DM430

Digital two-phase step driver

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[Please read this manual carefully before use to avoid damage to the bad drive]

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1. Product introduction

1.1 Overview

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.

1.2 Characteristics

●new 32-bit ARM technology
●ultra low vibration noise
●built-in high segmentation
● parameter 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 reach 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.

1.3 Application field

Be 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. Electrical, mechanical and environmental indicators

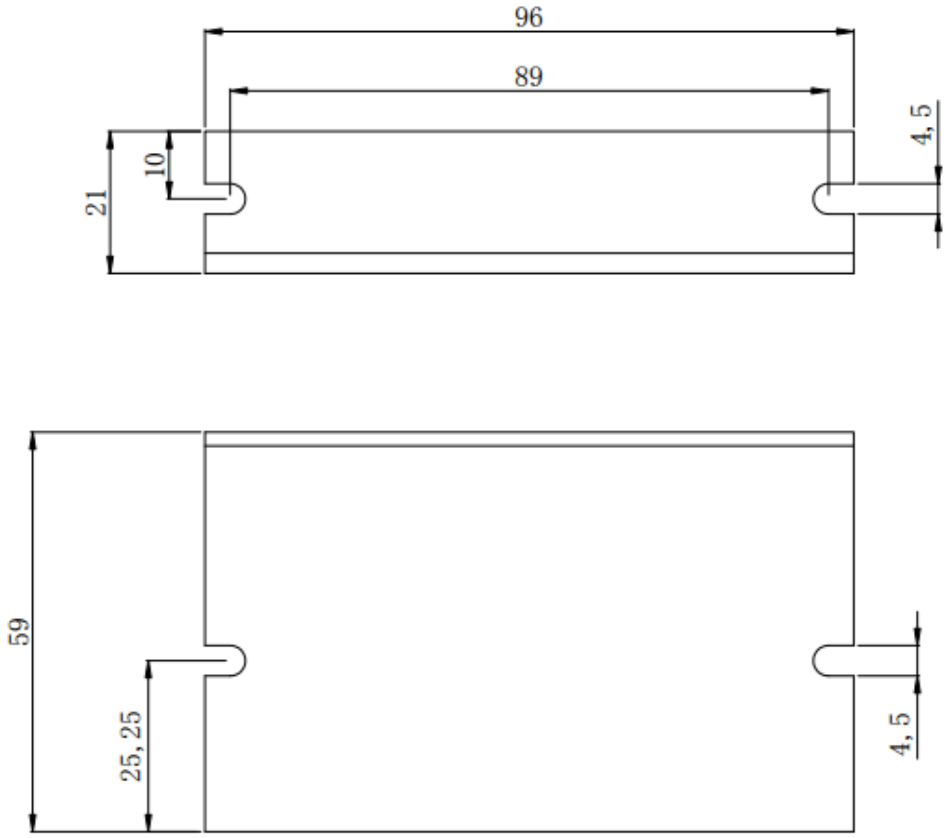
2.1. Electrical index

Description	DM430			
	Minimum value	Typical value	Maximum value	Unit
Output current	0.1	-	3.0	A
Input supply voltage	12	24	32	VDC
Control signal input current	6	10	16	mA
Control signal interface level	4.5	5	28	Vdc
Input signal minimum pulse width	1.5	-	-	us
Step pulse frequency	0	-	160	KHz
Insulation resistance	500			MΩ

2. 2. Use environment and parameters

cooling method		Natural cooling or forced air cooling
Use environment	occasion	Can not be placed next to other heat-generating equipment, to avoid dust, oil mist, corrosive gas, humidity and strong vibration, prohibiting flammable gas and conductive dust;
	temperature	-5℃ ～ +50℃
	humidity	40 ～ 90%RH
	vibration	5.9m/s2MAX
Storage temperature		-20℃～80℃
Use altitude		Below 1000 meters
Weight		About 90 g

2. 3 Mechanical installation diagram



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

2.4. Strengthen heat dissipation

1) The reliable operating temperature of the driver 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 of the motor and the drive;
3) When installing the driver, 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 driver to force heat dissipation to ensure the driver works within the reliable working temperature range.

3. Drive interface and wiring introduction

3.1 Interface description

1) Control signal interface

name	Features
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, in order to ensure reliable commutation of the motor, the direction signal should be established before the pulse signal is at least 2μs. 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 the direction of initial operation 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 turned 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 is left floating.
ENA-	

2）Power interface

name	Features
GND	DC power ground
+Vdc	DC power supply positive, power supply voltage range: DC 12~32Vdc, recommended 24Vdc operation.
A+、A-	Motor A phase coil interface.
B+、B-	Motor B phase coil interface.

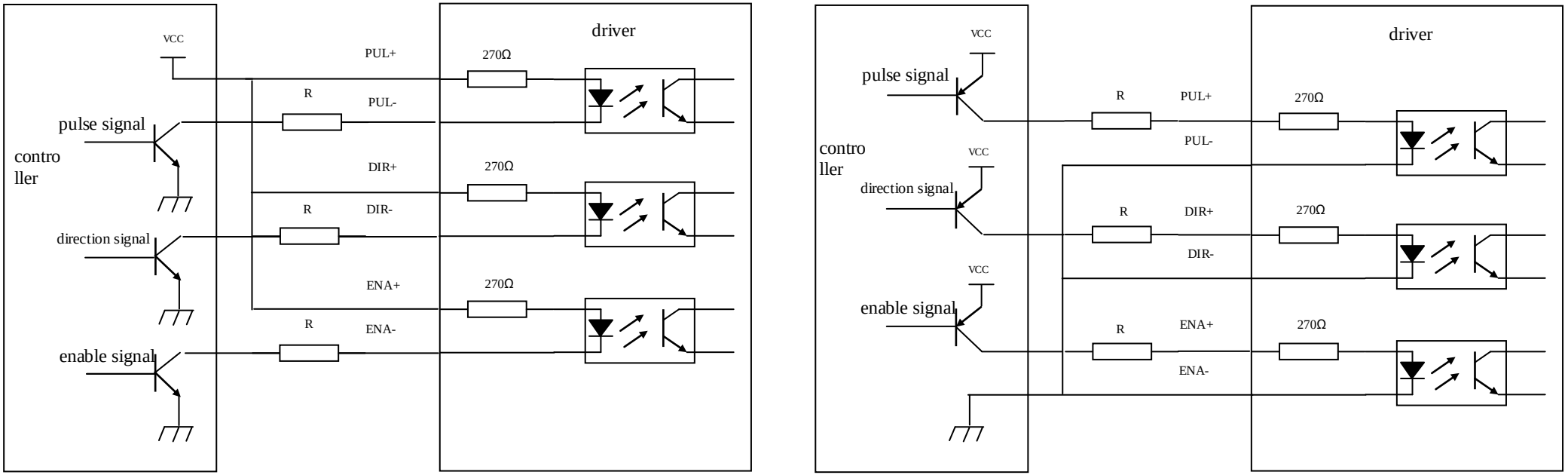
3) Status indication

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:

Serial number	Number of flashes	Red LED flashing waveform	Fault description
1	1		Overcurrent or phase-to-phase short circuit fault
2	2		Overvoltage fault
3	3		No definition
4	4		No definition

3.2. 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:

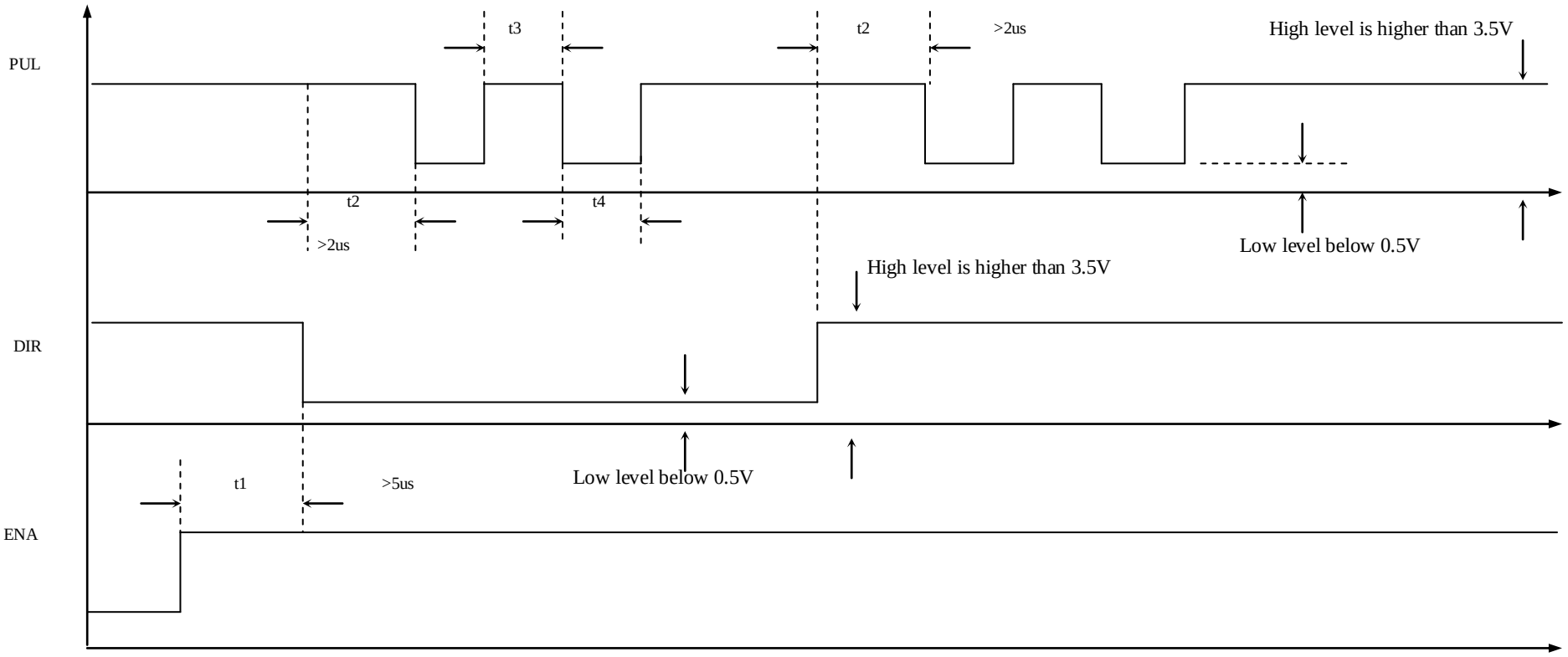


picture 3 Input interface circuit

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

3.3. 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:



picture 4 control signal timing diagram

Note：

1）t1：The ENA (enable signal) should be determined to be high by a DIR of at least 5 μs in advance. In general, it is recommended that ENA+ and ENA- be left floating.

2）t2：The DIR determines its state to be high or low at least 2 μs along the PUL fall.

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

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

3.4 Control signal mode setting

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

3.5 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. 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 is likely to interfere with the pulse direction signal, causing the motor to be inaccurately positioned, and the system is unstable.

3）If a 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.

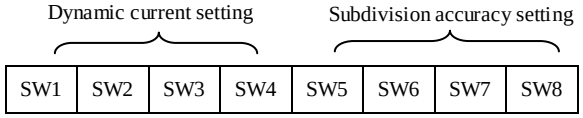
4）It is forbidden to plug and unplug the driver's strong P2 terminal. When the charged motor stops, there is still a large current flowing through the coil. Pulling the P2 terminal will cause a huge moment to induce the electromotive force to burn the driver.

5）It is forbidden to add the tin 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 the subdivision accuracy, dynamic current, static half-flow, and auto-tuning of motor parameters and internal tuning parameters. The detailed description is as follows:



4.1. Current setting

1) Working (dynamic) current setting

Output 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 (static) current setting

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

4.2. Subdivision setting

Steps / rpm	SW5	SW6	SW7	SW8
Default[200]	on	on	on	on
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

Speed setting in IO mode

Rpm/min	SW5	SW6	SW7	SW8
Default[40]	on	on	on	on
50	off	on	on	on
60	on	off	on	on
70	off	off	on	on
80	on	on	off	on
90	off	on	off	on
100	on	off	off	on
150	off	off	off	on
200	on	on	on	off
250	off	on	on	off
350	on	off	on	off
450	off	off	on	off
550	on	on	off	off
650	off	on	off	off
750	on	off	off	off
850	off	off	off	off

4.3. 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 a self-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) 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 matching

The DM430 can be used to drive 4, 6 and 8 wire two-phase, four-phase hybrid stepping 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 high-speed performance, but the current is large.

6.1. Motor matching

1）Determine load torque, drive ratio operating speed range

T motor = C (Jε + T load)

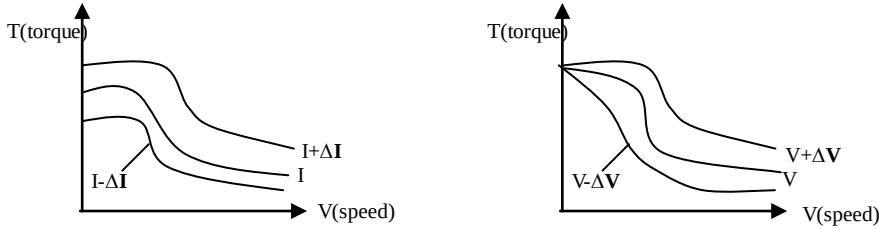
J: Moment of inertia of the load ε: Maximum angular acceleration of the load C: Safety factor, recommended value 1.2-1.4

T load: maximum load torque, including effective load, 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:

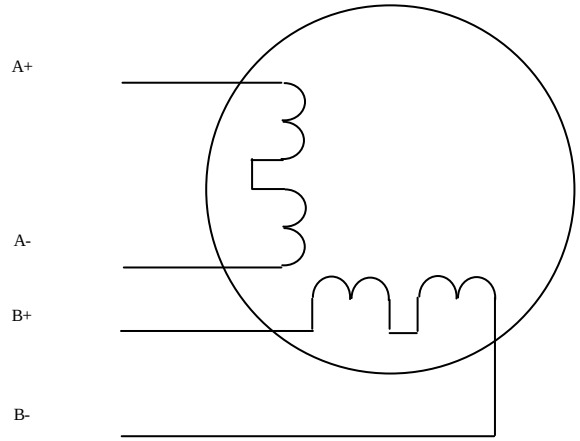
- The larger the actual motor current, the greater the output torque, but the more copper loss (P=I2R) of the motor, the more heat the motor generates;
- The higher the power supply voltage of the driver, the higher the high-speed torque of the motor;
- It can be seen from the moment frequency characteristic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



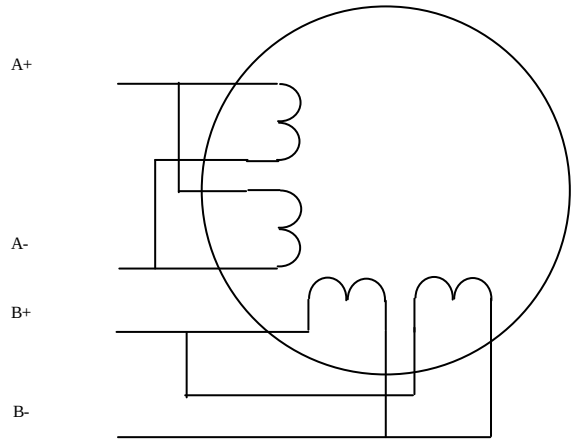
picture 5 moment frequency characteristic diagram

6.2 Motor wiring

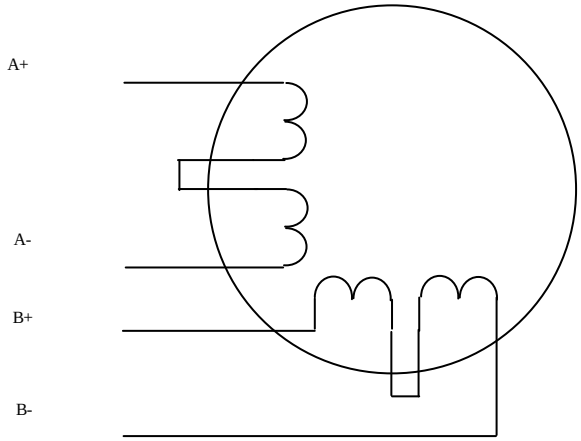
For 6- and 8-wire stepper motors, the performance of the connected motors of different coils is quite different, as shown in the following figure:



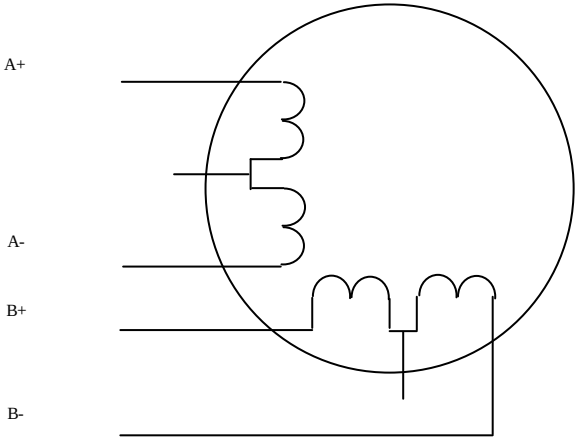
4-wire motor



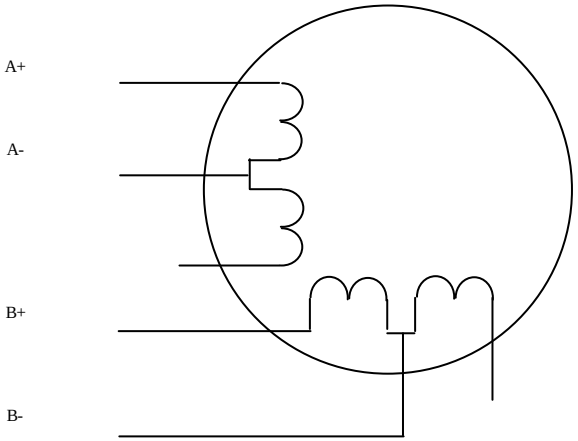
8-wire motor parallel connection
High speed performance



8-wire motor serial connection
Low speed torque



6-wire motor high torque mode



6-wire motor high speed mode

picture 6 Motor wiring diagram

6.3 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 when you are at high speed. 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) Set value of output current

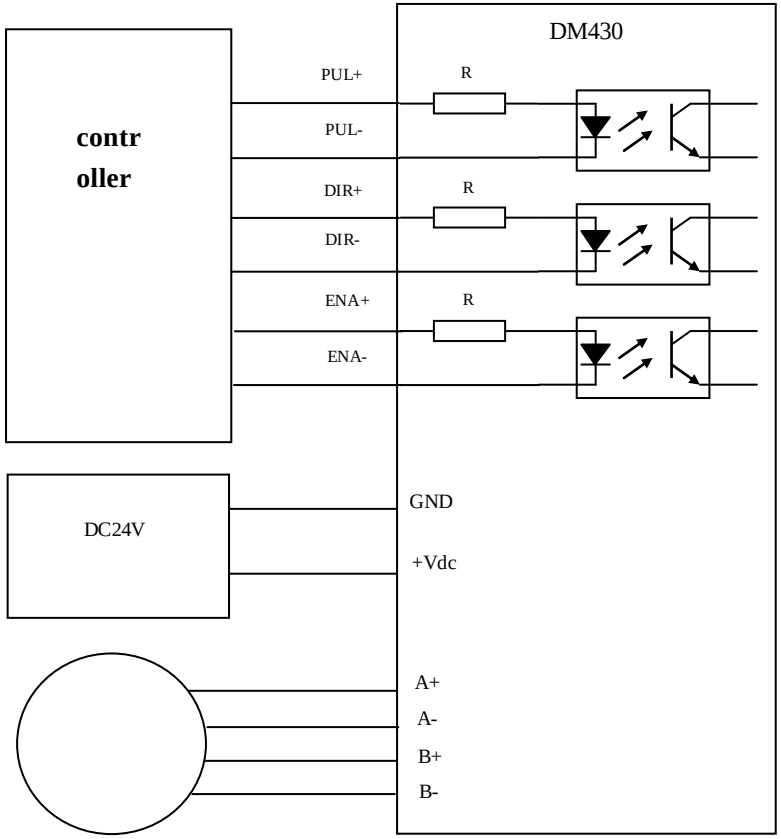
For the same motor, the larger the current setting value, the larger the motor output torque, but the heat of the motor and the driver is also more serious when the current is large. The magnitude of the specific heat generation is not only related to the current set value, but also to the type of exercise 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 ℃), 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 ℃), 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, and connection method (if the motor steering is different from the desired steering, only the position of A+, A- can be exchanged), DM430 driver can drive four-phase, six-wire or eight-wire two-phase / four-phase Motor. The following figure details the connection of 4-wire, 6-wire, 8-wire stepper motors:

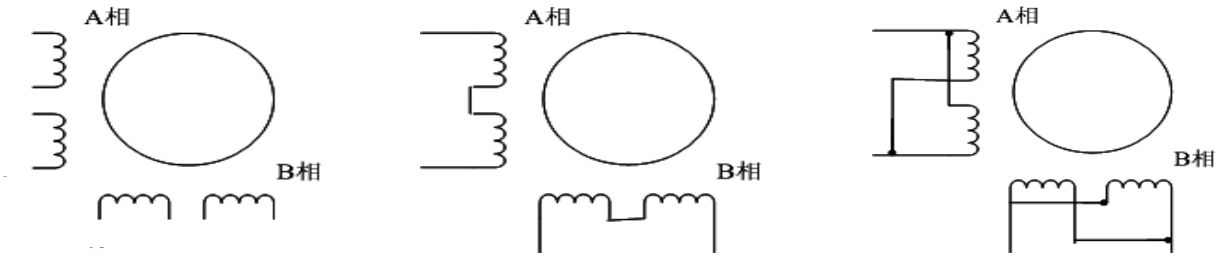


picture 7 DM430 typical connection

note：

1）Different motors have different colors. When using the motor data, the color of the 57 motor line 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), and the motor lead definition, string, and connection method are as shown in the following figure. Show.



（a）Lead definition (b) series connection (c) joint method

picture 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 an interphase 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

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 drive 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. common problem

9.1 Common problems and treatment methods 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
	Motor shaft is powerful	The pulse signal is weak and the signal current is increased to 7-16mA.
	Subdivision is too small	Selective segmentation
	Current setting is too small or not	Selective current
	Drive is protected	Power on again
	Enable signal is low	This signal is pulled high or not
	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 well	Reliable grounding
	The motor line has an open circuit	Check and pick up
	Subdivision error	Set the 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

9.2 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 drive 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.

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：Subdivision number (1 for the whole step and 2 for the half step)

3) What are the advantages of subdividing drivers?

●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.