the monitor display, details shown in the following Diagram .Use Up and Down key to select the display and press the Set key to enter the specific monitor and display interface.

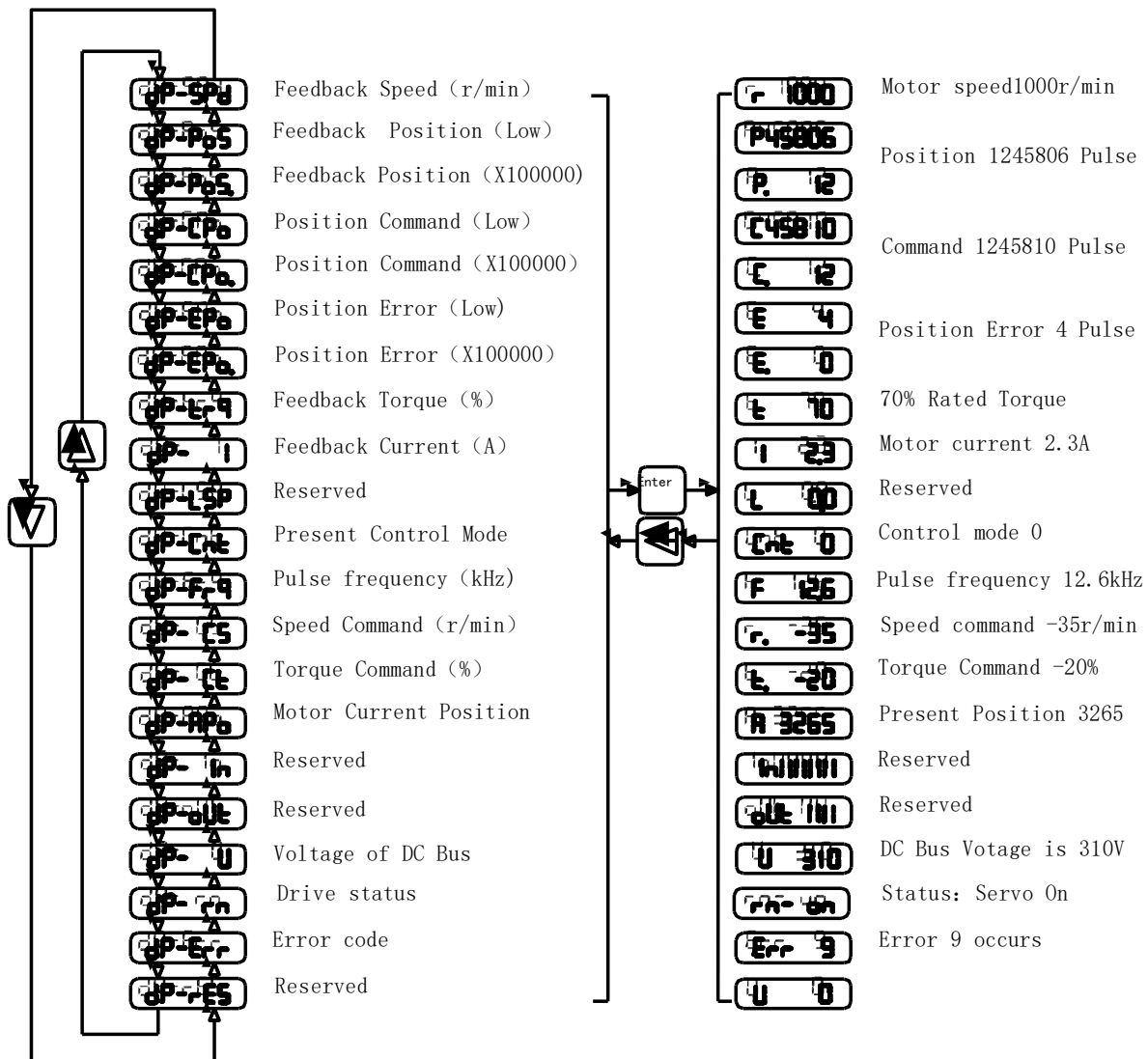


Diagram 4-3 The operational process of the monitor display

4.4 Parameter Setting (PA--)

Find the “PA-” on the main menu by using the Up and Down key, and then enter the parameter selection interface by pressing the Set key. By using the Up and Down key

you can select the parameters according to your requirement, and then press the Set key to enter the parameter modification interface. When the parameter is being modified, the LED digital display is ON , that means you are in the process of changing the parameters but they are not yet being activated. Press the Set key to save them and the light will go off. Press the Return key to cancel the settings if required.

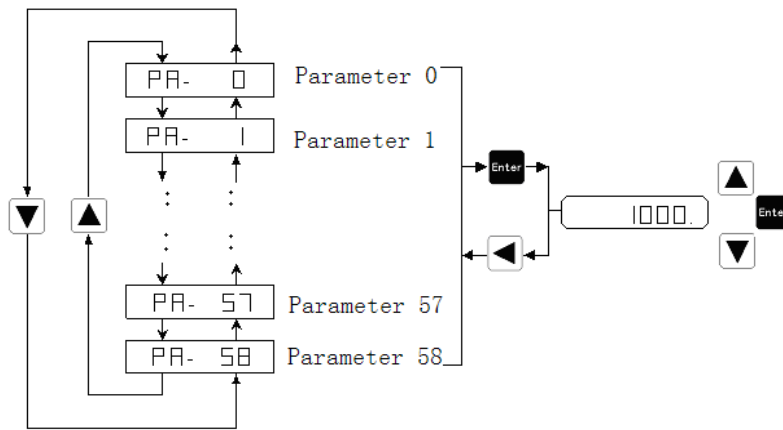


Diagram 4-4 Operation process of parameter settings

4.5 Parameter Management (EE--)

Find the “EE-” from the main menu by using the Up and Down key, and then enter the parameter management interface by pressing the Set key. The functions and descriptions of each symbol are shown in the Diagram 4-5. By using the Up and Down key you can select the operations according to your requirement. Press and hold the Set key for 3 seconds, when “FINISH” is displayed on the LED panel, it means the operation is completed. But if it displays “Error”, it means the operation failed, please press the Return key to cancel.

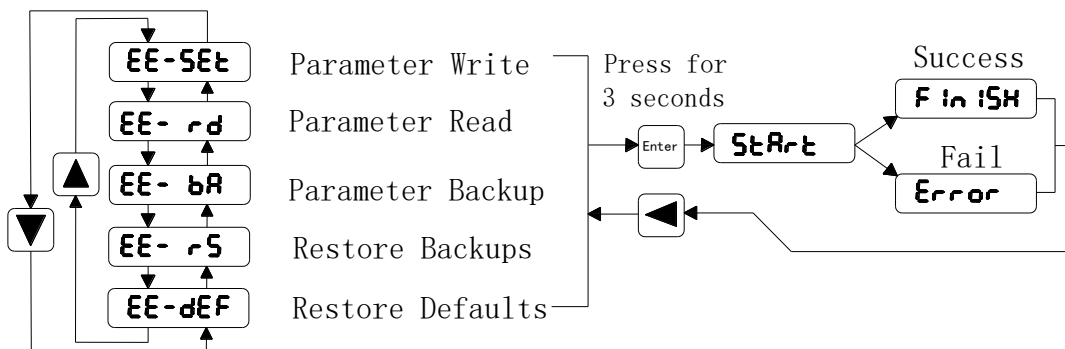


Diagram4-5 Operation process of parameter management

- EE-set Parameters write: It indicates that all the parameters will be stored in the EEPROM parameters district, power-off is not going to lose the saved settings.
- EE-rd Parameters read: you can read the parameters from EEPROM district, modify the parameters according to your request, however,when the power goes off, your revised data won't be saved.
- EE-rs Parameters restore: you can read the data from the EEPROM parameter list, do the changes according to your requirement, perform a write operation to save the revised parameters permanently.
- EE-def Restore the default parameters: when the parameters are disordered or changed improperly, you can bring all of the defaults into the parameter list, and then write the parameters into the EEPROM. After this operation, you should ensure that the motor code (PA1) is matching with the motor you are using.

4.6 Speed Trial Run Without Load (Sr--)

You can enable the “Sr” operation mode by set parameter PA4=3. Find the “Sr-” on the main menu by using the Up and Down key, and then enter the speed trial run operation interface by pressing the Set key. This mode will display an “s” and “Sr 0.00”, the speed unit is r/min, input the speed command by pressing Up or Down key.

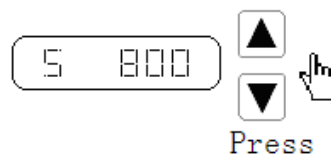


Figure 4-6 Speed trial (off load) display

4.7 JOG Trial Run Without Load (Jr--)

You can enable the “Jr” operation mode by set parameter PA4=4 and change the JOG speed command by setting parameter PA 21. You can find the “Jr-” on the main menu by using the Up and Down key, and then enter the JOG trial run operation interface by pressing the Set key. When “J 0.0” is displayed (unit is r/min), press Up or Down key to jog the motor CCW or CW direction. The motor will rotate according to the given speed command.



Figure 4-7 Jog trail run without load

4.8 Analog Zero-offset Adjustment (AU)

By performing the following operation, the drive can automatically detect the zero bias of the analog speed or torque command, and write the value in the parameter PA45 or PA39. After that, the drive will save the parameter in the EEPROM automatically. You can find the “AU-” from the main menu by using the Up and Down key, and then enter the operation interface for Zero-offset adjustment by pressing the Set key. The AU-SPD correspond to the speed zero-offset adjustment and the AU-trq correspond to torque zero-offset adjustment. Select the process by Up or Down key, and then press and hold the Set key for 3 seconds till the LED displays “FINISH”.

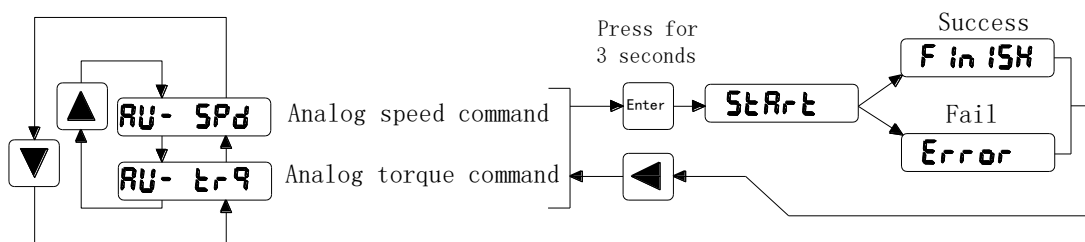


Figure 4-8 Operations of analog zero-offset adjustment

Chapter 5 Trial Run and Tuning

This chapter describes trial run for servo drive and motor, including the trial run without load and introductions about the operation mode of the drive. Please always make sure that you perform a trial run without load first, before an on-load running/operation.

5.1 Inspection Without Load

In order to prevent accidents and avoid any potential damages to the servo drive and mechanical system, the trial run should be performed without load. Please remove the load of the servo motor, including coupling on the shaft and accessories so as to avoid any damage on servo drive or mechanism. This is aiming to avoid the falling off of the disassembled parts of the motor shaft and indirectly causing the personnel injury or equipment damage during operation.

Always remember to perform the trial without load first before you connect the drive with power supply.

Before the trial run (without load), please inspect the following points carefully:

1. Check the drive and motor appearance to see whether or not there is any obvious damage.
2. Check all the wiring to see if they are correctly connected, especially R, S, T, U, V, W and PE terminal. The terminals should be connected with the specified cables.
3. Ensure that there are no extra things inside the drive, such as conductive objects and flammable objects.
4. Confirm that the electromagnetic brake is working normally if brake is required.
5. Please make sure the external voltage level of the servo drive is correct.
6. Make sure that the cable and the mechanical parts are not intertwined, to avoid wear or pulling phenomenon at the run time.
7. Ensure that the servo drive and motor are well connected to the ground.

Please pay attention to the following notes when you are undertaking the trial run.

1. Please check if there is any abnormal display of the power indicator and LED display panel.
2. Ensure that all user-defined parameters are being set correctly. The

characteristics of different machinery equipment differ from each other, in order to avoid accident or cause potential damage, do not adjust the parameter abnormally and change parameter to an excessive value.

3. Make sure that the servo drive is off when you set parameters.

4. Check the vibrations and sound during operation. If the servo motor is vibrating or there are unusual noises while the motor is running, please contact your local distributor or manufacturer for further assistance.

5. Please make sure that all the relays are working properly, contact our local distributor or us directly if there is any abnormal case.

5.1.1 Apply power to the drive

Turn on the control power supply (leave the main power off at the moment), the LED indicator should be lighted, if there is any alarm displayed on the panel, please check the wiring.

Next, connect the main power supply, the RUN indicator should be on, if not or there is any alarm, check the wiring, or replace your drive.

5.1.2 JOG trial run without load

It is very convenient to use JOG trial run without load to test the servo drive and motor as it doesn't require an extra wiring. In order to ensure a safe trial run, it is recommended to set JOG speed at low speed level such as 100r/min. The JOG speed could be set in the parameter PA21.

1. Parameter settings

Table 5-1 Parameter setting table of the JOG trial run

Parameter NO.	Name	Default	Setting	Description
PA04	Control Mode	0	4	Select the operation mode as JOG trial running mode.
PA20	Inhibit Drive Function	1	1	Ignore the drive prohibition
PA21	JOG speed	120	100	Speed command selection
PA40	Acceleration Time	0	Opportune	Reduce the acceleration Shock.

PA41	Deceleration Time	0	Opportune	Reduce the deceleration Shock.
PA53	Enabled Word 1	1	1	Enable the drive without the external force

2. Operation

Step 1: Set the parameter PA53=0001, the servo drive is activated, indicator Power and Run is on light, both the drive and motor are in a zero speed running status.

Step 2: Set parameter PA21 as JOG speed. After the desired JOG speed is set, and then press the Set key, the speed will be written into the control software.

Step 3: Enter the JOG operation interface by using the digital keypad, and the digital LED display should be displayed as the following:

J 0.0 (r/min)

Step 4: Press the Up key and the servo motor will run in CCW direction. After releasing Up key, the motor will stop running.

Step 5: Press the Down key and the servo motor will run in CW direction. After releasing Down key, the motor will stop running.

Step 6: Press Return key, the drive exits JOG operation mode.

CCW and CW definition.

CCW (): Face the servo motor shaft, CCW is running in the counterclockwise direction.

CW (): Face the servo motor shaft, CW is running in clockwise direction.

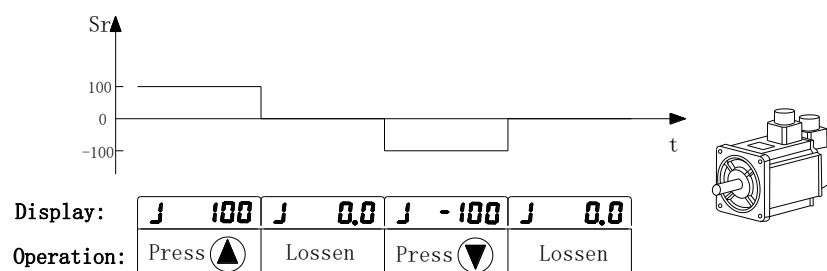


Figure 5-1 JOG trial run without load

5.1.3 Speed trial run without load

Before you perform this operation, please ensure all the parts and basement are properly tightened and secured with the servo drive and motor. During the high speed

running, any unsecured parts can cause malfunction and personnel injury.

1. Parameter setting

Table 5-2 Parameters for the speed trial run

Parameter	Name	Default	Setting	Description
PA04	Control mode	0	3	Select the operation mode as speed trial running control mode.
PA20	Inhibit Drive Function	1	1	Ignore the drive prohibition
PA53	Control word 1	1	1	Enable the drive without the external signal

2. Operation

Step 1: Set the parameter PA53=1 the servo drive is activated, indicator Power and Run is on light, both the drive and motor are in a zero speed running status.

Step 2: Set parameter PA04 =3, choose the speed trial running mode as the current mode.

Step 3: Enter the speed trial run operation interface by pressing the UP and DOWN key, the minimum given vale is 0.1r/min. Use the Up or Down key to select the "Sr" mode on the main menu, and the press the Set key to enter the operation interface for the speed trial running. And the LED display should be shown as the following:

S 0.0 (r/min)

Step 4: By pressing the UP and DOWN key, you can change the running speed as well as the running directions (CCW, and CW).

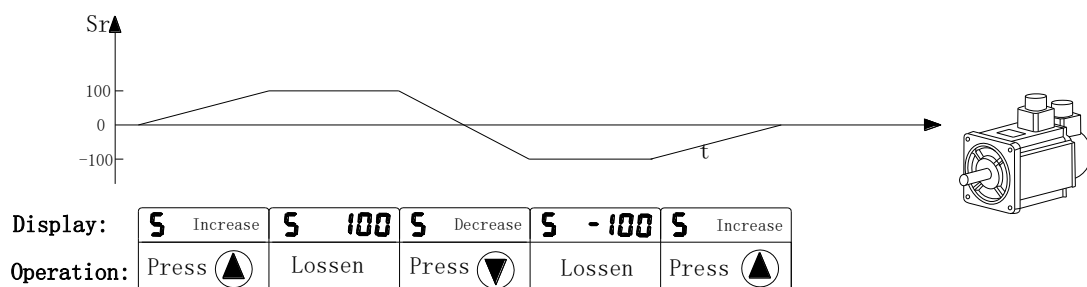


Figure 5-2 Speed trial run

5.2 Position Control Mode

The position control mode is usually used for the applications requiring precision positioning, i.e, industry positioning machine. Before position trial run, please carry out the following inspections:

1. Ensure that all wiring is correct and wiring terminals of the servo drive and motor are correctly insulated.
2. Ensure all the parts and basement are properly tightened and secured with the servo drive and motor. During the high speed running, any unsecured parts can cause malfunction and personnel injury.

5.2.1 Simple position control system

A simple position control system only requires two sets of position pulse command signals, drive enable signal, prohibited drive signal, servo ready and servo alarm output signals. Please refer to the wiring from the below Diagram 5-3.

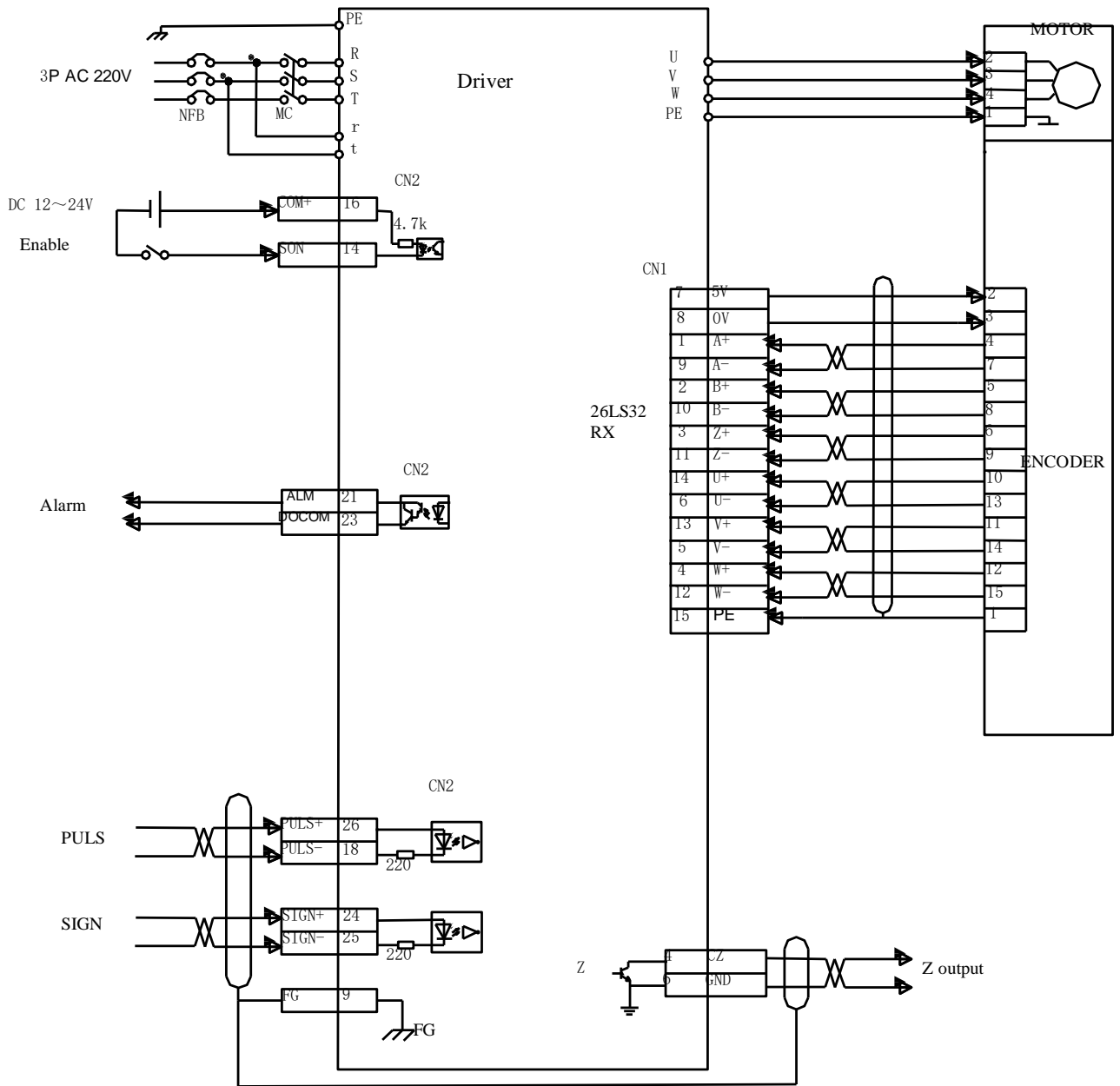


Diagram5-3 Wiring for the simple position control system

Note: In section 3.6.1, you can find the detailed wiring diagram for the position control system.




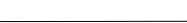

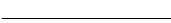





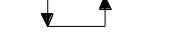
5.2.2 Parameters for the position control

Table 5-3 Parameters for the position control mode

Parameter NO.	Name	Value range	default	unit
PA04	Control mode	0~-5	0	
PA09	Proportional Position Loop Gain	1~1000	130	Hz
PA10	Position Feed Forward Gain	0~100	0	%
PA11	Filter time Constant of PA10	0~1000	0	ms
PA12	Pulse command Electronic Gear Ratio (Numerator) N1	1~30000	1	
PA13	Pulse command Electronic Gear Ratio (Denominator) M1	1~30000	1	
PA14	External Pulse Input Type	0~2	0	
PA15	Direction of external pulse	0~1	0	
PA16	Positioning Completion range	0~30000	20	
PA17	Position error Range	0~30000	400	100 pulse
PA18	Position Error Invalid control bit range	0~1	0	
PA19	Position command Smooth filter	0~30000	0	0.1Ms
PA20	Inhibit Drive Function Selection	0~1	0	
PA53	Digital Input Terminals Function Selection / Enabled Word 1	0~1	1	

Pulse command input type

Table 5-4 Type and waveform of position command input type

Pulse Type	Forward	Reverse	PA14
Pulse + Direction	PULS  SIGN 	PULS  SIGN 	0
CCW + CW	PULS  SIGN 	PULS  SIGN 	1
AB Phase Pulse	PULS  SIGN 	PULS  SIGN 	2

The host controller uses pulse command to control motor running and positioning via servo drive, in general, there are three different types of pulse outputting from the host controller: Pulse+ direction; CCW+CW;AB phase pulse..

The above three types are applicable with HSD2 series drive, you can select the required mode by setting parameter PA14.The detailed descriptions, please refer to the Table 5-4, the arrows indicate pulse counting, PA15 is used to change the pulse count direction.

Position pulse inputs through the terminals PULSE+(26) , PULSE-(18) , SIGN+(24), SIGN-(25) of CN2 connector, please refer to the detailed definition and description from section 3.4

Filter for position control

The filter is designed to smooth the motion command. You can set parameter PA19 to to achieve pulse filtering under the following circumstances: when the host controller doesn't have accelerate or decelerate function, electronic gear ratio set value being too high; system load inertia being high or command frequency value is low. By using the pulse filter, you can have a more stable and smooth pulse frequency, avoid position command lose, however, this performance will delay command reactions. When PA19=0,it means the filter is being disabled. This parameter indicates the time for position frequency varies from 0-63% of the external pulse frequency. The pre and after filtering diagram comparison, please refer to the following Diagram 5-4.

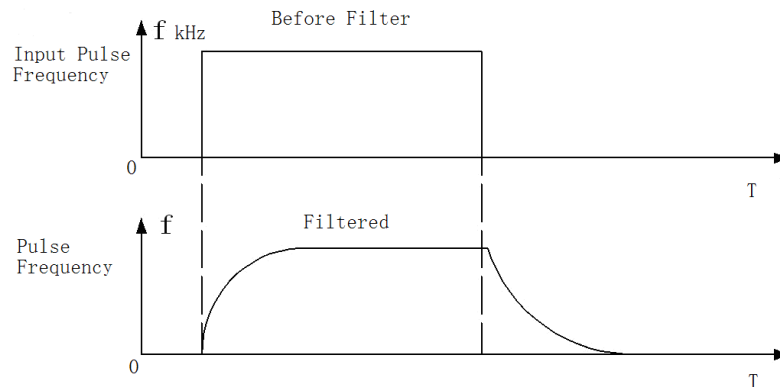


Diagram5-4 Comparison waveform between Pre and after filtering

5.2.3 Electronic gear ratio

Electronic gear provides simple ratio change of travel distance. The high electronic gear ratio would cause the position command to be the stepped command.

Please follow the below rules for setting:

N1: Numerator of the electronic gear ratio (PA12)

M1: Denominator of the electronic gear ratio (PA13)

P1: Number of pulses corresponding to 1mm in the host controller

F2: Number of encoder pulses per circle

S1: Screw pitch of the mechanical transmission (mm)

F1: Number of pulses required by actual moving distance 1mm.

$F1 = N1 * P1 / M1$ (pulses / mm)

$F1 = F2 / S1$ (pulses / mm) for actual moving distance without gearbox

Therefore the electronic gear ratio $N1/M1$ is equal to $F2 / (S1 * P1)$.

For example, if P1 of the host is 1000 pulses/mm, F2 of the H series servo drive is 10000, S1 of the screw is 6mm, the electronic gear ratio $N1/M1 = 10000 / (1000 * 6) = 5/3$. So you can set the parameter PA12 (N1)=5 and the PA13 (M1)=3.

If there is a gearbox between ball screw and motor, the ratio of the gearbox is $N2/M2$;

N2: rotation number of the motor

M2: rotation number of the ball screw

$F1 = N1 * P1 / M1$ (pulses / mm) for host controller

$F1 = F2 * N2 / (S1 * M2)$ (pulses / mm) for actual moving distance with gearbox

Therefore the electronic gear ratio $N1/M1$ equals to $F2 * N2 / (S1 * P1 * M2)$.

For the above-mentioned example, if the ratio of the gearbox is $N2/M2 = 5/3$.

According to the formula, the electronic gear ratio $N2/M2=10000*5/(1000*6*3)=25/9$. So you should set the parameter PA12 (N2) =25 and the PA13 (M2) =9 for the mechanical transmission system with a gearbox.

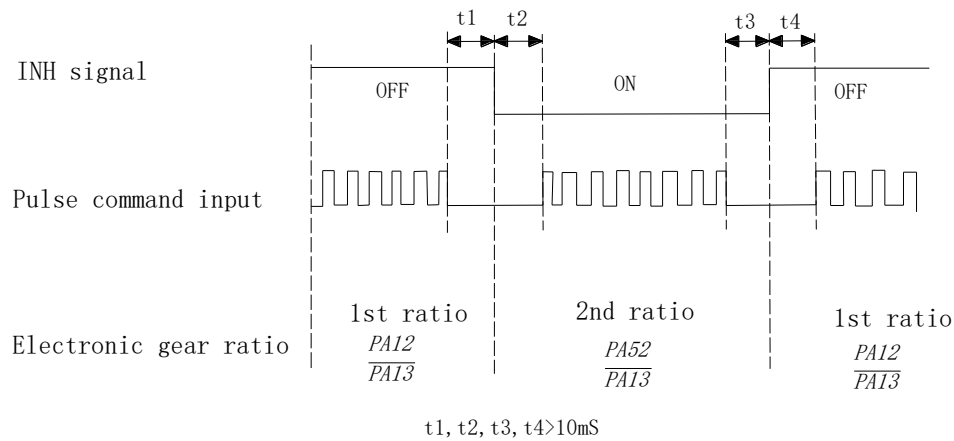


Diagram5-5 Dynamic electronic gear ratio

Note: HSD2 series servo drive provides two sets of dynamic electronic gear ratio. The second numerator of the electronic gear ratio is set in the parameter PA 52, and denominator is same as the first one (PA13). When the PA51 equal to 1, the function of the dynamic electronic gear is enabled and the signal connected to pin-15 of the I/O port CN2 could control the switching of the electronic gear. When the level of the signal is low, the servo drive chooses the second electronic gear ratio PA52/PA13.

5.2.4 Position control gain

Before you set the position control unit, please complete the setting of speed control unit manually since the speed loop is included in the position loop. After this operation, you can then adjust the position loop gain PA09 and position feed forward gain PA10 accordingly.

Table 5-5 The parameters for the position control gain

Parameter NO.	Name	Description	Value range	Defaults
PA-09	Position control gain	Increase the gain so as to enhance the response bandwidth of position loop.	0~1000	50
PA-10	Position feed forward gain	Minimize the deviation of phase delay	0~100	0
PA-11	Feed forward smooth filter	Smooth the accelerate and decelerate ,reduce overshoot.	0~1000	0

Because the positional control loop includes the speed control loop, the position loop bandwidth can be restricted by the one of the speed loop. It is recommended that the speed loop bandwidth should be at least four times faster than the position loop bandwidth. This means that the setting value of the proportional speed loop gain PA05 should be at least four times more than position control gain PA09.

The position loop bandwidth cannot exceed the speed loop bandwidth. It is suggested that $f_p \leq f_v/4$.

f_v : response bandwidth of speed loop (Hz).

f_p : response bandwidth of position loop(Hz)

$$KPP (PA09) = 2 \times \pi \times f_p$$

For example, the desired position loop bandwidth is 40 Hz.

$$\text{Then } PA09 = 2 \times \pi \times 40 = 251 \text{ rad/s}$$

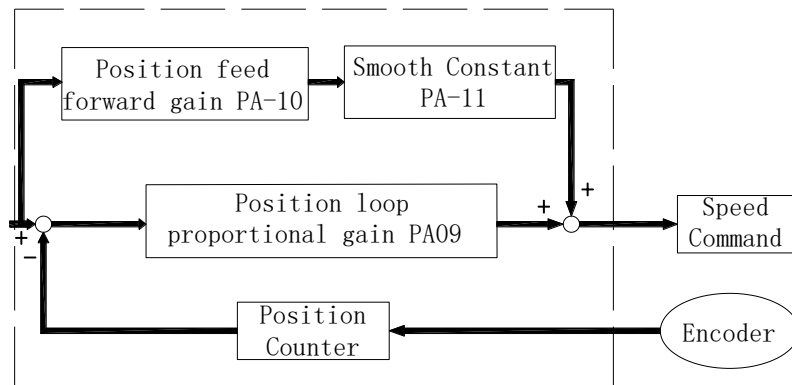


Diagram5-6 Flowchart of the position control loop

Increase the value of position loop gain can enhance the position response and reduce position error. If the set value is too high, it may cause vibration and noise.

If the position command is being transmitted smoothly, increasing the gain value can reduce the position error. However, if the position command is not transmitted smoothly, decreasing the gain value can tackle the problem of mechanical vibration.

When the value of proportional gain, (KPP set value) is too big, the response bandwidth of position loop will be increased and diminish the phase margin. And the motor rotor rotates back and forth with vibration. Thus, KPP has to be decreased until the rotor stops vibrating. When the external torque interrupts, the over low KPP (PA09) cannot meet the demand of position deviation. In this situation, adjusting parameter PA10 can effectively reduce the position error.

5.3 Gain Adjustment

Servo drive has three control loops: position control loop, speed control loop and current control loop. Please refer to the below Diagram 5-7 for detailed explanation.

The inner control loop bandwidth should always be higher than the outer control loop, otherwise it will cause motor rotor running back and forth with vibration and noise, affect the actual performance.

Therefore, having correct selection of response bandwidth for each control loop is very crucial. Generally speaking, the current loop has the highest response bandwidth while the position loop has the lowest.

The response bandwidth of the current loop is decided by the system itself, users can't modify this value by themselves. Please set and match the bandwidths for both speed loop and position loop properly through adjusting.

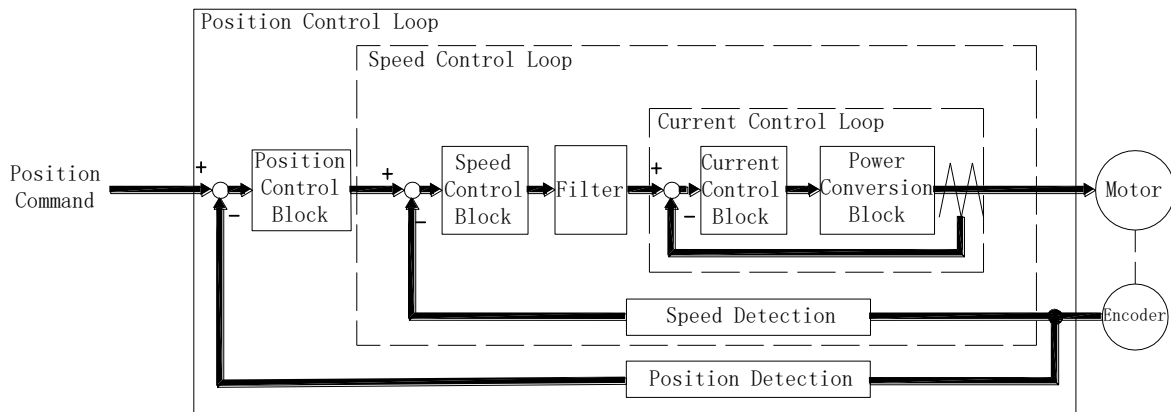


Diagram 5-7 Servo closed-loop control

5.3.1 Steps for gain adjustment

Since the motor load inertia, stiffness, damp ratio differ from the environment or application changes, the system default settings are not good enough to ensure a perfect response and cover all the circumstances. Therefore, adjusting the speed and position respond bandwidth according to each application is quite necessary to achieve a good performance from the servo system.

As for the whole system, when you change one of the parameters, the relevant ones also need to be modified accordingly, please do not set some excessive values and follow the below operation rules respectively:

Table 5-6 steps and rules for parameters setting

	Reduce vibration or overshoot	Increase response speed
Step 1	Decrease the proportional position control gain PA9	Increase the proportional speed control gain PA9
Step 2	Increase the integral time of the speed control PA6	Decrease the integral time of the speed control PA6
Step 3	Decrease the proportional speed control gain PA5	Increase the proportional position control gain PA9

5.3.2 Gain adjustment for speed control loop

You can adjust the relative speed control loop gain according to the following steps:

Step 1: Increase the integral time of the speed control loop PA6

Step 2: Gradually increase the value of the proportional speed control loop gain PA5 setting without causing major vibration or noise ,if this does occur, please decrease the gain setting value properly.

Step 3: Gradually decrease the integral time of the speed control loop PA6 until the resonance occurs, and then increase the setting value to eliminate the vibration.

Step 4: If the mechanical system resonates at a certain point, it's impossible to get a very good system response performance. In this case, please adjust the torque value PA7 for the low-pass filter to suppress the resonance, repeat the above steps to achieve a better response characteristic for the position and speed control loop.

5.3.3 Gain adjustment for position control loop

If the inertia of the machinery and conditions of applications is too high, and it creates system resonance, you can adjust the relative parameters according to the following steps:

Step 1: Increase the integral time of the speed control loop PA6

Step 2: Gradually increase the value of the proportional speed control loop gain PA5 setting without causing major vibration or noise ,if this does occur, please decrease the gain setting value properly.

Step 3: Gradually decrease the integral time of the speed control loop PA6 until the resonance occurs, and then increase the setting value to eliminate the vibration.

Step 4: Gradually increase the value of proportional position loop gain until the resonance occurs, and then decrease the setting value to eliminate the vibration.

Step 5: If want to shorten position control time and minimise position error, you can adjust position feed forward gain PA10 and PA11 (the smooth constant of feed forward gain) to achieve it.

Step 6: If the mechanical system resonates at a certain point, it's impossible to get a very good system response performance. In this case, please adjust the torque value PA7 for the low-pass filter to suppress the resonance, repeat the above steps to achieve a better response characteristic for the position and speed control loop.

5.4 Electromagnetic Brake

When operating brake via servo drive, if the digital output BRK is set to off, it

indicates that the electromagnetic brake is disabled and motor is locked. If the digital output BRK is set to ON, it indicates electromagnetic brake is enabled and motor can be operated. The electromagnetic brake is usually applied in Z-axis to reduce the large energy generated from servo motor. In order to avoid the brake error, it must be on when the servo drive is off. The brake has to be activated before the motor stops running (Servo OFF). The brake has to be released after Servo ON. Otherwise, it would become the load of the motor and may damage the brake.

If the brake is working during the process of acceleration or constant speed, the servo drive needs to generate more current to resist the force of brake and it may cause the alarm of overload warning.

5.4.1 Parameters of electromagnetic brake

The on delay time of the electromagnetic brake is set within the servo drive, except this there are three parameters about the off delay time (speed) of the electromagnetic brake. The users can use these three parameters to set the off delay time of electromagnetic brake.

Table 5-7 Parameters for the electromagnetic brake

Parameter NO.	Name	Value range	Defaults	Units	Applicable
PA47	Motion delay time of electromagnetic brake when motor is still	0~200	0	10ms	All
PA48	Motion delay time of electromagnetic brake when motor is running	0~200	50	10ms	All
PA49	Motion speed for electromagnetic relay when the motor is running.	0~3000	100	r/min	All

5.4.2 Wiring of electromagnetic brake

Wiring of the electromagnetic brake is shown in the below Diagram 5-8.

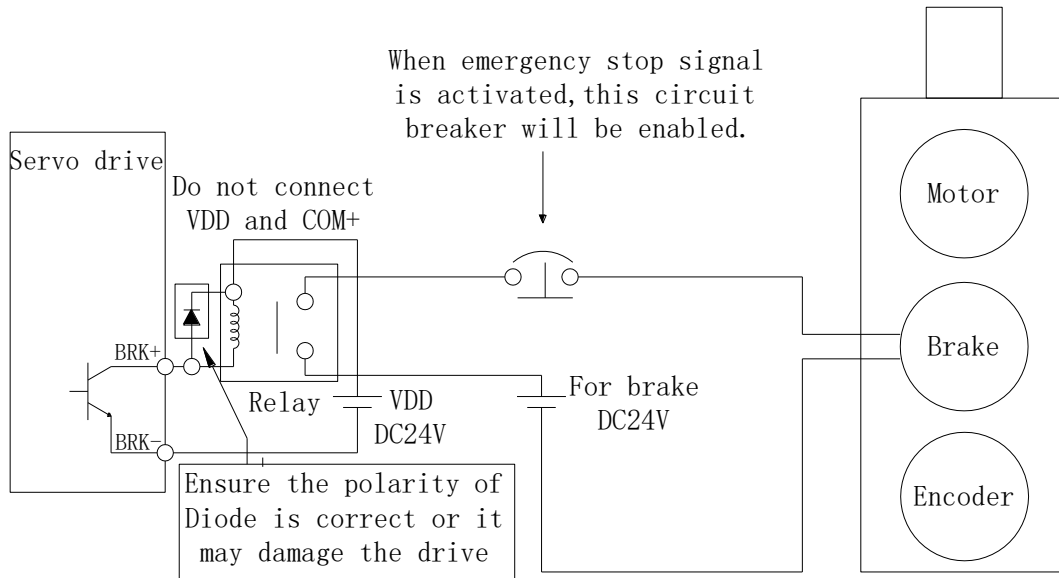


Diagram5-8 Diagram for electromagnetic brake

The BRK signal controls the brake operation. The VDD DC24V power supply supplied externally should be used to power the relay coil. When BRK is on, the motor brake is activated. Please note the coil of the brake has no polarity, while the diode has polarity, please ensure the polarity of the diode is correctly matched or it may cause damages to the drive. Power supply for brake is DC24V. Never use brake power and control power (VDD) at the same time.

Timing diagram of electromagnetic brake control:

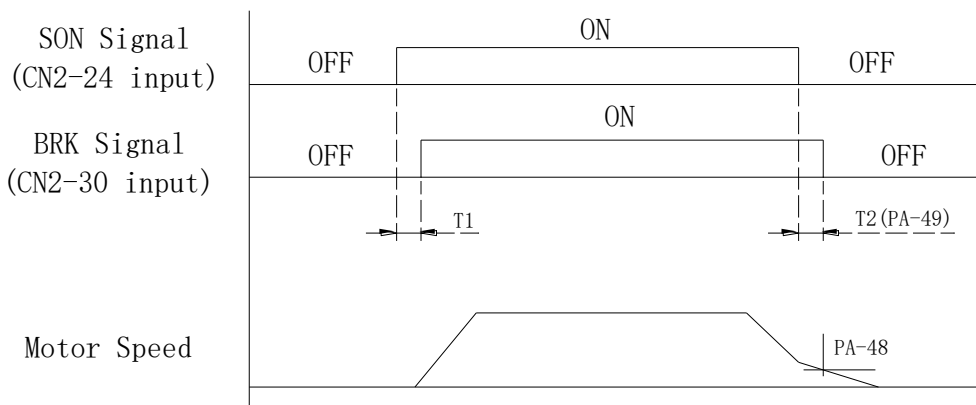


Diagram5-9 Timing diagram of brake control

BRK output timing explanation:

1. when servo off (when DI SON is not activated), the BRK output goes off (electromagnetic brake is locked) after the delay time set by PA48 reached and the motor speed is still higher than the setting value of PA49.

2. when servo off (when DI SON is not activated), the BRK output goes off (electromagnetic brake is locked) if the delay time set by PA48 has not reached but the motor speed is still lower than the setting value of PA49.

5.5 Timing

5.5.1 Timing for power supply

Step 1. Control power supply should be turned on earlier than the main power, or simultaneously.

Step 2. When the main power is turned on, it delays for about 1.2s. The servo SYDY signal is ready, then the servo drive is able to receive enable signal (SON) from host controller. When the drive detects SON signal, main circuit can be activated, the motor is now in a operational status. If the servo drive detects the invalid SON signal or there is any alarm, main circuit will be disabled and the motor will be in a zero-speed status.

Step 3. Please try to avoid switching the system power on and off too often.

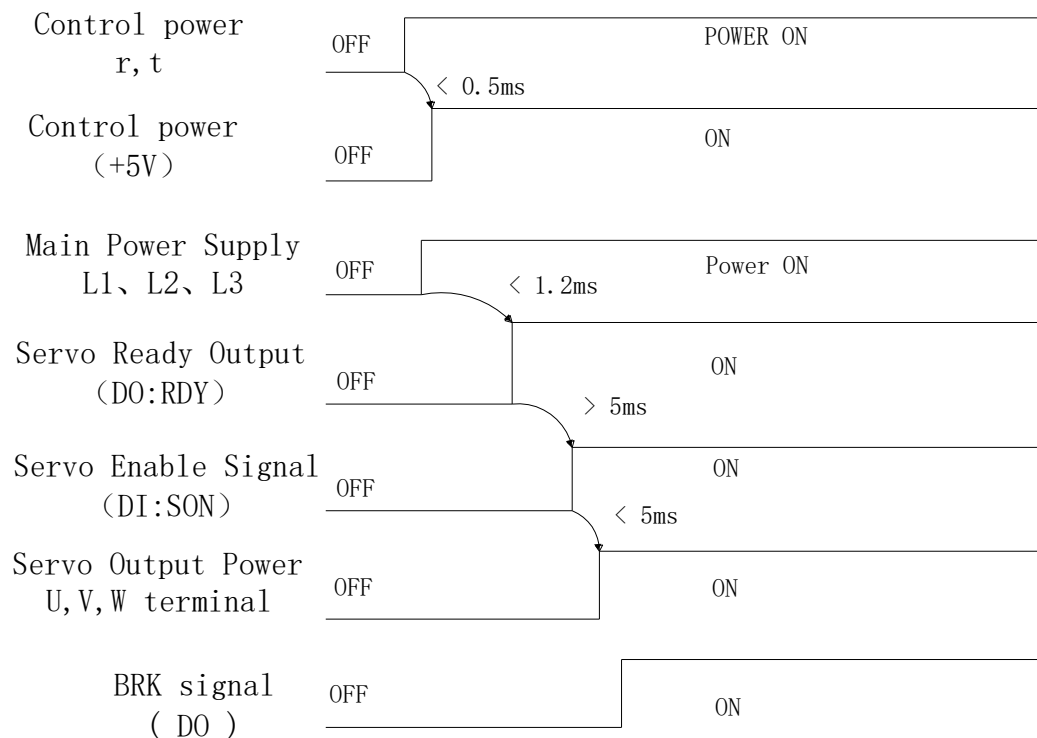


Diagram5-10

Timing flowchart of control power and main power

Note: Even if the host controller output the SON signal before the SRDY signal of the drive, the servo drive couldn't receive the SON until the SRDY signal is ON for 5 ms.

5.5.2 Timing for enable operation

1. Enable operation ON/OFF timing for standstill motor

When the motor is still, if the SON is OFF, the main circuit continues to work to hold the position, the brake is going through the stage of OFF-ON-OFF, wait for a while (PA47 setting value) and disable the power supply for the motor.

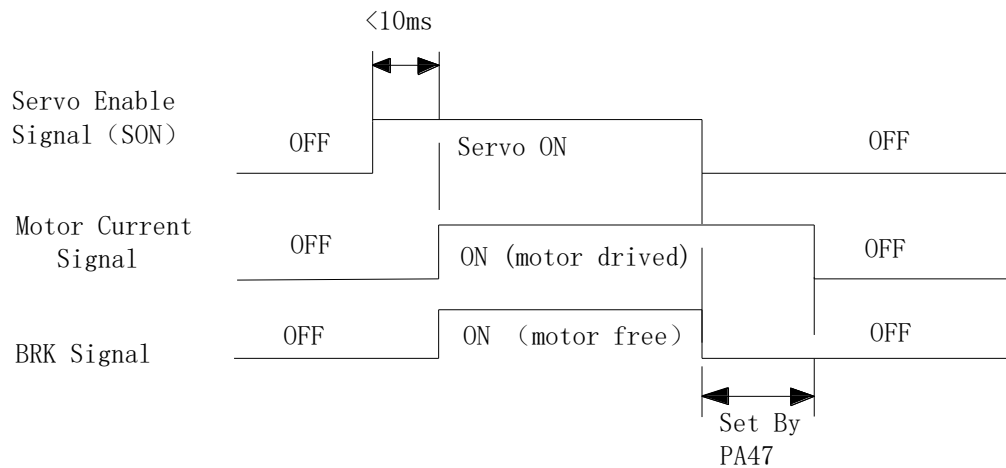


Diagram 5-11 Enable operation timing flowchart when motor is still

2. Enable operation ON/OFF timing when the motor is running

When the motor is running, if the SON is off, the main circuit of the drive will be disabled and the brake continues to be ON before it turns OFF because of the delay. In this way, we can avoid the potential damage to the brake when the motor is still running at a very high speed. The actual delay timing is decided either by parameter PA48 or the time for the motor to be slowed down to the set value of PA49, the lower one of the two numbers is the actual delay time.

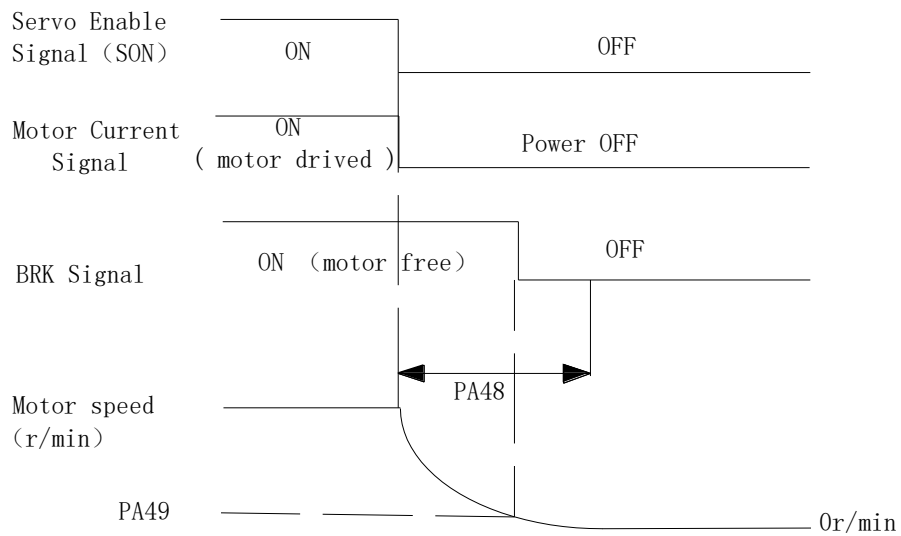
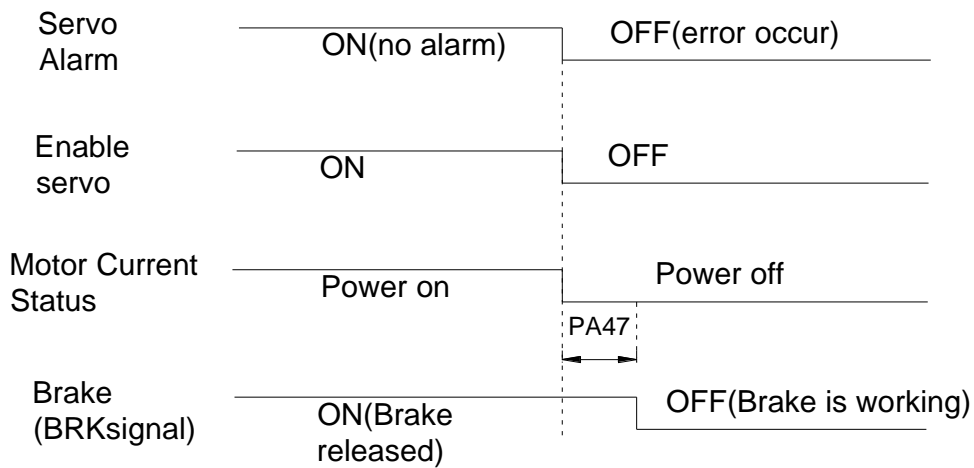


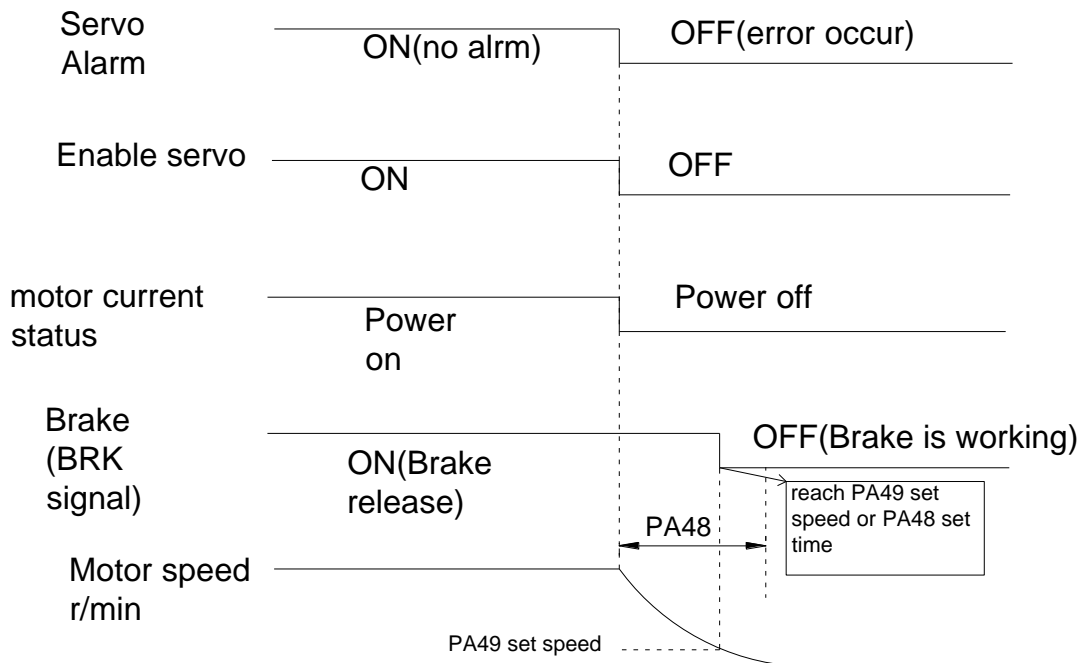
Diagram5-12 Disable operation timing flowchart when motor is running

5.5.3 Servo enable & servo alarm flowchart

1.servo enable & servo alarm timing flowchart when the motor is in static status:



Note: when the motor is in a static status, an error occurs, it will trigger the servo alarm, servo enable OFF very instantly, this will cut off the power at the same time.If you want the brake to work instantly,you need to set PA47=0.
servo enable & servo alarm timing flowchart when the motor is in the running status.



Note: when the motor is in a running status and there is an error and it triggered the servo alarm, servo enable will be off very instantly, power will be cut off at the same time. The motor may be running at a high speed when the alarm triggers, in this case, if the brake is enabled to stop the motor at a high speed, it may damage the brake. Therefore, we have PA48 and PA49 two parameters to avoid the potential damage. PA48 is the brake response delay time, PA49 is the set motor speed for the brake to enable. The brake will work if one of these parameters reached its set value.

If the motor is applied on the vertical axis of the equipment/machine, and it doesn't allow any degree of free-fall of the motor, set PA48=0, and the brake will be working straight after the alarm triggered.

If the applied equipment can allow a certain distance of free-fall for the motor, you can set proper values for PA48 & PA49, the brake will be enabled until the motor speed slows down to a certain degree (PA49 set value). During the speed slowdown process, the power is in OFF status for the servo, the load inertia slows the motor down in this case. If the time for the motor to reach PA49 set point is longer than PA48, then once it passed PA48 set time, brake enables.

5.6 Start & Stop

The drive start/stop characteristics is determined by many aspects, such as load inertia, on/off frequency, the status of both the drive itself and servo motor.

5.6.1 On-off frequency and load inertia

When the servo drive is used in the applications which require high on-off frequency, please confirm whether the frequency is within the rated frequency range of “H” series servo drives before you connect the application. The frequency range is determined by the motor type, the load inertia and the speed of the motor etc. Please refer to the detailed information from Table 5-8.

Table 5-8 On-off frequency VS Load inertia

Inertia multiples	On-off frequency and ACC/DEC time
$J \leq 3J_{\text{motor}}$	$f > 100$ /min; less than 70Ms
$J \leq 5J_{\text{motor}}$	$60 < f \leq 100$ /min; less than 130Ms
$J > 5J_{\text{motor}}$	$f \leq 60$ /min; greater than 150Ms

Note: The above table only provides the on-off frequency in the general cases, the specific circumstances will vary from the motor types and the load conditions.

5.6.2 Adjustment Method

When the load inertia is five times (or above) greater than the motor inertia, some errors may occur, such as position overshoot, excessive position deviation and speed response fault, break abnormal etc.

Under the above situations, you can take relevant actions according to the following steps:

Step 1: Increase the value of PA5 properly.

Step 2: Decrease the value of PA9 in the meantime. Reduce the inner torque limitation value PA36.

Step 3: Increase the value of the parameter PA40, PA41 and PA42. (ACC/DEC time content) along with the S-curve ACC/DEC time content.

Step 4. Increase the ACC/DEC time content of the host system.

You can also consider of selecting a bigger inertia motor to meet your requirement.

Chapter 6 Parameters

6.1 Parameter Summary

The defaults of the following parameter table is shown as an example of HSD2-030 drive. The value of the parameters marked “*” may be different from other types.

In the table, Applicable Mode means that the parameter can play a role in a certain control mode: P refers to position control mode, S refers to speed control mode, T refers to Torque control mode and ALL refers to all of the control mode(position, speed and torque control mode).

Input password parameter PA0 =315, you are able to set all parameters except for PA1.You need to set password PA0 = 302 to do changes about PA1.

Table 6.1 Parameter List

No.	Function Description	Applicable Mode	Range	Default	Unit
PA-0	Password	ALL	1-1000	315	
PA-1	Motor Type Code	ALL	20~200	53*	
PA-2	Software Version(read only)	ALL	0~99999	3.85.19*	
PA-3	Initial Display Status	ALL	0~19	0	
PA-4	Control Mode Selection	ALL	0~5	0	
PA-5	Proportional Speed Loop Gain	P, S	1~5000	280*	Hz
PA-6	Speed Integral Time	P, S	1~1000	30*	ms
PA-7	Torque filter	ALL	0~1000	10	0.1ms
PA-8	Speed Detection Filter	ALL	1~1000	10	0.1ms
PA-9	Proportional Position Loop Gain	P	1~1000	100	Hz
PA-10	Position Feed Forward Gain	P	0~100	0	%
PA-11	Smooth Constant of Position Feed Forward Gain	P	0~1000	25	ms
PA-12	Electronic Gear Ratio (Numerator) N1	P	1~30000	1	
PA-13	Electronic Gear Ratio (Denominator) M1	P	1~30000	1	
PA-14	External Pulse Input Type	P	0~2	0	
PA-15	Direction of External Pulse	P	0~1	0	

PA-16	Positioning Completed Width	P	0~30000	20	pulse
PA-17	Excessive Position Error Range	P	0~30000	400	×100 pulse
PA-18	Excessive Position Error Invalid	P	0~1	0	
PA-19	Smooth Constant of Position Command	P	0~30000	1	0.1Ms
PA-20	Inhibit Drive Function Invalid	ALL	0~1	1	
PA-21	JOG Operation Speed	S	-3600~3600	120	r/min
PA-22	Reserved			167	
PA-23	Inner Speed Command selection	S	0~5	0	
PA-24	Inner Speed Command 1	S	-3600~3600	0	r/min
PA-25	Inner Speed Command 2	S	-3600~3600	100	r/min
PA-26	Inner Speed Command 3	S	-3600~3600	300	r/min
PA-27	Inner Speed Command 4	S	-3600~3600	-100	r/min
PA-28	Target Motor Speed	S	0~3600	500	r/min
PA-29	Analog Torque Command Gain(input)	T	10~100	50	0.1V/100 %
PA-30	Direction of Torque Command	T	0~1	0	
PA-31	Zero-offset Compensation for Torque Command	T	-2000~2000	0	
PA-32	Max speed limit of Torque Command	T	0~3600	1000	r/min
PA-33	Reserved			167	
PA-34	Reserved			167	
PA-35	Max speed limit of motor	ALL	0~3600	1000	
PA-36	Internal torque limit	ALL	5~600	300	%
PA-37	Negative torque arrival set point	ALL	5~300	100	%
PA-38	Positive torque arrival set point	ALL	5~300	100	%
PA-39	Min speed limit under analog speed control mode	S	0~1000	3	
PA-40	Time of acceleration for 0 to 1000rpm	S	0~10000	0	Ms
PA-41	Time of deceleration for 0 to 1000rpm	S	0~10000	0	Ms

PA-42	ACC/DEC S-curve duration time	S	0~10000	0	Ms
PA-43	Analog Speed Command Gain	S	10~3000	300	(r/min)/V
PA-44	Direction of Speed Command	S	0~1	0	
PA-45	Zero-offset Compensation for Analog Speed Command	S	-2000 ~2000	0	
PA-46	Low-pass Filter for Speed Command	S	0~1000	3	Ms
PA-47	Motion control for Electromagnetic Brake when motor stops	ALL	0~300	0	×10Ms
PA-48	Motion control for Electromagnetic Brake when motor is running	ALL	0~300	50	×10Ms
PA-49	Speed control for Electromagnetic Brake when motor is running	ALL	0~3600	100	r/min
PA-50	Sampling Gain for Bus Voltage	ALL	10~3000	511*	
PA-51	effective electronic gear ratio	ALL	0~1	0	
PA-52	Electronic gear ratio(Numerator 2)	ALL	1~30000	1	
PA-53	Inside SON enable	ALL	0~1	1	
PA-54	Z signal output pulse width selection	ALL	0~1	1	
PA-55*	AB output dividing factor	ALL	0~1	0	
PA-56	Digital Output effect level	ALL	000~111	000	
PA-57	DO1 function definition(ALM)	ALL	1~5	1	
PA-58	DO2 function definition(COIN)	ALL	1~5	3	
PA-59	DO3 function definition(BRK)	ALL	1~5	4	
PA-60	Reserved			167	
PA-61	Input vibration elimination time constant	ALL	0~100	2	
PA-62	Digital Import effect level	ALL	0000 ~1111	0000	

PA-63	DI1 function definition(SON)	ALL	1~7	1	
PA-64	DI2 function definition(CLE)	ALL	1~7	2	
PA-65	DI3 function definition(SC2)	ALL	1~7	3	
PA-66	DI4 function definition(ALRS)	ALL	1~7	4	

Note1: "*" next to the parameter numbers means this function may be "reserved" for some models, for instance, PA-55*, it may not exist or reserved in some models, the detailed information, please consult with our after sales service center or local distributors.

6.2 Detailed Parameter Description

Table 6-2 Detailed description for the parameter settings

NO.	Name	Function description	Value range
0	Password	1: Password is 315 2: motor type password is 302, you only need this when you are modifying PA1	1~1000
1	Motor type code	Select the motor type that you are using; in case you need to revise this number, input PA0 is 302, which is the password, finish off your parameters setting, power the drive off and on again then the changes will be effective.	20~200
2	Software Version	Software version read only, you can't change the details, A means the drive power level, B C D E means the different software versions. A=1, 500W; A=2, 900W; A=3, 1.5kw; A=4, 1.5kw; A=5, 2.5kW; A=6, 3.5kW.	0~9999 9
3	Initial display status	Select the display status when the drive has been powered on: 0: actual motor speed. 1: low data of the feedback position 2: high data of the feedback position 3: Low data of the position command 4: High data of the position command 5: Low data of the position error 6: High data of the position error 7: motor torque 8: motor current(Q axis); 9: Reserved 10: control mode; 11: pulse frequency of position command 12: Speed command 13: Torque command 14: Motor feedback current -position.	0~19

		<p>15: D-axis current</p> <p>16: Reserved</p> <p>17: DC bus voltage</p> <p>18: Drive operation status</p> <p>19: Error/alarm code;</p>	
4	Control Mode selection	<p>Select the requested control mode by changing the following parameters:</p> <p>0: Position control mode, controlling the position command pulse input and output;</p> <p>1: Speed control mode.</p> <p>2: Torque control mode</p> <p>3: Speed trial run control mode, type in the numbers via keypad, users can test the drive and motor.</p> <p>4: JOG control mode, enter the Jog control operation panel, press and hold the UP key, the motor will be running at a JOG speed, release the UP key, the motor stops with a zero speed; press and hold the DOWN key, the motor will be running at the JOG speed in a reverse direction, release the DOWN key, motor stops.</p> <p>5: zeroing encoder control mode, set PA4=5 will enter this mode directly.</p>	0~5
5	Proportional Speed Loop Gain	<p>Generally speaking, increase this value can improve response performance and reduce the error. The default value is 170. The gain should be increased if the load inertia is relatively high.</p> <p>Generally if the load inertia is greater, the value should be modified larger. You can increase the gain as much as possible without causing big noise and obvious vibration.</p>	1~5000 Hz
6	Integral Time of Speed Control Loop	<p>The value of the integral time has an effect on the response performance of the speed control loop. The lower the value is, the quicker the speed will be, however, when the value is too low, it may cause overshoot. Users need to adjust the value by the motor type and load inertia etc. Generally, having a big load inertia requires a bigger value setting.</p>	1~1000 Ms

7	Time constant of torque low pass filter	Time constant for torque low-pass filter has an effect on the response performance of the torque control. The resonance can be suppressed by adjusting this setting. The bigger this value is, the lower the cut-off frequency would be, and this lower value will also eliminate the vibration and noise. If the load inertia is too big, you can increase this value slightly without causing obvious vibration and noise. If you require high torque response performance, please decrease this value considerably.	0~1000 ×0.1Ms
8	Speed Detection Filter time constant	1.the bigger this value is, the lower the cut-off frequency will be, less produced noise from the motor. If the load inertia is being very high, please increase this value considerably without causing major vibration and noise. 2.Decreasing the value can uplift the cut-off frequency, enhance the speed feedback response performance.	1~1000 ×0.1Ms
9	Proportional Position Loop Gain	Increasing this value can improve the response performance and position precision. However excessive value will cause vibration and overshoot. The detailed value will be decided by the motor type, load inertia etc.	1~1000 /S
10	Position Feed Forward Gain	Increasing the value can reduce the position track error, set value 100% means the total position error is always zero under any frequency pulse. Increase this value can enhance the system response performance, but will make the position loop unstable and cause possible vibration. Generally the set value is 0 unless users require very high response performance for specific applications.	0~100%
11	Smooth Constant for position feed forward	This parameter is used to set the time constant of low-pass filter for position feed forward gain. The function of this low-pass filter is to maintain the stability of position control.	0~1000 ×0.1ms
12	Electronic Gear Ratio (Numerator) N1	Under the control mode, users can matching different types of pulse commands and achieve their desired resolutions (angle/pulse) by adjusting PA12 & PA13.	1~ 30000

		<p>The electronic gear ratio can be calculated as the following :$N1/M1 = F2/(S1 * P1)$</p> <p>P1: Number of pulses corresponding to 1mm in the host controller</p> <p>F2: Number of encoder pulses per circle (Default is 10000)</p> <p>S1: Screw pitch of the mechanical transmission (mm)</p> <p>The ideal range of the gear ratio is from 1/50 to 50.</p>	
13	Electronic Gear Ratio (Denominator) M1	Refer to parameter PA12	1~30000
14	Position command Pulse Input Type	<p>Note the revised parameters will only be effective after you turn the power off and on again in completion of the changes.</p> <p>There are three different types of pulse input:</p> <p>0: pulse + direction.</p> <p>1: CCW pulse + CW pulse.</p> <p>2: AB phase pulse.</p> <p>Definitions of CCW and CW: face the motor, anti-clockwise direction is CCW(positive) while clockwise running direction is CW(negative).</p>	0~2
15	Position command Pulse Direction	<p>0: Normal direction</p> <p>1: Negative direction</p>	0~1
16	Positioning Completed Range	<p>In PT mode, this parameter is used to monitor the pulse range for the completion of the position controlling. The servo drive will need to use this value to judge whether or not the position control is completed.</p> <p>In the position control mode, the COIN signal will be on when the leftover pulse of the position error is less than set value of PA16.</p>	0~30000 pulse
17	Excessive Position Error Detection	Users can set position error detection range by adjusting this parameter. Under the position control mode, if the actual position error exceeds to the set value, the servo drive will send the alarm signal..	0~30000 ×100 pulse

	Range		
18	Excessive Position Error selection mode	0: Enable detection function for excessive position error. 1: Disable the function for detecting the position error.	0~1
19	Smooth Constant of Position Command	This filter is used to smooth the position command pulse, value means the smooth constant. Command pulse going through the filter won't cause any pulse lose, but result in command delays. When the set value is 0, this means the filter is disabled. This filter will be used under the following circumstances: <ul style="list-style-type: none"> • The host controller does not have a deceleration / acceleration function. • The electronic gear ratio is larger than 10. • The position frequency is low. ; • Step jumping and vibration occur when the motor is running. 	0~ 30000 x0.1Ms
20	Inhibition Function Selection	0: Enable the inhibition function for both CCW and CW, when the drive inhibition switch(FSTP) is ON, drive inhibition enabled, when it's in OFF status, the CCW torque value maintains at 0.(Same as CW direction operation). If both CCW and CW drive inhibitions are OFF, it will trigger the alarm. Cancel CCW and CW input inhibition, whether the FSTP is ON or off, both CCW and CW are enabled, in the meantime, if you turn both CCW and CW drive inhibitions off, it won't trigger any alarms.	0~1
21	JOG Operation Command	Set the operation speed command for JOG control mode.	-3600~3 600 r/min
22	Reserved		
23	Speed Command selection	0: External analog input(analog voltage between AS+,AS- to control the speed) 1:select the 1 st speed command(determined by PA24)	0~5

		<p>2: select the 2nd speed command(determined by PA25)</p> <p>3: select the 3rd speed command(determined by PA26)</p> <p>4: select the 4th speed command(determined by PA27)</p> <p>5:select the speed command via SC2, SC1 SC2=0, SC1=0, select the 1st speed command SC2=0, SC1=1, select the 2nd speed command SC2=1, SC1=0, select the 3rd speed command SC2=1, SC1=1, select the 4th speed command</p>	
24	1 st Speed Command	Set inner speed 1	-3600 ~3600 r/min
25	2 nd Speed Command	Set inner speed 2	-3600 ~3600 r/min
26	3 rd Speed Command	Set inner speed 3	-3600 ~3600 r/min
27	4 th Speed Command	Set inner speed 4	-3600 ~3600 r/min
28	Target Motor Speed	<p>1.this parameter is used to set the targeted speed value;</p> <p>2.Under the non position control mode, if the detected motor speed is over the set value, the SCMP will be ON, otherwise, the SCMP is OFF.</p> <p>3.There is no need to use this parameter under position control mode</p> <p>4.The motor speed has nothing to do with the rotating directions.</p>	0~3600 r/min
29	Analog Torque Command Gain	<p>Set the proportional relationship between analog input voltage and the value of torque command. This function is effective only under the torque control mode (PA4=2). The unit is 0.1V/100%. The default is 50, which means it will produce 100% rated torque by inputting 5v voltage.</p>	10~100 (0.1V/10 0%)

30	Direction of Analog Torque Command	0: The direction of the torque is CCW 1: The direction of the torque is CW	0~1
31	Zero-offset Compensation for Torque Command	The value is the offset compensation for the analog signal of torque command.	-2000 ~2000
32	Max speed Limit under torque mode	In torque control mode, this setting will limit the max running speed of the servo motor.	0~3600 r/min
33	DI status monitoring	1.monitoring the input level status for the 4 DI ports 2.Bit0 corresponds to DI1; Bit1 corresponds to DI2; Bit2 corresponds to DI3;Bit3 corresponds to DI4. Under the default parameter setting status, bit0=SON; bit1=CLE/SC1; bit2=SC2; bit3=ALRS 3.When Bitx=1,it means the related DI port input high level When Bitx=0, it means the related DI port input low level.	1111
34	DO status monitoring	1.monitoring the output level status for the 3 DO ports 2.Bit0 corresponds to DO1; Bit1 corresponds to DO2; Bit2 corresponds to DO3;Under the default parameters setting status: bit0=ALR; bit1=coin; bit2=BRK 3.When Bitx=1,it means the related DO port output high level When Bitx=0, it means the related DO port output low level.	111
35	Max speed limit of motor	Limit the max speed of motor, when you've done the parameter settings, turn the power off and on again to enable the changes.	0~3600 r/min
36	Internal torque limit	Control the drive torque output, $T_{max}=PA36 \cdot T_{rated} \cdot 1\%$.	5~400%
37	Negative torque arrived set point	When negative torque arrived at the set point, the TRQL signal output is active.But this value should not considered as the limited negative torque set point, the torque limit should be set by PA36.	5~300%
38	Positive	1.Under the position control mode,PA38 is set as	5~300%

	torque arrived set point	the positive torque arrived at the set point,theTRQL signal output is active. But this value should not considered as the limited positive torque set point. 2.under the trial run (PA4=3) and Jog mode(PA4=4), PA38 is the limit parameter of the max torque output.And the max drive output torque will be the lower value between PA36 & PA38.	
39	Min speed limit for Analog speed control mode	PA4=1 means it's in analog speed control mode, this parameter is used to control the min speed of the motor.	0~1000 r/min
40	Acceleration Time	1.set value indicates the acceleration time for the motor to reach the speed from 0 to 1000r/min. 2.It has a linear feature. 3.Only used under the speed control mode. 4.If the drive is being used together with the external position loop, please set PA40=0. 5.This parameter is effective when PA4=1 or PA4=4.	0~1000 0Ms
41	Deceleration Time	1.set value indicates the acceleration time for the motor to reach the speed from 0 to 1000r/min. 2.It has a linear feature. 3.Only used under the speed control mode. 4.If the drive is being used together with the external position loop, please set PA40=0. 5.This parameter is effective when PA4=1 or PA4=4.	0~1000 0Ms
42	Accel/Decel S-curve	Stabilise the motor start-up and stop, set the S-curve continuous time for acceleration or deceleration.This parameter is effective when PA4=1 or PA4=4.	0~1000 0Ms
43	Analog Speed Command Gain	Set the proportional relationship between analog input voltage and the speed command. Only when PA4=1 and PA22=0, or PA4=2, the function is active.	10~300 0 r/min/V
44	Direction of analog Speed input	Select the direction for the external speed command. 0: When analog speed command is positive, the	0~1

	Command	speed direction is CCW. 1: When analog speed command is negative, the speed direction is CW.	
45	Zero-offset Compensation for Analog Speed Command	This is the analog speed command zero speed clamp value.	-2000 ~2000
46	Low-pass Filter for Analog Command	1.this is a low-pass filter working on analog input. 2.Increase the set value will down grade the response performance but eliminate the noise impact to the signal. 3.this parameter is only active under the following conditions. 1. PA4=1 and PA23=0 2. PA4=2.	0~1000 ms
47	Enable Delay time of the electromagnetic Brake	Set the delay time between output terminal(BRK) ON to OFF and the actual current cut-off. This value shall not be lower than the mechanical brake delay time.	0~300 ×10Ms
48	Disable Delay Time of the electromagnetic Brake	Set the delay time between current cut-off and output terminal(BRK) OFF to ON. When the motor is running at a very high speed, wait until it slows down and enable the brake will protect the brake from potential damage. The actual time is the lowest one between PA48 and the required time for the motor to decrease the speed to the set value of PA49.	0~300 ×10Ms
49	Brake operating speed when the motor is running	Set the brake working speed from current cut-off to mechanical brake enabled,(output terminal BRK from ON to OFF)	0~3600 r/min
50	Sampling Gain for Bus Voltage	It is used to compensate the voltage offset for the input DC Bus. This parameter is not allowed to be changed.	10~300 0
51	Dynamic Gear ratio	0:dynamic gear ratio invalid, the function of the input terminal INH is to disable the pulse	0~1

		command, gear ratio is decided by PA12/PA13 1:dynamic gear ratio is effective, the function of the input terminal INH is to switch over the gear, when INH is in an invalid electric level,(valid electric level is set by PA62), gear ratio is decided by PA12/PA13, when INH is in an valid electric level, the gear ratio is PA52/PA13.													
52	Electronic gear ration(numerator)	The function is the same as PA12, only effective when there is INH signal.													
53	SON Force enable position	0: the drive can't be force enabled. 1:the drive can be force enabled.	0~1												
54	Z output pulse bandwidth select	0: output original Z pulse signal without processing 1:output Z pulse signal with a bandwidth min 0.2ms.	0~1												
55*	Position encoder AB signal output dividing factor	0:output original AB pulse signal 1,AB signal output bandwidth is 10.	0~1												
56	DO output effective electric level	<p>This parameter is to define the electric level of output terminals BRK COIN ALM</p> <table border="1" style="margin-left: 20px;"> <tr> <td>Symbol</td> <td>DO3</td> <td>DO2</td> <td>DO1</td> </tr> <tr> <td>default</td> <td>(BRK)</td> <td>(COIN)</td> <td>(ALM)</td> </tr> <tr> <td>Control position</td> <td>PA56.2</td> <td>PA56.1</td> <td>PA56.0</td> </tr> </table> <p>PA56.2=0,BRK effective level is low; PA56.2=1,BRK effective level is high. PA56.1=0,COIN effective level is low; PA56.1=1,COIN effective level is high. PA56.0=0,ALM effective level is low; PA56.0=1,ALM effective level is high.</p>	Symbol	DO3	DO2	DO1	default	(BRK)	(COIN)	(ALM)	Control position	PA56.2	PA56.1	PA56.0	000~111
Symbol	DO3	DO2	DO1												
default	(BRK)	(COIN)	(ALM)												
Control position	PA56.2	PA56.1	PA56.0												
57	DO1(ALM)se If define	DO has three actual output terminals, four functions: PA57=1,DO1 is fined as ALM; servo is alarm; PA57=2,DO1 is defined as SRDY; servo is ready;	1~5												

		PA57=3,DO1 is defined as COIN;when PA4=0,COIN means position reached,when PA4=1, it means speed reached. PA57=4,DO1 is defined as BRK; control brake PA57=5,DO1 is defined as TRQL; Torque arrived																
58	DO2(COIN) self define	Refer to PA57	1~5															
59	DO3(BRK) self define	Refer to PA57	1~5															
60	Reserved	零速钳位速度阈值																
61	Input filtering time constant	1. Define the input filtering time constant. 2. The lower this value is, the better response performance you will get, but in the meantime, it'll be very easy to introduce interference. 3. The bigger this value is, the poorer response you will get, but you will get a better anti-interference performance.	0~100m s															
62	Input terminal DI effective electric level self define	This parameter is to define the electric level of input terminal DI: <table border="1" data-bbox="531 1108 1165 1321"> <thead> <tr> <th>Symbol</th> <th>DI4</th> <th>DI3</th> <th>DI2</th> <th>DI1</th> </tr> </thead> <tbody> <tr> <td>Default definition</td> <td>(ALRS)</td> <td>(SC2)</td> <td>(CLE)</td> <td>(SON)</td> </tr> <tr> <td>Control position</td> <td>PA62.3</td> <td>PA62.2</td> <td>PA62.1</td> <td>PA62.0</td> </tr> </tbody> </table> PA62.3=0,DI4 effective level is low; PA62.3=1,DI4 effective level is high; PA62.2=0,DI3 effective level is low; PA62.2=1,DI3 effective level is high; PA62.1=0,DI2 effective level is low; PA62.1=1,DI2 effective level is high; PA62.0=0,DI1 effective level is low; PA62.0=1,DI1 effective level is high;	Symbol	DI4	DI3	DI2	DI1	Default definition	(ALRS)	(SC2)	(CLE)	(SON)	Control position	PA62.3	PA62.2	PA62.1	PA62.0	0000 ~1111
Symbol	DI4	DI3	DI2	DI1														
Default definition	(ALRS)	(SC2)	(CLE)	(SON)														
Control position	PA62.3	PA62.2	PA62.1	PA62.0														
63	DI1(SON) self define	DI1 has 4 actual output terminals,with 7 different functions: PA63=1,DIx is defined as SON, servo on; PA63=2,DIx is defined as CLE/SC1/ZCLAMP; PA63=3,DIx is defined as INH/SC2; PA63=4,DIx is defined as ALRS; PA63=5,DIx is defined as FSTP;	1~7															

		PA63=6,DIx is defined as RSTP; PA63=7,DIx is defined as AIR;Analog input reverse.	
64	DI2(CLE) self define	Refer to PA63	1~7
65	DI3(SC2)self define	Refer to PA63	1~7
66	DI4(ALRS) self define	Refer to PA63	1~7

Note1: "*" next to the parameter numbers means this function may be "reserved" for some models, for instance,55*, it may not exist or just reserved in some models, the detailed information, please consult with our after sales service center or local distributors.

Chapter 7 Motor Type Matching

Before you power the servo drive, please make sure the motor is properly selected and all parameters are set correctly, otherwise, it may cause malfunction, trigger the alarms off, or the motor may lose its control.

You need to input the password,(set PA0=302) before you modify the parameter PA1.

When you've done setting of PA1, please write(save) the parameters into servo drive(when the panel displays EE-SET, press the **Enter** key for 3 seconds until it displays "FINISH", this means the parameters are saved in the drive). Then power OFF and ON again, the set parameters will be effective.

Generally, please follow the following list when you are selecting the motor type:

Drive HSD2-020 is adaptive for 60, 80, 90, and 110 series motor.

Drive HSD2-030/030A is adaptive for 80, 90, 110 and 130 series motor.

Drive HSD2-050 is adaptive for 110, 130 and 150 series motor.

Drive HSD2-065 is adaptive for 130, 150 and 180 series motor.

If client want to match other motors which is not produced by our company, please consult with your local distributor or our technical department.

7.1 Motor Type List for HSD2-020

Table 7-1 Motor type list for HSD2-020

Code	Motor model	Power	Torque	Rated Speed	Rated Current
		(kw)	(Nm)	(rpm)	(A)
21	S60-2-006M30	0.2	0.6	3000	1.5
23	S60-2-013M30	0.4	1.3	3000	2.8
25	S60-2-019M30	0.6	1.9	3000	3.5
31	S80-2-013M30	0.4	1.3	3000	2.6
33	S80-2-024M30	0.75	2.4	3000	4.2
35	S80-2-033M30	1	3.3	3000	4.5
41	S90-2-024M30	0.75	2.4	3000	3
45	S90-2-035M20	0.75	3.5	2000	3
48	S90-2-040M25	1	4	2500	4
51	S110-2-020M30	0.6	2	3000	4
53	S110-2-040M30	1.2	4	3000	5
56	S110-2-060M30	1.2	6	2000	6
others	S80-2-024M30	0.75	2.4	3000	4.2

7.2 Motor Type List for HSD2-030

Table 7-2 Motor type list for HSD2-030

Code	Motor model	Power	Torque	Rated Speed	Rated Current
		(kw)	(Nm)	(rpm)	(A)
31	S80-2-013M30	0.4	1.3	3000	2.6
33	S80-2-024M30	0.75	2.4	3000	4.2
35	S80-2-033M30	1	3.3	3000	4.5
41	S90-2-024M30	0.75	2.4	3000	3
45	S90-2-035M20	0.75	3.5	2000	3
48	S90-2-040M25	1	4	2500	4
51	S110-2-020M30	0.6	2	3000	4
53	S110-2-040M30	1.2	4	3000	5
55	S110-2-050M30	1.5	5	3000	6
56	S110-2-060M30	1.2	6	2000	6
61	S130-2-040M25	1	4	2500	4
63	S130-2-050M20	1	5	2000	4.5
64	S130-2-050M25	1.3	5	2500	5
65	S130-2-050M30	1.5	5	3000	6
67	S130-2-060M25	1.5	6	2500	6
69	S130-2-077M20	1.6	7.7	2000	6
72	S130-2-100M10	1	10	1000	5
73	S130-2-100M15	1.5	10	1500	6
Others	S110-2-040M30	1.2	4	3000	5

7.3 Motor Type List for HSD2-050

Table 7-3 Motor type list for HSD2-050

Code	Motor model	Power	Torque	Rated Speed	Rated Current
		(kw)	(Nm)	(rpm)	(A)
51	S110-2-020M30	0.6	2	3000	4
53	S110-2-040M30	1.2	4	3000	5
55	S110-2-050M30	1.5	5	3000	6
56	S110-2-060M30	1.2	6	2000	6
58	S110-2-060M30	1.8	6	3000	8
61	S130-2-040M25	1	4	2500	4
63	S130-2-050M20	1	5	2000	4.5
64	S130-2-050M25	1.3	5	2500	5
65	S130-2-050M30	1.5	5	3000	6
67	S130-2-060M25	1.5	6	2500	6
69	S130-2-077M20	1.6	7.7	2000	6
70	S130-2-077M25	2	7.7	2500	7.5
71	S130-2-077M30	2.4	7.7	3000	9
72	S130-2-100M10	1	10	1000	5
73	S130-2-100M15	1.5	10	1500	6
75	S130-2-100M25	2.6	10	2500	10
78	S130-2-150M15	2.3	15	1500	9.5
79	S130-2-150M25	3.8	15	2500	17
82	S150-2-150M20	3	15	2000	14
83	S150-2-150M25	3.8	15	2500	17
86	S150-2-180M20	3.6	18	2000	16.5
Others	S130-2-077M20	1.6	7.7	2000	6

7.4 Motor Type List for HSD2-065

Table 7-4 Motor type list for HSD2-065

Code	Motor model	Power	Torque	Rated Speed	Rated Current
		(kw)	(Nm)	(rpm)	(A)
65	S130-2-050M30	1.5	5	3000	6
67	S130-2-060M25	1.5	6	2500	6
69	S130-2-077M20	1.6	7.7	2000	6
70	S130-2-077M25	2	7.7	2500	7.5
71	S130-2-077M30	2.4	7.7	3000	9
72	S130-2-100M10	1	10	1000	5
73	S130-2-100M15	1.5	10	1500	6
75	S130-2-100M25	2.6	10	2500	10
78	S130-2-150M15	2.3	15	1500	9.5
79	S130-2-150M25	3.8	15	2500	17
82	S150-2-150M20	3	15	2000	14
83	S150-2-150M25	3.8	15	2500	17
86	S150-2-180M20	3.6	18	2000	16.5
89	S150-2-230M20	4.7	23	2000	20.5
92	S150-2-270M20	5.5	27	2000	20.5
94	S180-2-172M15	2.7	17.2	1500	10.5
95	S180-2-190M15	3.0	19	1500	12
96	S180-2-215M20	4.5	21.5	2000	16
97	S180-2-270M15	4.3	27	1500	16
98	S180-2-350M10	3.7	35	1000	16
99	S180-2-350M15	5.5	35	1500	19
Others	S150-2-150M15	2.3	15	1500	9.5

7.5 Motor Type List for HSD2-030A

Table 7-5 Motor type list for HSD2-030A

Code	Motor Model	Power (Kw)	Torque (N.m)	Rated speed (rpm)	Rated current (A)
22	60ST-006M30	0.2	0.64	3000	1.2
23	60ST-013M30	0.4	1.27	3000	2.8
24	60ST-019M30	0.6	1.91	3000	3.7
25	80ST-013M30	0.4	1.3	3000	2.6
26	80ST-024M30	0.75	2.4	3000	4.2
27	80ST-033M30	1	3.3	3000	4.2
30	80ST-040M25	1	4	2500	4.4
31	90ST-024M30	0.75	2.4	3000	3
32	90ST-035M20	0.75	3.5	2000	3
33	90ST-040M25	1	4	2500	4
34	110ST-020M30	0.6	2	3000	4
35	110ST-040M30	1.2	4	3000	5
36	110ST-050M30	1.5	5	3000	6
37	110ST-M06020	1.2	6	2000	6
38	110ST-060M30	1.8	6	3000	8
44	130ST-040M25	1.0	4	2500	4
45	130ST-050M25	1.3	5	2500	5
46	130ST-060M25	1.5	6	2500	6
47	130ST-077M20	1.6	7.7	2000	6
48	130ST-077M30	2.4	7.7	3000	9
49	130ST-100M15	1.5	10	1500	6
50	130ST-100M25	2.6	10	2500	10
51	130ST-150M15	2.3	15	1500	9.5
52	130ST-120M20	2.4	12	2000	10
Others	110ST-040M30	1.2	4	3000	5

Chapter 8 Alarm, Protection Function & Troubleshooting

When any trouble occurs, the “Err xx” would be shown on the digital keypad and blink. “xx” is the code for the error kind. The common errors are Err 3, Err 9, Err 11, Err 13, Err 17 and Err 38, which caused by improper wiring or mechanical problem.

8.1 Alarm Code Check List

Table 8-1 Alarm code check list

Display Code	Fault Name	Fault Description
--	Normal	There is no error.
1	Over speed	Motor speed exceeds to set value
2	Over voltage	The voltage of the main circuit is higher than the standard voltage.
3	Under voltage	The voltage of the main circuit is lower than the standard voltage.
4	Excessive Deviation of position command	Position control deviation value exceeds to the set value
5	Internal incorrect parameter settings	Wrong model selection for servo drive or motor, or wrong settings for drive/motor
6	Wrong model type for the motor	The set model type can't be matched with the motor
7	Drive inhibition error	Both inhibition input for CCW and CW are OFF
8	Position deviation counter overflow	Position counter overflow absolute value exceeds to 2^{30}
9	Encoder error	The encoder produces abnormal pulse.
11	Current response fault	Current error has exceeded the specified value for a long time.
12	Over current	The current of the main circuit is more than the instantaneous current of the motor and cause short circuit.
13	Drive overheat for a long time	Drive overload, the temperature of drive is too high (I^2t inspection)
14	Breaking time being too long	Break circuit is working for a long period of time.

15	Breaking function is enabled too often	The breaking action has been enabled too often.
17	Speed response fault	Speed error has exceeded the specified value for a long time.
19	Warm reset	System warm reset
20	EE-PROM error	An error occurs when writing the current settings into EE-PROM.
21	DI function set error	Digital input port function setting duplicated
22	DO function set error	Digital output port function setting duplicated
23	Current sensor adjustment error	Adjusted value of the current sensor exceeds the limit of its allowable setting value.
29	Overload for motor torque	Servo motor is overload.
30	Encoder pulse Z lose	The pulse Z of the encoder is being lost.
32	Encoder U,V,W signal error	The signal of U,V,W (for encoder interface) are in error
37	Instantaneous overheat for motor	The instantaneous load of the motor is overload.
38	Long term motor overheat	The motor is overload for a long time.
10, 16, 18, 24, 25, 26, 27, 28, 31, 33, 34, 35, 36		Reserved

8.2 Potential Cause and Corrective Actions

Generally, when the alarm occurs, you can power off and on the drive to clear the error, and the drive back to work normally. If this doesn't work, and the alarm repeats, please follow up the following solutions or contact your local distributors if necessary.

Table 8-2 Corrective actions for trouble shooting

Code	Fault Name	Cause	Corrective Actions
Err1	Over speed	Improper input Pulse, or wrong gear ratio setting	Check the pulse frequency and the electronic gear ratio
		The load inertia is excessive	Decrease the load inertia Increase the Accel/Decel time
		Encoder fault	Replace the motor
		Encoder cable fault	Replace the cable
		Incorrect parameter settings	Reset the parameters and modify the settings again
Err2	Over voltage	Servo drive default U V W PE wiring error	Replace the drive; check the wiring or replace the cables
		The power voltage is too high	Check the power supply.
		The power waveform is abnormal	
Err3	Under voltage	Servo drive is damaged	Replace the drive
		The power voltage is too low.	Check the power supply.
		Transformer capacity is not enough.	Replace the transformer by a larger one
		Poor contact of RST terminal wiring	Check and rewire the related cables
Err4	Excessive position deviation	Encoder cable or encoder fault	Replace the cable or motor
		The stiffness is not enough	Increase the set value of PA5 and PA9
		The output torque of motor	Check the torque limit

		is not enough.	Decrease the load
			Replace and upgrade the power level of the drive and motor
		Improper command pulse	Decrease the pulse frequency.
Err5	Parameters set error	The parameters in the drive is or are being modified wrongly	Reset the parameters
Err6	Wrong model type setting for the motor	Wrong model type setting for the motor	Please choose the right motor type.
Err7	Drive inhibition abnormal alarm	Inhibition signal for both CCW and CW are disconnected	Check the digital input signal and wiring
		Enable Inhibition function is ON	Disable the function
Err8	Position counter overflow	The motor is being stuck by the mechanical parts	Check the mechanical structure
		Pulse signal is abnormal	Check the pulse signal
Err9	Encoder error	Encoder or drive being damaged	Replace the motor or drive.
		Encoder cable damaged or doesn't match the spec	Replace the cable
		The encoder cable is too long	Shorten the cable.
Err11	Current response fault	Servo motor is being stuck.	Check the mechanical parts
		Wrong wiring between U, V and W terminals	Check the wiring
		Poorly grounded	Check the grounding
		The lead wiring of U V W from the motor side is wrong	Replace the motor
Err12	Over current	Short-circuit between U, V and W terminals	Check the wiring

		Drive overload	Replace and upgrade the drive
		Encoder cable or encoder fault	Replace the encoder cable
		Servo drive is damaged	Replace the drive
Err13	Drive overheat for a long term	Drive is running with overload	Decrease the load or replace the current drive with a bigger powered one.
Err14	Brake error	Brake circuit fault or voltage detection fault	Replace the drive
		System inertia is too big, drive ON and OFF too often.	Set PA34 correctly, install a proper external brake resistor between P and C terminal.
			Increase the acceleration and deceleration time constant; reduce the load inertia
Err15	Breaking action is enabled too often	Load inertia is too high, servo on and off too often.	Under the speed control mode, increase the set value of PA40, PA41, PA42.
			Under the position control mode, set proper Accel/Decel curve for the host controller.
			Reduce the load inertia
			Replace the motor.
Err17	Speed response fault	Motor being stuck, drive fault	Check the mechanical parts, check the drive or replace the drive
		Interval time between start and stop is too short.	Set the Accel and Decel time constant correctly
		The lead wiring of U V W from the motor side is wrong	Replace the motor
Err19	Warm reset	The power supply is unstable	Check wiring or replace the drive
Err20	EEPROM error	Servo drive fault	Replace the servo drive

Err21	DI function set error	Check PA63,PA64,PA65,PA66, there may be duplication among these 4 parameters.	Set right parameters
Err21	DO function set error	Check PA57,PA58, PA59, there may be duplication among these 3 parameters.	Set right parameters
Err23	Current sensor adjustment fault	Servo drive fault	Replace the servo drive
Err29	Overload for motor torque	Overload	Check the load
		Motor type doesn't match with the drive	Match the drive with a proper motor
		Parameter is being set incorrectly	Increase the torque limit value properly within the safety allowed range
Err30	Encoder Z signal pulse lose	Encoder being damaged	Replace the servo motor
		Encoder cable improper shielding or poor encoder cable communication	Replace the encoder cable
		Shielding ground cable fault	Recheck interface and I/O circuit
Err32	U,V,W signal error for encoder	Encoder U V W signal damaged	Replace the motor
		Encoder cable improper shielding or poor encoder cable communication	Replace the encoder cable
		Encoder signal interface circuit fault	Replace the drive
Err37	Instantaneous overheat for motor	Overload for the motor	Decrease the load
		Short circuit for the motor	Recheck the wiring or replace the motor
		Motor type(model) is wrong	Choose a proper motor to match the drive

Err38	Motor overheat for a long time	Motor overload, or wrong type of motor being connected with the drive	Decrease the load or choose a proper spec of motor to match the drive
		Encoder cable or encoder fault; drive current detection fault	Replace the encoder cable or motor; replace the drive

Chapter 9 Connection to Motor

Our HSD2 series servo drive is only applicable with 2500ppr incremental photoelectric encoder. If you have purchased both our servo drive and motor, then the encoder and encoder cable and power cable will be included as our agreed standard package. For special requirement and our users may need to make the encoder cable or modify the cable, please follow up the following diagram for connections. Please use proper shield cable if you want to make encoder cable by yourself.

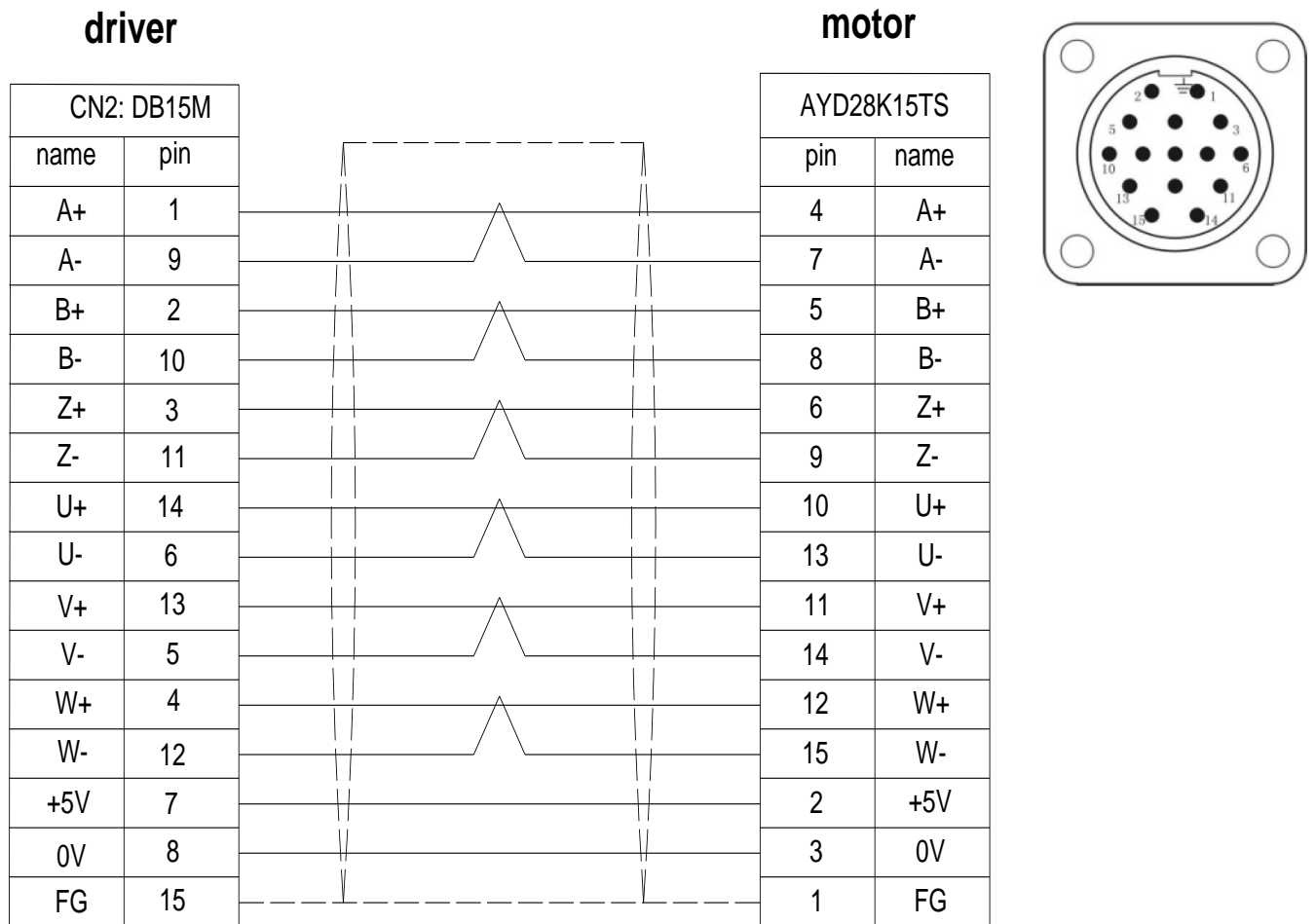
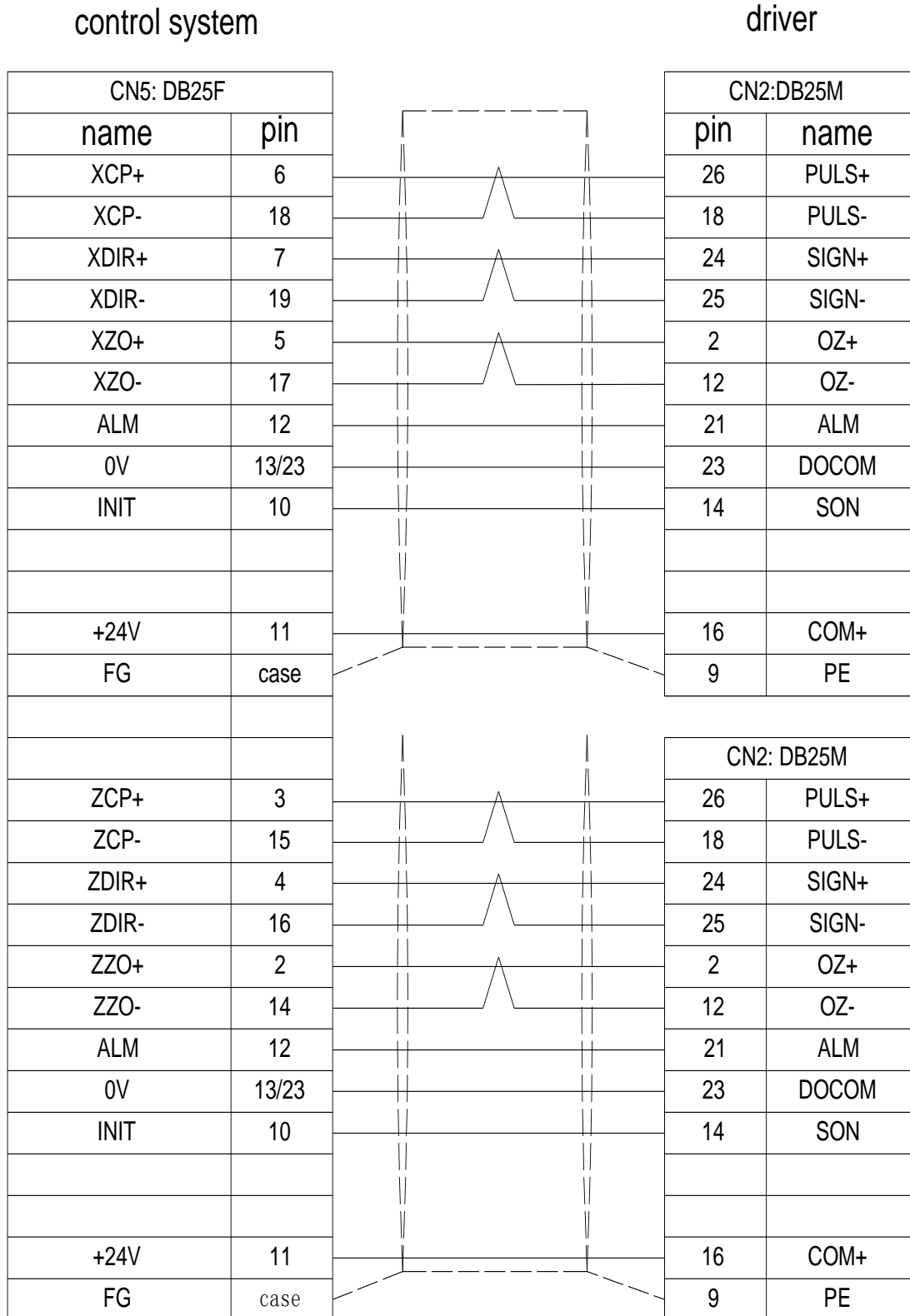


Diagram 9-1 Connecting diagram HSD2 series drive to motor encoder

Chapter 10 System Connection

The connection between HSD2 Driver and HNC-602 CNC control system show as below:



Thanks for choosing HNC product.
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