User’s Manual

For

DM542

Fully Digital Stepper Drive

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

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DM542

Digital two-phase stepper driver

一、 Introduction

1. Overview

DM542 is the new digital stepping motor driver of our company. It adopts the latest 32-bit DSP 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. With 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.

2. Features

- New 32-bit DSP technology
- Ultra low vibration noise
- Built-in high subdivision
- Parameter power-on auto-tuning function
- Variable current control makes the motor heat greatly reduced
- The current is automatically halved at rest

- 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)
- The current setting is convenient, and can be arbitrarily selected between 0.1-4.2A.
- The subdivision setting range is 200-51200
- With overvoltage, undervoltage, overcurrent protection

3. Application field

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.

二、Electrical, mechanical and environmental indicators

1. Electrical index

Description	DM542			
	Min	Typical	Max	Unit
Output current	0.1	-	4.2	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
Input signal minimum pulse width	1.5	-	-	us
Step pulse frequency	0	-	200	KHz
Insulation resistance	100			MΩ

2. Operating Environment and other Specifications

Cooling		Natural Cooling or Forced cooling
Operating nvironment	Environment	Avoid dust, oil fog and corrosive gases
	Ambient Temperature	-5℃ ～ +50℃
	Humidity	40 ～ 90%RH
	Vibration	5.9m/s2MAX
Storage Temperature		-20℃～80℃
weight		about 300 g

3. Mechanical Specifications (unit: mm [inch])

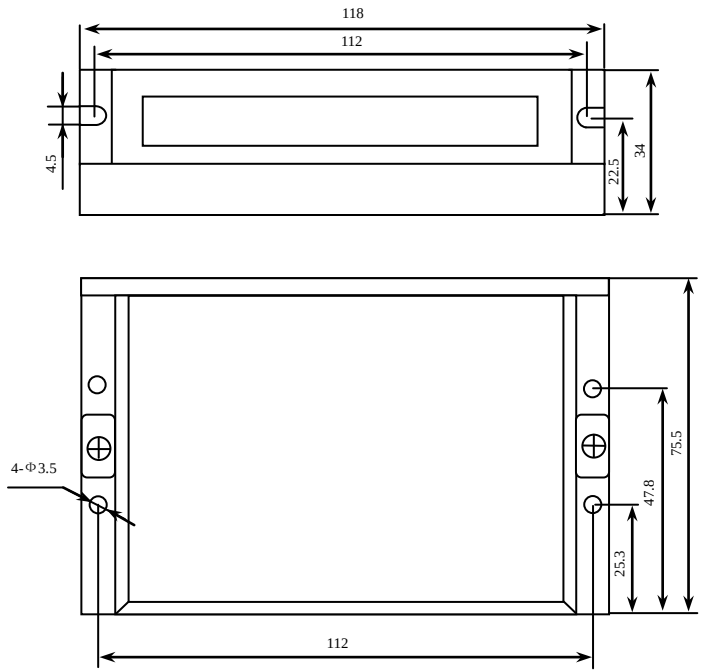


Figure 1: Mechanical specifications

***Recommend use side mounting for better heat dissipation**

4. Elimination of Heat

1）Driver’s reliable working temperature should be <70℃(158℉), and motor working temperature should be <80℃(176℉);

2）It is recommended to use automatic idle-current mode, namely current automatically reduce to 50% when motor stops, so as to reduce driver heating and motor heating;

3）It is recommended to mount the driver vertically to maximize heat sink area. Use forced cooling method to cool the system if necessary.

三、Pin Assignment and Description

1. Pin Assignment

1）Control signal interface

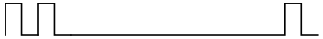
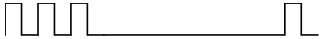
Name	function
PUL+	Pulse signal: pulse rising edge is valid; PUL is 4.5~28Vdc at high level and 0~0.5V at low level. In order to respond reliably to pulse signals, the pulse width should be greater than 1.5μs。
PUL-	
DIR+	Direction signal: High/low level signal. To ensure reliable commutation of the motor, the direction signal should be established before the pulse signal is at least 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 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）Connector Configurations

Name	function
GND	Power supply, 20~50 VDC, Including voltage fluctuation and EMF voltage.
+Vdc	Power Ground.
A+、A-	Motor Phase A
B+、B-	Motor Phase B

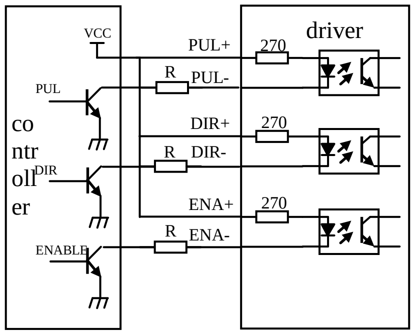
3） Status indication

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:

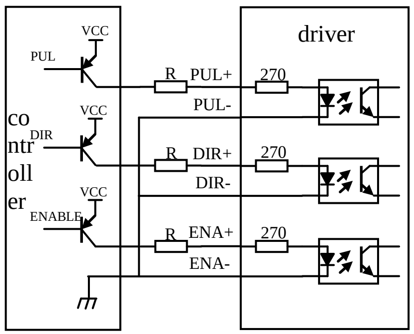
NO.	number of flashes	Red LED flashing waveform	Fault description
1	1		Overcurrent or phase-to-phase short circuit fault
2	2		Overvoltage fault
3	3		No definition
4	4		Open motor or poor contact failure

2. Control Signal Connector Interface

The DM542 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:



Connections to open-collector signal (common-anode)



Connection to PNP signal (common-cathode)

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

3. Sequence Chart of Control Signals

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In order to avoid some fault operations and deviations, PUL, DIR and ENA should abide by some rules, shown as following diagram:

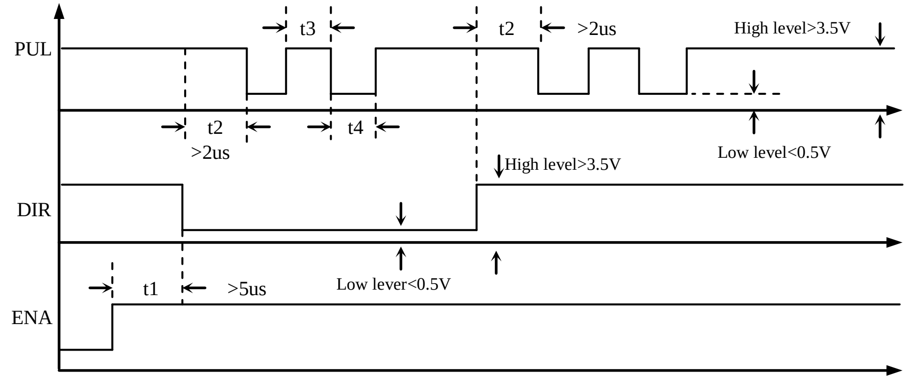


Figure 4 control signal timing diagram

Remark:

a) t1: ENA must be ahead of DIR by at least 5□s. Usually, ENA+ and are NC (not connected). See "Connector P1 Configurations" for more information.

2）b)t2: DIR must be ahead of PUL effective edge by 2□s to ensure correct direction;

3）c t3: Pulse width not less than 2□s;

4）d)t4: Low level width not less than 2□s.

4. 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.

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 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.

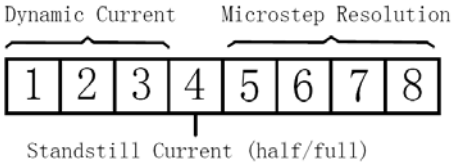
4）It is forbidden to plug and unplug the driver's strong P2 terminal. When the charged motor stops, there is still a large current flowing through the coil. Pulling the P2 terminal will cause a huge moment to induce the electromotive force to burn the driver.

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.

四、Current, subdivision DIP switch setting and parameter auto-tuning

The DM542 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. The detailed description is as follows:



1．Current Setting

1）Dynamic Current Setting

Peak Current	RMS Current	SW1	SW2	SW3
Default[1.0A,PK]		on	on	on
1.46A	1.04A	off	on	on
1.91A	1.36A	on	off	on
2.37A	1.69A	off	off	on
2.84A	2.03A	on	on	off
3.31A	2.36A	off	on	off
3.76A	2.69A	on	off	off
5.00A	3.50A	off	off	off

When SW1, SW2, and SW3 are set to off off, the required current can be set by PC software, the maximum value is 4.2A, and the resolution is 0.1A. If not set, the default current is 1.0A

2） Standstill Current Setting

SW4 is used for this purpose. OFF meaning that the standstill current is set to be half of the selected dynamic current, and ON meaning that standstill current is set to be the same as the selected dynamic current.

The current automatically reduced to 50% of the selected dynamic current one second after the last pulse. Theoretically, this will reduce motor heating to 36% (due to P=I2*R) of the original value. If the application needs a different standstill current, please contact Leadshine.

2. Microstep Resolution Selection

Steps/rev.	SW5	SW6	SW7	SW8
Default	on	on	on	on
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

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.

3. Parameter auto-tuning function

When the driver is open-loop stepping drive, each parameter of the motor can be automatically recognized once at each power-on, and the driver can automatically complete the self-tuning of the motor parameters and internal adjustment parameters; when the conditions of the motor and power supply voltage change Please restart the auto-tuning once again, otherwise the motor may not operate optimally. Note that the pulse cannot be input at this time, the direction signal should not change, and the enable signal cannot be accessed.

五、Power supply selection

The power supply voltage can work normally between the specified ranges. The DM542 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.

六、Motor matching

The DM542 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 a high-speed performance, but the current is large.

1. Motor

1）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 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.

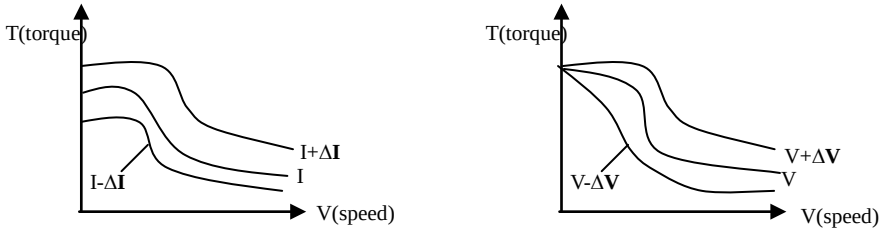
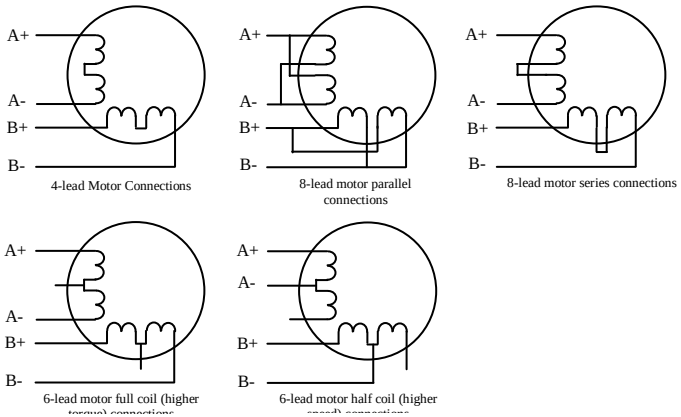


Figure 5 moment frequency characteristic diagram

2. Connecting the Motor

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:

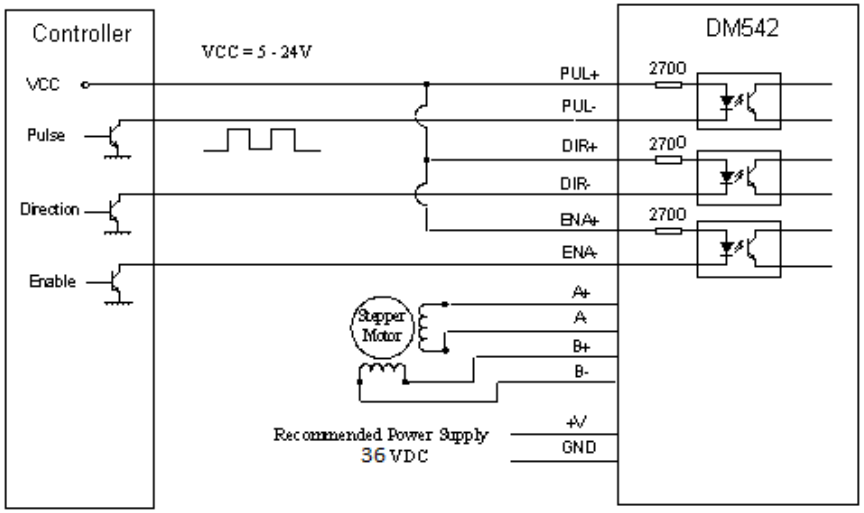


Connecting the Motor

3. Typical Connection

1） Typical Connection

A complete stepping system should include stepping motor, stepping driver, power supply and controller (pulse generator). A typical connection is shown



Typical connection

八、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

DM542 When the input voltage is higher than 60V, 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**