

# User's Manual

For

# DM860N

## Digital Microstep Drive

Version 1.1

Designed by STEPPERONLINE®

Manufactured by NC-THCH®

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

## Table of Contents

1. Products Introductions.....	2
1.1 Instructions & Features.....	2
1.2 Features.....	2
1.3 Safety Instructions.....	2
1.4 Applications.....	2
2. Specifications.....	3
2.1 Electrical Specifications.....	3
2.2 Operating Environment and other Specifications.....	3
2.3 Mechanical Specifications (Unit: mm) .....	4
3. Driver Wirings Description.....	4
3.1 Control Signal Wirings Description.....	4
3.2 Motor Wirings Description.....	5
3.3 Input Signals Description.....	5
3.4 Timing Diagram of Control Signals.....	6
3.5 Wiring Requirements.....	7
4. DIP Switch Setting.....	7
4.1 Operating Current Setting.....	7
4.2 Standstill Current Setting.....	8
4.3 Microstep Resolution Setting.....	8
5. Power Supply Selection.....	8
5.1 Power Supply Precautions.....	8
5.2 Power Supply Recommend.....	9
6. Motor selection.....	9
6.1 Motor matching.....	9
6.2 Motor connection.....	10
6.3 Input voltage and output current selection.....	10
7. Frequently Asked Questions.....	11

## 1 Product Instructions

### 1.1 Instructions

The DM860N is a fully digital stepper driver developed with advanced DSP control algorithm based on the latest motion control technology. It is especially effective in devices where users expect low cost, low noise, and high speed. Its motor auto-identification and parameter auto-configuration feature offers quick setup to optimal modes with different motors. Its unique features make DM860N an ideal choice for high requirement applications.

### 1.2 Features

The driver of DM860N features as bellow:

- Wide control signal voltage range, from +5V to 24V. Can be used directly without any external circuit
- Average current control, two-phase sinusoidal current output
- The servo microstep DSP algorithm, low noise, low vibration
- The max. power supply voltage can be 80VAC/110VDC
- Output peak current from 2.6A to 7.2A
- The standstill current can be set to half
- Can drive 4, 6 and 8 wire two-phase, four-phase stepper motors
- High-speed optocoupler isolation signal input, pulse response frequency up to 200 kHz
- Strong anti-high frequency interference ability
- Easy to set output current
- Microstep accuracy: 2, 4, 8, 16, 32, 64, 128, 5, 10, 20, 25, 40, 50, 100, 125
- Overvoltage, undervoltage, overcurrent, and phase-to-phase short circuit protection

### 1.3 Safety Instructions

- The product is powered by AC/DC power supply, please confirm that the power supply voltage is within the allowable range.
- Do not plug or unplug the cable when power on.
- This product is not sealed, do not mix conductive foreign matter or flammable materials inside. Pay attention to moisture-proof.
- Keep the operating environment cool and ventilated when in use.
- Connect to the stepper motor, adjust the current, work continuously for half an hour and observe if the temperature is in the rated range. If the motor temperature is too high, please contact the us.

### 1.4 Applications

Suitable for a variety of medium-sized automation equipment and instruments, such as: engraving

machine, marking machine, cutting machine, laser phototypesetting, plotter, CNC machine tool, pick and place device. It is especially effective in devices where users expect low cost, low noise, and high speed.

## 2. Specifications

### 2.1 Electrical Specifications

Instruction	DM556N			
	Minimum	Typical	Maximum	Unit
Output Current	2.6	-	7.2 (Peak)	Amps
Input Voltage	24	80~100	110 (contain the ripple)	VDC
	18	60~75	80(contain the ripple)	VAC
Control Signal Voltage	5	-	26(contain the ripple)	VDC
Control Signal Current	7	10	16	mA
Signal Pulse Frequency	0	-	200	KHZ
Insulation Resistance	500			MΩ

### 2.2 Operating Environment and other Specifications

Cooling		Natural Cooling
Operating Environment	Environment	Dustproof, anti-oil fog and corrosive gases
	Ambient Temperature	0 °C – +50 °C
	Max. Operating Temperature	70 °C
	Humidity	40-90% RH (No condensation or water drop)
	Vibration	10 – 55 Hz / 0.15 mm
Storage Temperature	-20°C – 125°C	
Weight	Approx. 500g (17.64 oz)	

**2.3 Mechanical Specifications (Unit: mm)**

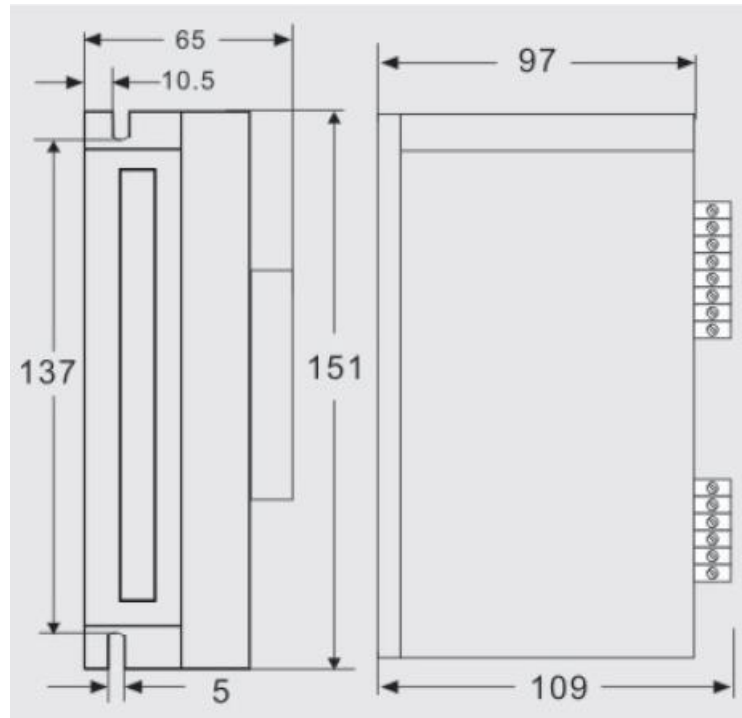


Figure 1: Mechanical specifications

*Note: Side mounting is recommended for better heat dissipation*

**3. Driver Wirings Description**

**3.1 Control Signal Wirings Description**

Pin Name	Descriptions
PUL(+5~24V)	Pulse control signal, falling edge is valid. For reliable response, the pulse width should be greater than 2.5μs. PUL voltage range is +5V~+24V.
PUL-(PUL)	
DIR(+5~24V)	This signal can modify the motor direction. In order to ensure the reliability of the motor, the DIR signal should be established at least 5μs ahead of the PUL signal. The initial running direction of the motor is related to the wiring sequence of the motor. DIR voltage range is +5V~+24V.
DIR-(DIR)	
ENA(+5~24V)	The ENA signal is used to enable/disable. When ENA is OFF, the driver is enabled; When ON, the driver is disable. Usually, the wirings are idle and the motor is enabled. ENA voltage range is +5V~+24V.
ENA-(ENA)	

### 3.2 Motor Wirings Description

Pin Name	Descriptions
AC	Power input, AC and DC universal. VAC: 18~80 V; VDC: 24~110 V
AC	
A+	Motor phase A wirings. Interchange A+, A-, can change the running direction of the motor once
A-	
B+	Motor phase B wirings. Interchange B+, B-, can change the running direction of the motor once
B-	

### 3.3 Input Signals Description

DM860N has high-speed optocoupler inside that allows reception of long-line controller signal, open collector signal, and PNP-type output signal. In the harsh environment, we recommend using a long-line controller circuit to make the anti-interference ability strong. Taking the open collector and PNP-type output as an example, and the connection circuit is as follows:

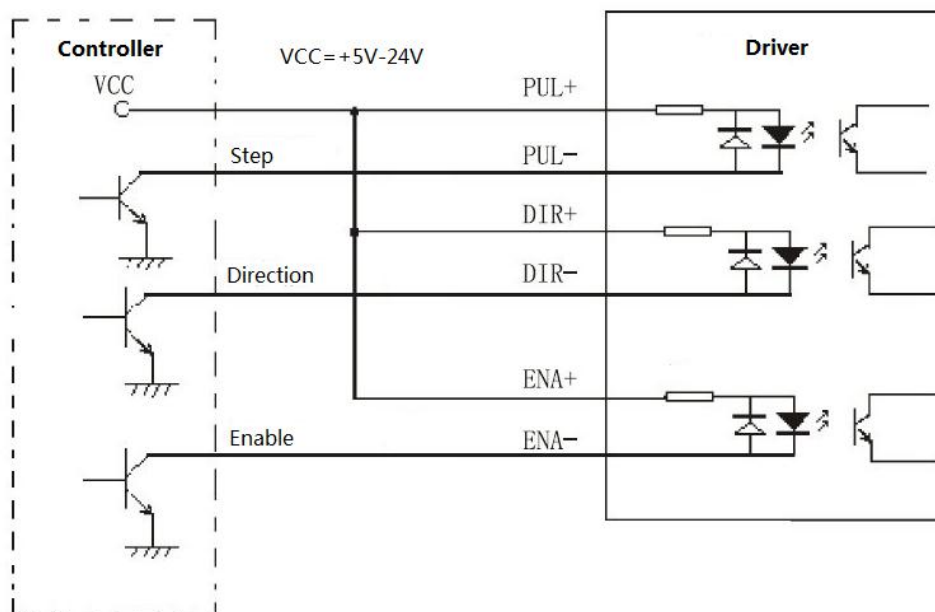


Figure 2: Connection to open-collector signal (common-anode)

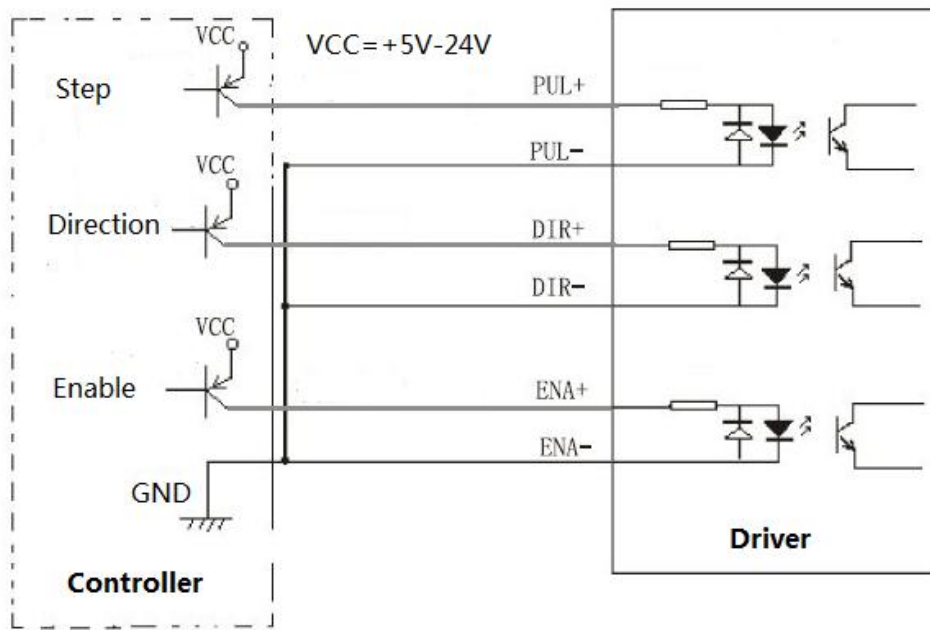


Figure 3: Connection to PNP-type signal(common-cathode)

### 3.4 Timing Diagram of Control Signals

In order to avoid some malfunctions and deviations, PUL, DIR and ENA signals should observe some rules, as following figure show.

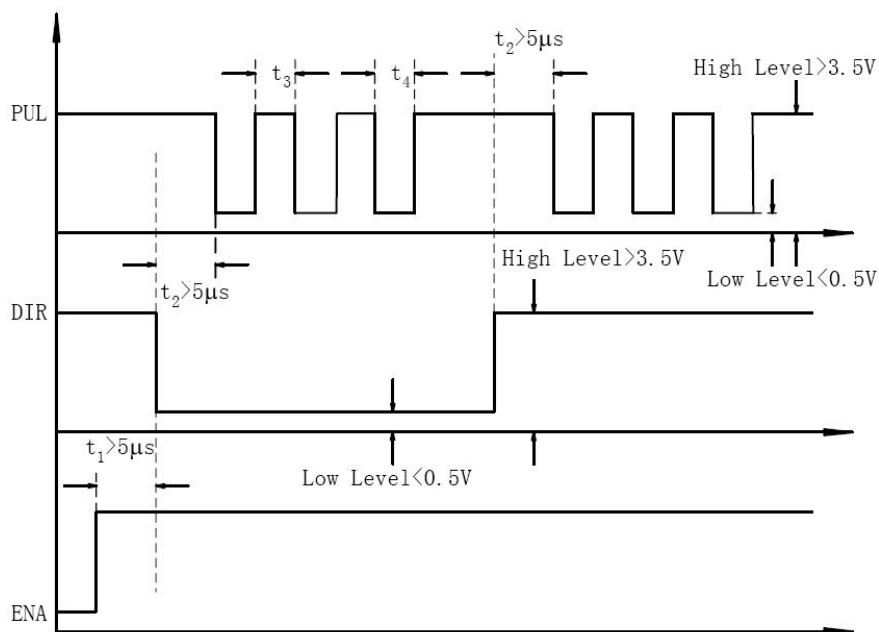


Figure 4: Timing diagram of control signals

**Remark:**

- (1).  $t_1$ : ENA signal must be ahead of DIR signal by at least  $5\mu s$ . Usually, ENA+ and ENA- should be suspended.
- (2).  $t_2$ : DIR signal must be ahead of PUL signal falling edge by  $5\mu s$  to ensure correct direction.
- (3).  $t_3$ : Pulse width is not less than  $2.5\mu s$ .

(4). t4: Low level width is not less than 2.5μs.

### 3.5 Wiring Requirements

- (1). In order to prevent the driver from being disturbed, it is recommended to use a twisted-pair shielded cable and the shield layer grounded (single-ended ground). Make sure the connection is true ground, otherwise the interference may be more serious.
- (2). The control signal lines and the motor lines are not allowed to be side by side, preferably separated by at least 10 cm. Otherwise, the motor electromagnetic noise easily interfere with the control signal, causing the motor to be inaccurately positioned and the system is unstable.
- (3). If one power supply is used for multiple drivers, parallel mode should be used at the power supply, and it is not allowed to connect to another driver at the driver's pin.
- (4). It is strictly forbidden to plug and unplug the driver motor line terminal. When the energized motor stops, there is still a large current flowing through the coil. Pulling out the motor line terminal will cause a huge instantaneous induced electromotive force to burn the driver.
- (5). It is strictly forbidden to add tin to the wire lead and then connect the terminal. Otherwise, the terminal may be damaged due to the contact resistance becoming large and overheating.

## 4. DIP Switch Setting

The DM860N driver uses a 8-bit DIP switch to set operating current, standstill current, and microstep resolution. The detailed description is as follows:

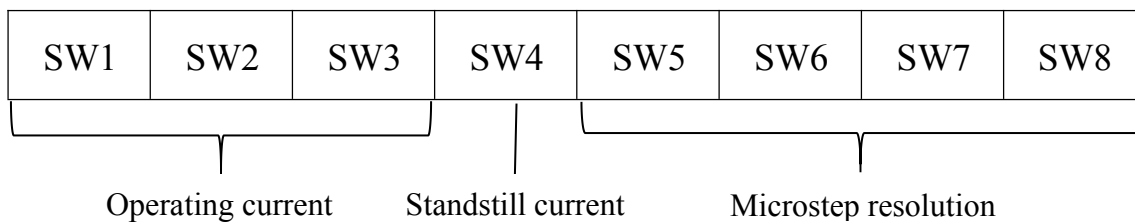


Figure 5: DIP switch setting

### 4.1 Operating Current Setting

The first three bits (SW1, SW2, SW3) of the DIP switches are used to set the operating current of the motor. Select the setting that is closest value to the motor as required current.

Peak Current	RMS Current	SW1	SW2	SW3
2.6A	1.9A	ON	ON	ON
3.2A	2.3A	OFF	ON	ON
3.8A	2.7A	ON	OFF	ON
4.4A	3.1A	OFF	OFF	ON
5.1A	3.6A	ON	ON	OFF
5.8A	4.1A	OFF	ON	OFF
6.5A	4.6A	ON	OFF	OFF
7.2A	5.2A	OFF	OFF	OFF



## 4.2 Standstill Current Setting

The standstill current can be set with the SW4, OFF means the standstill current is set to about half of the dynamic current (60%), and ON means the standstill current is the same as the operating current. In general, SW4 should be set to OFF, so that the heat generated by the motor and the driver is reduced, and the reliability is improved. After the pulse train stops for about 0.2 seconds, the current is automatically reduced to 60% of the set value, and the heat output is theoretically reduced to 36% (heat generation is proportional to the square of the current). When set to OFF, the motor's start response will be faster.

## 4.3 Microstep Resolution Setting

Microstep resolution is set by SW5-SW8 of the DIP switches as shown in the following table (the table is use for 1.8° motor):

Microstep	Pulses/rev.	SW5	SW6	SW7	SW8
2	400	OFF	ON	ON	ON
4	800	ON	OFF	ON	ON
8	1600	OFF	OFF	ON	ON
16	3200	ON	ON	OFF	ON
32	6400	OFF	ON	OFF	ON
64	12800	ON	OFF	OFF	ON
128	25600	OFF	OFF	OFF	ON
5	1000	ON	ON	ON	OFF
10	2000	OFF	ON	ON	OFF
20	4000	ON	OFF	ON	OFF
25	5000	OFF	OFF	ON	OFF
40	8000	ON	ON	OFF	OFF
50	10000	OFF	ON	OFF	OFF
100	20000	ON	OFF	OFF	OFF
125	25000	OFF	OFF	OFF	OFF

## 5. Power Supply Selection

The driver can work normally between DC24V-110V / AC18V-80V. Please note that the peak ripple of the power supply should not exceed this value. If using a transformer to supply power, you should consider the fluctuation rate of the local power grid to select the appropriate transformer power supply. If using a DC power supply, be aware that the output current range of the power supply needs to be greater than the operating current of the motor.

### 5.1 Power Supply Precautions

- (1). It is best to use an unregulated power supply.
- (2). When using an unregulated power supply, the output power of the power supply needs to be greater than to 60% of the driver set current.

- (3). When using a regulated DC power supply, the output current of the power supply should be greater than or equal to the operating current of the driver.
- (4). In order to reduce costs, two or three drivers can share a power supply, but should ensure that the power of the power supply is large enough.

## 5.2 Power Supply Recommend

- (1). For DC power, it is recommended to use unregulated DC power supply more than 48VDC.
- (2). For AC power, it is recommended to use transformer power 60VAC/75VAC.

## 6. Motor selection

It can be used to drive two-phase, four-phase hybrid stepper motors with an step angle of 1.8 degrees and 0.9 degrees.

When selecting a motor, the torque and rated current of the motor are mainly considered parameters. 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. The DM860N can drive Nema 34 two-phase and four-phase hybrid stepper motors.

### 6.1 Motor matching

- (1). Define the load torque, the ratio of the working speed range

$$T = C[(J \times a_1 \times \eta) / i^2 + 1/2 \mu \times M \times D + J_{rotation} \times a_2]$$

$J$ : Moment of inertia of the load     $a_1$ : Maximum angular acceleration of the load

$a_2$ : Transmission wheel or screw angular acceleration

$M$ : Load weight     $C$ : Safety factor, recommended value 1.2 - 1.4     $\mu$ : Coefficient of friction

$\eta$ : Rotation efficiency     $D$ : Screw and disc diameter

$J_{rotation}$ : Rotating wheel or screw moment of inertia     $i$ : Rotation ratio

- (2). Factors that determine the motor output torque:

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

- a. The larger the operating current of the motor, the greater the output torque, but the more copper loss of the motor, the more heat the motor generates;
- b. The higher the supply voltage of the driver, the higher the high speed torque of the motor;
- c. According to the torque curve of the stepper motor, the high speed is smaller than the medium and low speed torque.



Figure 6: Torque frequency curve diagram

## 6.2 Motor connection

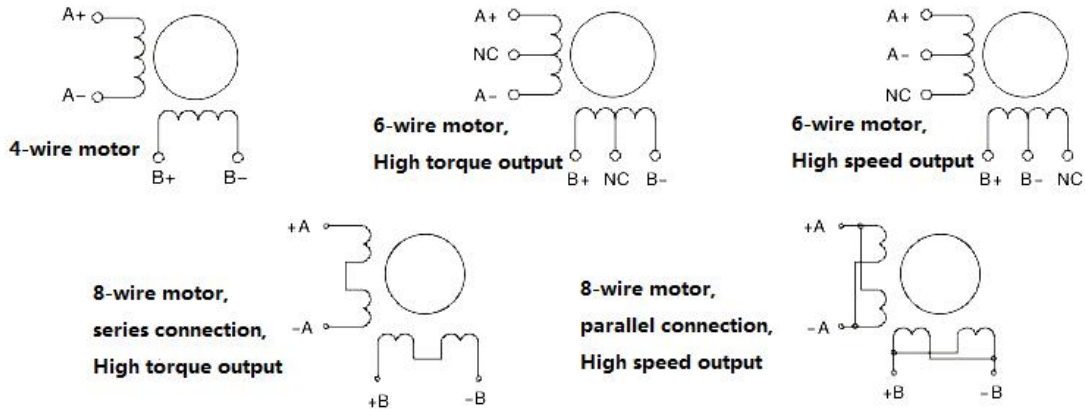


Figure 7: Motor connection diagram

## 6.3 Input voltage and output current selection

The DM860N driver can drive all two-phase and four-phase hybrid stepper motors. In order to obtain the best driving effect, it is necessary to select a reasonable supply voltage and set current. The voltage of the power determines the high-speed performance of the motor, and the current determines the torque of the motor.

### (1). Supply voltage setting

In general, the higher the supply voltage, the greater the torque at high-speeds, and the greater the loss of speed at high speeds. On the other hand, if the voltage is too high, the motor will generate more heat and may even damage the driver. 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 generated by the motor and the driver is more serious when the current is large. The calorific value is not only related to the current setting value, but also to the motor motion form and the motor dwell time. The following setting method uses the rated current value of the stepper motor as a reference, but the optimum value in practical applications should be adjusted based on this value. If the temperature is very low ( $<40^{\circ}\text{C}$ ), the current setting value can be increased to increase the motor output power (torque and high-speed performance).

- a. 4-wire motor and high-speed mode of 6-wire motor: output current is set equal to or slightly less than the rated current of the motor;
- b. High torque mode of 6-wire motor: output current is set to 70% of rated current;
- c. Series connection of 8-wire motor: because the resistance increases in series, the output current should be set to 70% of the rated current of the motor;

- d. The parallel connection of 8-wire motor: the output current can be set to 1.4 times the rated current of the motor.

*Note: Please run the motor for 30-60 minutes after the current is set. If the motor temperature rises too high (>70°C), the current setting should be reduced. Therefore, the general situation is to set the current to a value that the motor's temperature is warm but not too hot when the motor is working for a long time.*

## 7. Frequently Asked Questions

- (1). Q: When using the stepper drive for the first time, how can I get started as soon as possible?

A: After the power supply and motor are properly connected, only the pulse signal is connected (set the frequency to 1KHZ first), the microstep is set to 16, the DIR and ENA are suspended. At this time, the motor defaults to forward after power-on. After running correctly, test the functions of acceleration (increasing frequency), direction, microstep and ENA.

- (2). Q: If the control signal voltage is higher than 5V, must I add a series resistor?

A: It is not required. This driver has been compatible with all signal voltages between 5V and 24V.

- (3). Q: After the driver is working for a long time, the outer casing is hot, is it normal?

A: This is normal. Under normal temperature, the outer casing will not affect the performance below 70°C.

- (4). Q: After the wiring, the power indicator light is on, but the motor does not turn. What is the reason?

A: If the wiring is correct (the enable signal is not connected), but still does not turn, it indicates that the controller drive capability is not enough, please ensure that the controller has 5mA drive capability, or check if the driver signal is a double pulse format?

- (5). Q: How to judge the definition of four lines of stepper motor?

A: Connect any two wires of the motor together, at this time, there is resistance to twist the motor shaft by hand. The two wires are in the same phase and can be connected to the driver A+ and A-. If the other two wires are connected together, there will still be resistance. These two wires are connected to B+ B-. Or use a multimeter to measure, the two wires that pass through each other are the same phase, which can be connected to A+, A- or B+, B-.

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