

DM860H
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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DM860H

Digital two phase stepping driver

1、 Product introduction

1. summary

DM860H is a new digital stepping motor driver launched by our 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 heating, small motor vibration and stable operation. Users can set any subdivision within 200 ~ 51200 and any current value within the rated current, which can meet the application needs in 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. The low, medium and high-speed operation is very stable, and the noise is very small. The driver is integrated with parameter power on automatic setting function, which can automatically generate optimal operation parameters for different motors to maximize the performance of the motor.

2. characteristic

- New 32-bit DSP Technology
- Ultra low vibration noise
- Built in high subdivision
- Parameter power on automatic setting function
- Variable current control greatly reduces the motor heating
- Automatic half reduction of current at rest
- It can drive 4,6,8 wire two-phase stepping motor
- Optical isolation differential signal input
- Pulse response frequency up to 500KHz (factory default 200kHz)
- The current setting is convenient and can be selected between 2.1-7.2A
- The subdivision setting range is 200-51200
- It has over-voltage, under voltage, over-current protection functions

3. application area

Suitable for all kinds of small and medium-sized automation equipment and instruments, such as: engraving machine, marking machine, cutting machine, laser Phototypesetting, plotter, CNC machine tool, automatic assembly equipment, etc. The application effect is very good in the equipment with low noise and high speed expected by users.

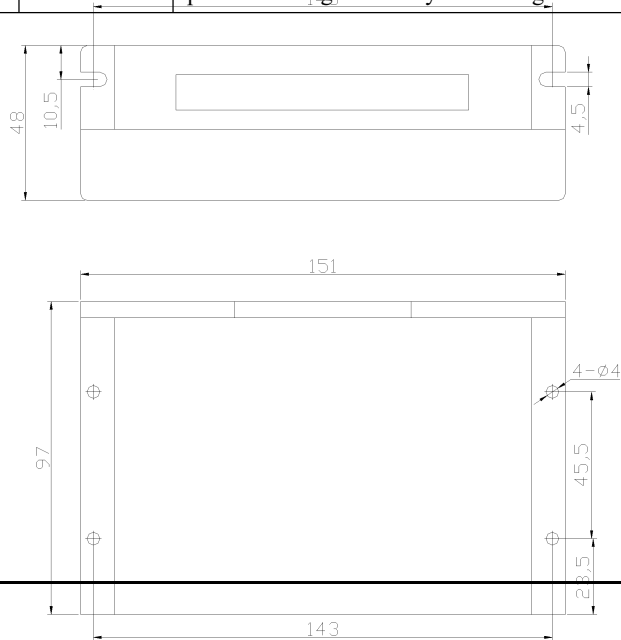
2、 Electrical, mechanical and environmental indicators

1. Electrical indicators

explain	DM860H			
	minimum value	Typical value	Maximum	Company
Output current[PK]	2.1	-	7.2	A
Input power voltage	24	48	75	VAC
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

2. Operating environment and parameters

Cooling mode		Forced air cooling
Usage environment	occasion	It should not be placed next to other heating equipment. Dust, oil mist and corrosive gas should be avoided. Combustible gas and conductive dust are not allowed in places with high humidity and strong vibration;



	temperature	-5℃ ~ +50℃
	humidity	40 ~ 90%RH
	Vibration	5.9m/s2MAX
Storage temperature		-20℃~80℃
Use altitude		Below 1000M
weight		About 0.4 g

3. Mechanical installation drawing

※It is recommended to adopt side installation for better heat dissipation effect. When designing the installation size, the terminal size and wiring should be considered !

4. Strengthen heat dissipation

- 1) The reliable working temperature of the driver is usually within 66 ℃, and that of the motor is within 85 ℃;
- 2) It is suggested that the automatic half current mode should be selected when using, and the current will be automatically reduced by half when the motor stops, so as to reduce the heating of motor and driver;

3) When installing the driver, please install it vertically on the side to make the cooling teeth form strong air convection; if necessary, install a fan close to the driver to force heat dissipation, so as to ensure that the driver works within the reliable working temperature range.

3、 Introduction of driver interface and wiring

1. Interface description

1) 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. In order to respond to the pulse signal reliably, the pulse width should be greater than 1.5 μ s.
PUL-	
DIR+	Direction signal: high / low level signal. In order to ensure reliable commutation of the motor, the directional signal should be established at least 2 μ s prior to the pulse signal. The initial running direction of the motor is related to the wiring of the motor. Exchanging any phase winding (such as a + and a-exchange) can change the initial running direction of the motor. Dir is 4.5 ~ 28vdc at high level and 0 ~ 0.5V at low level.
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 free state. At this time, the step pulse is not responded. When this function is not needed, enable the signal end to hang.
ENA-	

2) Strong current interface

name	function
AC	AC power supply AC input, AC 24 ~ 75vac.
AC	AC power supply AC input, AC 24 ~ 75vac.
A+, A-	Motor A phase coil interface.
B+, B-	Motor B phase coil interface.

4) 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. When there is a 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 flashing times of red LED in 3 seconds represent different fault information, and the specific relationship is shown in the table below:

Serial number	Flicker times	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

2. Control signal interface circuit

DM860H The driver adopts differential interface circuit, which can be used for differential signal, single ended common cathode and single end common anode interface, and has built-in high-speed optocoupler, which allows receiving signals from long-term driver, collector open circuit and PNP output circuit. In harsh environment, we recommend using long line driver circuit, which has strong anti-interference ability. Taking the collector open circuit and PNP output as an example, the interface circuit diagram is as follows:

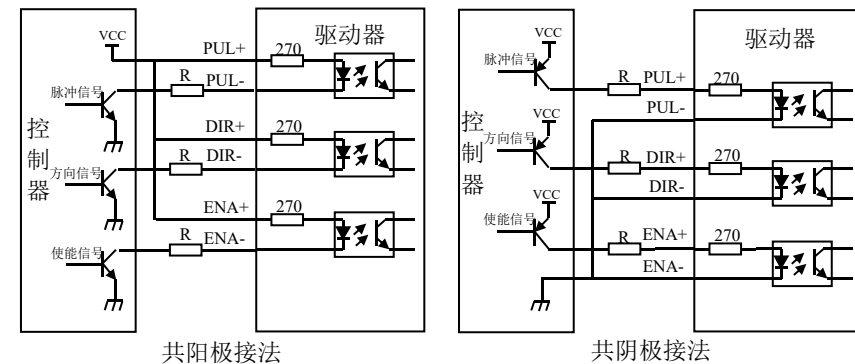
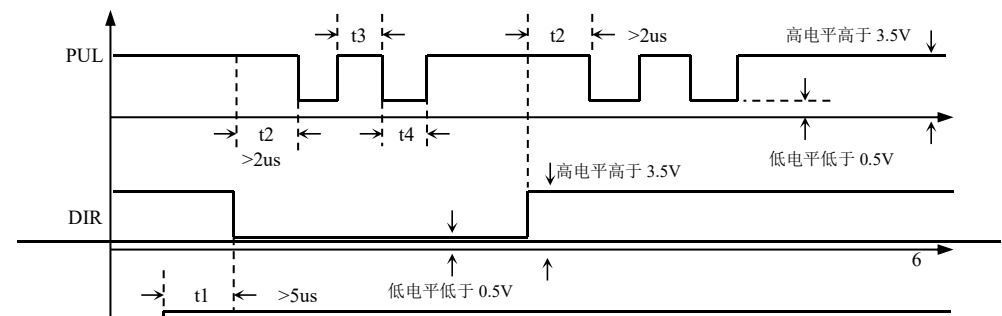


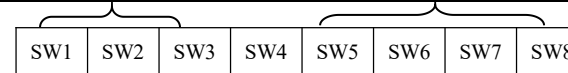
Figure 3 input interface circuit

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

3. Control signal sequence diagram

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





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

notes:

- 1) t1: ENA(enable signal) shall be determined as high by at least 5 μs in advance of dir. In general, it is suggested that ENA + and ENA - should be suspended.
- 2) t2: DIR was determined as high or low at least 2 μs ahead of pul.
- 3) t3: The pulse width should not be less than 2 μs.
- 4) t4: The width of low level is not less than 2 μs.

4. Control signal mode setting

Pulse trigger edge and single and double pulse selection: Through PC software protuner software or stu debugger, it is effective to set the rising edge or falling edge trigger of pulse, and can also set single pulse mode or double pulse mode. In dual pulse mode, the signal at the direction control terminal must be kept at high level or suspended.

5. Wiring requirements

- 1) In order to prevent the driver from being interfered, it is suggested that the control signal should be shielded cable, and the shielding layer should be short circuited with the ground wire. In addition to special requirements, the shielding wire of the control signal cable should be single ended grounded: one end of the upper computer of the shielding wire is grounded, and one end of the driver of the shielded wire is suspended. The same machine can only be grounded at the same point. If it is not the real grounding wire, the interference may be serious, and the shielding layer will not be connected.
- 2) The pulse and direction signal lines and motor lines are not allowed to be wrapped together side by side. It is better to separate them at least 10 cm, otherwise the motor noise will easily interfere with the pulse direction signal, resulting in inaccurate motor positioning and system instability.
- 3) If one power supply provides multiple drivers, parallel connection should be adopted at the power supply, and chain connection is not allowed from one to the other.
- 4) It is strictly forbidden to plug and plug the strong current P2 terminal of the driver. When the charged motor stops, there is still a large current flowing through the coil. Pulling and plugging the P2 terminal will lead to a huge instantaneous induced electromotive force that will burn the driver.
- 5) It is strictly forbidden to connect the wire head into the terminal after adding tin, otherwise the terminal may be damaged due to overheating due to increased contact resistance.

4. Setting of current, subdivision dial switch and parameter self-tuning

DM860H driver uses 8-bit dial switch to set subdivision precision, dynamic current, static half current and realize self-tuning of motor parameters and internal adjustment parameters. The details are as follows:

Dynamic current setting Subdivision precision setting

1. Current setting

1) Working (dynamic) current setting

Output peak current	Output average current	SW1	SW2	SW3	Current self setting
Default[2.0A]		on	on	on	When the current is set to sw2.0, the maximum value of swoff can be set to sw2.0. If it is not set, the default current is 2.0A.
3.08A	2.57A	off	on	on	
3.77A	3.14A	on	off	on	
4.45A	3.71A	off	off	on	
5.14A	4.28A	on	on	off	
5.83A	4.86A	off	on	off	
6.52A	5.43A	on	off	off	
7.20A	6.00A	off	off	off	

2) Static current setting

The static current can be set by SW4 dial switch. Off means that the static current is set to half of the dynamic current, and 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 heating of motor and driver and improve the reliability. About 400ms after the pulse train stops, the current will automatically reduce to about half (60% of the actual value) and the calorific value will be reduced to 30% theoretically.

2. subdivision settings

Steps / revolution	SW5	SW6	SW7	SW8	Detailed description
400	on	on	on	on	When SW5, SW6, SW7, and SW8 are all on, the driver subdivision adopts the default subdivision in the driver: the user can set the subdivision by PC software protuner or stu debugger. The minimum value is 1, the resolution is 1, and the maximum value is 51200. The serial port interface is built-in.
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	

3.Parameter self-tuning function

If SW4 is moved back and forth within 1 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 carry out a self-tuning, otherwise, the motor may run abnormally. **Note that the pulse can not be input at this time, and the direction signal should not change.**

Method 1) SW4 is switched from on to off, and then back to on from off within 1 second;

Method 2) SW4 is switched from off to on, and then back to off in 1 second.

Note: this type of driver has automatic setting function of power on parameters.

5、 Power supply selection

If the DM860H driver adopts DC power supply, it is better to use non stabilized DC power supply, or transformer step-down + bridge rectifier + capacitor filter can be used. However, it should be noted that the peak value of voltage ripple after rectification shall not exceed the specified maximum voltage. It is suggested that users should use DC voltage lower than the maximum voltage to avoid grid fluctuation exceeding the operating range of driver voltage.

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

Please note that:

- 1) When wiring, pay attention to the positive and negative poles of the power supply and do not connect in reverse;
- 2) It is better to use non regulated power supply;
- 3) When the non regulated power supply is used, the output capacity of power supply current should be greater than 60% of the set current of the driver;
- 4) When switching power supply is used, the output current of the power supply should be greater than or equal to the working current of the driver;
- 5) In order to reduce the cost, two or three drivers can share one power supply, but the power supply should be large enough.

6、 Motor selection

DM860HIt can be used to drive two-phase and four-phase hybrid stepper motors with 4,6,8 wires. The step angle of 1.8 degrees and 0.9 degrees can be applied. Motor selection is mainly determined by the torque and rated current of the motor. The torque is mainly determined by the motor size. The larger the size of the motor torque is, and the current is mainly related to the inductance. The small inductance motor has good high-speed performance, but the current is larger.

1.Motor selection

1) Determine the load torque, transmission ratio, operating speed range

$$T_{\text{电机}} = C (J\varepsilon + T_{\text{负载}})$$

J: Moment of inertia of load ε : Maximum angular acceleration of load C: Safety factor, the recommended value is 1.2-1.4

$T_{\text{负载}}$: Maximum load torque, including payload, friction, transmission efficiency and other resistance torque

2) What factors determine the motor output torque

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

- The larger the actual current, the greater the output torque. However, the more copper loss ($P = I^2R$) of the motor is, the more heating the motor is;
- The higher the supply voltage of the driver, the greater the high-speed torque of the motor;
- According to the torque frequency characteristic diagram of stepping motor, the torque at high speed is smaller than that at medium and low speed.

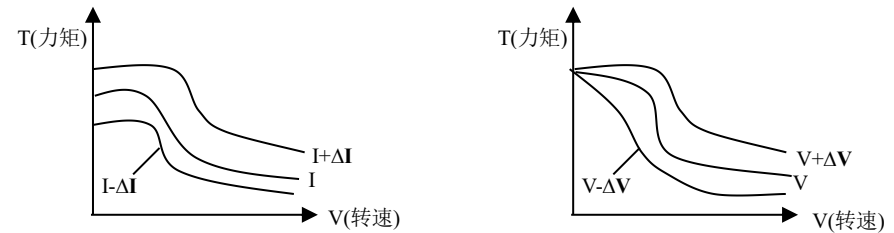


Figure 5 torque frequency characteristic diagram

2.Motor wiring

For 6-wire and 8-wire stepper motors, the performance of motors with different coil connections is quite different, as shown in the figure below:

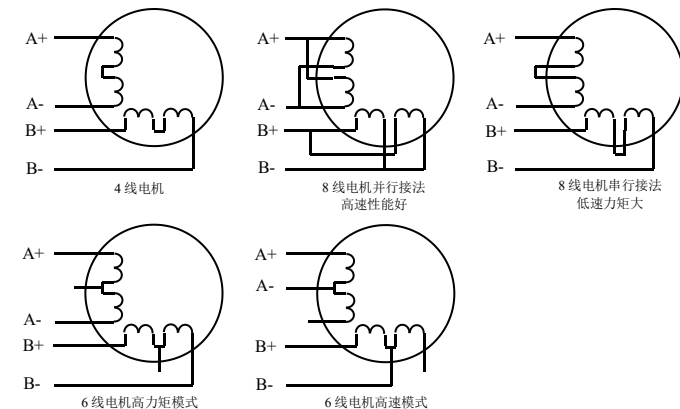


Figure 6 motor wiring diagram

3. Selection of input voltage and output current

1) Setting of power supply voltage

Generally speaking, the higher the supply voltage, the greater the torque of the motor at high speed. The more you can avoid falling off at high speed. But on the other hand, too high voltage will lead to over-voltage protection, motor heating more, and may even damage the driver. When the motor works under high voltage, the vibration of the motor at low speed will be greater.

2) Set value of output current

For the same motor, the higher the current setting value, the greater the motor output torque, but when the current is high, the motor and driver heating is more serious. The specific heat output is not only related to the current setting value, but also related to the movement type and residence time. The following setting mode uses the rated current value of stepping motor as reference, but the optimal value in practical application should be adjusted on this basis. In principle, if the temperature is very low ($< 40\text{ }^{\circ}\text{C}$), the current setting value can be appropriately increased to increase the motor output power (torque and high-speed response).

- Four wire motor: the output current is set to be equal to or slightly less than the rated current value of the motor;
- Six wire motor high torque mode: the output current is set to 50% of the rated current of single polarity connection;
- Six wire motor high speed mode: the output current is set to 100% of the rated current of single polarity connection;
- Series connection of eight wire motor: the output current can be set as 70% of the rated current of single polarity connection;
- Parallel connection of eight wire motor: the output current can be set as 140% of rated current of 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 ($> 70\text{ }^{\circ}\text{C}$), the current setting value should be reduced. Therefore, the general situation is to set the current to the value when the motor is warm but not hot for a long time.

DM860H is equipped with 86BYG250 in series and connected in parallel (only a + and a - positions can be exchanged if the motor steering is different from the expected steering). Td860ah driver can drive four wire, six wire or eight wire two-phase / four phase motor. The following figure lists the connection of 4-wire, 6-wire and 8-wire stepping motor in detail:

be careful:

- 1) The colors of different motors are different. When using, the motor information shall prevail. For example, the color of 57 type and 86 type motor wire is 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 + and A - are one phase, B + and B - are the other phase).

The definition, series and parallel connection of 86BYG250 motor lead are shown in the figure below.

- 3) HB860C The driver can only drive two-phase hybrid stepping motor, but not three-phase and five-phase stepping motor.
- 4) The method to judge whether the serial or parallel connection of stepping motor is correct or not: directly rotate the motor shaft by hand without connecting the driver. If the motor can rotate easily and evenly, the wiring is correct; if the resistance is large and uneven and accompanied with certain sound, the wiring is wrong.

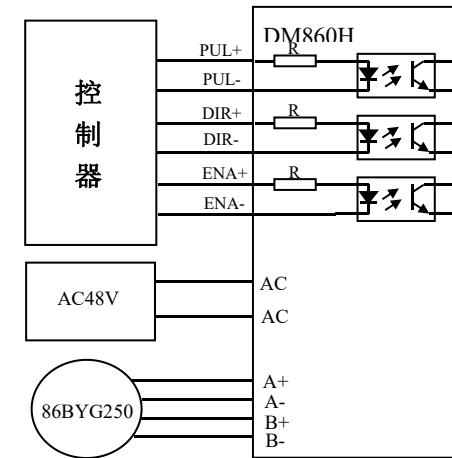


Figure 7 typical connection of DM860H with 86BYG250

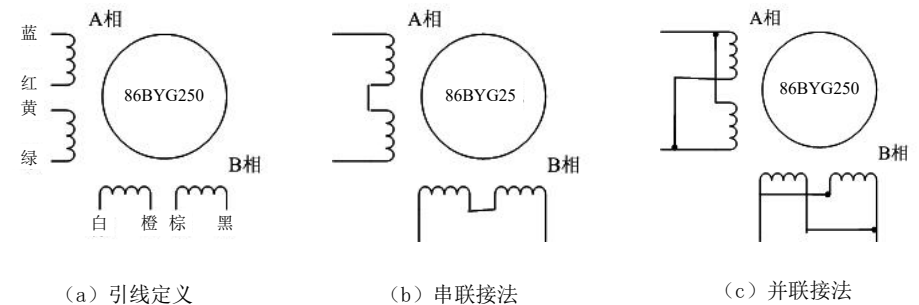


Figure 8 57 series parallel connection method of motor

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, the fault must be eliminated and

power on reset again.

2) Over voltage protection

DM860H When the input voltage is higher than 100vac, the red light of the driver flashes twice and repeatedly within 3 seconds. At this time, the fault must be eliminated and power on reset again.

3) Motor open circuit protection

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

Note: since the driver does not have the protection function of reverse connection of positive and negative poles of power supply, please confirm that the positive and negative wiring of power supply is correct before power on. Reverse connection of positive and negative poles will cause the fuse in the driver to be burnt out!

9、 Frequently asked questions

1.Common problems and solutions in application

phenomenon	Possible problems	Solutions
The motor doesn't work	The power light doesn't work	Check the power supply circuit and supply power normally
	The motor shaft is powerful	The pulse signal is weak and the signal current increases to 7-16mA
	The subdivision is too small	Select the right subdivision
	Is the current setting too small	Select the right current
	Drive protected	Power on again
	Enable signal is low	The signal is pulled high or not connected
	No response to control signal	No power on
Motor steering error	Wrong connection of motor wire	Arbitrary exchange of two wires of the same phase of the motor (e.g. A + and A-exchange connection position)
	There is an open circuit in the motor line	Check and connect
The alarm indicator is on	Wrong connection of motor wire	Check wiring
	The voltage is too high or too low	Check the power supply
	Motor or driver damaged	Replace the motor or driver
Inaccuracy of position	Signal disturbed	Eliminate interference
	The shielding ground is not connected or well connected	Reliable grounding
	There is an open circuit in the motor line	Check and connect
	Subdivision error	Set pair subdivision

	The current is too small	Increase the current
Motor stalling when accelerating	Acceleration time is too short	Longer acceleration time
	Motor torque too small	Select high torque motor
	Low voltage or low current	Increase the voltage or current appropriately

2.Drive FAQs answer user questions

1) What are stepping motor and stepping driver?

Stepper motor is a special kind of motor which is used for precise control of speed and position. It rotates step by step at a fixed angle (called "step angle"), so it is called stepping motor. Its characteristic is that there is no cumulative error, each pulse signal from the controller is received, and the motor runs at a fixed angle under the drive of the driver, so it is widely used in various open-loop control.

Step driver is a kind of power amplifier which can make the stepper motor run. It can convert the pulse signal sent by the controller into the power signal of the stepping motor. The speed of the motor is proportional to the pulse frequency, so the control pulse frequency can be accurately adjusted, and the number of control pulses can be accurately positioned.

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

Due to its unique structure, stepper motors are marked with "inherent step angle of motor" (for example, $0.9^\circ / 1.8^\circ$ indicates that the rotation angle of each step is 0.9° for half step operation and 1.8° for whole step). However, in many precision control and occasions, the angle of the whole step is too large, which affects the control accuracy, and the vibration is too large. Therefore, it is required to complete an inherent step angle of the motor in many steps, which is the so-called subdivision drive. The electronic device that can realize this function is called subdivision driver.

$$P * \theta_e$$

$$V = \frac{P * \theta_e}{360 * m}$$

$$V: \text{motor speed (r/s)} \quad P: \text{Pulse frequency (Hz)}$$

$$\theta_e: \text{Inherent step angle of motor} \quad m: \text{Subdivision (1 for whole step and 2 for half step)}$$

3) What are the advantages of subdivided drives?

- Because the step angle of each step is reduced and the step uniformity is improved, the control accuracy can be improved.
- Low frequency oscillation is the inherent characteristic of stepping motor. Subdivision is the best way to eliminate it.
- It can effectively reduce the torque ripple and improve the output torque.

These advantages are generally recognized by users and bring them substantial benefits, so it is recommended that you choose subdivision drive.

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

- It is possible that the directional signal is too weak, or the polarity of the wiring is wrong, or the signal voltage is too high, and the directional current limiting resistor is burnt out.
- Pulse mode mismatch, the signal is pulse / direction, the driver must be set to this mode; if the signal is CW / CCW (dual pulse mode), the driver must also be in this mode, otherwise the motor will only run in one direction.

Warranty terms of the company's products

1 One year warranty

Provide a one-year warranty for defects in raw materials and workmanship from the date of shipment. Provide free maintenance service for defective products during the warranty period.

2 Not covered by warranty

- Improper wiring, such as reverse connection of positive and negative poles of power supply and charged plug-in
- Unauthorized modification of internal components
- Use beyond electrical and environmental requirements
- Poor heat dissipation

3 Maintenance process

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

- 1) Call the company's customer service personnel to obtain the repair permit number before delivery;
- 2) A written instruction is attached with the goods to explain the fault phenomenon of the drive to be repaired; the voltage, current and operating environment at the time of failure; the name, telephone number and mailing address of the contact person.

4 Warranty restrictions

- The product warranty is limited to the device and process (i.e. consistency) of the product.
- There is no guarantee that its products can be suitable for the specific purpose of the customer, because the suitability is also related to the technical index requirements, service conditions and environment of the application.