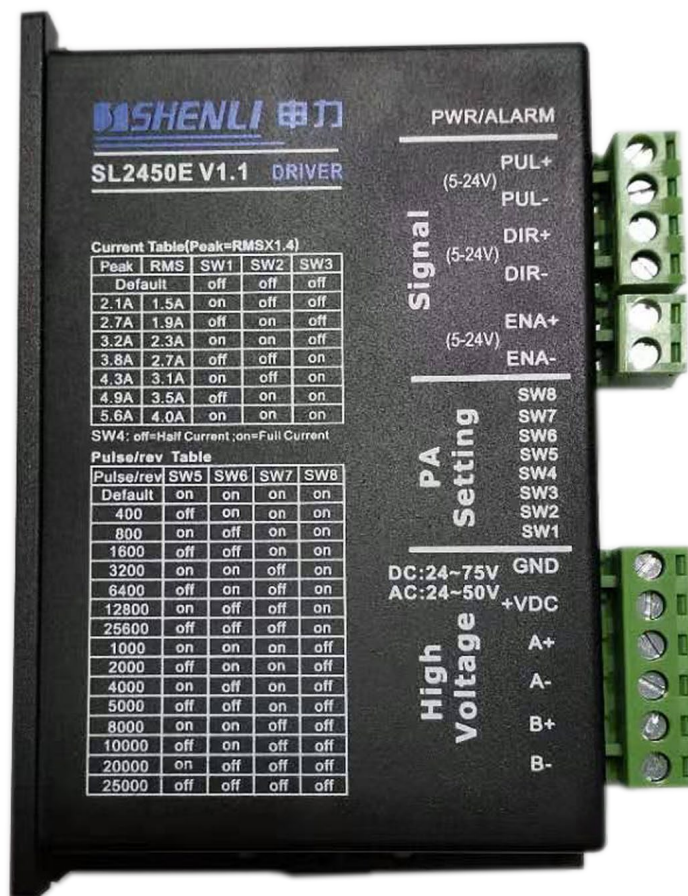


# SL2450E-V.1.1 DIGITAL 2PHASE STEPPER DRIVER

## INSTRUCTIONS



## 1.PRODUCT PROFILE

### 1.1.Outline

SL2450E.V.1.1 is a new digital stepping motor driver, adopting 32 bits DSP digital processing technology. Its control algorithm adopts advanced variable current and frequency technology with lower heat, little vibration and stable operation. User can arbitrarily set the subdivision from 200 to 51200 and current value within rated current. It can meet most application needs. Owing to adopting built-in micro-subdivision technology, although on the condition of low-subdivision, it can get effect of high-subdivision, stable operation among low, middle and high speed, and low noise. It integrates automatic setting parameters function when on power, which can automatically generate optimal operation parameters for different stepper motor so as to maximize its performance.

### 1.2.Characteristics

- 32 bits DSP technology
- built-in high subdivision
- low noise
- current from 0.1A-5.0A
- variable current control
- half current when stopping
- for 4/6/8 wires 2 phase stepper motor
- optical isolation differential signal input
- pulse response frequency Max 500KHz (default 200KHz)
- Automatically setting parameters function
- subdivision setting range of 200-51200
- protection function of over/low-voltage and over current

### 1.3.Application

It can be suitable for kinds of middle/small automation equipments and instruments such as engraving machine, label machine, cutting machine, laser phototypesetting machine, graphic plotter, CNC machine, automatically assembly machine etc. Especially for customers who have low noise and high speed requirements.

## 2. Electrical, mechanical and environmental parameters

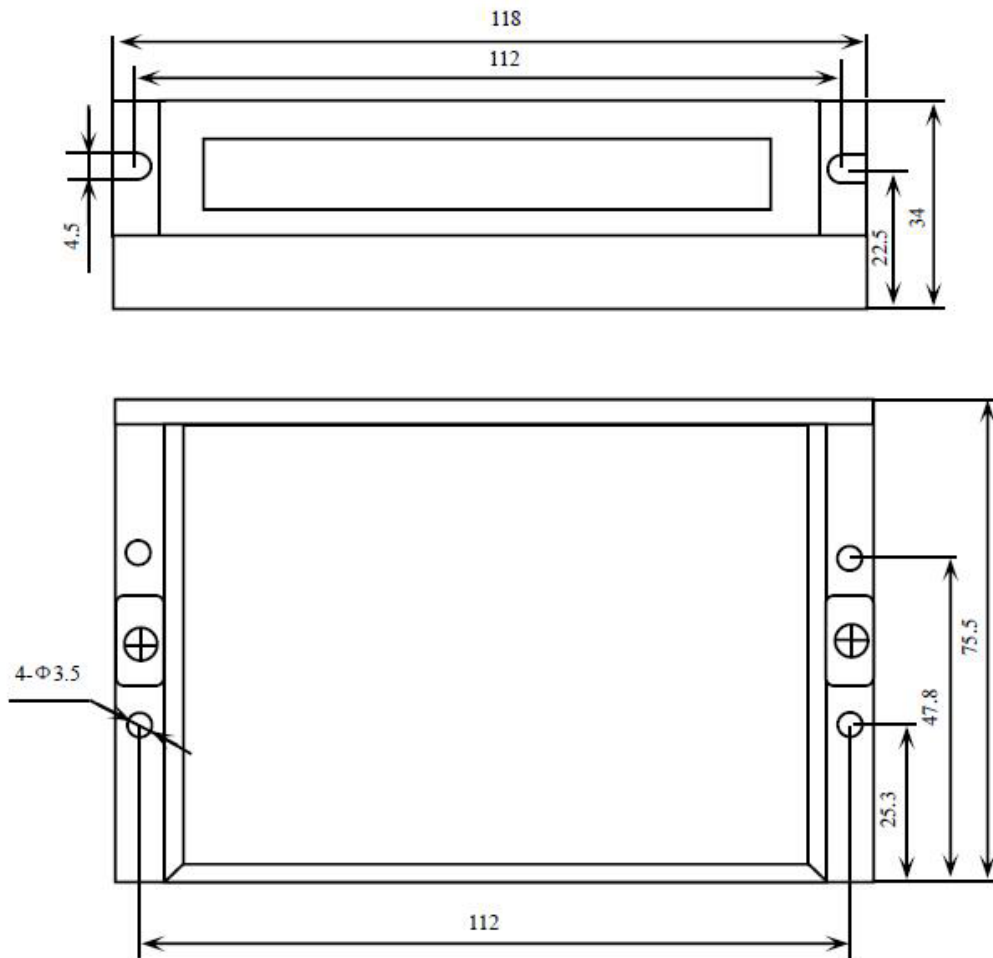
### 2.1. Electrical parameters

description	SL2450E.V.1.1			
	Min.	typical	Max.	Unit
output current	0.1	-	5.0	A
input power voltage	24	36	50	VDC
input current for control signal	6	10	16	mA
electrical level for control signal interface	4.5	5	28	Vdc
Min.pulse breadth for input signal	1.5	-	-	us
stepping pulse frequency	0	-	200	KHz
insulation resistance	100			MΩ

### 2.2. Operational environmental parameters

Cooling ways	Nature cooling or forced air cooling	
Service environment	Circumstances	Please keep it away from other heating equipments. Keep it away from the place with dust, oil, corrosive gases, humid and vibrating places. Combustible gas and conductive dust are prohibited
	Temperature	-5~+50°C
	Humidity	40~90% RH
	Vibration	5.9m/s <sup>2</sup> MAX
Storage temperature		-20°C~+80°C
Weight		280g

### 2.3.Mechanical installing graph



installing dimension graph (unit:mm)

Side installation are recommended for better fever dissipation,When designing installing dimension, please consider the terminal size and wiring.

### 2.4.Strengthening heat dissipation

2.4.1 Reliable working temperature usually within 60°C for this driver, 80°C for motor

2.4.2To recommend automatic half current way. When the motor stops, current automatically halves to reduce motor's and driver's heating

2.4.3 Side vertically installing are recommended to make dissipation gear forming strong air convection.

If necessary, please installing a fan near to driver forcing to dissipate fever so as to guarantee driver being within the reliable working temperature range.

### 3. Ports and wiring

#### 3.1 Ports description

##### 3.1.1 control signal ports

Name	Function
PUL+	Pulse signal: pulse rising edge effectively. PUL high electric level with 4.5~28Vdc, low electrical level with 0~0.5V. To reliably responding pulse signal, pulse breadth should be more than 1.5 $\mu$ s.
PUL-	
DIR+	Direction signal: High/low electrical level signal. Direction signal should be created at least 2 $\mu$ s earlier than pulse signal in order to change the turning direction correctly. The initial turning direction of motor is related to the wirings. changing any phase winding (such as exchanging A+ and A-) will alter motor's initial running direction. DIR high electrical level with 4.5~28Vdc, low electrical level with 0~0.5Vdc
DIR-	
ENA+	Enable signal: This signal is used for enables or prohibiting. when ENA+ connects 4.5~28Vdc, ENA- connects low level (or internal optocoupler conducting). The driver will cut off motor's phases current to make the motor being in free and not respond to the step pulse. When this function is not needed, please keep this enable port empty.
ENA-	

##### 3.1.2 strong power ports

Name	Function
GND	DC power ground
+VDC	DC power positive, 20V-50V,36 recommended
A+, A-	Motor phase A winding
B+, B-	Motor phase B winding

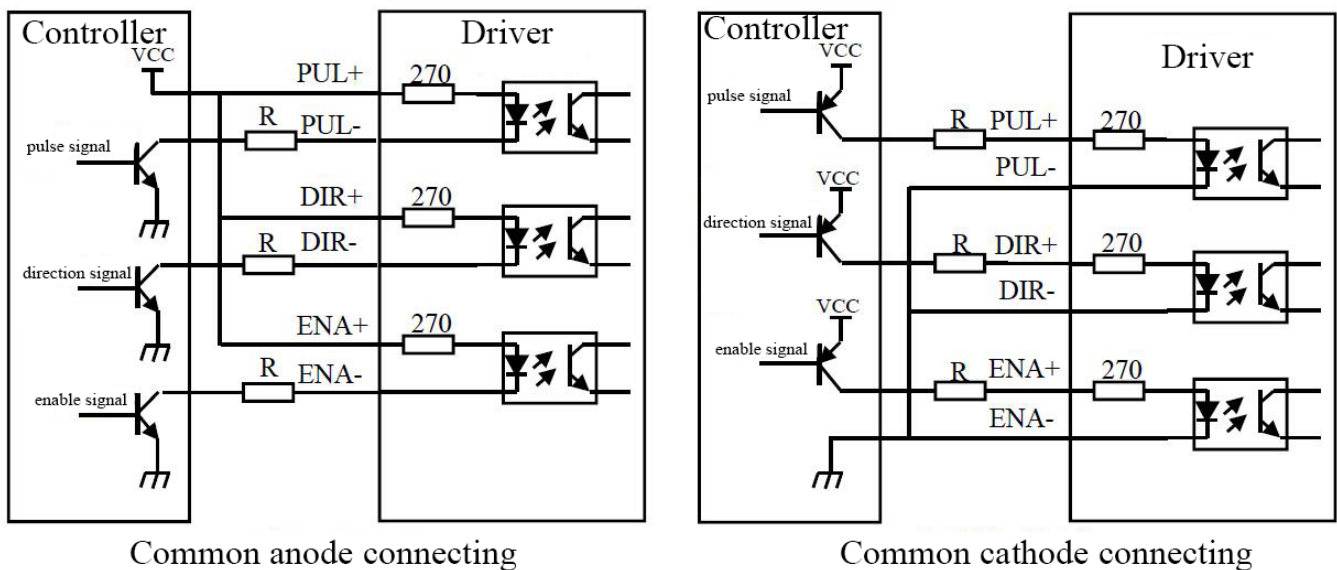
##### 3.1.3 state indicator

Green LED is power light. when driver connects the power, LED is always on. When the power is cut, LED is off. Red LED is fault light. Its cycle is based on circulating blinks within 3 second. When faults have been removed, red LED is always off. Red LED Blinking times within 3 second mean different faults.

No.	blinking times	red LED blinking wave	fault description
1	1		over-current or short-cut among phases faults
2	2		over-voltage faults
3	3		No definition
4	4		motor open circuit or wrong wiring faults

### 3.2 Control signal ports circuit

SL2450E.V1.1 driver adopts differential port circuit which is suitable for ports such as differential signal, single-ended common cathode and single-ended common anode etc. Built-in high speed photo-coupler allows to receive long wire driver circuit, integrated electrode open circuit and PNP output circuit signal. In the bad circumstance, long wire driver circuit is recommended with strong anti-interference. Taking integrated electrode open circuit and PNP output circuit as examples here. And the ports circuit diagrams are the below.

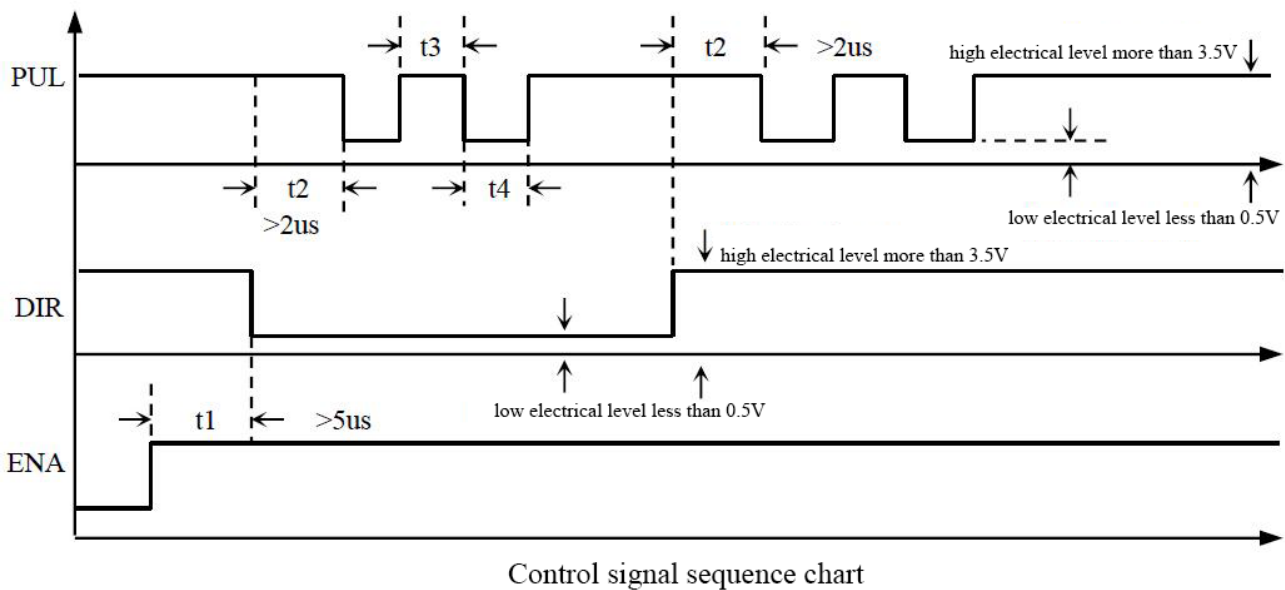


### Input ports circuit

**Note:** When VCC Value is 4.5~28Vdc, R short connecting or no connecting.

### 3.3 Control signal sequence chart

To avoid some wrong action or deviation, PUL, DIR and ENA should meet with certain requirements shown as the following diagram.



### Notes:

- 1) t1: ENA(enable signal) should be at least earlier 5 μs than DIR, identified as high. Generally it is okay to let ENA+ and ENA- empty.
- 2) t2: DIR should be at least earlier 2 μs than PUL declining edge, identified its state as high or low.
- 3) t3: pulse breadth at least no less than 2 μs.
- 4) t4: low electrical level breadth no less than 2 μs.

## 3.4 Control signal mode setting

selection of pulse trigger edge and single/ double pulse: to set pulse rising edge or declining edge trigger effective, single pulse mode or double pulse mode by PC software Pro Tuner or STU debugger. When in double pulse mode, the signal from direction control terminal should keep high electrical level or be empty.

## 3.5 Wiring requirements

- 1) To avoid the interference in the driver, we recommend to use the shielded cable controlling signal, and short connect the shielded layer and ground wire. Except for the special requirement, the shielded wire of controlling signal cable connects ground alone; the host end of shielded wire connects ground wire and the driver end empties. For the same machine only allowing to connect ground wire at the same point. If no really connecting the ground wire, there maybe have serious disturbance. In this case, the shielded layer don't connect the ground wire.
- 2) Impulse, direction signal wire and motor wire can't be wrapped side by side. The best way is to keep at least 10cm distance among them. Otherwise the motor noise easily interferes impulse direction signal to lead motor inaccurate positioning and system instability.
- 3) If many drivers only use one power supply, the connection should be in parallel. No allow the chain

connection from one motor to another.

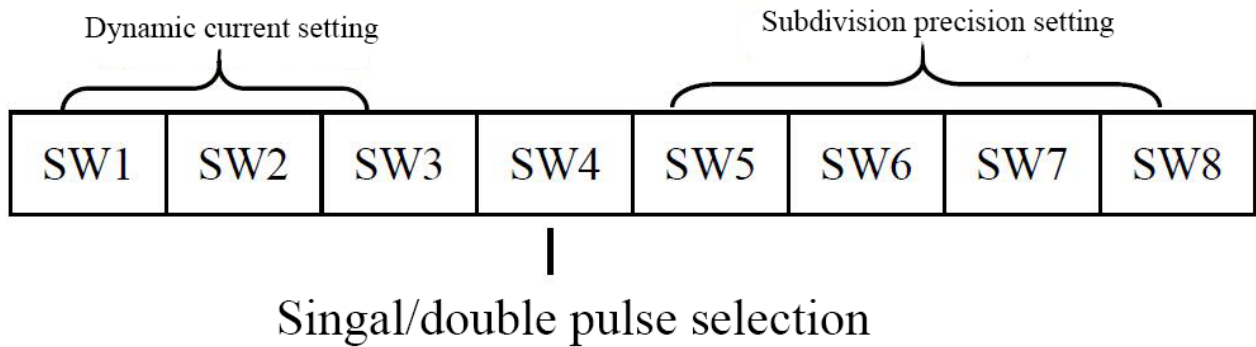
4) Forbidding to plug or pull out strong electricity P2 terminal of driver when the power is still on. There are still high current flowing through the coils even though the motor with electricity cease. In this case, plugging or pulling out the P2 terminals will destroy the driver because it will produce the huge instantaneous induced electromotive force.

5) Forbidding to connect the wire head added tin with connecting terminals. Otherwise the terminals maybe are destroyed owing to the resistance increasing and over fever.

6) The wiring ends shouldn't be exposed outside the terminals in case of accidentally short circuit to damage the driver.

## 4. Current, subdivision dial switch setting and parameters self-adjusting

SL2450E V.1.1 driver adopts 8 bits dial switch to set subdivision precision, dynamic current, static half current and to realize motor parameters and internal parameters self adjusting. Details are the below.



### 4. 1. Current setting

#### 4. 1.1. Working (dynamic) current setting

output peak current	output average current	SW1	SW2	SW3	current self-setting
Default[1.0A,PK]		on	on	on	When SW1、SW2、SW3 meantime set "off", can set needed current,Max.4.2A, 0.1A resolution ratio by PC software. Default current is 1.0A
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	

#### 4. 1.2. Stop (static) current setting

Static current can be set by SW4 dial switch. Off means that static current is set half current. On means that it is same between static current and dynamic current. Generally SW4 is set as OFF so that reduce the fever from motor and driver, and improve its reliability. after pulse string stopping about 400ms, current will reduce to about half (60% real value) , theoretically heat amount will reduce to 30%.

### 4. 2. Subdivision setting

step/rev	SW5	SW6	SW7	SW8	subdivision description
Default	on	on	on	on	When SW5、SW6、SW7、SW8 meantime set as "on", driver subdivision adopts internal default subdivision value. Min. 1, resolution ratio being 1, Max.51200
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	

### 4. 3. Parameter self-adjusting function

When driver is open loop, when it electrifies each time, it can automatically inspect motor's parameters one time, driver will automatically finish the internal parameter self-adjusting. When motor and power voltage change, please re-electrify and repeat one time self-adjusting. Otherwise, the motor maybe isn't in the best condition. Notes: Can't input pulse at this moment, direction signals also can't be changed, enable signal can't be connected.

## 5. Power supply selection

Power voltage should work normally within the recommended range. It's the best way for SL2450E.V.1.1 driver to adopt the instable-voltage DC power supply. We also use the voltage transformer, bridge rectifier and capacitor filtering. Please note that the voltage ripple peak value isn't more than its specified Max.voltage. DC power supply with less than Max.voltage value is recommended to avoid power grid fluctuation exceed driver working voltage.

If using stable-voltage switching power supply, please maximize the output current from switching power supply.

### Notes:

- 1) Please pay attention to the positive and negative electrode of the power when wiring, don't connect oppositely;
- 2) Instable-voltage power is the best;
- 3) It's ok when power current output capacity is more than 60% the setting current of the driver, if using instable-voltage power;
- 4) The output current of power should exceed or equal to the setting working current of driver, if using stable-voltage switching power;
- 5) To reduce the cost, two or three drivers can share the same power. Of course please guarantee there are enough power.

## 6. Motor selection

SL2450E.V.1.1 driver can drive 4/ 6/ 8 line 2/4 phase hybrid stepper motor with 1.8°/ 0.9°step angle. How to select motor depends on its torque and rated current. Motor dimension decides the torque. The bigger the motor size is, the more the torque is. Current amount is related to the inductance. Smaller inductance motor has good high speed performance, however its current is higher.

### 6.1. Motor selection

#### 6.1.1 Confirm load torque, transmission ratio and rotary speed range

$$T_{\text{motor}} = C (J_{\varepsilon} + T_{\text{load}})$$

$J$  : rotary inertia of load     $\varepsilon$ : max angle acceleration of load

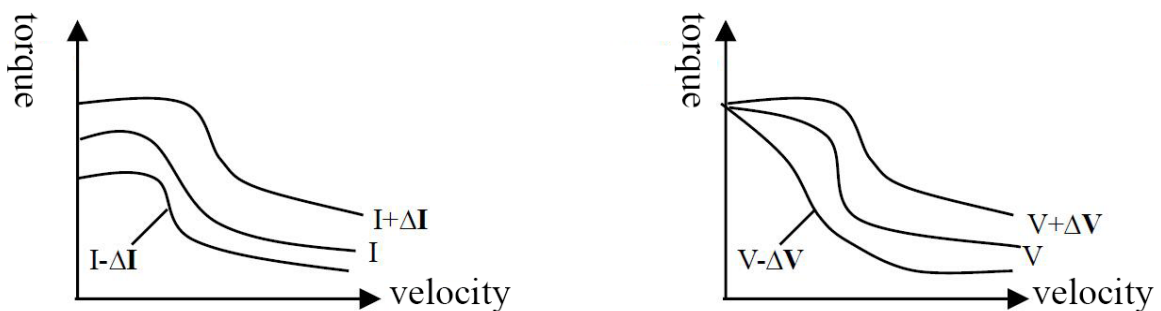
$C$ : safe coefficient, recommend values is 1.2-1.4

$T_{\text{load}}$  : max load torque, including resistance torque such as efficient load, friction, transmission efficiency and so on.

#### 6.1.2. Factors that decide motor's output torque

For the given stepper motor and coil connection ways, output torque has the following features.

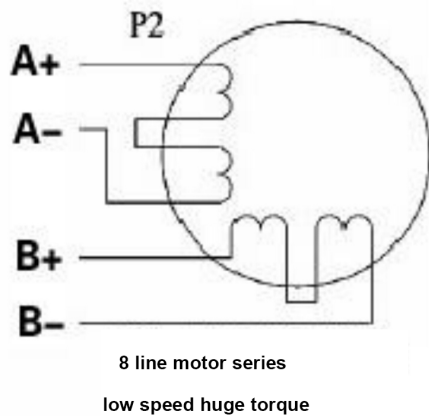
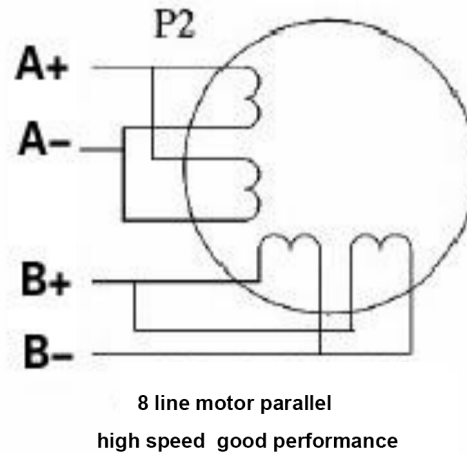
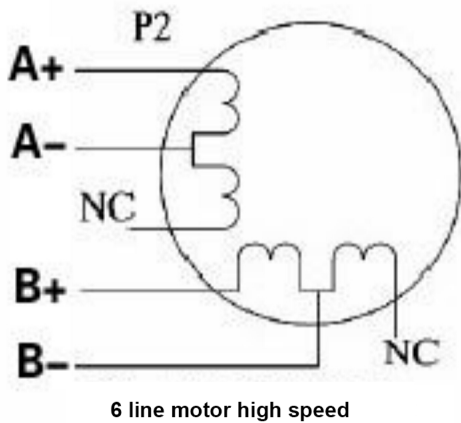
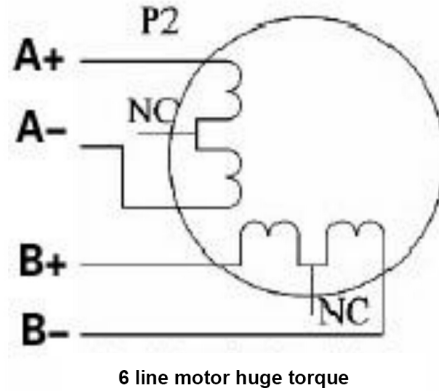
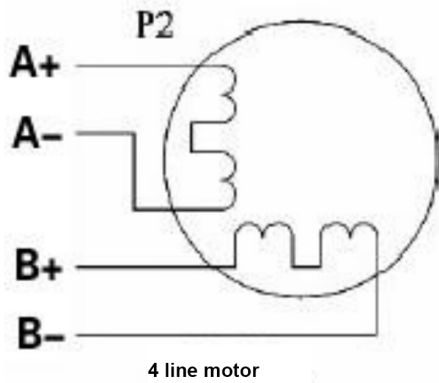
- 1) The bigger the motor's actual current is, the huger the output torque is. However the copper loss ( $P=I^2R$ ) is more, so is the motor fevers.
- 2) The higher the driver's power voltage is, the huger the motor's torque has.
- 3) The higher the rotary speed is, the smaller the torque is.



Torque-frequency characteristic diagram

### 6.2. Motor wiring

For 6/ 8 line stepper motor, different coils wiring have great difference in the motor performance. Which are shown as following.



### 6.3. Selection for input voltage and output current

#### 6.3.1. Power voltage setting

Generally, the higher the power voltage is, the huger the motor's torque is. the more the possibility is to make the motor avoid step lost in the high speed running. But on the other hand, too high voltage will lead to over-voltage protection, motor fevers more, even damage driver. When working with the high voltage, there are a little more vibration caused by motor with low speed running.

#### 6.3.2. Output current setting values

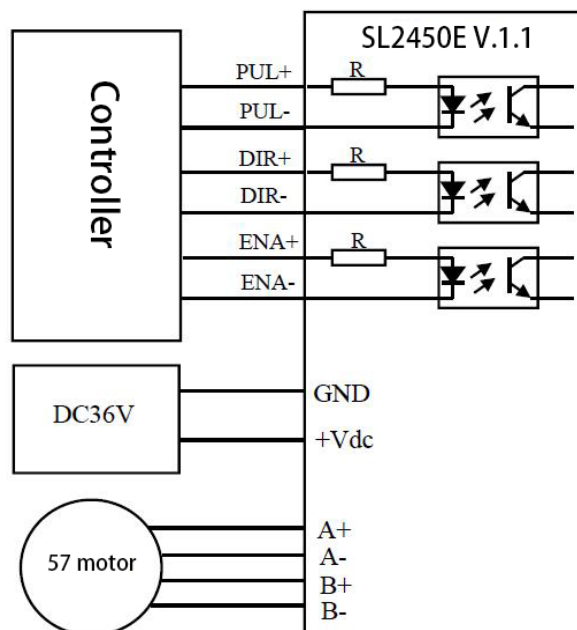
For the same motor, the more the current setting values is, the huger the motor output torque is. However motor and driver will fever seriously with the high current. The fever amount is not only related to the current setting values, but also to motion types and ceasing time. The following setting ways refer the stepper motor rated current. Of course, the optimal values for the actual application need to be adjusted on the basis of these values. Theoretically, when the temperature is low ( $<40^{\circ}\text{C}$ ), should properly increase the current setting values to heighten motor's output voltage if necessarily.

- ◆ 4 line motor: output current setting values equals to or slightly less than that of the motor rated current values.
- ◆ 6 line motor with huge torque mode: output current setting values equals to 50% rated current of motor single wiring ways.
- ◆ 6 line motor with high speed mode: output current setting values is same as the rated current of motor single wiring ways.
- ◆ 8 line motor wiring in series: output current setting values equals to 70% rated current of motor single wiring ways.
- ◆ 8 line motor wiring in parallels: output current setting values equals to 140% rated current of motor single wiring ways.

### Notes:

After setting current, please run the motor lasting for 15-30 minutes. If motor's temperature rises too high ( $>70^{\circ}\text{C}$ ), should degrade the current setting values. So the current should usually be set to the values that motor warms but not too hot for long working time.

SL2450E.V.1.1 driver can match with Nema23 stepper motor in series and in parallels (if the motor direction is different from the expectation, only need to change the position of A+ and A-). SL2450E.V.1.1 driver can drive 4/6/8 lines 2/4phase motor. The detailed connecting for 4/6/8 line stepper motor is shown as the following.



Typical connecting  
that SL2450E V.1.1 matches with Nema23

**Notes:**

- 1) Different colors for different motor, details refer stepper motor drawings or manual. Such as there are different color of the wires between 57mm motor and 86mm motor.
- 2) The phases are relatively. Different phase windings can't connect the same phase terminal of the driver (A+,A- are one phase, B+,B- are another phase), If the rotary directions between motor and expectation are different, only need to exchange the connection of A+ and A-.
- 3) The driver only drives 2 phase hybrid stepper motor, can't drive 3/ 5 phase stepper motor.
- 4) The way to identify whether the connection is correct for series or paralleling: not connecting driver, using hand to turn motor shaft, the connection is right if turning easily and smoothly. It will be wrong, if having huge resistance, not smoothly and companying certain noise.

## **7. Protection**

### **7.1. Short circuit protection**

When phase short circuit or driver internal over-current occur, the red light twinkles one time, and repeatedly twinkles in three second, at this time the fault should be solved, re-electrify and re-set.

### **7.2. Over voltage protection**

When the input voltage of SL2450E.V.1.1 driver is more than 60V, the red light twinkles two times, and repeatedly twinkles in three second, at this time the fault should be solved, re-electrify and re-set.

### **7.3. Motor open circuit protection**

When motor is open circuit or hasn't connected, the red light twinkles four times, and repeatedly twinkles in three second, at this time the fault should be solved, re-electrify and re-set.

#### **Notes:**

Owing to without power positive-negative reverse connection protection, before the driver electrifying, please reconfirm the correct connecting to power positive and negative electrode. Connecting positive and negative electrode reversely will burn out driver fuse.

## 8. Frequently asked questions (FAQ)

### 8. 1.Methods for common faults

Faults	Possible problems	Suggestion
Motor doesn't rotate	Power indication light doesn't work	To check power circuit, confirm the correct connecting to positive and negative electrode, power wire connecting well.
	too small values of subdivision selection is be selected	To select the right subdivision
	too small values of Current setting values is be selected	To select the right current
	Driver has been protected	Restart the power; if can't solve, refer alarm indication light description.
	Enable signal is low	Pull up the signal or hanging up.
	No response to control signals	Hasn't electrified
Motor direction wrong	Motor wires connect wrong	Arbitrarily exchange each phase's two different wires (like exchange positions of A+,A-)
	Motor wires exist broken circuits	Check and connect right
Alarm indication light is on	Motor wires short circuited	To check the wire connecting, make sure connecting correctly.
	Motor wires connect wrong	To check the wire connecting, make sure connecting correctly.
	Voltage is too high or too low	To check the power.
	Motor or Driver is damaged	To renew the motor or driver
Positioning fault	Signals are interfered	To remove the interference
	Shielded ground doesn't connect or connect wrong	Reliably connect ground
	Motor wires exist broken circuits	To check the wire connecting, make sure connecting correctly.
	The wrong subdivision	To set right subdivision
	Current is low	To increase current.
Motor speeding up failures	Speeding up time is too short	Extending the speeding up time.
	Motor torque is too small	To select a little more huge torque motor.
	Voltage is low or current is small	Appropriately enhance voltage or current.

### 8. 2.Frequently asked questions

### 8. 2.1.What is the stepper motor and stepper motor driver

Stepper motor is a kind special motor that professionally precisely control rotating speed and position. Its rotation is one kind of movement step by step based on certain fixed angle (also named step angle). So it is called stepper motor. Its characters include but not limiting without accumulating errors, receiving each impulse signal from the controller, motor rotates a fixed angle driven by the driver. It applies widely in various open control.

Stepper motor driver is a kind voltage amplifier to make stepper motor move. It can convert impulse signals from controller into frequency signals for stepper motor. Motor rotary speed is proportional to impulse frequency. So controlling impulse frequency can precisely adjust speed, controlling impulse numbers can accurately positioning.

### 8.2.2.What is stepper driver's subdivision? What the relationship between motor rotary speed and pulse frequency?

Owing to itself special structure, when shipping away from the factory, stepper motors usually mark its step angle (like 0.9°/ 1.8°, means each half step moving, the degree of motor rotated is 0.9°, each whole step moving, the degree of motor rotated is 1.8°).However for many precise control cases, the whole step is too big to affect control precision, at the same time with much vibrating. The needs of finishing one certain fixed angle with many different steps is produced. That is the so-called driven subdivisions. The electronic device which can realize this function is called subdivision driver.

$$V=P*\theta_e \div 360*m$$

V: motor speed(r/s)

P: pulse frequency (Hz)

θ<sub>e</sub>: motor inherent step angle

M:subdivision number (whole step is 1, half step is 2)

### 8. 2.3.What's the advantages of subdivision driver?

◆Reducing moved step angle degree by each step to keep each step distance evenly so as to enhance control precision.

◆Greatly reduce motor vibration. Low frequency vibration is stepper motor inherent drawback. It is the best way to remove it.

◆Efficiently reduce torque ripple and increase output torque.

Above advantages are generally admired by users, and which has given them much benefits. So we strongly recommend you to select subdivision drivers.

### 8. 2.4.Why does the motor only rotate towards one direction?

◆Maybe the signals are weak, or the wrong wire connection, or too high signal voltage burn out direction

current-limited resistance.

◆Pulse mode mismatches. Signal is pulse /direction, driver must set this mode; If signal is also the CW/CCW (double pulse mode), driver must be this kind mode, or motor only rotate towards one direction.

If any other problems, please contact us.

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