User’s Manual

For

DM430

Two-phase Digital Stepper Drive

Version 1.0

Attention: Please read this manual carefully before using the Driver!

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DM430

Two-phase Digital Stepper Drive

1. Introduction, Features and Applications

Introduction

DM430 is the company's new digital stepping motor driver. It adopts the latest 32-bit ARM digital processing technology. The driver control algorithm uses advanced variable current technology and advanced frequency conversion technology. The driver has low heat generation, 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 of most occasions. Thanks to the built-in micro-segmentation technology, even in the case of low subdivision, high subdivision can be achieved, and the operation at low, medium and high speeds is smooth and the noise is extremely small. The parameter internal power-on auto-tuning function is integrated in the drive, which can automatically generate optimal operating parameters for different motors to maximize the performance of the motor.

Features

- New 32-bit ARM technology
- Ultra low vibration noise
- Built-in high segmentation
- Power-on auto-tuning function
- Variable current control greatly reduces motor heating
- The current is automatically halved at rest
- Can drive 4,6,8 line two-phase stepper motor
- Optically isolated differential signal input
- The impulse response frequency can be up to 500KHz (factory default 160KHz)
- Easy to set current, can choose between 0.1-3.0A
- The subdivision setting range is 200-51200
- Protection against overvoltage, undervoltage, overcurrent, etc.

Applications

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. It is especially effective in applications where users expect small noise and high speed.

2. Specifications

Electrical Specifications

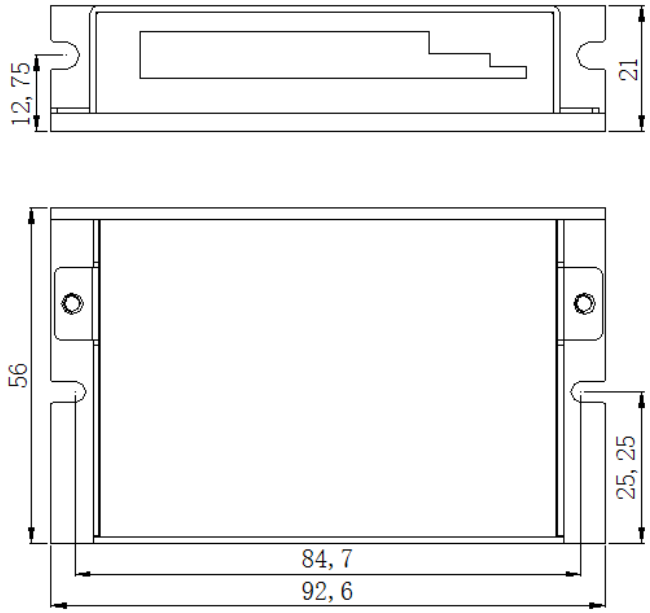
Parameters	DM430			
	Min	Typital	Max	Unit
Output current	0.1	-	3.0	A
Supply voltage	12	24	32	VDC
Logic signal current	6	10	16	mA

Logic interface level	4.5	5	28	Vdc
Signal min pulse width	1.5	-	-	us
Pulse input frequency	0	-	160	KHz
Isolation resistance	500			MΩ

Operating Environment and Parameters

Cooling method		Natural cooling or forced air cooling
Operating Environment	Environment	Avoid dust, oil fog and corrosive gases;
	Temperature	-5℃ ～ +50℃
	Humidity	40 ～ 90%RH
	Vibration	5.9m/s2MAX
Storage Temperature		-20℃～80℃
Operating altitude		Below 1000 meters
Weight		Approx. 90g

Mechanical Specifications



※It is recommended to use side mounting for better heat dissipation. When designing the mounting dimensions, pay attention to the terminal size and wiring!

Elimination of Heat

1）The reliable operating temperature of the drive is usually within 60 ° C, and the motor operating temperature is within 80 ° C;

2）It is recommended to use the automatic semi-flow mode when using the motor. When the motor stops, the current is automatically reduced by half to reduce the heat generated by the motor and the drive;

3）When installing the drive, please install it on the vertical side to make the heat dissipating teeth form a strong air convection; if necessary, install a fan near the drive to force heat dissipation to ensure the drive works within the reliable operating temperature range.

3. Pin Assignment and Description

Interface description

1）Control signal interface

Pin Function	Details
PUL+	Pulse signal: pulse rising edge is valid; PUL is 4.5~28Vdc at high level and 0~0.5V at low level. In order to respond reliably to pulse signals, the pulse width should be greater than 1.5 μs.
PUL-	
DIR+	Direction signal: High/low level signal. To ensure reliable commutation of the motor, the direction signal should be established before the pulse signal is at least 2 μs. The initial running direction of the motor is related to the wiring of the motor. Interchanging any phase winding (such as A+, A-exchange) can change thedirection of the initial running 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, when 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 free, and the stepping pulse will not be responded. When this function is not needed, the enable signal terminal can be left floating.
ENA-	

2）Strong electrical interface

Pin Function	Details
GND	DC power ground
+Vdc	DC power supply positive, power supply voltage range: DC 12~32Vdc, recommended 24Vdc operation.
A+、A-	Motor Phase A
B+、B-	Motor Phase B

3）232 communication USB interface

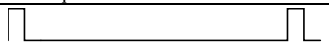
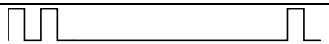
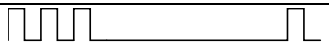
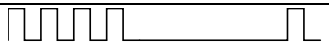
The PC or STU debugger can be connected through a dedicated UCB serial cable, and hot plugging and unplugging is prohibited. Through the STU or in the PC software ProTuner, the subdivision and current values, effective edges and single and double pulses required by the customer can be set, and the resonance point can be eliminated and adjusted.

Terminal number	Symbol	Pin Function	Details
1	+5V	5V power positive terminal	External STU only
2	TxD	RS232 sender	
3	RxD	RS232 receiver	
4	GND	5V power ground	0V
5	NC	RS232 receiver	

Note: The cable connecting the DM430 to the PC, text display or STU servo debugger must be a dedicated cable (supplied according to the user's condition). Please confirm before use to avoid damage.

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 a fault indicator. When a fault occurs, the indicator flashes in a cycle of 3 seconds. When the fault is cleared by the user, the red LED is always off. The number of flashes of the red LED in 3 seconds represents different fault information, as shown in the following table:

Priority	Time(s) of ON	Sequence wave of RED LED	Description
1	1		Over-current or Phase error protection
2	2		Over-voltage protection
3	3		No definition
4	4		No definition

Control signal interface circuit

The DM430 driver uses a differential interface circuit for differential signaling, single-ended common-cathode and single-ended common anode interfaces, and a built-in high-speed optocoupler that accepts signals from long-line drivers, open collectors, and PNP output circuits. In the harsh environment, we recommend long-line driver circuit, anti-interference ability. Now take the open collector and PNP output as an example. The interface circuit is as follows:

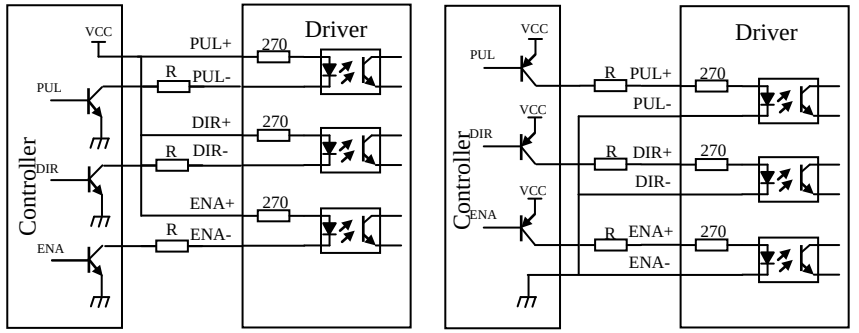


Figure 3 input interface circuit

Note: When the VCC value is 4.5~28Vdc, R is shorted or not connected;

Control signal timing diagram

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

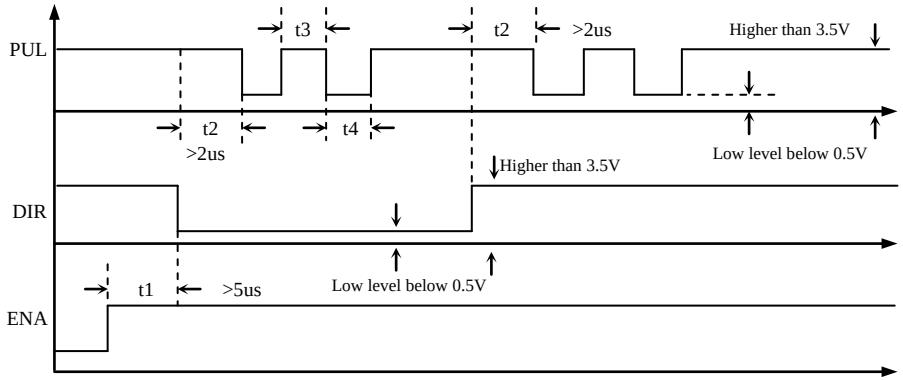


Figure 4 Control signal timing diagram

Comment:

1）t1: ENA (enable signal) should be DIR at least 5 μ s in advance 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 2 μs along the PUL falling edge.

3）t3: The pulse width is at least not less than 2 μs.

4）t4: The low level width is not less than 2μs.

Control signal mode setting

Pulse Trigger Edge and Single and Double Pulse Selection: The pulse rising edge or falling edge trigger is enabled by the PC software ProTuner software or STU debugger. It is also possible to set the single pulse mode or the double pulse mode. In dual pulse mode, the signal from the direction control must be held high or left floating.

Wiring requirements

1）In order to prevent the driver from being disturbed, it is recommended to use the shielded cable for the control signal, and the shield layer is shorted to the ground wire. Unless otherwise specified, the shielded cable of the control signal cable is grounded at one end: the upper end of the shielded cable is grounded at one end, and the shielded cable is driven. One end is suspended. Only the grounding at the same point is allowed in the same machine. If it is not a real grounding wire, the interference may be serious. At this time, the shielding layer is not connected.

2）The pulse and direction signal lines and the motor lines are not allowed to be bundled side by side, preferably separated by at least 10 cm. Otherwise, the motor noise easily interferes with the pulse direction signal, causing the motor to be inaccurately positioned, and the system is unstable.

3）If one power supply is used for multiple drives, parallel connections should be made at the power supply. It is not allowed to go to one chain and then to another chain.

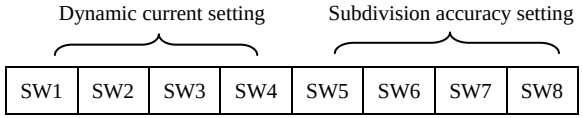
4）It is forbidden to plug and unplug the driver's strong P2 terminal. When the charged motor stops, there is still a large current flowing through the coil. Pulling the P2 terminal will cause a huge moment to induce the electromotive force to burn the driver.

5）It is forbidden to add the tin wire to the terminal after adding the tin wire. Otherwise, the terminal may be damaged due to overheating of the contact resistance.

6）The wiring heads should not be exposed outside the terminals to prevent accidental short circuits and damage the drive.

4. Current, subdivision DIP switch setting and parameter auto-tuning

The DM430 driver uses an eight-position dial switch to set subdivision accuracy, dynamic current, static half-flow, and auto-tuning of motor parameters and internal tuning parameters. Detailed description is as follows：



Current setting

1）Working (dynamic) current setting

RMS Current	SW1	SW2	SW3	SW4
0.1A	on	on	on	on
0.2A	off	on	on	on
0.3A	on	off	on	on
0.5A	off	off	on	on
0.6A	on	on	off	on
0.7A	off	on	off	on
0.8A	on	off	off	on
1.0A	off	off	off	on
1.2A	on	on	on	off
1.3A	off	on	on	off
1.5A	on	off	on	off
1.6A	off	off	on	off
1.7A	on	on	off	off
1.8A	off	on	off	off
2.0A	on	off	off	off
2.2A	off	off	off	off

2）Static current setting

The quiescent current can be automatically half-flowed by default.

Microstep setting

Steps/rev	SW5	SW6	SW7	SW8	Microstep description
Default[200]	on	on	on	on	When SW5, SW6, SW7, and SW8 are all on, the driver subdivision adopts the default internal subdivision number of the driver: the user sets the subdivision number through the PC software ProTuner or STU debugger, the minimum value is 1, the resolution is 1, The maximum value is 51200.
400	off	on	on	on	
800	on	off	on	on	
1600	off	off	on	on	
3200	on	on	off	on	
3600	off	on	off	on	
6400	on	off	off	on	
12800	off	off	off	on	
1000	on	on	on	off	
2000	off	on	on	off	
4000	on	off	on	off	
5000	off	off	on	off	
7200	on	on	off	off	
8000	off	on	off	off	
10000	on	off	off	off	
20000	off	off	off	off	

Parameter auto-tuning function

The driver can automatically complete the self-tuning of the motor parameters and internal adjustment parameters within 200ms after power-on; when the conditions such as the motor and power supply voltage change, please perform an auto-tuning. Otherwise, the motor may run abnormally. **Note that the pulse cannot be input at this time, and the direction signal should not change.**

5. Power Supply Selection

The power supply voltage can work normally between the specified ranges. The DM430 driver is preferably powered by an unregulated DC power supply, or a transformer buck + bridge rectifier + capacitor filter. Note, however, that the peak voltage ripple after rectification should not exceed its specified maximum voltage. It is recommended that the user supply power with a DC voltage lower than the maximum voltage to prevent the grid from fluctuating beyond the operating range of the driver voltage.

If using a regulated switching power supply, be aware that the output current range of the switching power supply must be set to maximum.

Please note：

1）When wiring, pay attention to the positive and negative poles of the power supply.

2）It is best to use an unregulated power supply;

3）When using an unregulated power supply, the power supply current output capability should be greater than 60% of the drive set current;

4）When using a 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 drives can share a single power supply, but the power supply should be large enough.

6. Motor matching

The DM430 can be used to drive 4-, 6- and 8-wire hybrid stepper motors with a step angle of 1.8 degrees and 0.9 degrees. When selecting a motor, it is mainly determined by the torque and rated current of the motor. The torque is mainly determined by the size of the motor. The large-sized motor has a large torque; the current is mainly related to the inductance, and the small-inductance motor has a high-speed performance, but the current is large.

Motor matching

1）Determine load torque, drive ratio operating speed range

$T_{motor}=C（J\varepsilon+T_{load}）$

J：Moment of inertia of the load　　ε：Maximum angular acceleration of the load

C：Safety factor, recommended value 1.2-1.4

T_{load}：Maximum load torque, including effective torque, friction, transmission efficiency and other resistance torque

2）What factors are determined by the motor output torque

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

- The larger the actual motor current, the greater the output torque, but the more copper loss (P=I2R) of the motor, the more heat the motor generates;
- The higher the supply voltage of the drive, the higher the high speed torque of the motor;
- It can be seen from the moment frequency characteristic diagram of the stepping motor that the high speed is smaller than the medium and low speed torque.

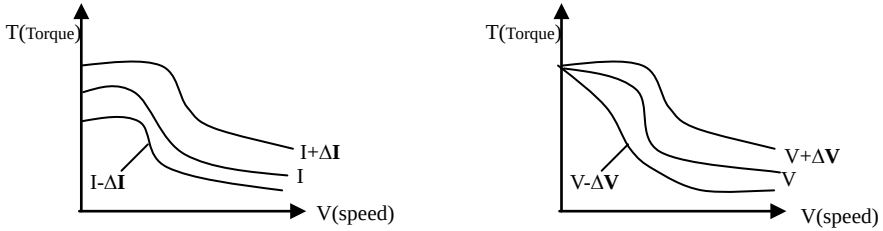


Figure 5　Moment frequency characteristic diagram

Motor wiring

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

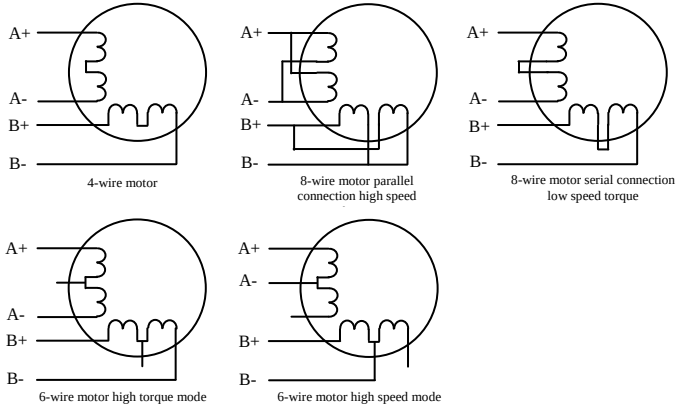


Figure 6　Motor wiring diagram

Input voltage and output current selection

1）Supply voltage setting

In general, the higher the supply voltage, the greater the torque at high motor speeds. The more you can avoid falling at high speeds. On the other hand, if the voltage is too high, it will cause overvoltage protection, and the motor will generate more heat and may even damage the driver. When operating at high voltages, the vibration of the motor at low speeds will be greater.

2）Output current setting

For the same motor, the larger the current setting value, the larger the motor output torque, but the heat of the motor and the driver is also more serious when the current is large. The specific heat generation is related not only to the current set value, but also to the type of exercise and the dwell time. The following setting method uses the rated current value of the stepping motor as a reference, but the optimum value in practical applications should be adjusted based on this. In principle, if the temperature is very low (<40 ° 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 smaller than the rated current of the motor;
- ●Six-wire motor high torque mode: the output current is set to 50% of the rated current of the motor unipolar connection;
- ●Six-wire motor high-speed mode: the output current is set to 100% of the rated current of the motor unipolar connection;
- ●Eight-wire motor series connection method: the output current can be set to 70% of the rated current of the motor unipolar connection;
- ●Eight-wire motor and connection method: The output current can be set to 140% of the rated current of the motor unipolar connection.

△Note: Please run the motor for 15-30 minutes after the current is set. If the motor temperature rise is too high (>70 °C), the current setting should be reduced. Therefore, it is generally the case that the current is set to a value that is warm but not hot when the motor is operated for a long period of time.

7. Typical wiring case

DM430 with TO42-08 series connection and connection method (if the motor steering is different from the desired steering, only the positions of A+ and A- can be exchanged), DM430 driver can drive two-phase/four-phase or four-phase two-phase/four-phase Motor. The following figure details the connection of 4-wire, 6-wire, 8-wire stepper motors：

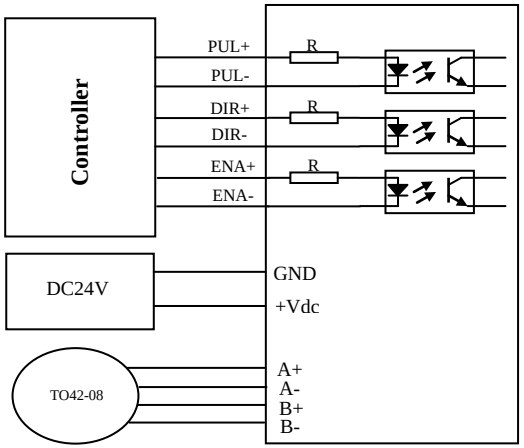


Figure 7　TD430S with TO42-08 typical connection

Note: 1）The colors of different motors are different. When using the motor data, the color of the 57 motor lines 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+, A- is one phase, B+, B- is another phase), 57HS22 motor lead definition, string, and connection method As shown below

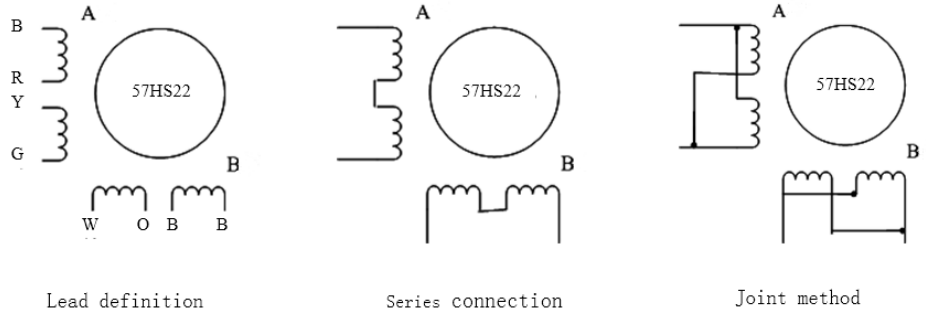


Figure 8　57 motor string and joint method

3）The DM430 drive can only drive two-phase hybrid stepper motors and cannot drive three-phase and five-phase stepper motors.

4）The method of judging whether the stepping motor is connected in series or in the correct connection method: directly rotate the shaft of the motor by hand without connecting the driver. If it can be easily and evenly rotated, the wiring is correct, if the resistance is large and uneven And accompanied by a certain voice to explain the wiring error.

8.Protective function

1） Short circuit protection

When a phase-to-phase short circuit occurs or an internal overcurrent occurs in the driver, the red light of the driver flashes once and blinks repeatedly within 3 seconds. At this point, the fault must be discharged and the power-on reset should be resumed.

2） Overvoltage protection

DM430 When the input voltage is higher than 38V, the red light of the driver flashes twice, and it flashes repeatedly within 3 seconds. At this point, the fault must be discharged and the power-on reset should be resumed.

3） Motor open circuit protection

4） When the motor is open or not connected, the drive driver flashes red 4 times and flashes repeatedly within 3 seconds. At this point, the fault must be discharged and the power-on reset should be resumed.

△ **Note**: Since the driver does not have the reverse polarity protection function of the power supply, please confirm the correct connection between the positive and negative terminals of the power supply before powering on. Reversing the positive and negative poles will cause the fuse in the drive to burn out!

9.Frequently Asked Questions

Common problems and treatments in the application

Phenomenon	Possible problem	Solution
The motor does not turn	Power light is not lit	Check the power supply circuit, normal power supply
	Powerful motor shaft	The pulse signal is weak and the signal current is increased to 7-16mA.
	Subdivision is too small	Selective subdivision
	Current setting is too small	Selective current
	Drive is protected	Power on again
	Enable signal is low	This signal is pulled high or left floating
	Does not respond to control signals	Not powered
Motor steering error	Motor line is wrong	Any two wires of the same phase of the exchange motor (for example, A+, A-exchange wiring positions)
	The motor line has an open circuit	Check and pick up
Alarm indicator is on	Motor line is wrong	Check wiring
	Voltage is too high or too low	Check the power supply
	Motor or drive damage	Replace the motor or drive
Inaccurate location	Signal interference	Eliminate interference
	The shield is not connected or not connected	Reliable grounding
	The motor line has an open circuit	Check and pick up
	Subdivision error	Selective subdivision
	Small current	Increase current
Stall when the motor accelerates	Acceleration time is too short	Accelerated acceleration time
	Motor torque is too small	Select a large torque motor
	Low voltage or too small current	Appropriately increase the voltage or current

Driver FAQ User Answer

1）What is a stepper motor and a stepper drive?

Stepper motor is a special motor specially designed for precise control of speed and position. Its rotation is operated step by step at a fixed angle (called "step angle"), so it is called stepper motor. Its characteristic is that there is no accumulated error, every pulse signal sent from the controller is received, and the motor runs at a fixed angle under the push of the driver, so it is widely used in various open loop control.

The stepping driver is a power amplifier that can operate the stepping motor. 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 precisely adjusted. Speed, the number of control pulses can be accurately positioned.The stepping driver is a power amplifier that can operate the stepping motor. 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 precisely adjusted. Speed, the number of control pulses can be accurately positioned.

2）What is the breakdown of the drive? What is the relationship between the speed of the stepper motor and the pulse frequency?

The stepper motor is determined by its own unique structure. The factory is marked with the "inherent step angle of the motor" (such as 0.9°/1.8°, which means that the angle of the half step work is 0.9° for each step, and 1.8° for the whole step.). However, in many precision control and occasions, the angle of the whole step is too large, affecting the control precision, and the vibration is too large. Therefore, it is required to complete the inherent step angle of a motor in many steps. This is called a subdivision drive and can realize this function. The electronic device is called a subdivision driver.

$$V=\frac{P*\theta e}{360*m}$$

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

θe：Inherent step angle of the motor m： Number of subdivisions (1 for the whole step and 2 for the half step)

3）What are the advantages of subdividing drives?

- By reducing the step angle that each step has passed, the step uniformity is improved, so that the control accuracy can be improved.
- Motor vibration can be greatly reduced, low frequency oscillation is an inherent characteristic of stepper motor, and subdivision is the best way to eliminate it.
- It can effectively reduce torque ripple and increase output torque.

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

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

- The direction signal may be too weak or the wiring polarity is wrong.
- The pulse mode does not match, the signal is pulse/direction, the driver must be set to this mode; if the signal is CW/CCW (double pulse mode), the driver must also be in 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 on raw materials and process defects for its products from the date of shipment. During the warranty period, the company provides free repair services for defective products.

2 Not covered by the warranty

- Improper wiring, such as positive and negative poles of the power supply and live plugging
- Unauthorized changes to internal devices
- Exceeding electrical and environmental requirements
- Environmental heat dissipation is too bad

3 Maintenance process

If you need to repair the product, it will be processed as follows：

1）You need to call the company's customer service personnel to obtain the return permit number before shipment.

2）The written instructions accompanying the goods indicate the fault phenomenon of the repaired drive; the voltage, current and environment of use when the fault occurs; the name, telephone number and mailing address of the contact person.

4 Warranty limit

- The warranty for the company's products is limited to the device and process (ie, consistency) of the product.
- The company does not guarantee that its products will be suitable for the specific use of the customer, as it is also suitable for the technical requirements and conditions of use and the environment.

DM430 digital two-phase stepper drive instruction manual