**HB556C**

**Digital two phase stepping driver**

**an instruction manual**

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[please read this manual carefully before use to avoid damaging the drive]



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**HB556C**

**Digital two phase stepping driver**

**1、Product introduction**

**1. Overview**

Hb556C is a new digital stepping motor driver introduced by the company. It adopts the latest 32-bit DSP digital processing technology. The driver control algorithm adopts advanced variable current technology and advanced frequency conversion technology. The driver has small heat, small motor vibration and stable operation. Users can set any subdivision within 200 ~ 25600 and any current value within the rated current, which can meet the application needs of most occasions. Due to the use of built-in micro separation technology, even under the condition of low subdivision, it can achieve the effect of high subdivision, low, medium and high speed operation are very stable, and the noise is very small. The driver integrates the automatic parameter setting function, which can automatically generate the optimal operation parameters for different motors and maximize the performance of the motor.

**2.characteristic**

●New 32-bit DSP Technology

●Can drive 4, 6, 8-wire two-phase stepping motor

● ultra low vibration noise

●Optical isolation differential signal input

●Built in high subdivision

●Pulse response frequency up to 500KHz (factory default200kHz)

●Parameter power on automatic setting function

●The current setting is convenient, and it can be freely selected between 0.1-5.6a

●Variable current control greatly reduces the motor heating

●The subdivision setting range is 200-25600

●Automatic half reduction of current at standstill

●With overvoltage, undervoltage, overcurrent and other protection functions

**3.Applications**

Suitable for a variety of small and medium-sized automation equipment and instruments, such as: engraving machine, marking machine, cutting machine, laser typesetting, plotter, CNC machine tools, automatic assembly equipment, etc. The application effect is very good in the equipment with low noise and high speed.

**2、Electrical, mechanical and environmental indicators**

**1. Electrical index**

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|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Explain | HB556C | | | |
| minimum value | Typical value | Maximum value | Company |
| Output current | 0.1 | - | 5.6 | A |
| Input supply voltage | 24 | 36 | 50 | VDC |
| Control signal input current | 6 | 10 | 16 | mA |
| Control signal interface level | 4.5 | 5 | 28 | Vdc |
| Minimum pulse width of input signal | 1.5 | - | - | us |
| Step pulse frequency | 0 | - | 200 | KHz |
| insulation resistance | 500 |  |  | MΩ |

1. **Operating environment and parameters**

|  |  |  |
| --- | --- | --- |
| insulation resistance | Natural cooling or forced air cooling | |
| Use environment | occasion | It shall not be placed next to other heated equipment. Dust, oil mist and corrosive gas shall be avoided. Places with too high humidity and strong vibration shall be avoided. Combustible gas and conductive dust are prohibited; |
| temperature | -5℃ ～ +50℃ |
| humidity | 40 ～ 90%RH |
| Vibration | 5.9m/s2MAX |
| Storage temperature | | -20℃～80℃ |
| Using altitude | | Less than 1000M |
| weight | | About 280 grams. |

3.**Mechanical installation drawing**

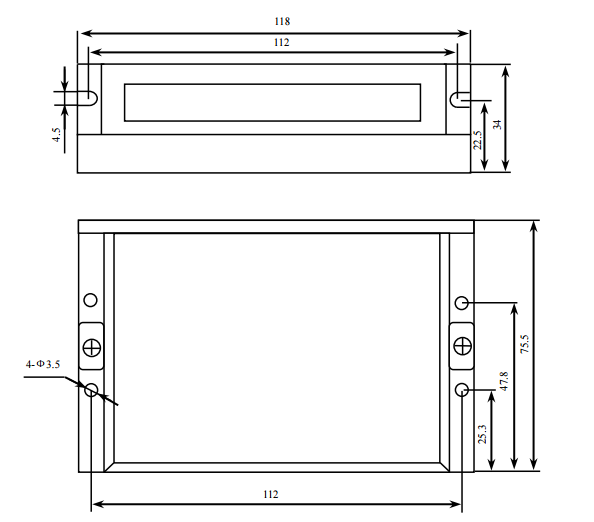


Figure 1 installation dimension drawing (unit: mm)

It is recommended to use side installation, with better heat dissipation effect. When designing the installation size, pay attention to the terminal size and wiring!

**4.Strengthen the way of heat dissipation**

1. The reliable working temperature of the driver is usually within 60 ℃, and that of the motor is within 80 ℃;
2. It is recommended to select the automatic half current mode when using, and the current will be reduced by half automatically when the motor stops, so as to reduce the heating of the motor and the driver;
3. When installing the driver, please use the vertical side installation to make the cooling teeth form strong air convection; when necessary, install a fan near the driver to force the cooling to ensure that the driver works within the reliable working temperature range.
   1. **Driver interface and wiring introduction**
4. **Interface description**
5. Control signal interface

|  |  |
| --- | --- |
| Name | function |
| PUL+ | Pulse signal: the rising edge of pulse is effective; pul is 4.5-28vdc at high level and 0-0.5v at low level. For reliable response to pulse signal, pulse width shall be greater than 1.5 μ s. |
| PUL- |
| DIR+ | Direction signal: high / low level signal. To ensure reliable commutation of motor, direction signal shall be established at least 2 μ s before pulse signal. The initial running direction of the motor is related to the wiring of the motor. The direction of the initial running of the motor can be changed by exchanging any phase winding (such as a +, a-exchange). The high current level of dir is 4.5-28vdc, and the low current level is 0-0.5v. |
| DIR- |
| ENA+ | Enable signal: this input signal is used to enable or disable. When ENA + is connected to 4.5-28vdc and ENA - is connected to low level (or internal optocoupler is on), the driver will cut off the current of each phase of the motor to make the motor in a free state. At this time, the step pulse will not be responded. When this function is not needed, the enable signal end can be suspended. |
| ENA- |

1. Strong current interface

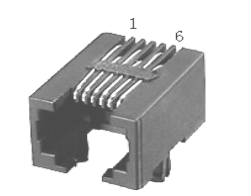
|  |  |
| --- | --- |
| Name | function |
| GND | DC power ground |
| +Vdc | DC power supply positive pole, power supply voltage range: DC 24 ~ 50VDC, 36VDC recommended. |
| A+、A- | Motor A phase coil interface. |
| B+、B- | Motor B phase coil interface. |

1. 232 communication interface

It can be connected to PC or stu debugger through special serial port cable, and it is forbidden to plug and unplug with power. Through stu or PC software protuner, you

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can set the subdivision and current value, effective edge, single pulse and double pulse required by customers, and also can eliminate and adjust the resonance point

Figure 2 RS232 interface pin arrangement definition

|  |  |  |  |
| --- | --- | --- | --- |
| Terminal number | Symbol | Name | Explain |
| 1 | NC |  |  |
| 2 | +5V | 5V power supply positive terminal | External STU only |
| 3 | TxD | RS232 transmitter |  |
| 4 | GND | 5V power source | 0V |
| 5 | RxD | RS232 receiver |  |
| 6 | NC |  |  |

Note: the cable between hb556c and PC, text display or stu servo debugger must be a special cable (attached randomly according to the user's situation) before use, please confirm to avoid damage.

1. Status indication

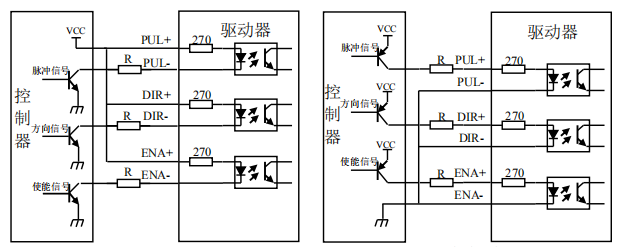
The green LED is the power indicator. When the driver is powered on, the LED is always on; when the driver is powered off, the LED is off. The red LED is the fault indicator light. In case of fault, the indicator light flashes in a cycle of 3 seconds; when the fault is cleared by the user, the red LED is always off. The blinking times of red LED in 3 seconds represent different fault information, and the specific relationship is shown in the table below:

|  |  |  |  |
| --- | --- | --- | --- |
| Serial number | Number of flashes | Red LED flashing waveform | Fault description |
| 1 | 1 |  | Over current or phase to phase short circuit fault |
| 2 | 2 |  | Over voltage fault |
| 3 | 3 |  | undefined |
| 4 | 4 |  | undefined |

1. **Control signal interface circuit**

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HB556c driver adopts differential interface circuit, which can be applied to differential signal, single ended common cathode, single ended common anode and other interfaces, with built-in high-speed optocoupler, allowing to receive signals from long-line driver, collector open circuit and PNP output circuit. In the case of bad environment, we recommend using long wire driver circuit, which has strong anti-interference ability. Now take the collector open circuit and PNP output as an example, and the schematic diagram of the interface circuit is as follows:



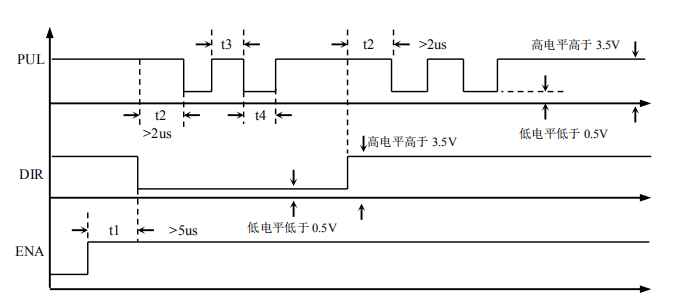
Common anode connection Common cathode connection

**Figure 3 input interface circuit**

Note: when VCC value is 4.5-28vdc, R is short circuited or not;

1. **Control signal sequence diagram**

In order to avoid some misoperation and deviation, pul, dir and ENA shall meet certain requirements, as shown in the following figure:



**Fig. 4 control signal sequence diagram**

**notes:**

1) T1: ENA (enable signal) shall be at least 5 μ s ahead of dir, which is determined as high. Generally, it is recommended that ENA + and ENA - be suspended.

2) T2: at least 2 μ s in advance of the pul falling edge of dir to determine its high or low state.

3) T3: the pulse width shall not be less than 2 μ s. 4) T4: the width of low level shall not be less

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than 2 μ s.

Fig. 4 control signal sequence diagram

1. **Control signal mode setting**

**Selection of pulse triggering edge and single and double pulse:** it is effective to set pulse rising edge or falling edge triggering through PC software proturner or stu debugger; it can also set single pulse mode or double pulse mode. In the double pulse mode, the signal at the direction control end must be kept at high level or suspended.

1. **Wiring requirements**

1) In order to prevent the driver from being interfered, it is recommended to use shielded cable for the control signal, and the shielding layer is short circuited with the ground wire. Except for special requirements, control Single end grounding of shield wire of signal cable: one end of upper computer of shield wire is grounded, and one end of driver of shield wire is suspended. Only allowed in the same machine

If it is not a real ground wire, the interference may be serious. At this time, the shielding layer is not connected.

2) Pulse and direction signal lines and motor lines are not allowed to be bound together side by side. It is better to separate them at least 10cm, otherwise motor noise is easy to interfere The pulse direction signal causes motor positioning error, system instability and other faults.

3) If one power supply is used for multiple drives, parallel connection shall be adopted at the power supply, and it is not allowed to connect to one drive first and then to another chain.

4) It is strictly prohibited to plug and unplug the strong P2 terminal of the driver with electricity. When the charged motor stops, there is still a large current flowing through the coil. Plugging and unplugging the P2 terminal will lead to a huge The driver will be burnt by the electric potential generated in an instant.

5) It is forbidden to connect the wire head to the terminal after tin filling, otherwise the terminal may be damaged due to overheating due to the increase of contact resistance.

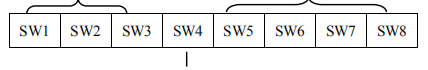
6) The terminal shall not be exposed outside the terminal to prevent the driver from being damaged due to accidental short circuit.

**4、 Current, subdivision dial switch setting and parameter self-tuning**

HB556C driver uses 8-bit dip switch to set subdivision accuracy, dynamic current, static half current and realize self-tuning of motor parameters and internal adjustment parameters. The details are as follows:

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Dynamic current setting Subdivision accuracy setting



Half flow / full flow mode setting / parameter self-tuning

1. **Current setting**
2. **Working (dynamic) current setting**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Output peak current | Output average current | SW1 | SW2 | SW3 | Current self setting |
| Default(1.0A) | | Off | Off | Off | When SW1, SW2 and SW3 are set as off off off, the required current can be set through PC software, the maximum value is 5.6A, and the resolution is 0.1A. If not set, the default current is 1.4A. |
| 2.1A | 1.5A | on | Off | Off |
| 2.7A | 1.9A | Off | on | Off |
| 3.2A | 2.3A | on | on | Off |
| 3.8A | 2.7A | Off | Off | on |
| 4.3A | 3.1A | on | Off | on |
| 4.9A | 3.5A | Off | on | on |
| 5.6A | 4.0A | on | on | on |

1. **Static current setting**

The static current can be set with SW4 dial switch, off means that the static current is set as half of the dynamic current, on means that the static current is the same as the dynamic current. In general use, SW4 should be set to off to reduce the heat of motor and driver and improve the reliability. After the pulse train stops, the current will automatically reduce to about half (60% of the actual value) after about 400ms, and the calorific value will theoretically reduce to 30%.

**2. Subdivision setting**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Steps / revolution | SW5 | SW6 | SW7 | SW8 | Breakdown description |
| Default(3600) | on | on | on | on | When SW5, SW6, SW7 and SW8 are all on, the drive subdivision adopts the default fine fraction inside the drive: the user sets the fine fraction through the PC software protuner or stu debugger, with the minimum value of 1, the resolution of 1 and the maximum value of 51200. |
| 400 | Off | on | on | on |
| 800 | on | Off | on | on |
| 1600 | Off | Off | on | on |
| 3200 | on | on | Off | on |
| 6400 | Off | on | Off | on |
| 12800 | on | Off | Off | on |
| 25600 | 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 |
| 25000 | Off | Off | Off | Off |

**3.Parameter self-tuning function**

If SW4 is moved back and forth once within one second, the driver can automatically complete the self-tuning of motor parameters and internal adjustment parameters; when the motor, power supply voltage and other conditions change, please conduct the self-tuning once, otherwise, the motor may not operate normally. **Note that the pulse cannot be input at this time, and the direction signal shall not change.**

**Implementation method 1)** SW4 is switched from on to off, and then from off to on within 1 second;

**Implementation method 2)** SW4 is switched from off to on, and then switched from on to off within 1 second.

**5、Power supply selection**

The power supply voltage can work normally within the specified range. It is better for hb556c driver to use non stabilized voltage DC power supply, or Transformer step-down + bridge rectifier + capacitor filter are adopted. However, the peak value of voltage ripple after rectification shall not exceed the specified maximum voltage. Proposal .The user uses the DC voltage lower than the maximum voltage to supply power, so as to avoid the grid fluctuation exceeding the working range of the driver voltage.

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

Please note that:

1) When wiring, the positive and negative poles of the power supply shall not be reversed;

2) It is better to use non stabilized voltage power supply;

3) When the non stabilized voltage power supply is adopted, the current output capacity of the power supply should be greater than 60% of the set current of the driver;

4) When the stabilized voltage switching power supply is adopted, the output current of the power supply shall be greater than or equal to the working current of the driver;

5) In order to reduce the cost, two or three drives can share one power supply, but the power supply should be large enough.

**6、 Motor selection**

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HB556C can be used to drive 4, 6, 8-wire two-phase, four phase hybrid stepping motor, and the step angle of 1.8 degree and 0.9 degree can be applied. When selecting a motor, it is mainly determined by the torque and rated current of the motor. The torque is mainly determined by the motor size. The motor with large size has larger torque, while the current is mainly related to inductance. The motor with small inductance has good high-speed performance, but the current is larger.

**1. Motor selection**

**1) Determine the load torque and transmission ratio working speed range**

Tmotor = C (J ε + T load)

J: Moment of inertia of load ε: maximum angular acceleration of load C: safety factor, recommended value 1.2-1.4

T load: maximum load torque, including resistance torque such as payload, friction, transmission efficiency, etc

**2) What factors determine the motor output torque**

For a given stepping motor and coil connection, the output torque has the following characteristics:

● the greater the actual current of the motor is, the greater the output torque is, but the more copper loss (P = I2R) the motor has, the more heat generated;

● the higher the power supply voltage of the driver, the greater the high-speed torque of the motor;

● it can be seen from the torque frequency characteristic diagram of stepping motor that the torque of high speed is smaller than that of medium and low speed.

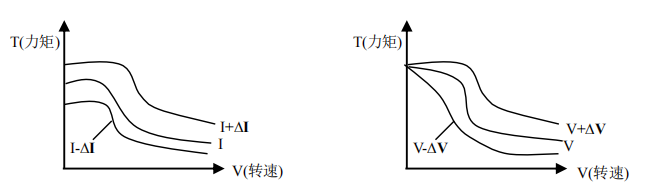


Fig. 5 characteristic diagram of moment frequency

**2 .Motor wiring**

For 6-wire and 8-wire stepping motors, the performance of motors connected with different coils is quite different, as shown in the following figure:

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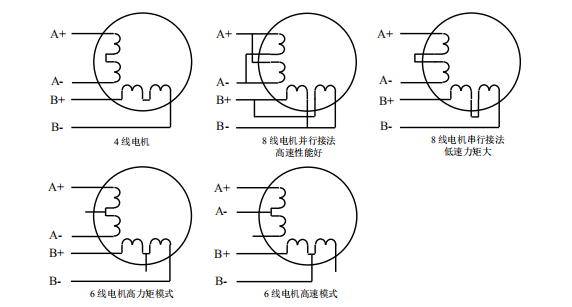


Fig. 6 motor wiring diagram

**3. Selection of input voltage and output current**

**1) Setting of supply voltage**

Generally speaking, the higher the power supply voltage, the greater the torque when the motor is at high speed. The better to avoid falling off at high speed. But on the other hand, too high voltage will lead to over-voltage protection, motor heating, and even damage the driver. When working under high voltage, the vibration of motor moving at low speed will be larger.

**2) Set value of output current**

For the same motor, the larger the current setting value is, the greater the motor output torque is, but when the current is large, the heating of the motor and the driver is also serious. The specific calorific value is not only related to the current setting value, but also to the type of motion and residence time. The following setting mode adopts the rated current value of stepping motor as reference, but the best value in practical application shall be adjusted on this basis. In principle, if the temperature is very low (< 40 ℃), increase the current setting value as necessary to increase the motor output power (torque and high-speed response).

● four wire motor: the output current is set equal to or slightly less than the rated current of the motor;

● high torque mode of six wire motor: the output current is set to 50% of the rated current of motor single polarity connection method;

● six wire motor high-speed mode: the output current is set to 100% of the rated current of motor single polarity connection method;

● 8-wire motor series connection method: the output current can be set as 70% of the rated current of motor single polarity connection method;

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● 8-wire motor parallel connection: the output current can be set as 140% of the rated current of motor single polarity connection.

|  |
| --- |
| △ note: please run the motor for 15-30 minutes after setting the current. If the temperature rise of the motor is too high (> 70 ℃), reduce the current setting value. Therefore, in general, the current is set as the value when the motor is warm but not hot during long-term operation. |

HB556C is equipped with 57 motors in series and connected in parallel (if the rotation direction of the motor is different from the desired rotation direction, only exchange the positions of a +, a -), hb556c driver can drive four -, six -, or eight wire two-phase / four phase motors. The following figure lists the connection methods of 4-wire, 6-wire and 8-wire stepping motors in detail:

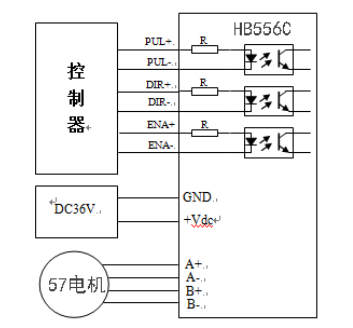


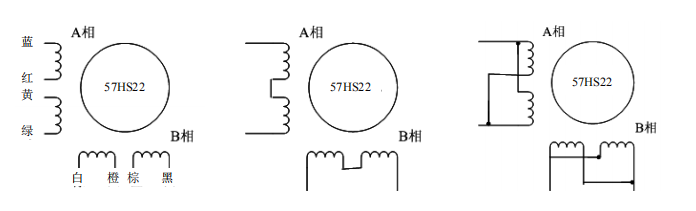
Figure 7typical connection method of HBb556C with 57 motor

be careful:

1) The colors of different motors are different. When using, the motor data description shall prevail. For example, the colors of 57 and 86 motor wires are different.

2) The phases are relative, but the windings of different phases cannot be connected to the terminals of the same phase of the driver (a +, a - is one phase, B +, B - is another phase). 57 motor leads are defined, connected in series and parallel as shown in the figure below.

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1. Leader definition (b) Series connection (c) Parallel connection

Figure 8 57 series parallel connection method of motor

3) Hb556c driver can only drive two-phase hybrid stepping motor, not three-phase and five phase stepping motor.

4) The method to judge whether the series connection or parallel connection of stepping motor is correct or not: directly rotate the motor shaft by hand without connecting the driver. If it can be easily and evenly rotated, the wiring is correct. If there is large resistance and uneven and accompanied by certain sound, the wiring is wrong.

**8、 Protection function**

1) Short circuit protection

In case of phase to phase short circuit or internal over-current of the driver, the red light of the driver flashes once and repeatedly within 3 seconds. At this time, it must be discharged.Power on again to reset.

2) Overvoltage protection

When the input voltage of hb556c is higher than 90V, the red light of the driver

flashes twice and repeatedly within 3 seconds. At this time, the fault must be eliminated,Power on again and reset.

3) Motor open circuit protection

When the motor is open or not connected, the red light of the driver flashes 4 times and repeatedly within 3 seconds. At this time, the fault must be eliminated New power on reset.

|  |
| --- |
| △ **note**: since the driver does not have the reverse connection protection function of the positive and negative poles of the power supply, please confirm the correct connection of the positive and negative poles of the power supply again before power on. If the positive and negative poles are connected reversely, the fuse in the driver will be burnt! |

1. **FAQs**
2. **Common problems and solutions in application**

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|  |  |  |
| --- | --- | --- |
| **phenomenon** | **Possible problems** | **Solutions** |
| **Motor does not run** | Power light is not on | Check the power supply circuit, normal power supply |
| Strong motor shaft | The pulse signal is weak, and the signal current increases to 7-16ma |
| Too small segmentation | Selected pair subdivision |
| Is the current setting too small | Pair selection current |
| Drive protected | Power on again |
| Enable signal is low | This signal is pulled high or not connected |
| No response to control signal | No power on |
| **Motor steering error** | Wrong connection of motor wires | Two wires of the same phase of any switching motor (such as a +, a-switching wiring position) |
| There is an open circuit in the motor line | Check and connect |
| **Alarm indicator is on** | Wrong connection of motor wires | Check wiring |
| Voltage too high or too low | Check the power supply |
| Motor or driver damaged | Replace motor or driver |
| **Inaccurate position** | Signal disturbed | Eliminate interference |
| Shielding ground is not connected or not well connected | Reliable grounding |
| There is an open circuit in the motor line | Check and connect |
| Subdivision error | Set up subdivision |
| Low current | Increase current |
| **Locked rotor during motor acceleration** | Acceleration time is too short | Longer acceleration time |
| Motor torque too low | Select large torque motor |
| Low voltage or current | Increase the voltage or current properly |

**2. FAQ of driver**

**1) What are stepper motors and stepper drivers?**

Stepping motor is a kind of special motor specially used for precise control of speed and position. It rotates at a fixed angle (called "step angle").Step by step operation, so called step motor. Its characteristic is that there is no accumulated error, and every pulse signal sent by the controller is driven.It is widely used in various open-loop control because the motor operates at a fixed angle.

The step driver is a kind of power amplifier which can make the step motor run. It can convert the pulse signal from the controller into the work of the step motor

Rate signal, the speed of the motor is proportional to the pulse frequency, so the

control pulse frequency can be accurately adjusted, and the control pulse number

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can be accurately located.

**2) What is drive segmentation? What is the relationship between the speed of stepping motor and the pulse frequency?**

Due to the special structure of stepping motor, the "inherent step angle of motor" is indicated in the factory (for example, 0.9 ° / 1.8 °, which means that the turning angle of each step of half step operation is 0.9 °, and that of the whole step is 1.8 °). However, in many precise control and occasions, the angle of the whole step is too large, which affects the control accuracy, and the vibration is too large, so it is required to complete a motor's inherent step angle in many steps, which is called subdivision drive. The electronic device that can achieve this function is called subdivision drive.



V: Motor speed (r / s) P: pulse frequency (Hz)

θ e: inherent step angle of motor M: fine fraction (1 for the whole step and 2 for the half step)

**3) What are the benefits of segmented drives?**

● the control accuracy can be improved by reducing the step angle of each step and improving the step uniformity.

● it can greatly reduce motor vibration. Low frequency vibration is the inherent characteristic of stepping motor, and subdivision is the best way to eliminate it.

● it can effectively reduce torque ripple and improve output torque. These advantages are generally recognized by users and bring them benefits, so it is recommended that you choose subdivision drive.

**4) Why does my motor only run in one direction?**

● the direction signal may be too weak or the wiring polarity may be wrong.

● the pulse mode does not match, the signal is pulse / direction, and the driver must be set as this mode; if the signal is CW / CCW (double pulse mode), the driver must also be this mode, otherwise the motor will only run in one direction.

**Company product warranty**

**1 one year warranty**

The company provides a one-year warranty for the defects in raw materials and workmanship of its products from the date of shipment. During the warranty period, the company provides free maintenance services for defective products.

**2 not covered by warranty**

●Improper wiring, such as reverse connection of positive and negative poles of power supply and live plug-in

● change internal components without permission

● use beyond electrical and environmental requirements

● poor environmental heat dissipation

**3 maintenance process**

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If the product needs to be repaired, the following process will be followed:

1) Call the customer service personnel of the company to obtain the repair license number before delivery;

2) Attached with the goods is a written description of the failure of the repaired drive; the voltage, current, operating environment, etc. at the time of failure; the name, telephone number, mailing address and other information of the contact person.

**4 warranty restrictions**

● the warranty scope of the company's products is limited to the devices and processes of the products (i.e. consistency).

● the company does not guarantee that its products can be suitable for the specific use of customers, because whether they are suitable is also related to the technical index requirements, use conditions and environment of the use.

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