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User Manual of 2MA2282

High Performance Microstepping Driver

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Contents

1 Introduction, Features and Application

1.1 Introduction

The 2MA2282 is a high performance and low noise microstepping driver based on pure-sinusoidal current control technology. By using advanced bipolar constant-current chopping technique, the 2MA2282 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. It's 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 2MA2282 has a built-in EMI filter which can make the driver operate with higher reliability. It is suitable for driving 2-phase and 4-phase hybrid stepping motors, so the Nema34, Nema42 and Nema51 stepper motors with a 0.7A-8.2A current will be suitable

1.2 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

1.3 Application

Suitable for large and medium automation machines and devices, such as engraving machines, labeling machines, cutting machines, laser phototypesetting systems, plotting instruments, CNC lathe, 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

2.1 Electrical Specifications

Parameters	2MA2282			
	Min	**Typical**	**Max**	**Unit**
Output current	0.7(0.5A RMS)	-	8.2(5.86A RMS)	A
Supply voltage	150	180	220	VAC
Logic signal current	7	10	16	mA
Pulse input frequency	0	-	200	KHz
Isolation resistance	500			MΩ

2.2 Operating Environment & 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. 1000g	

2.3 Mechanical Specification

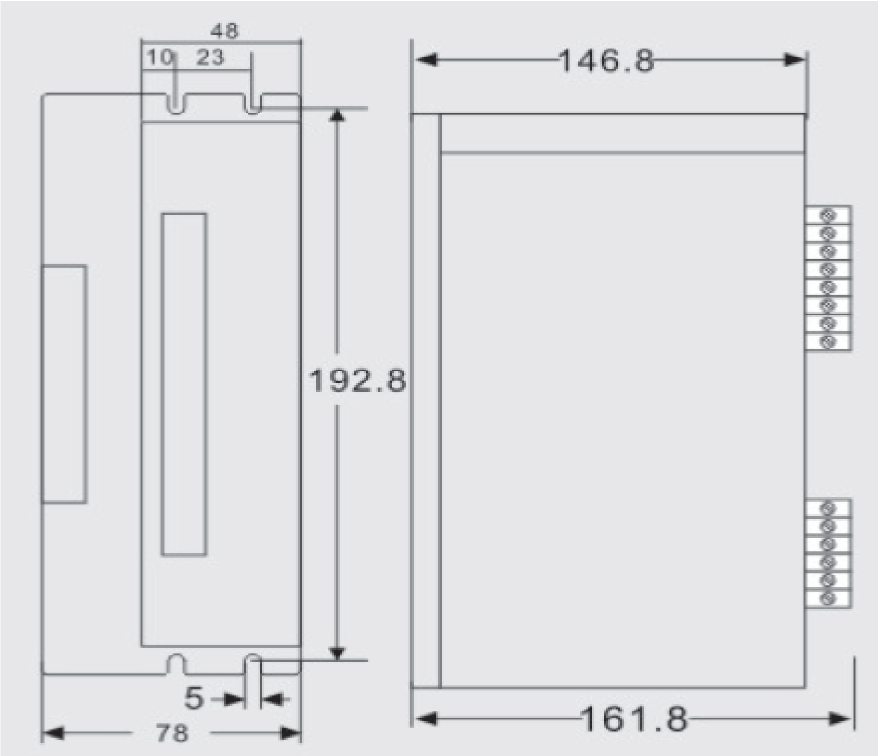


Figure 2-1 Mechanical Specification

Note: Recommend use side mounting for better heat dissipation Elimination of Heat

- Reliable working temperature of driver should be <70℃(158℉), and motor working temperature should be <80℃(176℉);
- 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 2MA2282 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 2MA2282.

3.1 Connector P1 Configurations

Pin Function	Details
PUL+	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 1.2 μs. Series connect resistors for current-limiting when +12V or +24V used.
PUL-	
DIR+	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 5 μs 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-	
ENA+	(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-	
FAULT+	Fault signal positive: FAULT+ is an opto-coupler 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.

3.2 Connector P2 Configurations

Pin Function	Details
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
PE	Ground terminal. Recommend connect this port to the ground for better safety.

4 Connections to Stepping Motors

4.1 Connections to 4-lead Motors

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

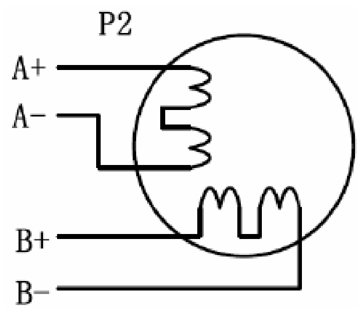


Figure 4-1: 4-lead Motor Connections

4.2 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.

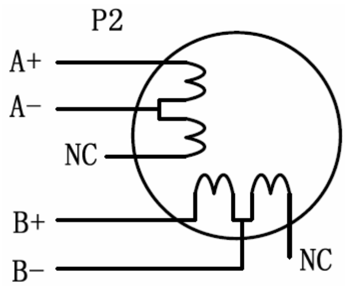


Figure 4-2: 6-lead motor half coil (higher speed) connections

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 overheating.

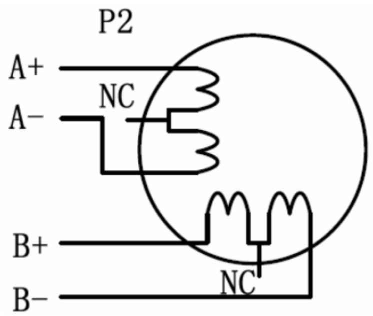


Figure 4-3: 6-lead motor full coil (higher torque) connections

4.3 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 overheating.

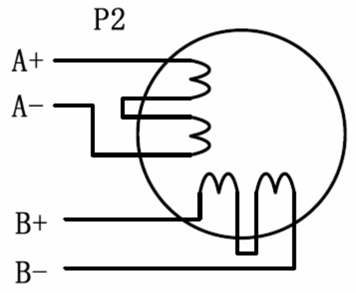


Figure 4-4: 8-lead motor series connections

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 per phase (or unipolar) current rating by 1.96, or the bipolar current rating by 1.4, to determine the peak output current.

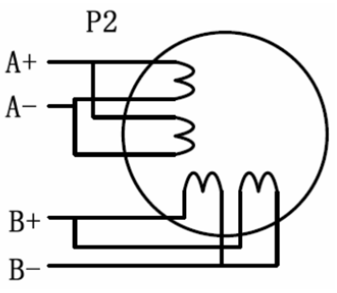
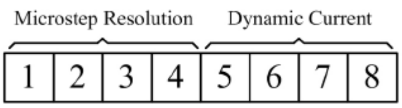


Figure 4-5: 8-lead motor parallel connections

5 Microstep Resolution and Output Current Settings

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



5.1 Microstep Resolution Selection

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

Microstep	Steps/rev.(for 1.8° motor)	SW1	SW2	SW3	SW4
2	400	ON	ON	ON	ON
2	400	OFF	ON	ON	ON
4	800	ON	OFF	ON	ON
8	1600	OFF	OFF	ON	ON
16	3200	ON	ON	OFF	ON
32	6400	OFF	ON	OFF	ON
64	12800	ON	OFF	OFF	ON
128	25600	OFF	OFF	OFF	ON
5	1000	ON	ON	ON	OFF
10	2000	OFF	ON	ON	OFF
20	4000	ON	OFF	ON	OFF
25	5000	OFF	OFF	ON	OFF
40	8000	ON	ON	OFF	OFF
50	10000	OFF	ON	OFF	OFF
100	20000	ON	OFF	OFF	OFF
125	25000	OFF	OFF	OFF	OFF

5.2 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's 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.

5.2.1 Dynamic Current Setting

Peak current(A)	RMS(A)	SW5	SW6	SW7	SW8
0.7	0.5	OFF	OFF	OFF	OFF
1.2	0.86	OFF	OFF	OFF	ON
1.72	1.23	OFF	OFF	ON	OFF
2.2	1.57	OFF	OFF	ON	ON
2.75	1.96	OFF	ON	OFF	OFF

3.28	**2.34**	OFF	ON	OFF	ON
3.75	**2.68**	OFF	ON	ON	OFF
4.22	**3.01**	OFF	ON	ON	ON
4.72	**3.37**	ON	OFF	OFF	OFF
5.2	**3.72**	ON	OFF	OFF	ON
5.78	**4.13**	ON	OFF	ON	OFF
6.24	**4.46**	ON	OFF	ON	ON
6.78	**4.84**	ON	ON	OFF	OFF
7.31	**5.22**	ON	ON	OFF	ON
7.81	**5.58**	ON	ON	ON	OFF
8.2	**5.68**	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.

5.2.2 Standstill Current Setting

The 2MA2282 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 us.

6 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.

7 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.

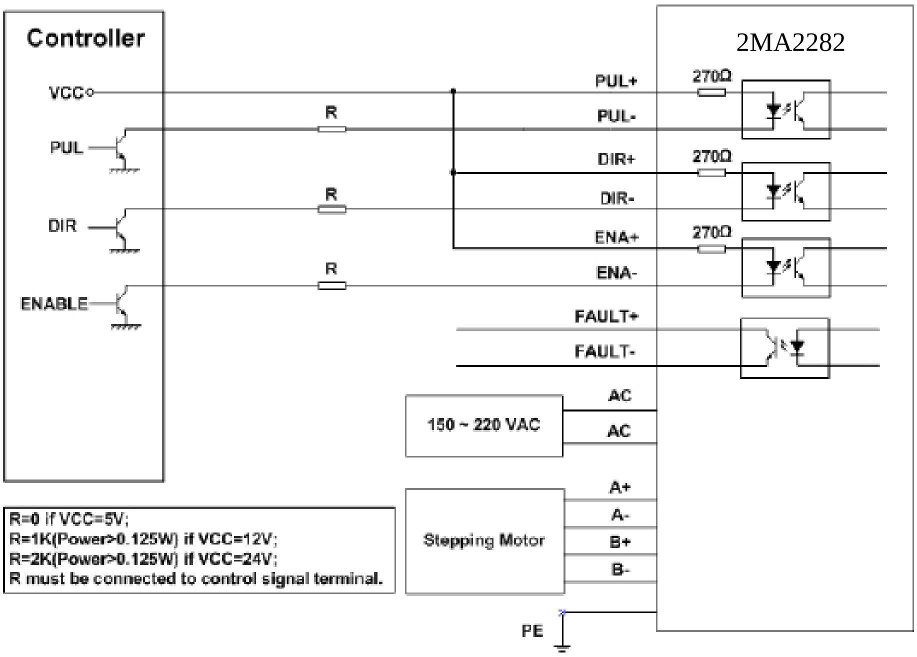


Figure 7-1: Typical connection

8 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:

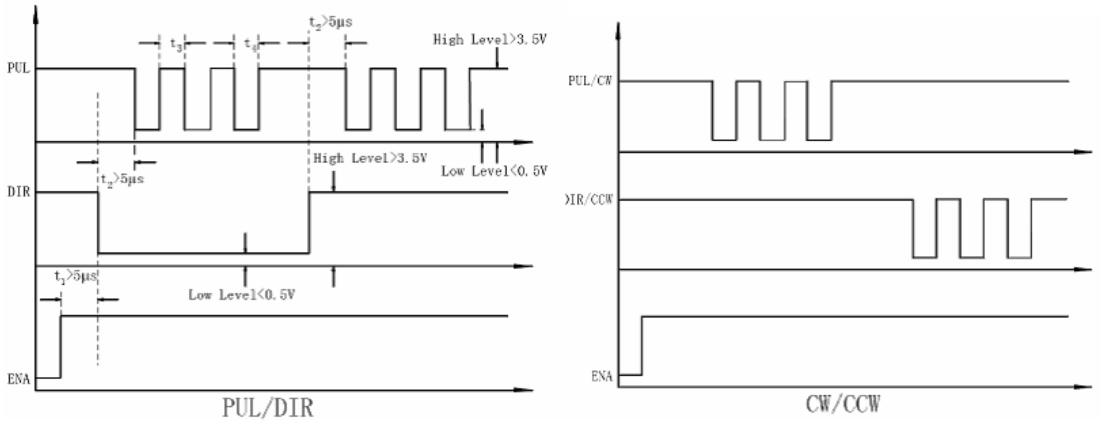


Figure 8-1: Sequence chart of control signals

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.

9 Protection Functions

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

Short-voltage and Over-voltage protection

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.

Over-current Protection

Protection will be activated when continuous current exceeds the limit.

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℃.

Note: 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.

10 Frequently Asked Questions

In the event that your driver does not 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. 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	Microstep resolution setting is wrong
	DIP switch current setting is wrong
	Fault condition exists
	The driver is disable
Motor rotates in the wrong direction	Motor phase 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