

# **HBS86H**

## **Hybrid Stepper Servo Drive**

### **Manual**

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## 1. Overview

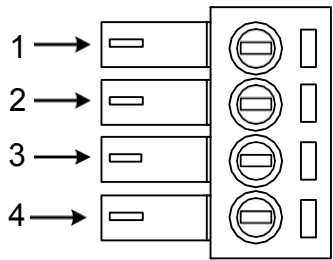
The HBS86H hybrid stepper servo drive system integrates the servo control technology into the digital stepper drive perfectly. And this product adopts an optical encoder with high speed position sampling feedback of 50  $\mu$  s, once the position deviation appears, it will be fixed immediately. This product is compatible the advantages of the stepper drive and the servo drive, such as lower heat, less vibration, fast acceleration, and so on. This kind of servo drive also has an excellent costperformance.

## 2. Features

- ◆ Without losing step, High accuracy in positioning
- ◆ 100% rated output torque
- ◆ Variable current control technology, High current efficiency
- ◆ Small vibration, Smooth and reliable moving at low speed
- ◆ Accelerate and decelerate control inside, Great improvement in smoothness of starting or stopping the motor
- ◆ User-defined microsteps
- ◆ Compatible with 1000 and 2500 lines encoder
- ◆ No adjustment in general applications
- ◆ Over current, over voltage and over position error protection
- ◆ Green light means running while red light means protection or offline

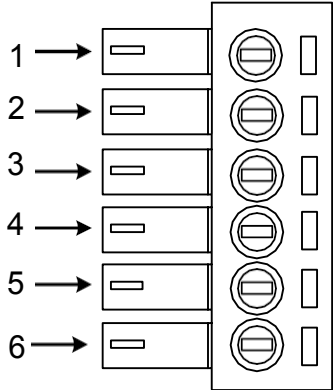
### 3. Ports Introduction

#### 3.1 ALM and PEND signal outputports



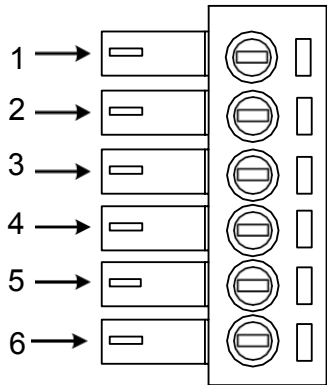
| Port | Symbol | Name                        | Remark                                                                                                                                                                                                                                                                  |
|------|--------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | PEND+  | In position signal output + | A circuit diagram showing a PNP transistor with its emitter connected to a positive supply rail (+) and its base connected to a diode. The collector is connected to a load resistor and the output terminal. The output terminal is also connected to a ground symbol. |
| 2    | PEND-  | In position signal output - |                                                                                                                                                                                                                                                                         |
| 3    | ALM+   | Alarm output +              |                                                                                                                                                                                                                                                                         |
| 4    | ALM-   | Alarm output -              |                                                                                                                                                                                                                                                                         |

#### 3.2 Control Signal InputPorts



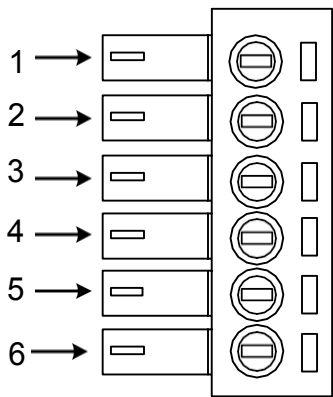
| Port | Symbol | Name              | Remark                       |
|------|--------|-------------------|------------------------------|
| 1    | PLS+   | Pulse signal +    | Compatible with<br>5V or 24V |
| 2    | PLS-   | Pulse signal -    |                              |
| 3    | DIR+   | Direction signal+ | Compatible with<br>5V or 24V |
| 4    | DIR-   | Direction signal- |                              |
| 5    | ENA+   | Enable signal +   | Compatible with<br>5V or 24V |
| 6    | ENA-   | Enable signal -   |                              |

### 3.3 Encoder Feedback Signal InputPorts



| Port | Symbol | Name               | Wiring color |
|------|--------|--------------------|--------------|
| 1    | PB+    | Encoder phase B +  | Blue         |
| 2    | PB-    | Encoder phase B -  | White        |
| 3    | PA+    | Encoder phase A +  | Yellow       |
| 4    | PA-    | Encoder phase A -  | Green        |
| 5    | VCC    | Input power        | Red          |
| 6    | GND    | Input power ground | Black        |

### 3.4 Power InterfacePorts



| Port | Identification              | Symbol | Name             | Remark        |
|------|-----------------------------|--------|------------------|---------------|
| 1    | Motor Phase Wire InputPorts | A+     | Phase A+ (Red)   | Motor Phase A |
| 2    |                             | A-     | Phase A- (Blue)  |               |
| 3    |                             | B+     | Phase B+ (Green) | Motor Phase B |
| 4    |                             | B-     | Phase B- (Black) |               |
| 5    | Power Input Ports           | VCC    | Input Power +    | AC24V-70V     |
| 6    |                             | GND    | Input Power-     | DC30V-100V    |

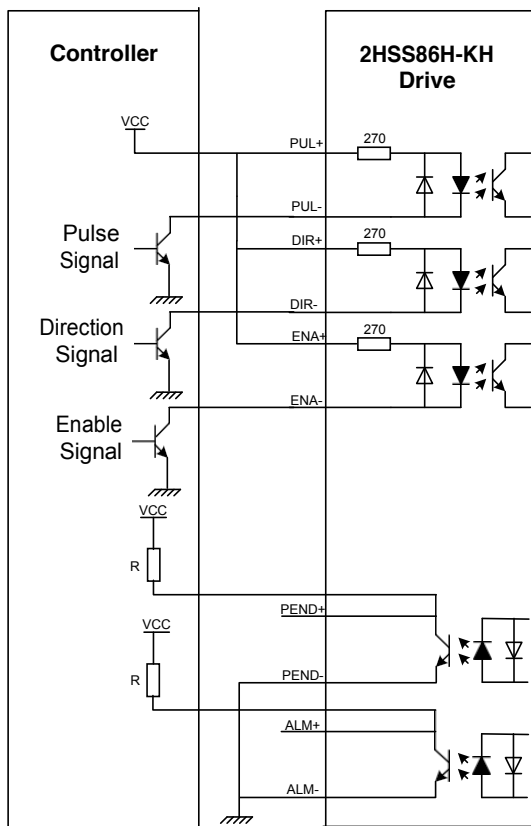
## 4. Technological Index

|                            |                       |                                                                                                                                                                                          |
|----------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Voltage              |                       | 24~70VAC or<br>30~100VDC                                                                                                                                                                 |
| Output Current             |                       | 6A 20KHz PWM                                                                                                                                                                             |
| Pulse Frequency max        |                       | 200K                                                                                                                                                                                     |
| Communication rate         |                       | 57.6Kbps                                                                                                                                                                                 |
| Protection                 |                       | <ul style="list-style-type: none"> <li>● Over current peak value12A±10%</li> <li>● Over voltage value130V</li> <li>● The over position error range can be set through theHISU</li> </ul> |
| Overall Dimensions (mm)    |                       | 150×97.5×53                                                                                                                                                                              |
| Weight                     |                       | Approximate 580g                                                                                                                                                                         |
| Environment Specifications | Environment           | Avoid dust, oil fog and corrosive gases                                                                                                                                                  |
|                            | Operating Temperature | 70℃ Max                                                                                                                                                                                  |
|                            | Storage Temperature   | -20℃~+65℃                                                                                                                                                                                |
|                            | Humidity              | 40~90%RH                                                                                                                                                                                 |
|                            | Cooling method        | Natural cooling or forced air cooling                                                                                                                                                    |

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## 5. Connections to ControlSignal

### 5.1 Connections to CommonAnode

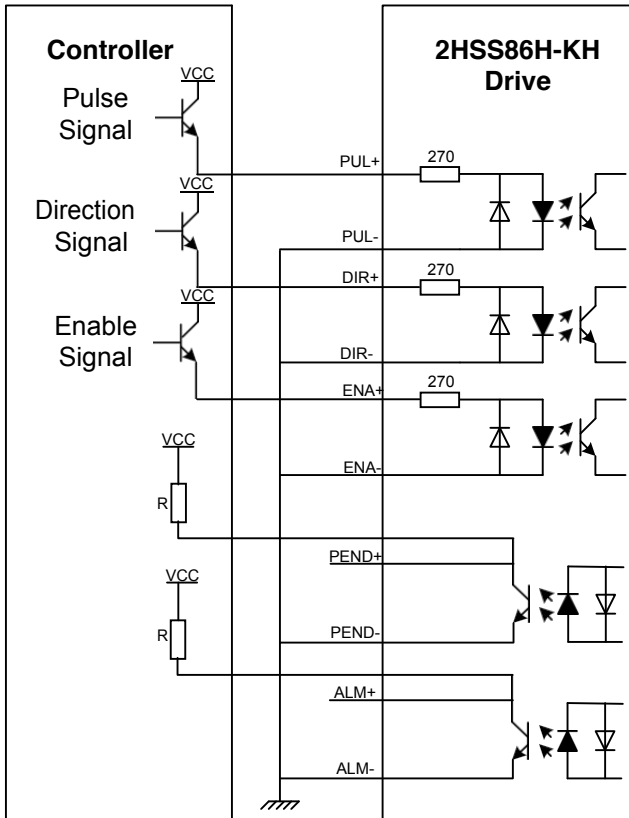


#### Remark:

VCC is compatible with 5V or 24V;

R(3~5K) must be connected to control signal terminal.

## 5.2 Connections to CommonCathode

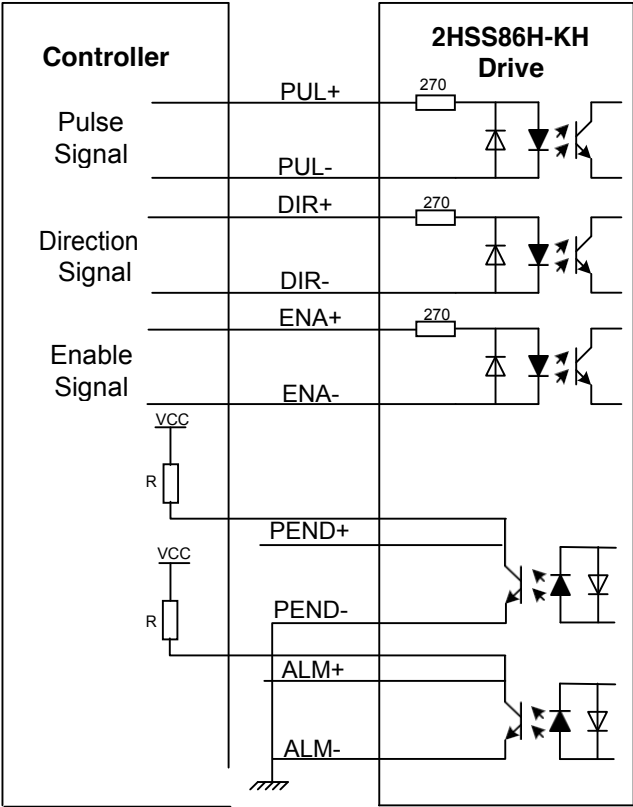


### Remark:

VCC is compatible with 5V or 24V;

R(3~5K) must be connected to control signal terminal.

### 5.3 Connections to DifferentialSignal

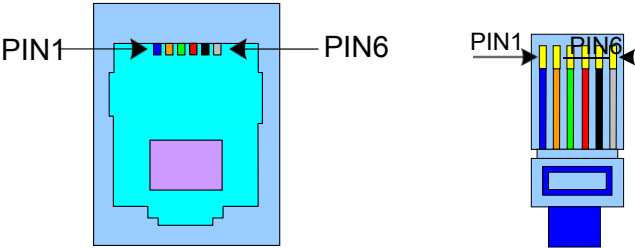


**Remark:**

VCC is compatible with 5V or 24V;  
R(3~5K) must be connected to control signal terminal.

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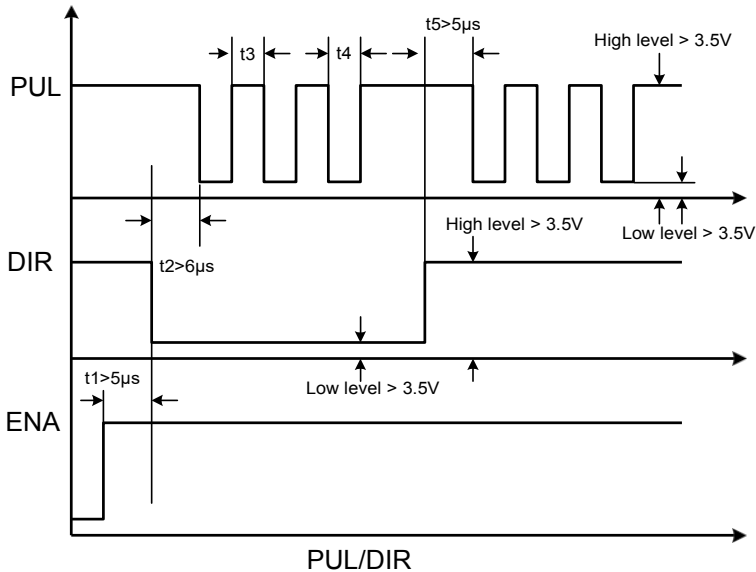
## 5.4 Connections to 232 Serial CommunicationInterface



| Crystal Head<br>foot | Definition | Remark               |
|----------------------|------------|----------------------|
| 1                    | TXD        | Transmit Data        |
| 2                    | RXD        | Receive Data         |
| 4                    | +5V        | Power Supply to HISU |
| 6                    | GND        | Power Ground         |

## 5.5 Sequence Chart of ControlSignals

In order to avoid some fault operations and deviations, PUL, DIR and ENA should abide by some rules, shown as following diagram:



### Remark:

- $t_1$ : ENA must be ahead of DIR by at least  $5\mu s$ . Usually, ENA+ and ENA- are NC (notconnected).
- $t_2$ : DIR must be ahead of PUL active edge by  $6\mu s$  to ensure correct direction;
- $t_3$ : Pulse width not less than  $2.5\mu s$ ;
- $t_4$ : Low level width not less than  $2.5\mu s$ .

## 6. DIP SwitchSetting

### 6.1 Activate EdgeSetting

SW1 is used for setting the activate edge of the input signal, “off” means the activate edge is the rising edge, while “on” is the falling edge.

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## 6.2 Running DirectionSetting

SW2 is used for setting the running direction, “off” means CCW, while “on” means CW.

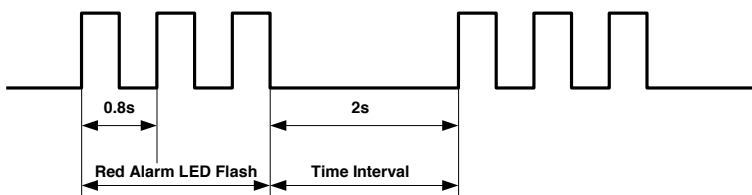
## 6.3 Micro stepsSetting

The micro steps setting is in thefollowingtable, whileSW3 、SW4 、 SW5 、 SW6 are all on, the internal default micro steps inside is activate, this ratio can be setting through the HISU.

| Dial switch<br>Micro steps | SW3 | SW4 | SW5 | SW6 |
|----------------------------|-----|-----|-----|-----|
| Default                    | on  | on  | on  | on  |
| 800                        | off | on  | on  | on  |
| 1600                       | on  | off | on  | on  |
| 3200                       | off | off | on  | on  |
| 6400                       | on  | on  | off | on  |
| 12800                      | off | on  | off | on  |
| 25600                      | on  | off | off | on  |
| 51200                      | off | off | off | on  |
| 1000                       | on  | on  | on  | off |
| 2000                       | off | on  | on  | off |
| 4000                       | on  | off | on  | off |
| 5000                       | off | off | on  | off |

|       |     |     |     |     |
|-------|-----|-----|-----|-----|
| 8000  | on  | on  | off | off |
| 10000 | off | on  | off | off |
| 20000 | on  | off | off | off |
| 40000 | off | off | off | off |

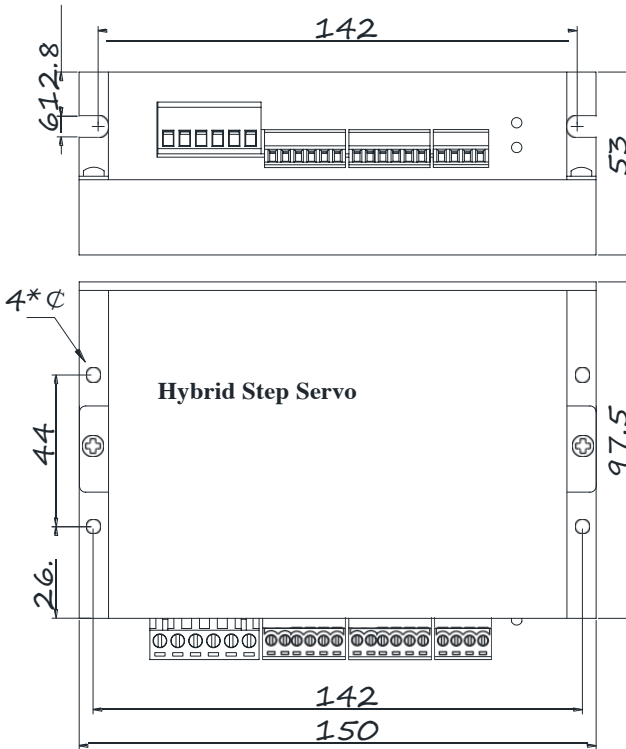
## 7. Faults alarm and LED flickerfrequency



| Flicker Frequency | Description to the Faults                                                                                                 |
|-------------------|---------------------------------------------------------------------------------------------------------------------------|
| 1                 | Error occurs when the motor coil current exceeds the drive's current limit.                                               |
| 2                 | Voltage reference error in the drive                                                                                      |
| 3                 | Parameters upload error in the drive                                                                                      |
| 4                 | Error occurs when the input voltage exceeds the drive's voltage limit.                                                    |
| 5                 | Error occurs when the actual position following error exceeds the limit which is set by <b>the position error limit</b> . |

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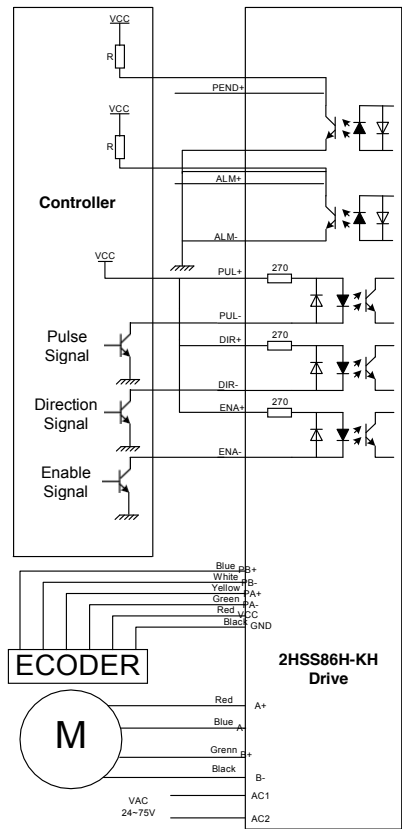
## 8. Appearance and Installation Dimensions



## 9. Typical Connection

This drive can provide the encoder with a power supply of +5v, maximum current 80mA. It adopts a quadruplicated-frequency counting method, and the resolution ratio of the encoder multiply 4 are the pulses per rotate of the servo motor. Here is the typical connection of

2HSS86H-KH.



10. ParameterSetting

The parameter setting method of 2HSS86H-KH drive is to use a HISU adjuster through the 232 serial communication ports, only in this way can we setting the parameters we want. There are a set of best defaultparameterstothe correspondingmotorwhicharecarefully

adjusted by our engineers, users only need refer to the following table, specific condition and set the correct parameters.

**Actual value = Set value × the corresponding dimension**

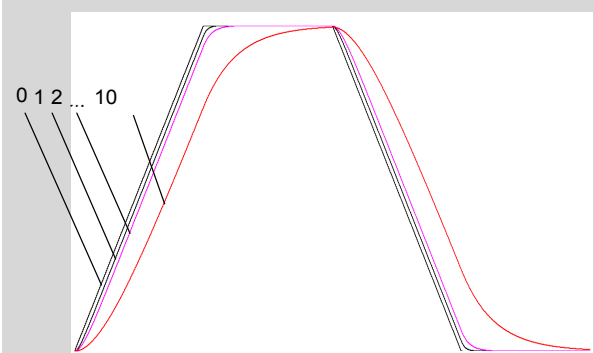
| Mode       | Definition           | Range  | Dimension | Drive Restart | Default Value |
|------------|----------------------|--------|-----------|---------------|---------------|
| <b>P1</b>  | Current loop Kp      | 0—4000 | 1         | N             | 1000          |
| <b>P2</b>  | Current loop Ki      | 0—1000 | 1         | N             | 100           |
| <b>P3</b>  | Damping coefficient  | 0—1000 | 1         | N             | 100           |
| <b>P4</b>  | Position loop Kp     | 0—4000 | 1         | N             | 1300          |
| <b>P5</b>  | Position loop Ki     | 0—1000 | 1         | N             | 250           |
| <b>P6</b>  | Speed loop Kp        | 0—3000 | 1         | N             | 50            |
| <b>P7</b>  | Position loop Ki     | 0—1000 | 1         | N             | 10            |
| <b>P8</b>  | Open loop current    | 0—60   | 0.1       | N             | 45            |
| <b>P9</b>  | Close loop current   | 0—40   | 0.1       | N             | 20            |
| <b>P10</b> | Alarm level          | 0—1    | 1         | N             | 0             |
| <b>P11</b> | Reserved             |        |           |               |               |
| <b>P12</b> | Stop lock enable     | 0—1    | 1         | N             | 0             |
| <b>P13</b> | Enable signal level  | 0—1    | 1         | N             | 0             |
| <b>P14</b> | Arrival level        | 0—1    | 1         | N             | 1             |
| <b>P15</b> | Encoder line number  | 0—1    | 1         | Y             | 0             |
| <b>P16</b> | Position error limit | 0—3000 | 10        | N             | 1000          |
| <b>P17</b> | Reserved             |        |           |               |               |
| <b>P18</b> | Motor type           | 0—5    | 0         | Y             | 4             |
| <b>P19</b> | Speed smoothness     | 0—10   | 1         | N             | 0             |
| <b>P20</b> | User-defined p/r     | 4-1000 | 50        | Y             | 8             |

There are total 20 parameter configurations, use the HISU to download the configured parameters to the drive, the detail descriptions to every parameter configuration are as follows:

| Item                                               | Description                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Current loop Kp</b>                             | Increase Kp to make current rise fast. Proportional Gain determines the response of the drive to setting command. Low Proportional Gain provides a stable system (doesn't oscillate), has low stiffness, and the current error, causing poor performances in tracking current setting command in each step. Too large proportional gain values will cause oscillations and unstable system. |
| <b>Current loop Ki</b>                             | Adjust Ki to reduce the steady error. Integral Gain helps the drive to overcome static current errors. A low or zero value for Integral Gain may have current errors at rest. Increasing the integral gain can reduce the error. If the Integral Gain is too large, the system may "hunt" (oscillate) around the desired position.                                                          |
| <b>Damping coefficient</b>                         | This parameter is used to change the damping coefficient in case of the desired operating state is under resonance frequency.                                                                                                                                                                                                                                                               |
| <b>Position loop Kp</b><br><b>Position loop Ki</b> | The PI parameters of the position loop. The default values are suitable for most of the application, you don't need to change them. Contact us if you have any question.                                                                                                                                                                                                                    |

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|                           |                                                                                                                                                                                                                                                      |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Speed loop Kp</b>      | The PI parameters of the speed loop. The default values are suitable for most of the application, you don't need to change them. Contact us if you have any question.                                                                                |
| <b>Speed loop Ki</b>      |                                                                                                                                                                                                                                                      |
| <b>Open loop current</b>  | This parameter affects the static torque of the motor.                                                                                                                                                                                               |
| <b>Close loop current</b> | This parameter affects the dynamic torque of the motor. (The actual current = open loop current + close loop current)                                                                                                                                |
| <b>Alarm Control</b>      | This parameter is set to control the Alarm optocoupler output transistor. 0 means the transistor is cut off when the system is in normal working, but when it comes to fault of the drive, the transistor becomes conductive. 1 means opposite to 0. |
| <b>Stop lock enable</b>   | This parameter is set to enable the stop clock of the drive. 1 means enable this function while 0 means disable it.                                                                                                                                  |
| <b>Enable Control</b>     | This parameter is set to control the Enable input signal level, 0 means low, while 1 means high.                                                                                                                                                     |
| <b>Arrival Control</b>    | This parameter is set to control the Arrival optocoupler output transistor. 0 means the transistor is cut off when the drive satisfies the arrival                                                                                                   |

|                      |                                                                                                                                                                                                                                                                                        |           |       |       |       |   |   |      |       |       |       |       |       |  |      |      |      |       |       |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------|-------|-------|---|---|------|-------|-------|-------|-------|-------|--|------|------|------|-------|-------|
|                      | command, but when it comes to not, the transistor becomes conductive. 1 means opposite to 0.                                                                                                                                                                                           |           |       |       |       |   |   |      |       |       |       |       |       |  |      |      |      |       |       |
| Encoder resolution   | This drive provides two choices of the number of lines of the encoder. 0 means 1000 lines, while 1 means 2500 lines.                                                                                                                                                                   |           |       |       |       |   |   |      |       |       |       |       |       |  |      |      |      |       |       |
| Position error limit | The limit of the position following error. When the actual position error exceeds this value, the drive will go into error mode and the fault output will be activated. (The actual value = the set value × 10)                                                                        |           |       |       |       |   |   |      |       |       |       |       |       |  |      |      |      |       |       |
| Motor typeselection  | <table><tr><td>Parameter</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>Type</td><td>86J18</td><td>86J18</td><td>86J18</td><td>86J18</td><td>86J18</td></tr><tr><td></td><td>65EC</td><td>80EC</td><td>95EC</td><td>118EC</td><td>156EC</td></tr></table>          | Parameter | 1     | 2     | 3     | 4 | 5 | Type | 86J18 | 86J18 | 86J18 | 86J18 | 86J18 |  | 65EC | 80EC | 95EC | 118EC | 156EC |
| Parameter            | 1                                                                                                                                                                                                                                                                                      | 2         | 3     | 4     | 5     |   |   |      |       |       |       |       |       |  |      |      |      |       |       |
| Type                 | 86J18                                                                                                                                                                                                                                                                                  | 86J18     | 86J18 | 86J18 | 86J18 |   |   |      |       |       |       |       |       |  |      |      |      |       |       |
|                      | 65EC                                                                                                                                                                                                                                                                                   | 80EC      | 95EC  | 118EC | 156EC |   |   |      |       |       |       |       |       |  |      |      |      |       |       |
| Speed smoothness     | <p>This parameter is set to control the smoothness of the speed of the motor while acceleration or deceleration, the larger the value, the smoother the speed in acceleration or deceleration.</p>  |           |       |       |       |   |   |      |       |       |       |       |       |  |      |      |      |       |       |

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**User-defined p/r**

This parameter is set of user-defined pulse per revolution, the internal default microsteps inside is activate while SW3、SW4、SW5、SW6 are all on, users can also set the micro steps by the outer DIP switches. (The actual microsteps = the set value  $\times 50$ )

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## **11. Processing Methods to Common Problems and Faults**

### **11.1 Power on power light off**

- No power input, please check the power supply circuit. The voltage is too low.

### **11.2 Power on red alarm light on**

- Please check the motor feedback signal and if the motor is connected with the drive.
- The stepper servo drive is over voltage or under voltage. Please lower or increase the input voltage.

### **11.3 Red alarm light on after the motor running a small angle**

- Please check the motor phase wires if they are connected correctly, if not, please refer to the 3.4 Power Ports.

- 
- Please check the parameter in the drive if the poles of the motor and the encoder lines are corresponding with the real parameters, if not, set them correctly.
  - Please check if the frequency of the pulse signal is too fast, thus the motor may be out of its rated speed, and lead to position error.

#### **11.4 After input pulse signal but the motor not running**

- Please check the input pulse signal wires are connected in a reliable way.
- Please make sure the input pulse mode is corresponding with the real input mode.