TWO-PHASE

HYBRID STEPPER MOTOR DRIVER

Model: 2L542v2

Features

* Patented technology
* Low cost , good high-speed torque
* Supply voltage up to +50VDC, current output up to 4.2A peak
* Optically isolated input signals, pulse frequency up to 400 KHz
* Automatic idle-current reduction
* 3-state current control for less motor heating
* 15 selectable resolutions in decimal and binary
* Suitable for 4,6,8 lead motors
* Stepping on upward or downward pulse edge (selectable)
* DIP switch current setting with 8 different value
* CW/CCW mode available (optional)
* Over-voltage and short-circuit protection
* Small size (118x75.5x33mm)

1. Introduction

2L542V2 is a low cost high performance microstepping driver based on most advanced technology in the world today. It is suitable for driving any 2-phase and 4-phase hybrid step motors. By using advanced bipolar constant-current chopping technique, it can output more speed and power from the same motor, compared with traditional technologies such as L/R drivers. Its 3-state current control technology allows coil currents to be well controlled, with relatively small current ripple and therefore less motor heating.

2. Applications

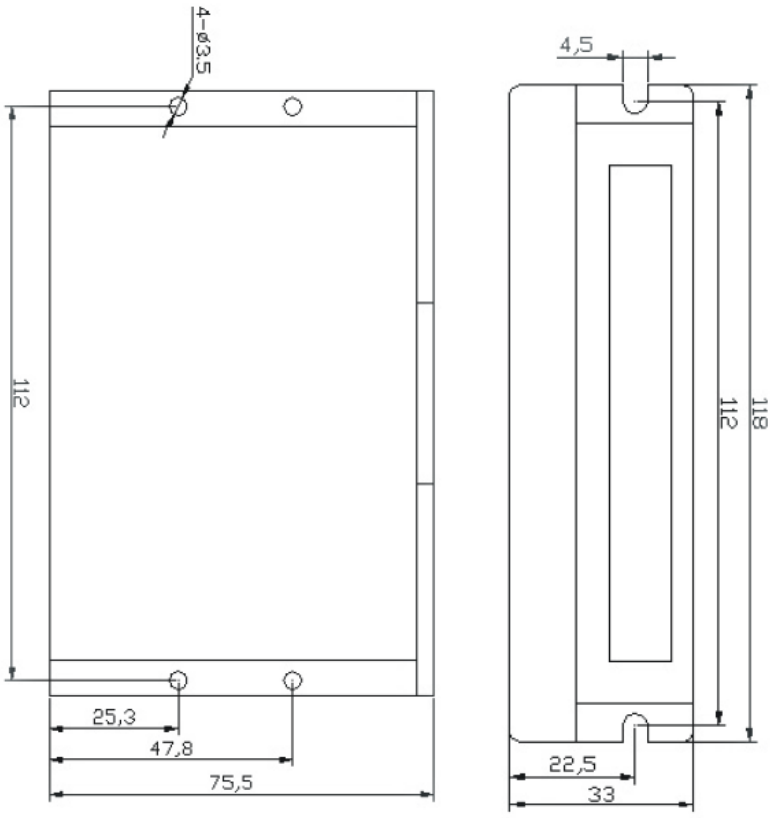
Suitable for a wide range of stepping motors of Nema 17, 23 and 34, and usable for various kinds of machines, such as X-Y tables, labeling machines, laser cutters, engraving machines, and pick-place devices. Particularly useful in applications with low vibration, high speed and high precision are desired.

3. Electrical and Mechanical Specifications

3.1 Electric Specifications (Tj = 25_)

Parameters	2L542V2			
	Min.	Typical	Max.	Unit
Output Current	0.54	-	4.2(RMS 3A)	Amps
Supply voltage	20	36	50	VDC
Logic signal current	7	10	16	mA
Pulse input frequency	0	-	400	Khz
Isolation resistance			500	MΩ

3.2 Mechanical Dimensions (unit = mm, 1 inch = 25.4 mm)



4. Connection Configuration

4.1 Connector P1 configuration

Signal	Functions
PUL+(+5V) PUL- (PUL)	Pulse signal: in single pulse(pulse/direction) mode, this input represents pulse signal, effective for each upward – rising edge; in double pulse mode (pulse/pulse) this input represents clockwise(CW)pulse. For reliable response, pulse width should be longer than 1.5μs.
DIR+ (+5V) DIR- (DIR)	Direction signal: in single-pulse mode, this signal has low/high voltage levels, representing two directions of motor rotation; in double-pulse mode (set by inside jumper JMP1), this signal is counter-clock (CCW) pulse, effective on each rising edge. For reliable motion response, direction signal should be sent to driver 2μs before the first pulse in the reverse motion direction.
ENA+ (+5V) ENA- (ENA)	Enable signal: this signal is used for enable/disable, high level for enabling driver and low level for disabling driver. Usually left unconnected(enabled).

4.2 Connector P2 configuration

Pin No.	Signal	Functions
1	Gnd	DC power ground
2	+V	DC power supply, +18VDC - +50VDC, Including voltage fluctuation and EMF voltage.
3, 4	Phase A	Motor coil A (leads A+ and A-)
5, 6	Phase B	Motor coil B (leads B+ and B-)

5. Setting Driver Output Current and Microstep Resolution

5.1 Current Setting

DIP Setting for current during motion:

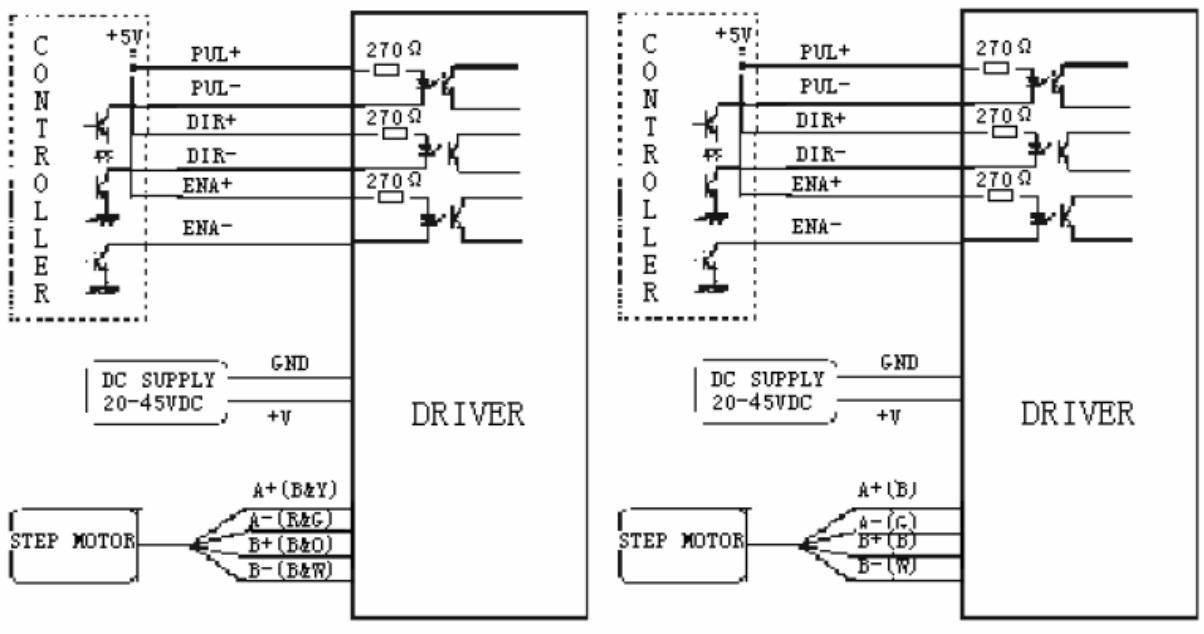
Peak current	RMS	SW1	SW2	SW3
1.00A	0.71A	on	on	on
1.46A	1.04A	off	on	on
1.91A	1.36A	on	off	on
2.37A	1.69A	off	off	on
2.84A	2.03A	on	on	off
3.31A	2.36A	off	on	off
3.76A	2.69A	on	off	off
4.20A	3.00A	off	off	off

5.2 Microstep Resolution Selection

Microstep resolution is set by SW5, 6, 7, 8 of the DIP switch as shown in the following table:

Microstep	ustep/rev.(for 1.8°motor)	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

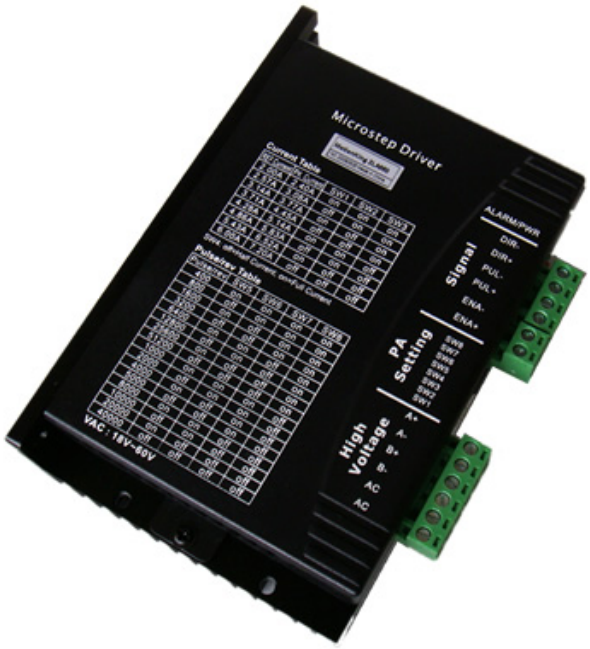
6. Typical Wiring Diagram



PARALLEL CONNECTION TO MOTOR

SERIES CONNECTION TO MOTOR

Remark: B (blue) Y (yellow) R (red) G (green) B (brown) O (orange) B (black) W (white)



TWO-PHASE

HYBRID STEPPER MOTOR DRIVER

Model: 2LA860

1. Introduction, Features and Applications

Introduction

The 2LA860 is a high performance microstepping driver based on pure-sinusoidal current control technology. Owing to the above technology and the self-adjustment technology (self-adjust current control parameters) according to different motors, the driven motors can run with smaller noise, lower heating, smoother movement and have better performances at higher speed than most of the drivers in the markets. It is suitable for driving 2-phase and 4-phase hybrid stepping motors.

Features

High performance, cost-effective • Automatic idle-current reduction
Supply voltage up to 60VAC or +80VDC • 15 selectable resolutions in decimal and
Output current up to 7.2A binary, up to 25,600 steps/rev
Self-adjustment technology • Suitable for 2-phase and 4-phase motors
Pure-sinusoidal current control technology • Support PUL/DIR and CW/CCW modes
Pulse input frequency up to 300 KHz • Short-voltage, over-voltage, over-current
TTL compatible and optically isolated input and over temperature protection

Applications

Suitable for a wide range of stepping motors, from NEMA size 17 to 43. It can be used in various kinds of machines, such as X-Y tables, labeling machines, laser cutters, engraving machines, pick-place devices, and so on. Particularly adapt to the applications desired with low noise, low heating, high speed and high precision.

2. Specifications

Electric Specifications (Tj = 25) ℃

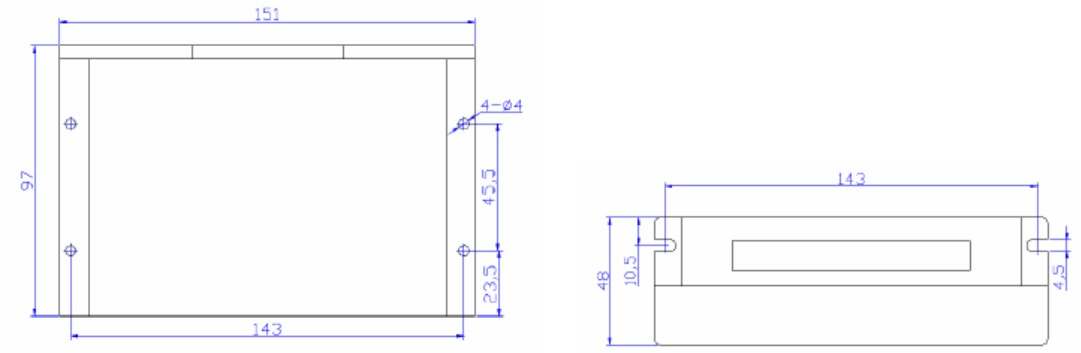
Parameters	2LA860			
	Min.	Typical	Max.	Unit
Output current	1.8	-	7.2(5.1RMS)	Amps
Supply voltage	18	48	60	VAC
	+24	+68	+80	VDC
Logic signal current	7	10	16	mA

Pulse input frequency	0	-	300	Khz
Isolation resistance	500	-	-	MΩ

Operating Environment and other Specifications

Cooling	Natural Cooling or Forced cooling	
Operating Environment	Environment	Avoid dust, oil fog and corrosive gases
	Ambient Temperature	0℃ — 50℃
	Humidity	40%RH — 90%RH
	Operating Temperature	70℃ Max
	Vibration	5.9m/s^2 Max
Storage Temperature	-20℃ — 65℃	
Weight	Approx. 570g (20.10 oz)	

Mechanical Dimensions (unit = mm, 1 inch = 25.4 mm)



(a) Front view (b) Side view

Figure 1: Mechanical specifications

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

Elimination of Heat

- * Driver's reliable working temperature should be <60℃, and motor working temperature should be<80℃
  * It is recommended to use automatic idle-current mode, namely current automatically reduce to 60% when motor stops, so as to reduce driver heating and motor heating;
  * It is recommended to mount the driver vertically to maximize heat sink area. Use forced cooling method to cool the system if necessary.

3. Pin Assignment and Description

The 2LA860 has two connectors, connector P1 for control signals connections, and connector P2 for power and motor connections. The following tables are brief descriptions of the two connectors.

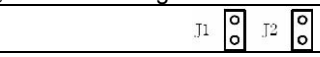
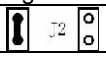
Control Signal Connector pins

Pin Function	Details
PUL +	**Pulse signal**: In single pulse (pulse/direction) mode, this input represents pulse signal,

PUL-	active at each rising or falling edge (set by inside jumper J1); 4-5Vwhen PUL-HIGH, 0-0.5V when PUL-LOW. In double pulse mode, this input represents clockwise (CW) pulse， active at high level or low level (set by inside jumper J1). For reliable response, pulse width should be longer than 1.5μs. Series connect resistors for current-limiting when +12V or +24V used. The same as DIR and ENA signals.
DIR+ (+5V)	**DIR signal**: In single-pulse mode, this signal has low/high voltage levels, representing two directions of motor rotation; in double-pulse mode (set by inside jumper J2), this signal is counter-clock (CCW) pulse， active at high level or low level (set by inside jumper J1). For reliable motion response, DIR signal should be ahead of PUL signal by 5μs at least. 4-5V when DIR-HIGH,0-0.5V when DIR-LOW. Please note that motion direction is also related to motor-driver wiring match. Exchanging the connection of two wires for a coil to the driver will reverse motion direction.
DIR- (DIR)	
ENA+	**Enable signal**: This signal is used for enabling/disabling the driver. High level (NPN control signal, PNP and Differential control signals are on the contrary, namely Low level for enabling.) for enabling the driver and low level for disabling the driver. Usually left UNCONNECTED (ENABLED).
ENA-	

Selecting Effective Pulse Edge or Effective Level and Control Signal Mode

There are two jumpers J1 and J2 inside the 2LA860 specifically for selecting effective pulse edge or effective level and control signal mode, as shown in figure 2. Default setting is PUL/DIR mode and upward-rising edge effective.

	
(a) J1, J2 open circuit PUL/DIR mode and active at upward-rising edge	(b) J1 short circuit, PUL/DIR mode and active at downward-falling edge
	
(c)J1 open circuit, J2 short circuit CW/CCW mode and active at high level (The fixed level)	(d) J1, J2short circuit CW/CCW mode and active at low level (The fixed level)

Connector P2 Configurations

Pin Function	Details
AC	Power supply, 18 ~ 60 VAC or 24~80 VDC, Including voltage fluctuation and EMF voltage.
AC	
Phase A	Motor coil A (leads A+ and A-)
Phase B	Motor coil B (leads B+ and B-)

4. Control Signal Connector (P1) Interface

The 2LA860 can accept differential and single-ended inputs (including open-collector and PNP output). The 2LA860 has 3 optically isolated logic inputs which are located on connector P1 to accept line driver control signals. These inputs are isolated to minimize or eliminate electrical noises coupled onto the drive control signals. Recommend use line driver control signals to increase noise immunity of the driver in interference environments. In the following figures, connections to open-collector and PNP signals are illustrated.

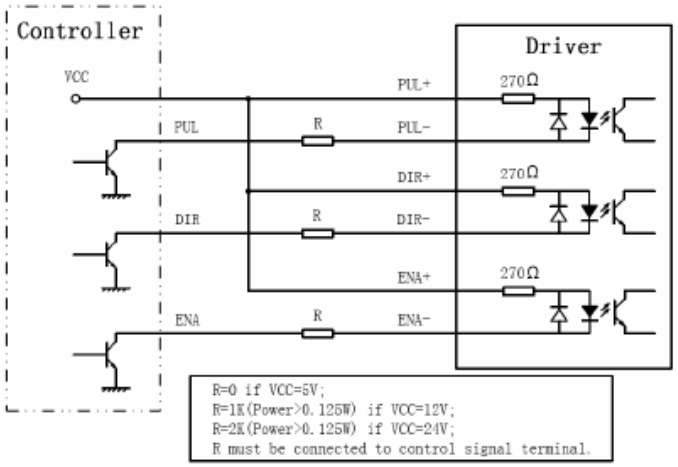


Figure 3: Connections to open-collector signal (common-anode)

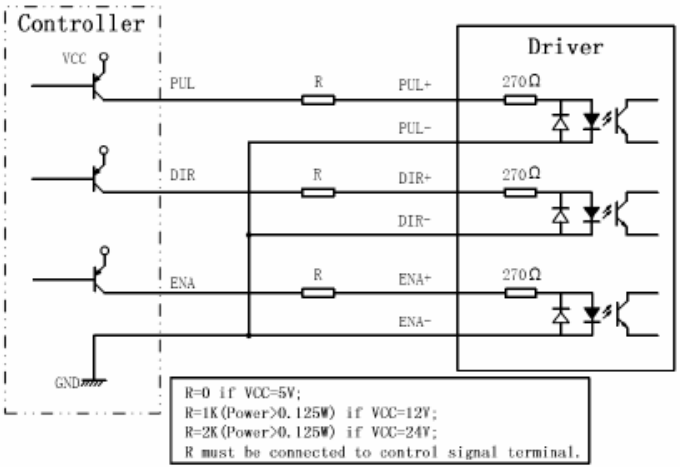


Figure 4: Connection to PNP signal (common-cathode)

5. Connecting the Motor

The 2LA860 can drive any 2-pahse and 4-pahse hybrid stepping motors.

Connections to 4-lead Motors

4 lead motors are the least flexible but easiest to wire. Speed and torque will depend on winding inductance. In setting the driver output current, multiply the specified phase current by 1.4 to determine the peak output current

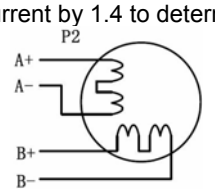


Figure 5: 4-lead Motor Connections

Connections to 6-lead Motors

Like 8 lead stepping motors, 6 lead motors have two configurations available for high speed or high torque operation. The higher speed configuration, or half coil, is so described because it uses one half of the motor's inductor windings. The higher torque configuration, or full coil, uses the full windings of the phases.

Half Coil Configurations

As previously stated, the half coil configuration uses 50% of the motor phase windings. This gives lower inductance, hence, lower torque output. Like the parallel connection of 8 lead motor, the torque output will be more stable at higher speeds. This configuration is also referred to as half chopper. In setting the driver output current multiply the specified per phase (or unipolar) current rating by 1.4 to determine the peak output current.

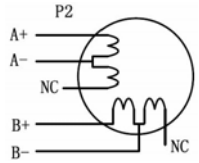


Figure 6: 6-lead motor half coil (higher speed) connections

Full Coil Configurations

The full coil configuration on a six lead motor should be used in applications where higher torque at lower speeds is desired. This configuration is also referred to as full copper. In full coil mode, the motors should be run at only 70% of their rated current to prevent over heating.

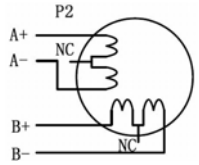


Figure 7: 6-lead motor full coil (higher torque) connections

Connections to 8-lead Motors

8 lead motors offer a high degree of flexibility to the system designer in that they may be connected in series or parallel, thus satisfying a wide range of applications.

Series Connections

A series motor configuration would typically be used in applications where a higher torque at lower speeds is required. Because this configuration has the most inductance, the performance will start to degrade at higher speeds. In series mode, the motors should also be run at only 70% of their rated current to prevent over heating.

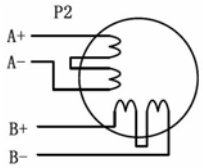


Figure 8: 8-lead motor series connections

Parallel Connections

An 8 lead motor in a parallel configuration offers a more stable, but lower torque at lower speeds. But because of the lower inductance, there will be higher torque at higher speeds. Multiply the per phase (or unipolar) current rating by 1.96, or the bipolar current rating by 1.4, to determine the peak output current.

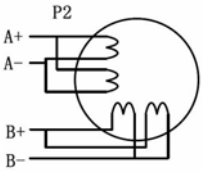


Figure 9: 8-lead motor parallel connections

6. Power Supply Selection

The 2LA860 can match medium and small size stepping motors (from Nema size 17 to 43) made by Leadshine or other motor manufactures around the world. To achieve good driving performances, it is important to select supply voltage and output current properly. Generally speaking, supply voltage determines the high speed performance of the motor, while output current determines the output torque of the driven motor (particularly at lower speed). Higher supply voltage will allow higher motor speed to be achieved, at the price of more noise and heating. If the motion speed requirement is low, it's better to use lower supply voltage to decrease noise, heating and improve reliability.

Regulated or Unregulated Power Supply

Both regulated and unregulated power supplies can be used to supply the driver. However, unregulated power supplies are preferred due to their ability to withstand current surge. If regulated power supplies (such as most switching supplies.) are indeed used, it is important to have large current output rating to avoid problems like current clamp, for example using 4A supply for 3A motor-driver operation. On the other hand, if unregulated supply is used, one may use a power supply of lower current rating than that of motor (typically 50%～70% of motor current). The reason is that the driver draws current from the power supply capacitor of the unregulated supply only during the ON duration of the PWM cycle, but not during the OFF duration. Therefore, the average current withdrawn from power supply is considerably less than motor current. For example, two 3A motors can be well supplied by one power supply of 4A rating.

Multiple Drivers

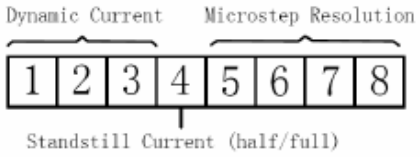
It is recommended to have multiple drivers to share one power supply to reduce cost, if the supply has enough capacity. To avoid cross interference, **DO NOT** daisy-chain the power supply input pins of the drivers. (Instead, please connect them to power supply separately.)

Selecting Supply Voltage

The power MOSFETS inside the 2LA860 can actually operate within 18 ~ 60VAC or +24 ~ +80VDC, including power input fluctuation and back EMF voltage generated by motor coils during motor shaft deceleration. Higher supply voltage can increase motor torque at higher speeds, thus helpful for avoiding losing steps. However, higher voltage may cause bigger motor vibration at lower speed, and it may also cause over-voltage protection or even driver damage. Therefore, it is suggested to choose only sufficiently high supply voltage for intended applications, and it is suggested to use power supplies with theoretical output voltage of 18 ~ 55VAC or +24 ~ +75VDC, leaving room for power fluctuation and back-EMF.

7. Selecting Microstep Resolution and Driver Output Current

This driver uses an 8-bit DIP switch to set microstep resolution, and motor operating current, as shown below:



Microstep Resolution Selection

Microstep resolution is set by SW5, 6, 7, 8 of the DIP switch as shown in the following table:

Microstep	Steps/rev.(for 1.8°motor)	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

Current Settings

For a given motor, higher driver current will make the motor to output more torque, but at the same time causes more heating in the motor and driver. Therefore, output current is generally set to be such that the motor will not overheat for long time operation. Since parallel and serial connections of motor coils will significantly change resulting inductance and resistance, it is therefore important to set driver output current depending on motor phase current, motor leads and connection methods.

Phase current rating supplied by motor manufacturer is important in selecting driver current, however the selection also depends on leads and connections.
The first three bits (SW1, 2, 3) of the DIP switch are used to set the dynamic current. Select a setting closest to your motor's required current.

Dynamic current setting

Ref Current (Screen printing)	Peak Current	SW1	SW2	SW3
2.00A	2.40A	ON	ON	ON
2.57A	3.08A	OFF	ON	ON
3.14A	3.77A	ON	OFF	ON
3.71A	4.45A	OFF	OFF	ON
4.28A	5.14A	ON	ON	OFF
4.86A	5.83A	OFF	ON	OFF
5.43A	6.52A	ON	OFF	OFF
6.00A	7.20A	OFF	OFF	OFF

Notes: Ref Current table on the screen printing is used for the users of the 2LA860 to refer. Due to motor inductance, the actual current in the coil may be smaller than the dynamic current setting, particularly under high speed condition.

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 60% of the selected dynamic current one second after the last pulse. Theoretically, this will reduce motor heating to 36% (due to $P=I^2*R$) of the original value. If the application needs a different standstill current, please contact Leadshine.

8. Wiring Notes

* In order to improve anti-interference performance of the driver, it is recommended to use twisted pair shield cable.
* To prevent noise incurred in PUL/DIR signal, pulse/direction signal wires and motor wires should not be tied up together. It is better to separate them by at least 10 cm, otherwise the disturbing signals generated by motor will easily disturb pulse direction signals, causing motor position error, system instability and other failures.
* If a power supply serves several drivers, separately connecting the drivers is recommended instead of daisy-chaining.
* It is prohibited to pull and plug connector P2 while the driver is powered ON, because there is high current flowing through motor coils (even when motor is at standstill). Pulling or plugging connector P2 with power on will cause extremely high back-EMF voltage surge, which may damage the driver.

9. Typical Connection

A complete stepping system should include stepping motor, stepping driver, power supply and controller (pulse generator). A typical connection is shown as figure 10.

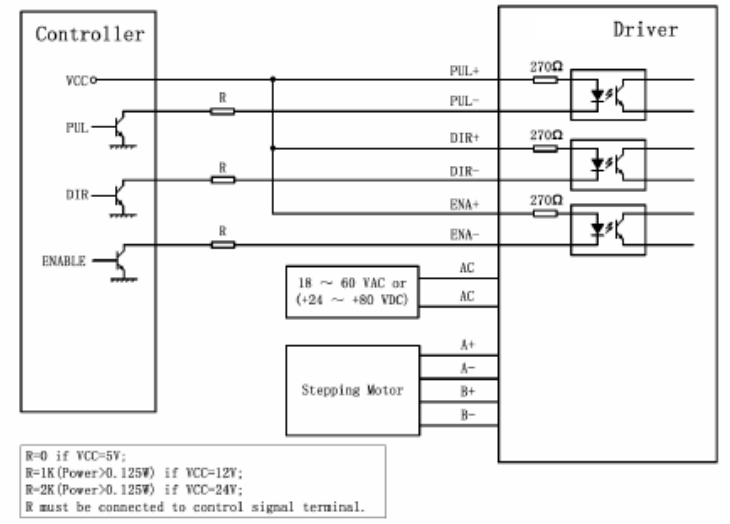


Figure 10: Typical connection

10. Sequence Chart of Control Signals

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

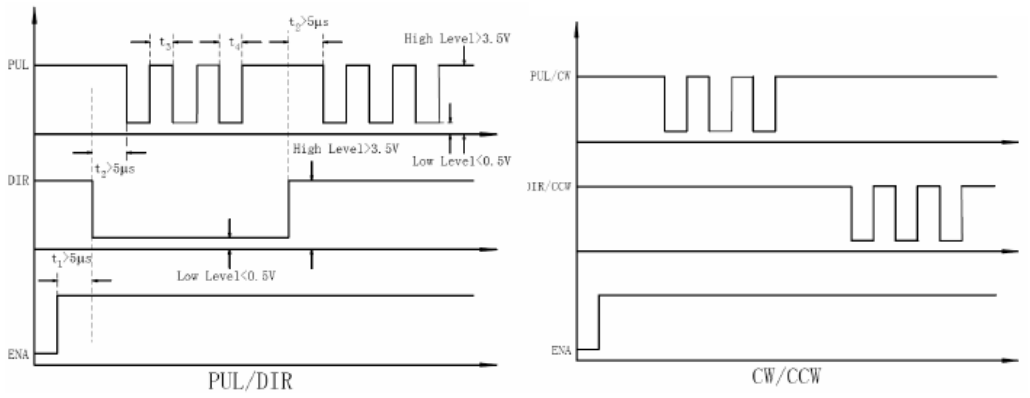


Figure 11: Sequence chart of control signals

Remark:

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

b) t2: DIR must be ahead of PUL effective edge by 5μs to ensure correct direction;

c) t3: Pulse width not less than 1.5μs;

d) t4: Low level width not less than 1.5μs.

11. Protection Functions

To improve reliability, the driver incorporates some built-in protections features.

Lowt-voltage and Over-voltage protection

When power supply voltage is lower than 13VAC or +18VDC, short-voltage protection will be activated and power indicator LED will turn off. When power supply voltage exceeds 67VAC or +94VDC, over-voltage protection will be activated and Alarm indicator LED will turn on.

Over-current Protection
Protection will be activated when continuous current reaches to 16A.

Short Circuit Protection
Protection will be activated in case of short circuit between motor coils or between motor coil and ground.

Over temperature Protection
Protection will be activated when driver temperature reaches to 75℃.
When above protections are active, the motor shaft will be free or the RED LED will turn red (except short-voltage protection). Reset the driver by repowering it to make it function properly after removing above problems.

12. Frequently Asked Questions

In the event that your driver doesn't operate properly, the first step is to identify whether the problem is electrical or mechanical in nature. The next step is to isolate the system component that is causing the problem. As part of this process you may have to disconnect the individual components that make up your system and verify that they operate independently. It is important to document each step in the troubleshooting process. You may need this documentation to refer back to at a later date, and these details will greatly assist our Technical Support staff in determining the problem should you need assistance.

Many of the problems that affect motion control systems can be traced to electrical noise, controller software errors, or mistake in wiring.

Problem Symptoms and Possible Causes

Symptoms	Possible Problems
Motor is not rotating	No power
	Microstep resolution setting is wrong
	DIP switch current setting is wrong
	Fault condition exists
	The driver is disabled
Motor rotates in the wrong direction	Motor phases may be connected in reverse
The driver in fault	DIP switch current setting is wrong
	Something wrong with motor coil
Erratic motor motion	Control signal is too weak
	Control signal is interfered
	Wrong motor connection
	Something wrong with motor coil
	Current setting is too small, losing steps
Motor stalls during acceleration	Current setting is too small
	Motor is undersized for the application
	Acceleration is set too high
	Power supply voltage too low
Excessive motor and driver heating	Inadequate heat sinking / cooling
	Automatic current reduction function not being utilized
	Current is set too high

TWO-PHASE

HYBRID STEPPER MOTOR DRIVER

Model: 2L110M

2L110M Summary

2L110M are high performance microstepping drivers incorporating the most advanced technology in the world today. They are suitable for driving any 2-phase and 4-phase hybrid step motors(current 7.8A/3.9A). By using advanced bipolar constant-current chopping technique, they can produce more motor torque at high speed than other drivers. The microstep capability allows stepping motors run at higher smoothness, less vibration and lower
noise. The 3-state current control feature leads to lower motor heating.

Applications

Applicable for automated machinery and equipment, for instance, air-driven inscription machines, labeling machines, cutting machines, laser engraving, plotter, medical instruments, and pick-place devices.

Features

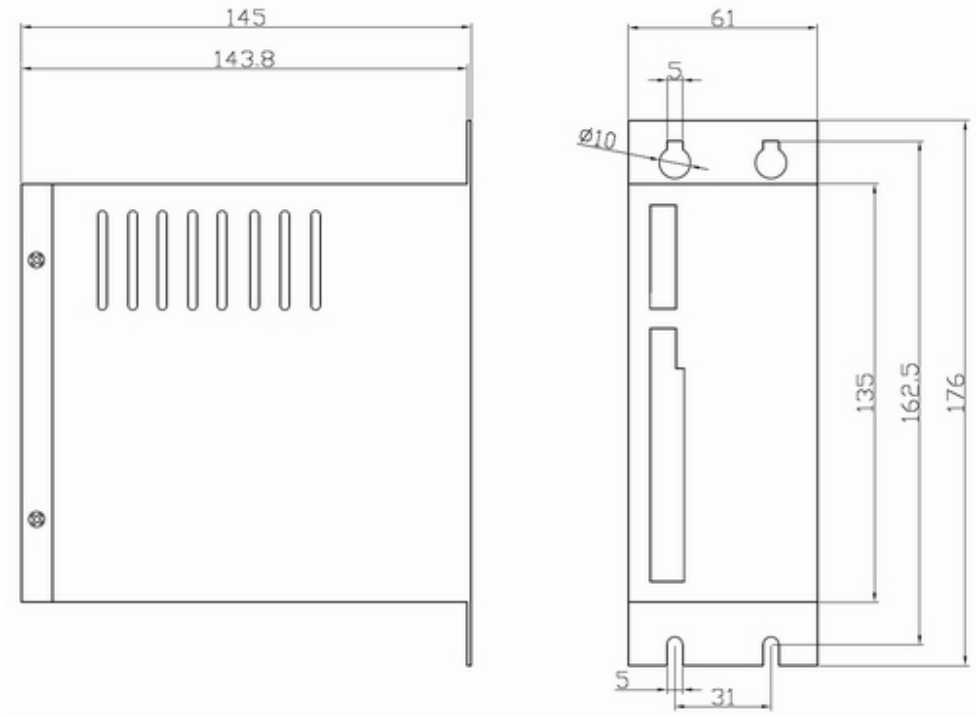
* High performance, low cost, extremely low noise;
* Both driver and motor low heating;
* Supply voltage up to 80-220VAC, current output up to 7.8A peak (RMS5.57A);
* TTL compatible and optically isolated input signals, pulse frequency up to 400 KHz;
* Automatic idle-current reduction;
* 16 selectable resolutions in decimal and binary;
* Suitable for 4,6,8 lead motors;
* DIP switch current setting with 8 different value;
* CW/CCW mode available (optional);
* Over-voltage, short-voltage, over-current, over-heating and short-circuit protection;
* Suited for NEMA34 and 43 motors.

3. Electrical and Mechanical Specifications

3.1 Electric Specifications (Tj = 25) ℃

Parameters	2L110M			
	Min.	Typical	Max.	Unit
Output current	0.45	-	7.8	Amps
Supply voltage	80	180	220	VAC
Logic signal current	7	10	16	mA
Pulse input frequency	0	-	400	Khz
Isolation resistance	500	-	-	MΩ

3.2 Mechanical Dimensions (unit = mm, 1 inch = 25.4 mm)



4. Driver Connectors, P1 and P2

Control Signal Connector P1 pins

Pin Function	Details
PUL + (+5V)	Pulse signal: in single pulse(pulse/direction) mode, this input represents pulse signal, effective for each upward-rising edge; in double pulse mode (pulse/pulse) this input represents clockwise(CW)pulse. For reliable response, pulse width should be longer than 1.2us.
PUL- (PUL)	
DIR+ (+5V)	DIR signal: in single-pulse mode, this signal has low/high voltage levels,

DIR- (DIR)	representing two directions of motor rotation; in double-pulse mode (set by SW5), this signal is counter-clock (CCW) pulse, effective on each rising edge. For reliable motion response, direction signal should be sent to driver 5us before the first pulse in the reverse motion direction.
ENA+ (+5V)	Enable signal: this signal is used for enabling/disabling the driver. High level for enabling the driver and low level for disabling the driver. Usually left unconnected(enabled).
ENA- (ENA)	
READY+	Output alarm signal positive: READY is a photocouper output from open-collector circuit, effectively output when driver operate normally, maximum permitted input voltage 30VDC; maximum output current 20mA, generally can be serial connected to PLC input terminal.
READY-	Output alarm signal negative.

Remark 1: *SW5 ON means PUL/DIR mode , OFF means CW/CCW (pulse/pulse) mode.*
Remark 2: *Please note motion direction is also related to motor-driver wiring match. Exchanging the connection of two wires for a coil to the driver will reverse motion direction. (for example, reconnecting motor A+ to driver A- and motor A- to driver A+ will invert motion direction).*

Power connector P2 pins

Pin Funtion	Details
AC	AC input, varies from 80V to 220V, recommended to use 180V. (**Pls use a transformer as a power, but not directly connect to condition AC**.)
AC	
Phase A	Motor coil A (leads A+ and A-)
Phase B	Motor coil B (leads B+ and B-)
PE	Connect ground terminal

5. Setting Driver Output Current and Microstep Resolution

5.1 Current Setting

SW6-9 of the DIP switch are used to set the current during motion (dynamic current)

Peak Current (A)	RMS (A)	SW6	SW7	SW8	SW9
0.45	**0.32**	OFF	OFF	OFF	OFF
0.63	**0.45**	OFF	OFF	OFF	ON
1.41	**1.00**	OFF	OFF	ON	OFF
1.88	**1.34**	OFF	OFF	ON	ON
2.33	**1.66**	OFF	ON	OFF	OFF
2.85	**2.04**	OFF	ON	OFF	ON
3.23	**2.31**	OFF	ON	ON	OFF
3.75	**2.68**	OFF	ON	ON	ON
4.26	**3.04**	ON	OFF	OFF	OFF
4.65	**3.32**	ON	OFF	OFF	ON
5.18	**3.70**	ON	OFF	ON	OFF

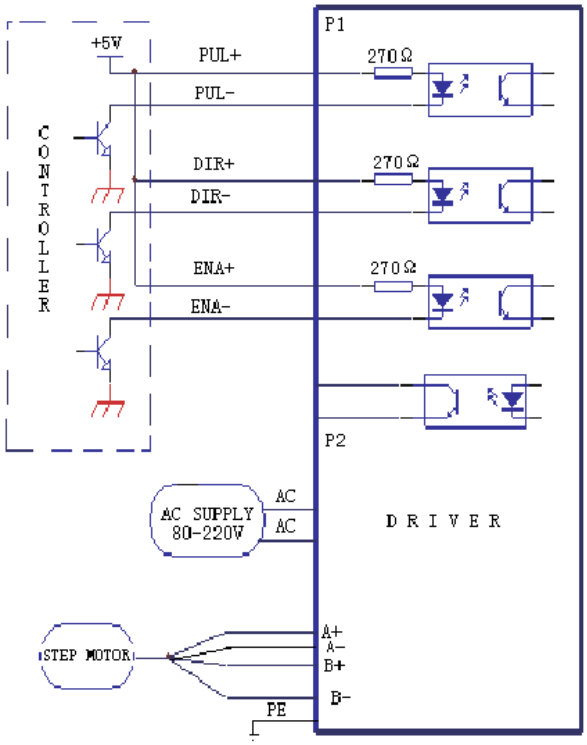
5.55	**3.96**	ON	OFF	ON	ON
6.15	**4.39**	ON	ON	OFF	OFF
6.60	**4.71**	ON	ON	OFF	ON
7.20	**5.14**	ON	ON	ON	OFF
7.80	**5.57**	ON	ON	ON	ON

5.2 Microstep Resolution Selection

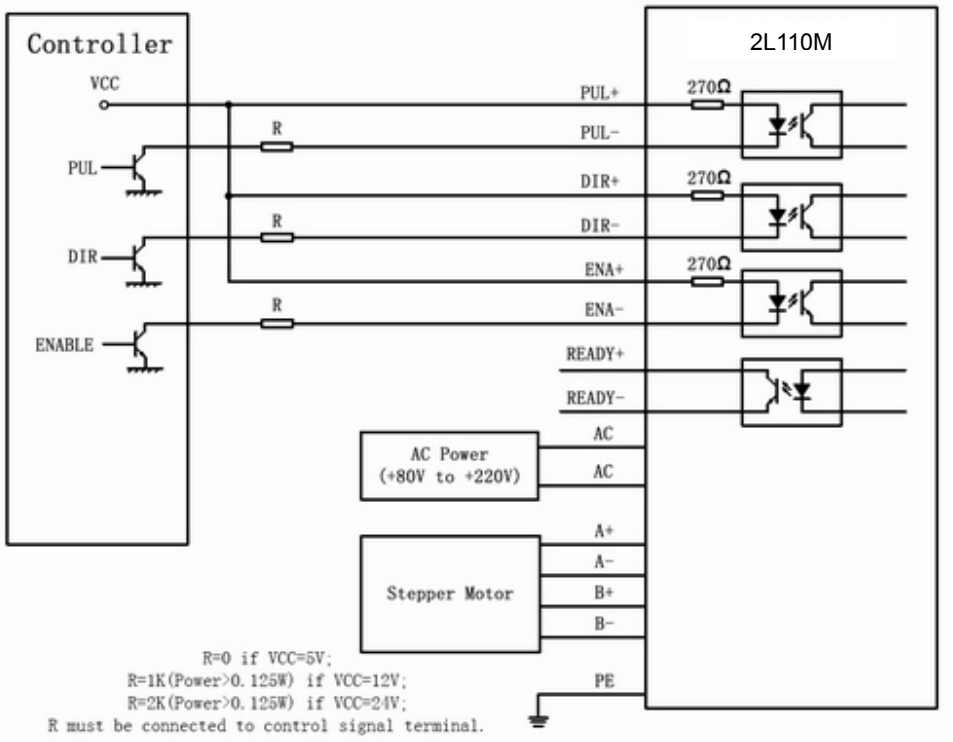
Microstep resolution is specified by 1, 2, 3, 4 DIP switches as shown in the following table:

usteps/rev.(1.8°/rev)	SW1	SW2	SW3	SW4
400	ON	ON	ON	ON
500	OFF	ON	ON	ON
600	ON	OFF	ON	ON
800	OFF	OFF	ON	ON
1000	ON	ON	OFF	ON
1200	OFF	ON	OFF	ON
1600	ON	OFF	OFF	ON
2000	OFF	OFF	OFF	ON
2400	ON	ON	ON	OFF
3200	OFF	ON	ON	OFF
4000	ON	OFF	ON	OFF
5000	OFF	OFF	ON	OFF
6000	ON	ON	OFF	OFF
6400	OFF	ON	OFF	OFF
8000	ON	OFF	OFF	OFF
10000	OFF	OFF	OFF	OFF

6. Typical Wiring Diagram



7 Typical Connections



User's Manual

For

2L130M

High Performance & Low Noise Microstepping Driver

Version 1.0

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

MotionKing(China) Motor Industry Co., Ltd.

T: (86)519-8988 6261 F: (86)519-8515 1172

Web site: www.MotionKing.com E-Mail: sales@MotionKing.com

The content in this manual has been carefully prepared and is believed to be accurate, but no responsibility is assumed for inaccuracies.

MotionKing reserves the right to make changes without further notice to any products herein to improve reliability, function or design. MotionKing does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under its patent rights of others.

MotionKing's general policy does not recommend the use of its products in life support or aircraft applications wherein a failure or malfunction of the product may directly threaten life or injury. According to MotionKing's terms and conditions of sales, the user of MotionKing's products in life support or aircraft applications assumes all risks of such use and indemnifies MotionKing against all damages.

Table of contents

1. Introduction, Features and Applications

Introduction

The 2L130M is a high performance and low noise microstepping driver based on pure-sinusoidal current control technology. It's suitable for driving 2-phase and 4-phase hybrid stepping motors. By using advanced bipolar constant-current chopping technique, the 2L130M can output more torque than other drivers at high speed. The microstep capability allows stepping motors to run at higher smoothness, less vibration and lower noise. Its pure-sinusoidal current control technology allows coil current to be well controlled with relatively small current ripple, therefore smaller motor noise and less motor heating can be achieved. In addition, the 2L130M has a built-in EMI filter which can make the driver operate with higher reliability.

Features

- High quality, cost-effective
- Low motor noise and heating
- Supply voltage up to 220VAC (310VDC)
- Output current up to 8.2A(5.86 ARMS)
- TTL compatible and Opto-isolated inputs
- Automatic idle-current reduction
- Input frequency up to 200KHz
- 15 microstep resolutions selectable
- Suitable for 2-phase and 4-phase stepping motors
- DIP switch microstep & current settings
- Support PUL/DIR & CW/CCW modes

Applications

Suitable for large and medium automation machines and equipments, such as engraving machines, labeling machines, cutting machines, laser phototypesetting systems, plotting instruments, NC machines, pick-place devices, and so on. Particularly adapt to the applications desired with low motor noise, low motor heating, high speed and high precision.

2. Specifications

Electrical Specifications (25℃/77℉)

Parameters	2L130M			
	Min	Typical	Max	Unit
Output current	0.7 (0.5A RMS)	-	8.2(5.86A RMS)	A
Supply voltage	150(210)	180(250)	220(310)	VAC(VDC)
Logic signal current	7	10	16	mA
Pulse input frequency	0	-	200	KHz
Isolation resistance	500			MΩ

Mechanical Specifications (unit: mm [inch])

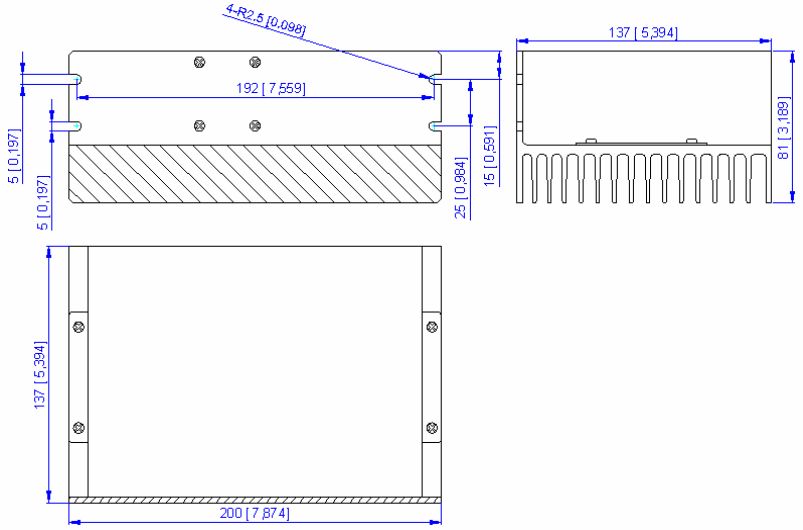


Figure 1: Mechanical specifications

Operating Environment and Other Specifications

Cooling	Natural Cooling or Forced cooling	
Operating Environment	Environment	Avoid dust, oil fog and corrosive gases
	Ambient Temperature	0℃ — 50℃ (32℉ — 122℉)
	Humidity	40%RH — 90%RH
	Operating Temperature	70℃ (158℉) Max
	Vibration	5.9m/s^2 Max
Storage Temperature	-20℃ — 65℃ (-4℉ — 149℉)	
Weight	Approx. 1.0 kg (35.25 oz)	

Elimination of Heat

- Driver's reliable working temperature should be <70℃(158℉), and motor working temperature should be <80℃(176℉);
- Forced cooling the driver if it's necessary.

3. Pin Assignment and Description

The 2L130M has two connectors, connector P1 for control signals connections, and connector P2 for power and motor connections. The following tables are brief descriptions of the two connectors of the 2L130M. More detailed descriptions of the pins and related issues are presented in section 4, 5, 9.

Connector P1 Configurations

Pin Function	Details
PUL+(+5V)	Pulse signal: In single pulse (pulse/direction) mode, this input represents pulse signal, effective for each rising edge; 4-5V when PUL-HIGH, 0-0.5V when PUL-LOW. In double pulse mode (pulse/pulse) , this input represents clockwise (CW) pulse，effective for high level. For reliable response, pulse width should be longer than 1.2μs. Series connect resistors for current-limiting when +12V or +24V used.
PUL-(PUL)	
DIR+(+5V)	DIR signal: In single-pulse mode, this signal has low/high voltage levels, representing two directions of motor rotation; in double-pulse mode(set by inside jumper), this signal is counter-clock (CCW) pulse, effective for high level. For reliable motion response, DIR signal should be ahead of PUL signal by 5μs at least. 4-5V when DIR-HIGH, 0-0.5V when DIR-LOW. Please note that motion direction is also related to motor-driver wiring match. Exchanging the connection of two wires for a coil to the driver will reverse motion direction.
DIR-(DIR)	
ENA+(+5V)	Enable signal: This signal is used for enabling/disabling the driver. High level (NPN control signal, PNP and Differential control signals are on the contrary, namely Low level for enabling.) for enabling the driver and low level for disabling the driver. Usually left **UNCONNECTED (ENABLED)**.
ENA-(ENA)	
FAULT+	Fault signal positive: FAULT+ is an optocoupler output from open-collector circuit, maximum permitted input voltage is 30VDC; maximum output current 20mA. It generally can be serial connected to PLC input terminal.
FAULT-	Fault signal negative.

Connector P2 Configurations

Pin Function	Details
PE	Ground terminal. Recommend connect this port to the ground for better safety.
AC	AC power supply inputs. Recommend use isolation transformers with theoretical output voltage of 150～220 VAC.
AC	
A+, A-	Motor phase A.
B+, B-	Motor phase B.

4. Control Signal Connector (P1) Interface

The 2L130M can accept differential and single-ended input signals (including open-collector and PNP output). The 2L130M has 3 optically isolated logic inputs which are located on connector P1 to accept line driver control signals. These inputs are isolated to minimize or eliminate electrical noises coupled onto the drive control signals. Recommend use line driver control signals to increase noise immunity of the driver in interference environments. In the following figures, connections to open-collector and PNP signals are illustrated.

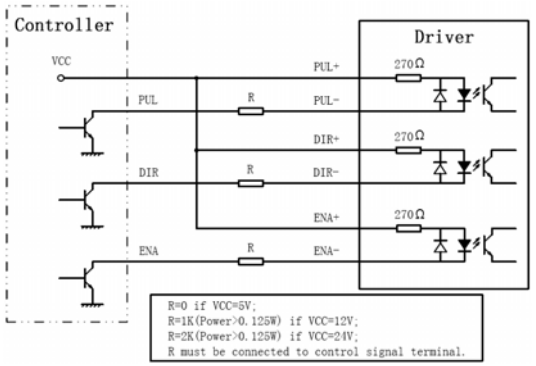


Figure 2: Connections to open-collector signal (common-anode)

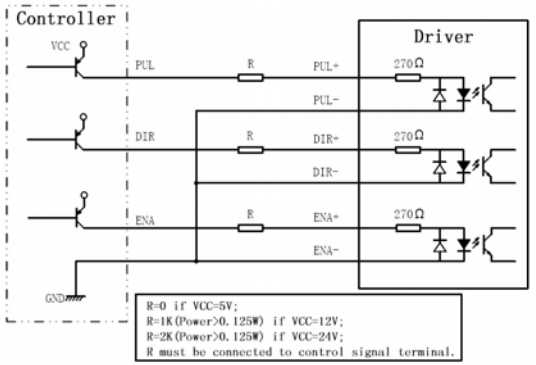


Figure 3: Connection to PNP signal (common-cathode)

5. Connecting the Motor

The 2L130M can drive 2-pahse and 4-pahse hybrid stepping motors.

Connections to 4-lead Motors

4 lead motors are the least flexible but easiest to wire. Speed and torque will depend on winding inductance. In setting the driver output current, multiply the specified phase current by 1.4 to determine the peak output current.

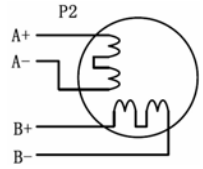


Figure 4: 4-lead Motor Connections

Connections to 6-lead Motors

Like 8 lead stepping motors, 6 lead motors have two configurations available for high speed or high torque operation. The higher speed configuration, or half coil, is so described because it uses one half of the motor's inductor windings. The higher torque configuration, or full coil, uses the full windings of the phases.

Half Coil Configurations

As previously stated, the half coil configuration uses 50% of the motor phase windings. This gives lower inductance, hence, lower torque output. Like the parallel connection of 8 lead motor, the torque output will be more stable at higher speeds. This configuration is also referred to as half chopper. In setting the driver output current multiply the specified per phase (or unipolar) current rating by 1.4 to determine the peak output current.

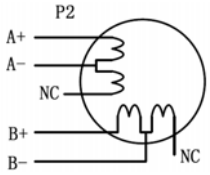


Figure 5: 6-lead motor half coil (higher speed) connections

Full Coil Configurations

The full coil configuration on a six lead motor should be used in applications where higher torque at lower speeds is desired. This configuration is also referred to as full copper. In full coil mode, the motors should be run at only 70% of their rated current to prevent over heating.

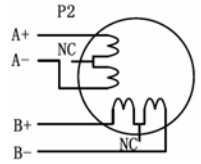


Figure 6: 6-lead motor full coil (higher torque) connections

Connections to 8-lead Motors

8 lead motors offer a high degree of flexibility to the system designer in that they may be connected in series or parallel, thus satisfying a wide range of applications.

Series Connections

A series motor configuration would typically be used in applications where a higher torque at lower speeds is required. Because this configuration has the most inductance, the performance will start to degrade at higher speeds. In series mode, the motors should also be run at only 70% of their rated current to prevent over heating.

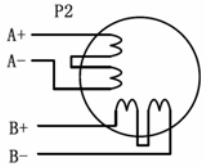


Figure 7: 8-lead motor series connections

Parallel Connections

An 8 lead motor in a parallel configuration offers a more stable, but lower torque at lower speeds. But because of the lower inductance, there will be higher torque at higher speeds. Multiply the per phase (or unipolar) current rating by 1.96, or the bipolar current rating by 1.4, to determine the peak output current.

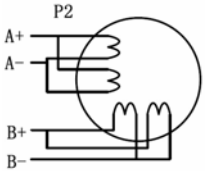


Figure 8: 8-lead motor parallel connections

6. Power Supply Selection

The 2L130M can match large and medium size stepping motors (from NEMA size 34 to 42) made by MotionKing or other motor manufactures around the world. To achieve good driving performances, it is important to select supply voltage and output current properly. Generally speaking, supply voltage determines the high speed performance of the motor, while output current determines the output torque of the driven motor (particularly at lower speed).

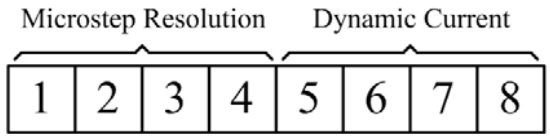
Attention: For safety and to improve reliability, it is recommended to use isolation transformer instead of directly use network source to supply the 2L130M. Recommend use isolation transformers with theoretical output voltage of 150～220VAC or 210～310VDC, leaving room for power fluctuation and back-EMF. And the power of the isolation transformer should larger than 500 watts.

Selecting Supply Voltage

The 2L130M can actually operate within 80～220VAC or 112～310VDC, including power input fluctuation and back EMF voltage generated by motor coils during motor shaft deceleration. Higher supply voltage can increase motor torque at higher speeds, thus helpful for avoiding losing steps. However, higher voltage may cause bigger motor vibration at lower speed, and it may also cause over-voltage protection or even driver damage. Therefore, it is suggested to choose only sufficiently high supply voltage for intended applications, and it is suggested to use power supplies with theoretical output voltage of 150～220VAC or 210～310VDC, leaving room for power fluctuation and back-EMF. If the motion speed requirement is low, it's better to use lower supply voltage to decrease noise, heating and improve reliability.

7. Selecting Microstep Resolution and Driver Output Current

This driver uses a 8-bit DIP switch to set microstep resolution, motor operating current and control signal mode as shown in the following figure:



Microstep Resolution Selection

Microstep resolution is set by SW1, 2, 3, 4 of the DIP switch as shown in the following table:

Steps/rev.(for 1.8°motor)	SW1	SW2	SW3	SW4
400	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

Current Settings

For a given motor, higher driver current will make the motor to output more torque, but at the same time causes more heating in the motor and driver. Therefore, output current is generally set to be such that the motor will not overheat for long time operation. Since parallel and serial connections of motor coils will significantly change resulting inductance and resistance, it is therefore important to set driver output current depending on motor phase current, motor leads and connection methods. Phase current rating supplied by motor manufacturer is important in selecting driver current, however the selection also depends on leads and connections.

The latter four bits (SW5, 6, 7, 8) of the DIP switch are used to set the dynamic current. Select a setting closest to your motor's required current.

Dynamic Current Setting

Peak current (A)	RMS (A)	SW5	SW6	SW7	SW8

0.7A	**0.5A**	OFF	OFF	OFF	OFF
1.2A	**0.86A**	OFF	OFF	OFF	ON
1.72A	**1.23A**	OFF	OFF	ON	OFF
2.2A	**1.57A**	OFF	OFF	ON	ON
2.75A	**1.96A**	OFF	ON	OFF	OFF
3.28A	**2.34A**	OFF	ON	OFF	ON
3.75A	**2.68A**	OFF	ON	ON	OFF
4.22A	**3.01A**	OFF	ON	ON	ON
4.72A	**3.37A**	ON	OFF	OFF	OFF
5.2A	**3.72A**	ON	OFF	OFF	ON
5.78A	**4.13A**	ON	OFF	ON	OFF
6.24A	**4.46A**	ON	OFF	ON	ON
6.78A	**4.84A**	ON	ON	OFF	OFF
7.31A	**5.22A**	ON	ON	OFF	ON
7.81A	**5.58A**	ON	ON	ON	OFF
8.2A	**5.68A**	ON	ON	ON	ON

Notes: Due to motor inductance, the actual current in the coil may be smaller than the dynamic current setting, particularly under high speed condition.

Standstill Current

The 2L130M has automatic idle-current reduction function. The current automatically be reduced to 60% of the selected dynamic current setting 0.2 second after the last pulse. Theoretically, this will reduce motor heating to 36% (due to $P=I^2*R$) of the original value. If the application needs a different standstill current, please contact MotionKing.

8. Wiring Notes

- In order to improve anti-interference performance of the driver, it is recommended to use twisted pair shield cable.
- To prevent noise incurred in pulse/dir signal, pulse/direction signal wires and motor wires should not be tied up together. It is better to separate them by at least 10 cm, otherwise the disturbing signals generated by motor will easily disturb pulse direction signals, causing motor

position error, system instability and other failures.

- If a power supply serves several drivers, separately connecting the drivers is recommended instead of daisy-chaining.
- It is prohibited to pull and plug connector P2 while the driver is powered ON, because there is high current flowing through motor coils (even when motor is at standstill). Pulling or plugging connector P2 with power on will cause extremely high back-EMF voltage surge, which may damage the driver.

9. Typical Connection

A complete stepping system should include stepping motor, stepping driver, power supply and controller (pulse generator). A typical connection is shown as figure 9.

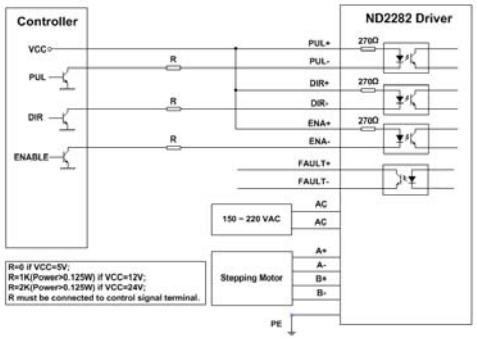


Figure 9: Typical connection

10. Sequence Chart of Control Signals

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

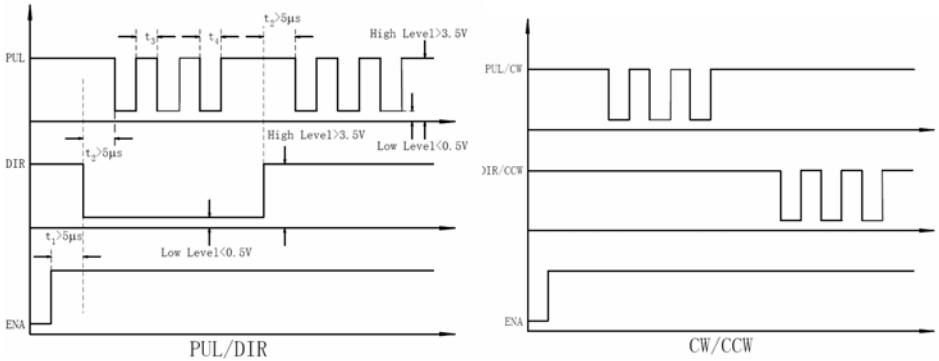


Figure 10: Sequence chart of control signals

Remark:

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

(2) t2: DIR must be ahead of PUL effective edge by at least 5μs to ensure correct direction;

(3) t3: Pulse width not less than 1.5μs;

(4) t4: Low level width not less than 1.5μs.

11. Protection Functions

To improve reliability, the driver incorporates some built-in protection features.

Over-voltage and Short-voltage Protections

When power supply voltage exceeds 286VAC or 405VDC, over-voltage protection will be activated and the RED ALARM LED will light. When power supply voltage is lower than 56VAC or 80VDC, short-voltage protection will be activated and the RED ALARM LED will light.

Short Circuit Protection

Protection will be activated in case of short circuit between motor coils or between motor coil and ground.

Wrong Motor Connection Protection

Protection will be activated when the motor is connected in a wrong way.

Over temperature Protection

Protection will be activated when driver temperature reaches to 75℃.

When above protections are active, the motor shaft will be free and the RED ALARM LED will light. Reset the driver by repowering it to make it function properly after removing above problems.

12. Frequently Asked Questions

In the event that your 2L130M doesn't operate properly, the first step is to identify whether the problem is electrical or mechanical in nature. The next step is to isolate the system component that is causing the problem. As part of this process you may have to disconnect the individual components that make up your system and verify that they operate independently. It is important to document each step in the troubleshooting process. You may need this documentation to refer back to at a later date, and these details will greatly assist our Technical Support staff in determining the problem should you need assistance.

Many of the problems that affect motion control systems can be traced to electrical noise, controller software errors, or mistake in wiring.

Problem Symptoms and Possible Causes

Symptoms	Possible Problems
Motor is not rotating	No power
	Microstep resolution setting is wrong
	DIP switch current setting is wrong
	Fault condition exists
	The driver is disabled
Motor rotates in the wrong direction	Motor phases may be connected in reverse
The driver in fault	DIP switch current setting is wrong
	Something wrong with motor coil
Erratic motor motion	Control signal is too weak
	Control signal is interfered
	Wrong motor connection
	Something wrong with motor coil

	Current setting is too small, losing steps
Motor stalls during acceleration	Current setting is too small
	Motor is undersized for the application
	Acceleration is set too high
	Power supply voltage too low
Excessive motor and driver heating	Inadequate heat sinking / cooling
	Automatic current reduction function not being utilized
	Current is set too high