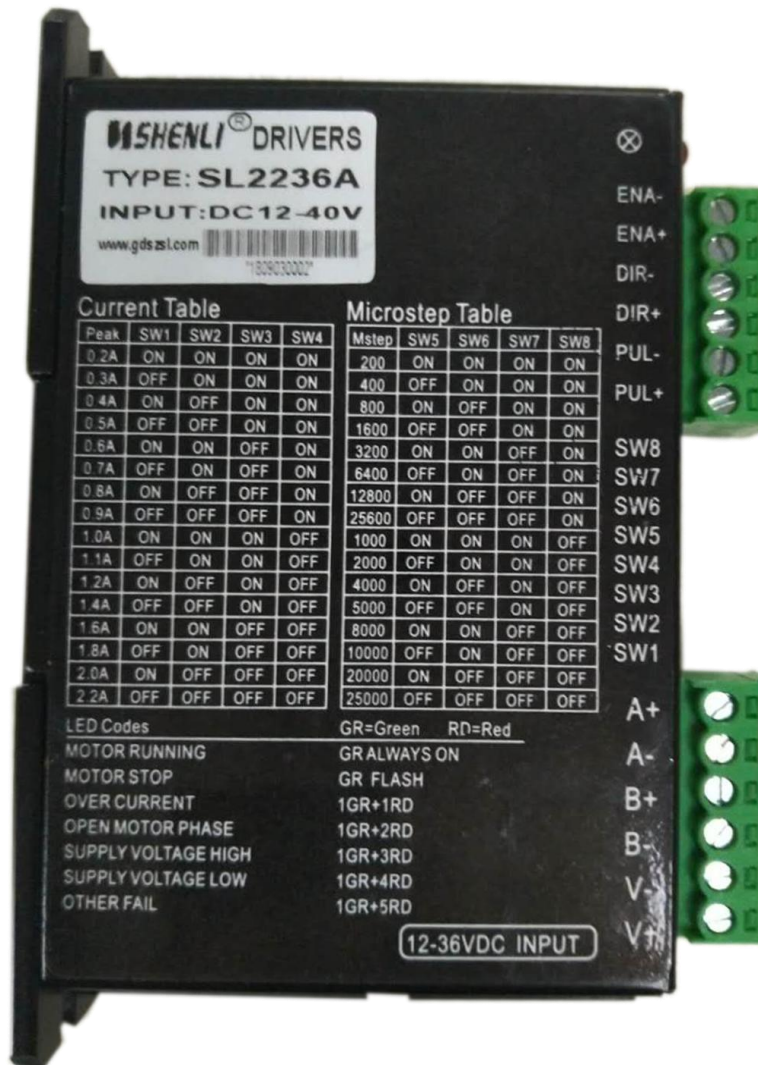


SL2236A 2-PHASE STEPPER MOTOR DRIVER

INSTRUCTIONS



Product brief

1. Outline

SL2236A is the digital 2 phase stepper motor driver. It adopts the way of PI control algorithm, be of low noise, little vibration, few fever, good stability and quality performance. Which can be suitable for any small-medium 2 phase or 4 phase hybrid stepper motor below 2.2A. we can choose the running current and subdivision by DIP. There are 16 kinds of subdivision and currents to be selected. It is of over/under-voltage alarm, phase over-current protection, motor phase open circuit detection. Photoelectric isolation control signal input. Built-in self-running model can set controlled self-running model and consistent self-running model through jumper setting. SW5-SW8 can set self-running speed. External signal controls its on/off and rotary direction. There are constant current protection and reverse protection for impulse, direction and enable terminals. Which can connect 4-28V signal electric level directly. The built-in self- running half-current setting dramatically degrade motor's fever.

2.Features

- ◆ PI control algorithm, low noise, little vibration, few fever;
- ◆ Signal input: single end, impulse+ direction and double impulse;
- ◆ Built-in micro-subdivision;
- ◆ Power supply: up to DC 36V;
- ◆ Convenient current setting, 16 numerical values for choice, peak output current up to 2.2A;
- ◆ Current halves after 1s ceasing;
- ◆ To drive 4/6/8 line 2 phase stepper motor, self –setting any motor's parameters;
- ◆ Factory default max subdivision up to 128, can be customized for customers;
- ◆ Photoelectric isolation differential signal input, max input impulse frequency up to 300KHz;
- ◆ Be of over/under- alarm, phase over-current protection, motor phase open circuit detection;
- ◆ Be of constant current input for impulse, direction and enable terminal. Connect input signal directly not needing the external protection from series resistances to degrade the voltage and limit current.
- ◆ High reliability. Adopting multilayer board and surface affixed seal, enough room for power parts。

3. Application

Be suitable for various small-medium automation equipment and instruments, Such as gas marking machine, marking machine label machine, cutting letter machine, laser marking machine, graph plotter, CNC machine, small carving machine and so on. Especially for customers who have low noise, high precise and high speed requirements.

Performance index

1. electric index

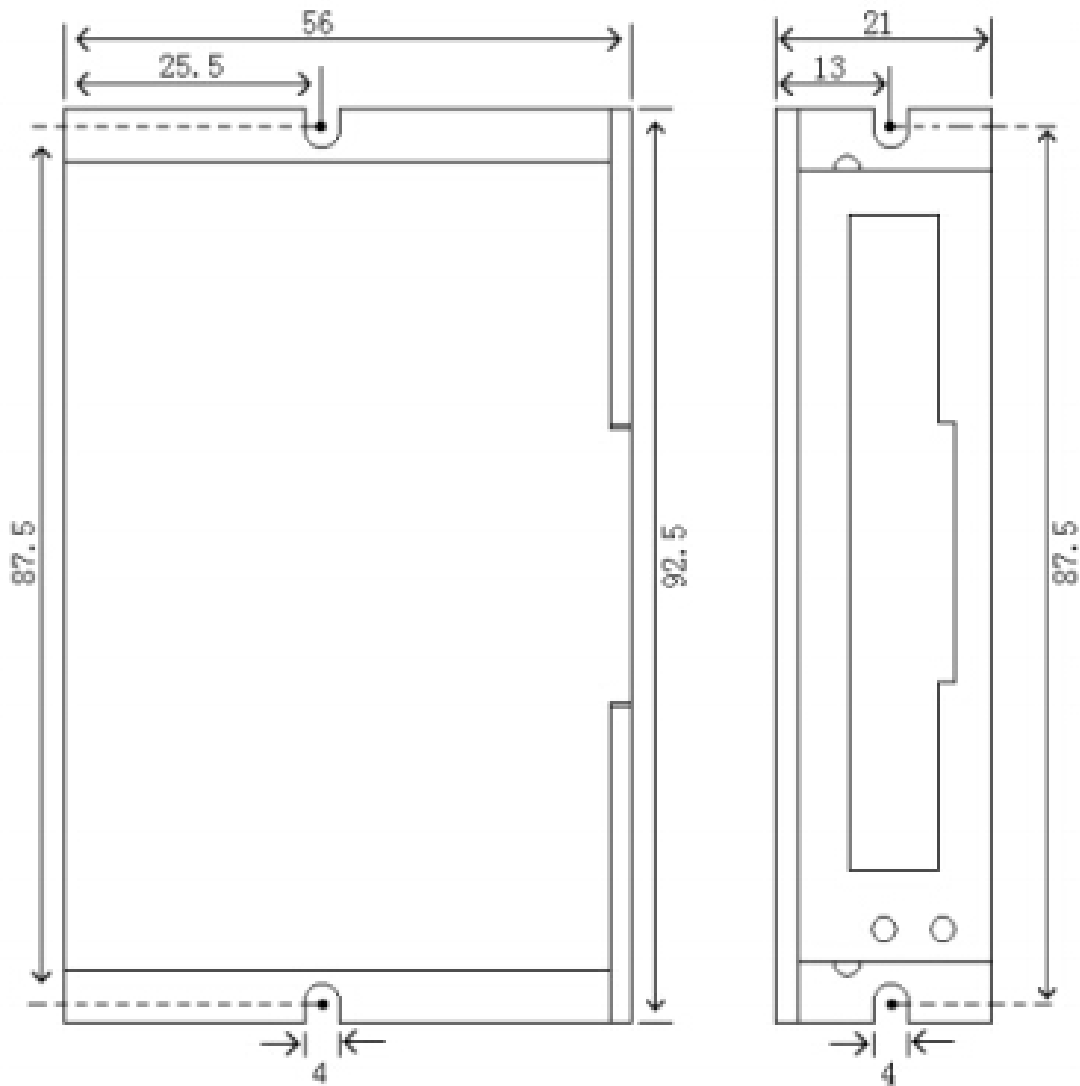
Genre	Minimum values	Typical values	Maximum values	Unit
Output current(peak)	0.2	—	2.2	A
Power supply voltage	8	24	36	VDC
Control signal current	6	10	16	mA
Step impulse frequency	0	—	300	Khz
Step impulse breadth	2	—	—	μs
Direction signal breadth	100	—	—	μs
Under-voltage protection point	—	7.5	—	VDC
Over-voltage protection point	—	42	—	VDC
Driver initialization time	2	—	—	s
Isolation resistance	500	—	—	mΩ

2.Environmental index

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	0-+50°C
	Humidity	40-90% RH
	Vibration	10~55HZ/0.15mm
Storage temperature		-20°C--+65°C
Weight		350g

3. Mechanical installation and strengthen heat dissipation

Installation size (unit: mm)



Side installation, better fever dissipation

Notes:

- 1) When designing, be considering the space for connecting terminals size and heat dissipation;
- 2) Driver's reliable operation temperature usually is below 60°C, motor's operation temperature is below 80°C;
- 3) Please upright side mounting to lead more air convection for radiating teeth. If necessarily, please mount fan near the driver to dissipate the heat in order to keep the driver working within the reliable temperature.

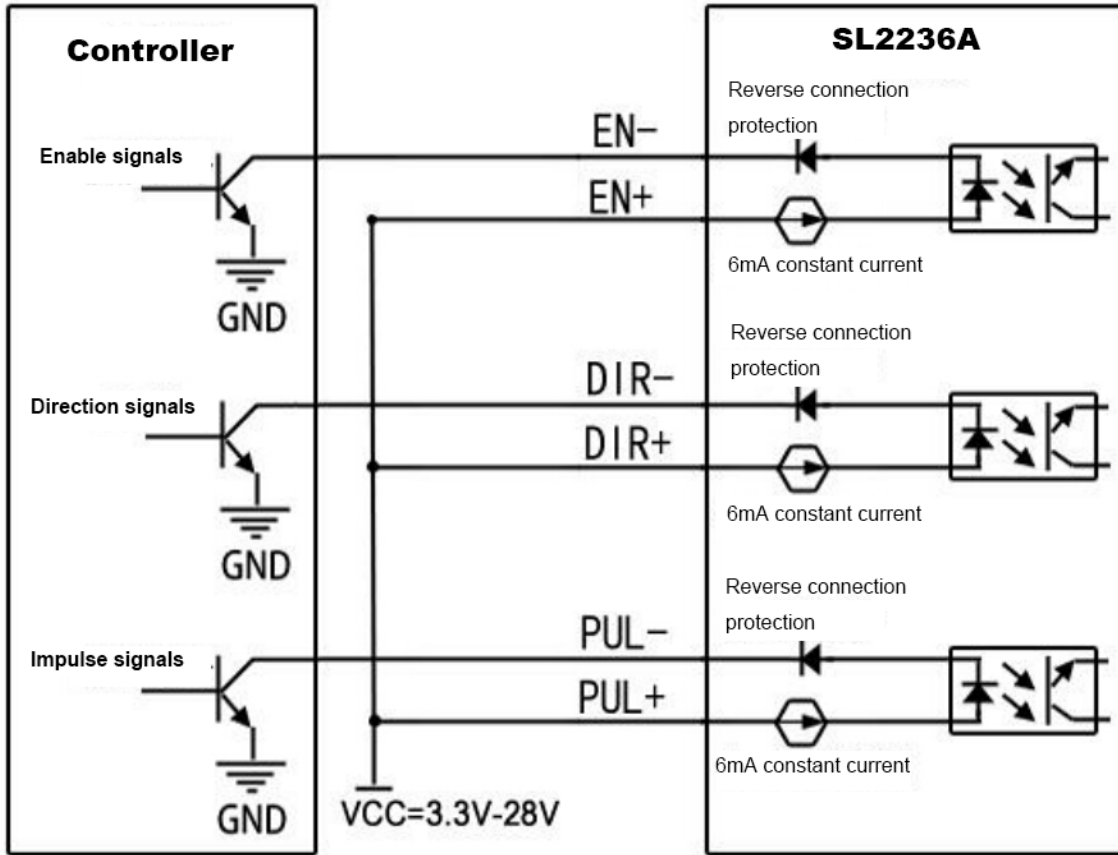
Ports and Wiring

1. Ports description

Name	Function
PUL+(CCW+)	Pulse input signal: Pulse effective along adjustable. Default Pulse rising edge is effective. Pulse width should be more than 1.2 μ s in order to respond to the pulse signal. Input voltage 3.3-28V. Double pulse mode CCW
PUL-(CCW-)	
DIR+(CW+)	Direction input signal: High/low level signal. Direction signal should be created at least 5 μ s earlier than direction 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. Double pulse mode CW.
DIR-(CW-)	
ENA+(ALM+)	Enable control signal: The signal enables or prohibits the output of driver. When ENA is close to low level or when internal optocoupler is conducted. The driver will cut off motor's current to make the motor be in free and not respond to the step pulse. When this function is not needed, please keep this enable port empty. Input voltage 3.3-28V. customizing the output terminal alarm or self-run speed adjustment output terminal for customers
ENA-(ALM-)	
GND	DC power ground
VDC	DC power positive, 8V-36V,24 recommended
A+, A-	Motor A phase winding
B+, B-	Motor B phase winding

2. Control signal connection

SL2236A driver adopts differential interface circuit being suitable for differential signal, single end common negative interface and single end common positive interface. Built-in high speed optocoupler, can connect driver with long wire, integrated the electrode open circuit and PNP output circuit signal. If in the bad condition, we recommend the long wire driver circuit for its strong anti-disturbance. The following interface circuit graph based in the integrated the electrode open circuit and PNP output.



Notes:

Impulse, direction and enable are all of constant current input, which can connect input signal directly not needing the external protection from series resistance to degrade voltage and limit current.

3.Control signal mode setting

Running ways	Jumper 1	Jumper 2
Single impulse	open circuit	open circuit
Double impulse	short circuit	open circuit
Controlled self-running	open circuit	short circuit
Constant self-running	short circuit	short circuit

4.Wiring requirement

1) In case of disturbing 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 allow 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 the failure of motor missing-positioning and system instability.

3)If many drivers only use one power, should adopt parallel connection. No allow the chain connection from one motor to another.

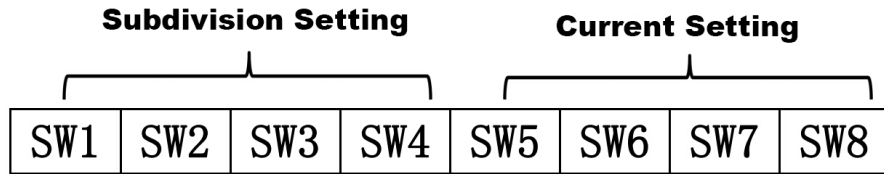
4) Forbidding to plug and pull out strong electricity P2 terminal of driver when the power is still on. There are still high current flowing through the coils even though the motor with electricity cease. In this case, plugging and pulling out the P2 terminals will destroy the driver because it will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

Current and subdivision setting

SL2236A driver adopts 8 DIP to set subdivision, running current, ceasing and halving. The details are as follows.



1. Running current, subdivision and self-running speed (SPD) setting

current (peak)	SW1	SW2	SW3	SW4
0.2A	ON	ON	ON	ON
0.3A	OFF	ON	ON	ON
0.4A	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
0.9A	OFF	OFF	OFF	ON
1.0A	ON	ON	ON	OFF
1.1A	OFF	ON	ON	OFF
1.2A	ON	OFF	ON	OFF
1.4A	OFF	OFF	ON	OFF
1.6A	ON	ON	OFF	OFF
1.8A	OFF	ON	OFF	OFF
2.0A	ON	OFF	OFF	OFF
2.2A	OFF	OFF	OFF	OFF

steps/turn	SPD/turn	SW5	SW6	SW7	SW8
200	5	ON	ON	ON	ON
400	10	OFF	ON	ON	ON
800	15	ON	OFF	ON	ON
1600	20	OFF	OFF	ON	ON
3200	30	ON	ON	OFF	ON
6400	45	OFF	ON	OFF	ON
12800	60	ON	OFF	OFF	ON
25600	90	OFF	OFF	OFF	ON
1000	120	ON	ON	ON	OFF
2000	150	OFF	ON	ON	OFF
4000	180	ON	OFF	ON	OFF
5000	210	OFF	OFF	ON	OFF
8000	240	ON	ON	OFF	OFF
10000	270	OFF	ON	OFF	OFF
20000	300	ON	OFF	OFF	OFF
25000	360	OFF	OFF	OFF	OFF

2. Static current setting

After impulse signal ceases on second, the current halves automatically, in theoretically the fever amount degrade to 25% of its.

Power connection and appropriate selection of power supply

1. Power connection

Power voltage should work normally within the recommended range. It's the best way for SL2236A driver to adopt the instable-voltage DC power supply. We also use the voltage transformer, bridge rectifier and capacitor filtering. DC power supply is recommended. Please avoid power grid fluctuation exceed driver working voltage. If using stable-voltage switching power supply, please pay more attention to the output current range of the switching power.

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 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.

2. Selecting appropriate power

1) Voltage

To guarantee both the high efficiency and low noise at the same time, the power voltage of driver is at least 5 times as the phase rated voltage of motor(that is motor rated phase current \times phase resistance) . To obtain better high speed performance, please raise driver power supply voltage. If using stable-voltage of power, the power supply voltage can't be more than 40V. If using voltage transformer, the power supply voltage can't be more than 24V. For voltage transformer power, when it is in little loads (such as motor stops) , its voltage about exceed 1.4 time of its voltage when it is rotating. To select a little lower voltage to keep motor run stably and quietly.

2) Current

The maximum power current should be the sum of two phase current. Generally, the current depends on motor type, voltage, rotary speed and load condition. The actual power current much lower than its maximum values. Driver adopts switching ample, the high voltage low current convert to low voltage high current, the more the power voltage exceed motor voltage , the less the power current needs.

3) Regenerative discharge

When motors slow down, like generator, it will convert the kinetic energy to electric energy. Some energy can be consumed by driver and motor. If there are large load running at high speed, the large amount of kinetic energy will convert to electric energy. Generally simple linear power has a huge capacitor absorbing these energy to prevent the system from damage. Switching power usually close at the case of over-voltage, Redundant energy returning to driver maybe destroys the driver. In this case, these resistance and capacitor need to be absorbed.

Motor connection

SI2236A driver can drive 4/6/8 line 2/4 phase hybrid stepper motor with $1.8^\circ / 0.9^\circ$ step angle. The selected 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 relative to the inductance. Smaller inductance motor has good high speed performance, however its current is higher.

1. Motor selection

1) Confirm load torque, transmission ratio rotary speed range

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

J : load rotary inertia ε : load max angle acceleration

C: safe coefficient, recommend values is 1.2

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

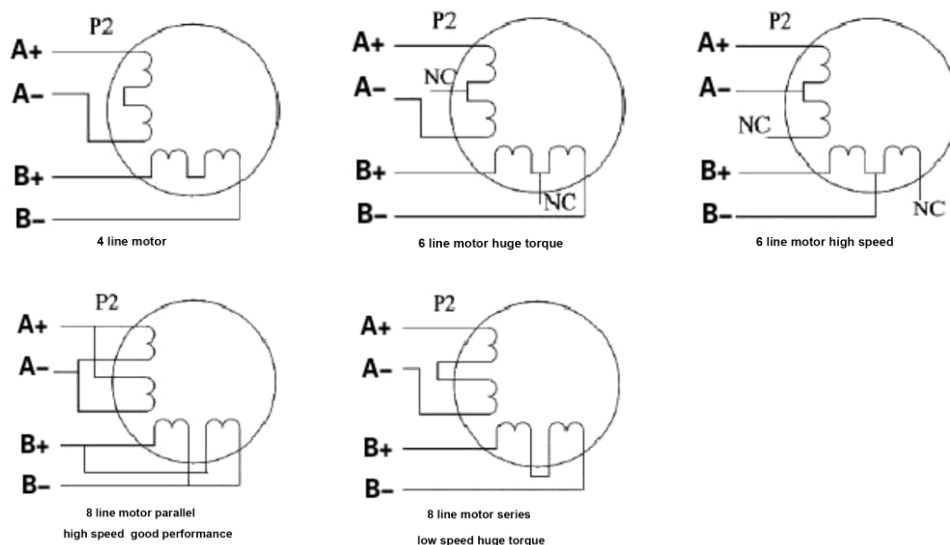
2) Factors decided the motor's output torque

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

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

2. Motor wiring

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



3. Selection for input voltage and output current

1) Power voltage setting

Generally, in the high speed running, the higher the power voltage is, the huger the motor's torque is, the more possible the motor avoid step lost. 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 low speed running.

2) Output current setting values

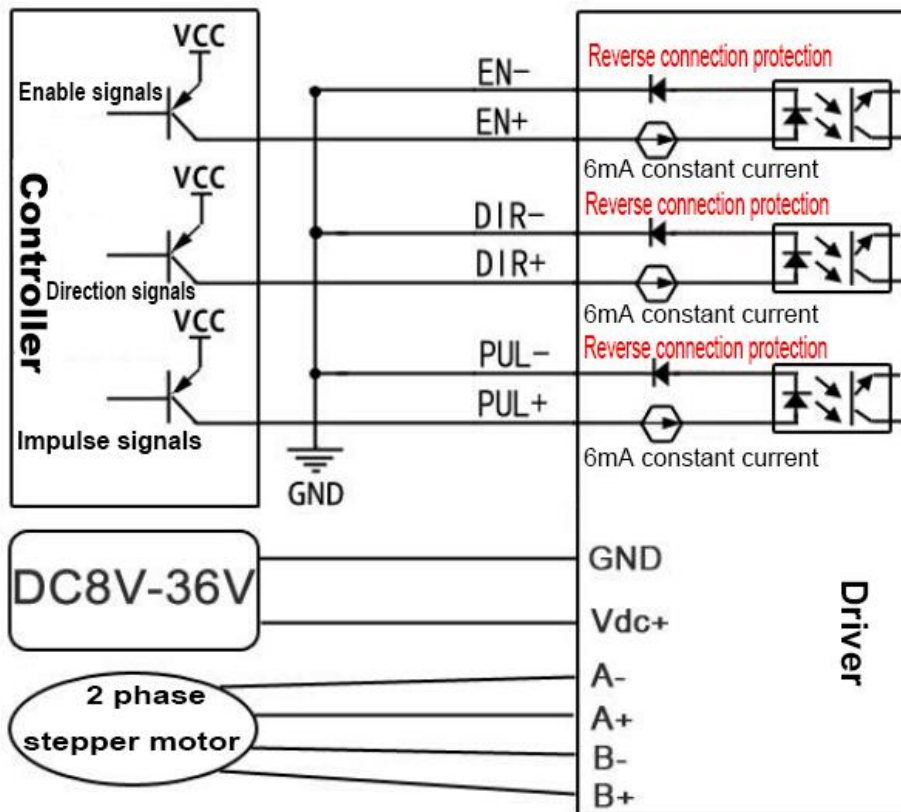
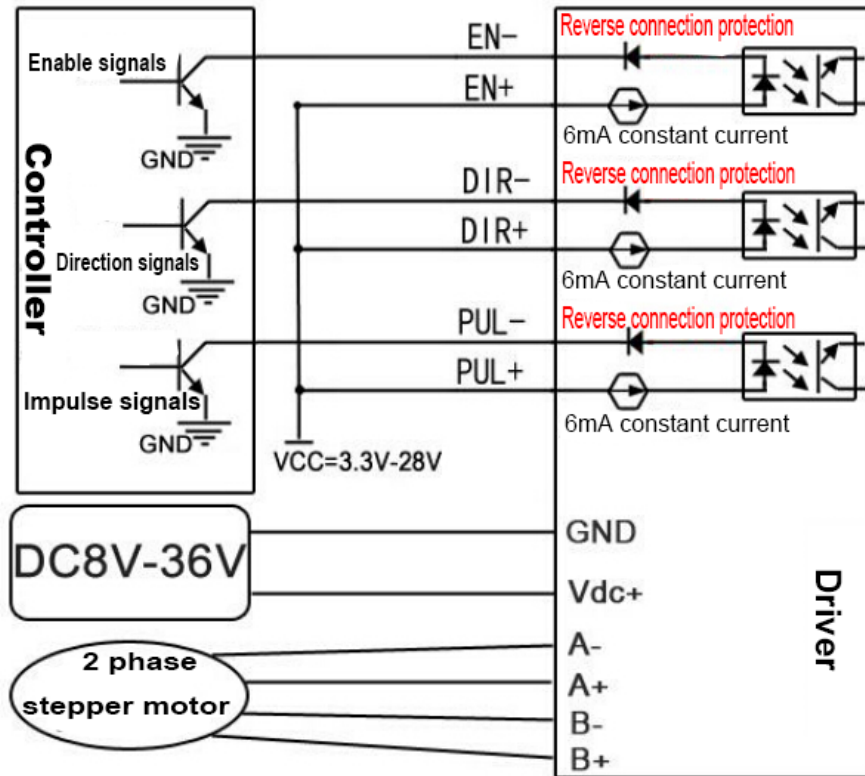
For the same motor, the more the current setting values, the huger the motor output torque is. However motor and driver will fever seriously with the high current. The fever amount is not only relative to the current setting values, but also to motion types and ceasing time. The following setting ways 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°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 series wiring: output current setting values equals to 70% rated current of motor single wiring ways.
- ◆ 8 line motor parallel wiring: 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°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.

Typical wiring graph



SL2236A driver can drive 4/6/8 line 2/4 phase stepper motor.

Notes:

- 1) Different colors for different motor, details refer stepper motor drawings or manual. Such as there are different color of the wires between 35mm motor and 42mm motor.
- 2) The phases are relatively. Different phase windings can't connect the same 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 drive 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 accompanying certain noise.

protection

- ◆ when 1 green and 1 red alternately twinkling, means phase over current;
- ◆ when 1 green and 2 red alternately twinkling, means motor phase open circuit;
- ◆ when 1 green and 3 red alternately twinkling, means power voltage is too high;
- ◆ when 1 green and 4 red alternately twinkling, means power voltage is low;
- ◆ when 1 green and 5 red alternately twinkling, means there are failures.

When the protection starts, motor shaft loses self-lock ability. If needing to recover normal working, please confirm to remove fault, then restart the power, the green light is on, motor shaft is locked, driver recover norm working.

Notes:

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

Frequently asked questions (FAQ)

1. Common fault treatment method

Faults	Possible problems	Treatment 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.
	subdivision selection is too small	To select the right subdivision
	Current setting values is too small	To select the right current
	Driver has been protected	Restart the power; if can't solve, refer alarm indication light description.
	Enable terminal electric level is too high	Adjusting driver side to make enable terminal electric level lower or hanging up.
	No response to control signals	Enhancing signals range to make high-low electric level of control signals meet with the description of manuals.
Motor directs wrong	Motor wires connect wrong	For 2 phase, arbitrarily exchange each phase's two different wires (like exchange positions of A+,A-); For 3 phase, arbitrarily adjust two phases among UVW.
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.
	Impulse direction timing sequence is wrong	To modify impulse efficient edge.
	The connection between motor and load loosens	To check whether it is reasonable that connecting and fastening do.
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.
	Motor shaft and load aren't concentric	To change the relative position of Motor shaft and load to make them be concentric
Motor jitter	Windings are asymmetrical	To check motor connection
	Driver or motor failures	To renew driver or motor
	Rotating at the resonance point	To avoid using at the resonance point
	The ratio between the motor shaft load inertia and rotor inertia is over 5	Selecting big inertia motor or reasonable reduction ratio to control inertia ratio as low as possible.
Housing power leakage	Without reliable ground connecting protection for driver and motor	To make driver and motor connect ground reliably

2. Frequently asked questions

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.

2) What is stepper driver's subdivision? What the relationship between motor rotary speed and pulse frequency?

Owing to special itself 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_e : motor inherent step angle M:subdivision number (whole step is 1, half step is 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 material benefits. So we strongly recommend you to select subdivision drivers.

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 mismatch. 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.