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**HS86 digital hybrid stepper servo driver**

1. **Product Introduction**
2. **Overview**

HS86 is the latest digital hybrid step servo driver with serial port debugging function launched by Green IoT Technology Co., Ltd. It adopts the latest 32-bit DSP control technology and integrates MODBUS-RTU standard protocol specifications. Users can set any subdivision within 200-40000 and multiple parameters such as working mode through the host computer debugging software, which greatly enriches the practical functions of the product and can meet the application needs of most occasions.

The HS86 driver adopts a servo-like control principle, which is compatible with the dual advantages of open-loop stepping and servo systems, completely solving the problem of open-loop stepping step loss, greatly improving the performance of the stepping system, and reducing the heating and low-speed vibration of the motor. Compared with the servo system, it greatly reduces the difficulty of debugging, has the advantages of fast start and stop, no vibration when shutting down, etc., and its small size, low cost, high cost performance, can meet the application of most occasions.

1. **Features**

●With serial port debugging function ●External dial selects the driver working mode

●New 32-bit DSP technology ●Small size, easy to install

Optically isolated differential signal input ●Built-in micro-segmentation

●The impulse response frequency can reach up to 200KHz (higher can be modified) ●Subdivision setting range 200-40000

●Precise current control greatly reduces motor heating ●Low vibration and low noise

●The current is automatically halved when stationary ●With overvoltage, undervoltage, overcurrent and other protection functions

1. **Application Areas**

Suitable for various small and medium-sized automation equipment and instruments, such as: engraving machines, marking machines, cutting machines, plotters, CNC machine tools, automatic assembly equipment, etc. It has a particularly good application effect in equipment applications where users expect low noise and high speed.

**2. Electrical, Mechanical and Environmental Indicators**

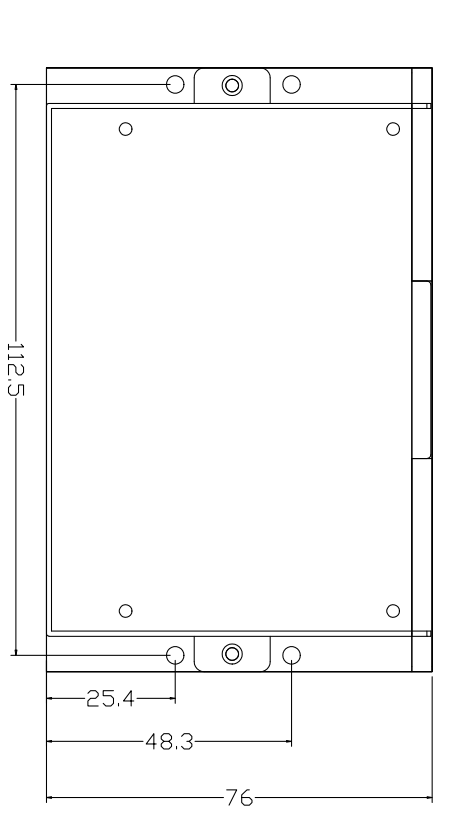
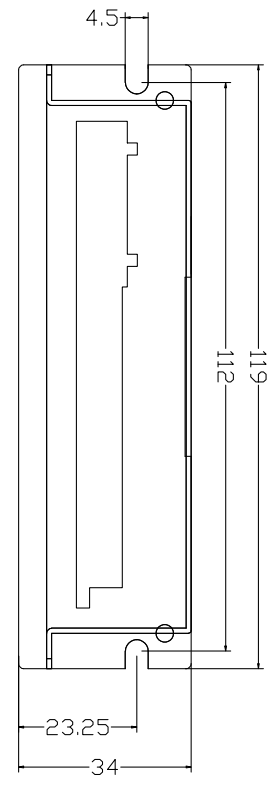
1. **Electrical Specifications**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **illustrate** | **HS86** | | | |
| **Minimum** | **Typical Value** | **Maximum** | **unit** |
| **Input power voltage** | 20 | 60 | 80 | VAC |
| **Control signal input current** | 7 | 10 | 16 | mA |
| **Step pulse frequency** | 0 | - | 200 | KHz |
| **Insulation resistance** | 50 |  |  | MΩ |

1. **Use environment and parameters**

|  |  |  |
| --- | --- | --- |
| **Cooling method** | | Natural cooling, fan cooling |
| **Usage Environment** | **occasion** | Do not place it near other heating equipment. Avoid dust, oil mist, corrosive gas, high humidity and strong vibration. Flammable gas and conductive dust are prohibited. |
| **temperature** | 0——50℃ |
| **humidity** | 40-90%RH |
| **vibration** | 10~55Hz/0.15mm |
| **Storage temperature** | | -20℃~65℃ |

1. **Mechanical installation drawing**

Front installation diagram Side installation diagram

Figure 1 Installation dimensions (unit: mm)

**※Side installation is recommended for better heat dissipation. When designing the installation dimensions, pay attention to the terminal size and wiring!**

1. **Enhanced heat dissipation**
2. The reliable operating temperature of the driver is usually within 50℃, and the operating temperature of the motor is within 80℃;
3. It is recommended to select the automatic half-current mode when using, that is, when the motor stops, the current is automatically reduced by half to reduce the heating of the motor and driver;
4. When installing the driver, please install it sideways and allow strong air convection to form on the bottom of the driver. If necessary, install a fan near the driver inside the machine to form air convection to assist in heat dissipation and ensure that the driver operates within a reliable operating temperature range.

**3. Driver interface and wiring introduction**

1. **Interface Description**
2. **Control signal interface**

|  |  |
| --- | --- |
| **name** | **Function** |
| PLS+ | Pulse control signal: +5V-+24V can be driven, rising edge is effective, every time the pulse changes from high to low, the motor takes a microstep. In order to reliably respond to the pulse signal, the pulse width should be greater than 2μs. |
| PLS- |
| DIR+ | Direction control signal: can be driven by +5V-+24V, high/low level signal. To ensure reliable commutation of the motor, the direction signal should be established at least 5μs before the pulse signal. The initial running direction of the motor is related to the motor wiring. Interchanging any phase winding (such as A+ and A-) can change the initial running direction of the motor. |
| DIR- |
| ENA+ | Enable control signal: +5V-+24V can be driven, high/low level signal. Used to enable or disable the operation of the motor. When ENA+ is connected to +5V and ENA- is connected to a low level, the driver will cut off the current of each phase of the motor to put the motor in a free state, and the step pulse will not be responded to at this time. When this function is not needed, the enable signal terminal can be left floating. In addition, the ENA terminal can also be used to clear the out-of-tolerance alarm signal. |
| ENA- |

**2) Output signal interface**

|  |  |
| --- | --- |
| **name** | **Function** |
| PEND+ | In-position signal output: When the motor reaches the position specified by the control instruction, the in-position signal output is valid;  PEND+ is connected to the pull-up resistor to the positive pole of the output power supply, and PEND- is connected to the signal input terminal of the controller; the maximum driving current is 50mA. |
| PEND- |
| ALM+ | Alarm signal output: When overcurrent, overvoltage, undervoltage or position out-of-tolerance alarm occurs, the alarm signal output is valid;  ALM+ is connected to the pull-up resistor to the positive pole of the output power supply, and ALM- is connected to the signal input terminal of the controller; the maximum driving current is 50mA. |
| ALM- |

**3) Encoder interface**

|  |  |
| --- | --- |
| **name** | **Function** |
| PB+ | Encoder B phase input interface, please pay attention to the line sequence. |
| PB- |
| PA+ | Encoder A phase input interface, please pay attention to the line sequence. |
| PA- |
| VCC | Encoder 5V power supply positive terminal. |
| EGND | Negative terminal of the encoder 5V power supply. |

▶**Note: The wiring sequence of the encoder is marked on the label at the bottom of the closed-loop motor, and the wiring must be strictly in accordance with the label.**

**4) Strong power interface**

|  |  |
| --- | --- |
| **name** | **Function** |
| AC1 | AC input power, AC20V-80V (DC30V-110V) |
| AC2 |
| A+、A- | For the motor A phase coil, pay attention to the line sequence. |
| B+, B- | For the motor B phase coil, pay attention to the line sequence. |

▶**Note: The wiring sequence of the motor is marked on the label at the bottom of the closed-loop motor, and the wiring must be strictly in accordance with the label.**

**5) 232 communication interface**

The serial communication interface of the HS86 driver uses a PH2.0-7P terminal, which can be connected to the PC through a dedicated serial cable via a USB to TTL serial conversion tool. Do not plug or unplug the power supply! On the PC side, customers can set the required parameters, such as current, subdivision, working mode, etc. For details, please refer to the upper computer software interface.

|  |  |  |  |
| --- | --- | --- | --- |
| **Terminal No.** | **symbol** | **name** | **illustrate** |
| 1 | NC | - | Internal Use |
| 2 | NC | - | Internal Use |
| 3 | GND | RS232 communication ground | 0V |
| 4 | NC | - | Internal Use |
| 5 | NC | - | Internal Use |
| 6 | TXD | RS232 transmitter |  |
| 7 | RxD | RS232 Receiver |  |

▶**Note: The cable connecting HS86 and PC must be a dedicated cable (provided with the computer depending on the user's needs). Please check before use to avoid damage.**

**6) Status Indicator**

The green LED is the power indicator light. When the driver is powered on, the LED is always on; when the driver is powered off, the LED is off.

The red LED is a fault indicator. When a fault occurs, the indicator flashes in a cycle of 3 seconds. When the fault is eliminated by the user, the red LED goes out. The number of times the red LED flashes in 3 seconds represents different fault information. The specific relationship is shown in the following table:

|  |  |  |  |
| --- | --- | --- | --- |
| **Serial number** | **Number of flashes** | **Red LED flashing waveform** | **Fault Description** |
| 1 | 1 | b4b7420fd81022979949bd221bdc593 | Overcurrent, phase short circuit or poor contact fault |
| 2 | 2 | 07aaeaeba1020372a59a448bd381b86 | Overvoltage fault (voltage>AC80V/DC110V） |
| 3 | 3 | 6ba76b7c1245b14a916aadd4c40f2f2 | Undervoltage fault (voltage<AC20V/DC30V） |
| 4 | 5 | 6f084afacbf711a593eea399b047aa1 | Motor open circuit(Phase missing) |

▶**Note: When the out-of-tolerance alarm occurs, the red LED is always on. If the out-of-tolerance alarm is caused by overvoltage or undervoltage, the red LED will flash rapidly and continuously. In addition, when an out-of-tolerance alarm occurs, the out-of-tolerance alarm signal can be cleared through the ENA terminal.**

1. **Control signal interface circuit**

The HS86 driver control signal end adopts a differential interface circuit, which is applicable to differential signals, single-ended common cathode and common anode interfaces. It has a built-in high-speed photocoupler and has strong anti-interference ability in harsh environments. The interface circuit diagram is shown in Figure 2.

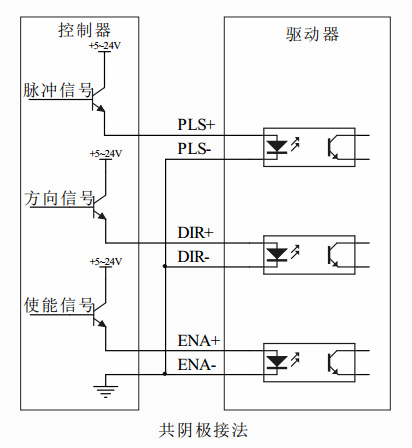
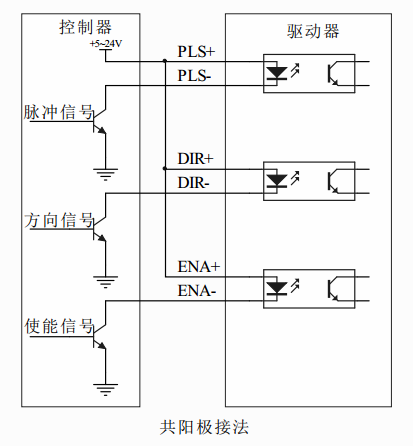


Figure 2 Input interface circuit

▶**Note: HS86 is a 5V-24V universal driver, so the signal control end does not need a series resistor!**

1. **Control signal timing diagram**

In order to avoid some false actions and deviations, PLS, DIR and ENA should meet certain requirements, as shown in the following figure:

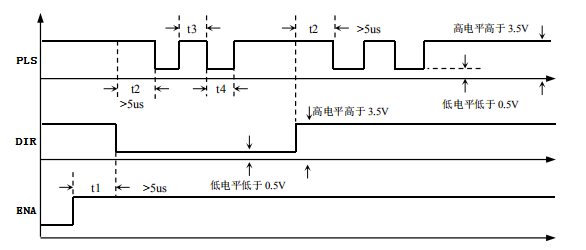


Figure 3 Control signal timing diagram

**Notes:**

1. t1: ENA (enable signal) should be at least 5ms ahead of DIR and determined to be high. In general, it is recommended that ENA+ and ENA- be left floating.
2. t2: DIR determines its state high or low at least 5μs in advance of the falling edge of PLS.
3. t3: The pulse width is at least 2.5μs.
4. t4: Low level width is not less than 2.5μs.
5. **Control signal mode setting**

Pulse trigger edge selection: The rising edge or falling edge of the pulse can be set to trigger effectively through the PC software.

1. **Wiring requirements**
2. In order to prevent the driver from being interfered, it is recommended that the control signal use shielded cable, and the shield layer is short-circuited with the ground wire. Except for special requirements, the shield line of the control signal cable is grounded at one end: the host computer end of the shield line is grounded, and the driver end of the shield line is suspended. Only the same point is allowed to be grounded in the same machine. If it is not a real ground wire, there may be serious interference. In this case, the shield layer is not connected.
3. The pulse and direction signal lines are not allowed to be wrapped side by side with the motor lines. It is best to separate them by at least 10 cm. Otherwise, the motor noise will easily interfere with the pulse direction signals and cause inaccurate motor positioning, system instability and other faults.
4. If one power supply supplies multiple drives, they should be connected in parallel at the power supply. Chain connection from one drive to another is not allowed.
5. It is strictly forbidden to plug or unplug the high-voltage terminals of the driver while it is powered on. When the motor is stopped, there is still a large current flowing through the coil. Plugging or unplugging the terminals while it is powered on will cause a huge instantaneous induced electromotive force that will burn out the driver.
6. It is strictly forbidden to connect the wire end to the terminal after tinning it, otherwise the contact resistance may increase and the terminal may be damaged by overheating.
7. The wiring ends must not be exposed outside the terminals to prevent accidental short circuits and damage to the driver.
8. **DIP switch function setting**

The HS86 driver uses a 10-bit DIP switch. SW1-SW4 is used for ALM, PEND output configuration settings, algorithm selection, maximum peak current settings, and direction selection; SW5-SW8 is used for subdivision settings; and SW9-SW10 is used for working mode selection. The detailed description is as follows:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SW1** | **SW2** | **SW3** | **SW4** | **SW5** | **SW6** | **SW7** | **SW8** | **SW9** | **SW10** |
| Function settings | | | | Segment settings | | | | Working mode settings | |

1. **Function settings**
2. **ALM, PENDOutput Configuration Settings**

SW1 sets the output signal resistance state of ALM and PEND. When SW1=off, it is normally open; when SW1=on, it is normally closed.

1. **Algorithm selection**

SW2 is used to select the control algorithm of the driver. When SW2=off, it is algorithm A; when SW2=on, it is algorithm B.

1. **Maximum current setting**

SW3 sets the maximum output current of the driver. When SW3=off, it is a small current output, mainly suitable for 57 or 60 closed-loop motors; when SW3=on, it is a large current output, mainly suitable for 86 closed-loop motors.

1. **Direction selection**

SW4 sets the initial rotation direction of the motor. When SW4=off, it rotates in the forward direction; when SW4=on, it rotates in the reverse direction.

1. **Segment settings**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Steps/turn** | **SW5** | **SW6** | **SW7** | **SW8** | **Segment Description** |
| 400 | on | on | on | on | When SW5, SW6, SW7, and SW8 are all off, the user can set any subdivision value from 200 to 40000 through the PC software, with a resolution of 1. |
| 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 |

1. **Working mode settings**

|  |  |  |  |
| --- | --- | --- | --- |
| **SW9** | **SW10** | **Working mode selection** | **Remark** |
| off | off | Pulse+Direction | When SW9 and SW10 are both off, users can use the PC softwareSet the working mode yourself. |
| on | off | Pulse + direction with smoothing |
| off | on | Double Pulse |
| on | on | Spontaneous pulses |

▶**Note: After modification, power must be restarted for it to take effect.**

1. **Power supply selection**

The power supply voltage can work normally within the specified range. The HS86 driver can be powered by a transformer. It is recommended that the AC output voltage of the transformer does not exceed its specified maximum voltage. The HS86 driver can also be powered by an unregulated DC power supply, but it should be noted that the peak value of the rectified voltage ripple should not exceed its specified maximum voltage. It is recommended that users use a DC voltage lower than the maximum voltage to avoid grid fluctuations exceeding the driver's operating voltage range.

If a voltage-regulated switching power supply is used, it should be noted that the output current range of the switching power supply must be set to the maximum.

▶**Notice:**

1. When wiring, pay attention to the position of the power interface and do not connect it to the motor port. After connecting, it is best to confirm whether it is connected correctly;
2. It is best to use an unregulated power supply;
3. When using an unregulated power supply, the power supply current output capacity should be greater than 60% of the driver set current;
4. When using a voltage-regulated switching power supply, the output current of the power supply should be greater than or equal to the operating current of the driver;
5. To reduce costs, two or three drivers can share one power supply, but the power supply must be large enough.
6. **Protection function**
7. **Short circuit protection**

When a phase-to-phase short circuit or overcurrent occurs inside the driver, the driver red light flashes once and flashes repeatedly in a cycle of 3 seconds. At this time, the fault must be eliminated and the power must be turned on again for a reset.

1. **Overvoltage protection**

When the input voltage is higher than AC80V, the red light of the driver flashes twice and flashes repeatedly in a cycle of 3 seconds. At this time, the fault must be eliminated and the power must be turned on again for reset.

1. **Undervoltage protection**

When the input voltage is lower than AC20V, the red light of the driver flashes 3 times and flashes repeatedly in a cycle of 3 seconds. At this time, the fault must be eliminated and the power must be turned on again for reset.

1. **Phase loss protection**

When the power is initially turned on and the motor is out of phase, the driver red light flashes 5 times and flashes repeatedly in a 3-second cycle. At this time, the fault must be eliminated and the power must be turned on again to reset.

1. **Out-of-tolerance alarm signal**

When an out-of-tolerance alarm occurs, the red light of the driver will remain on or flash rapidly. At this time, the alarm can be cleared through the ENA terminal or reset by powering on again.