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User Manual of 3MA2283

High Performance Microstepping Driver

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Contents

1 Introduction, Features and Application

1.1 Introduction

The 3MA2283 is a high performance and low noise microstepping driver based on pure-sinusoidal current control technology. It is suitable for driving 3-phas hybrid stepping motors. By using advanced bipolar constant-current chopping technique, this driver 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.

1.2 Features

- High quality, cost-effective
- Low motor & driver heating
- Supply voltage **"150V AC** to **220V(peak) AC"** or **"210V DC** to **310V(peak) DC"**
- Output current up from **2A** to **8.3A**
- TTL compatible and optic-isolated inputs
- Automatic idle-current reduction
- Input frequency up to 400 KHz
- 16 microstep resolutions selectable
- Suitable for 3-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 noise, low vibration, high speed and high precision.

2 Specifications

2.1 Electrical Specifications

Parameters	3MA2283			
	Min	Typical	Max	Unit
Output current	2	-	8.3(5.9A RMS)	A
Supply voltage	150	180	220	VAC
Logic signal current	7	10	16	mA
Pulse input frequency	0	-	400	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/s2 Max
Storage Temperature	-20 ℃ — 65℃ (-4℉ — 149℉)	
Weight	Approx. 1500g	

2.3 Mechanical Specification

Unit = mm, 1 inch = 25.4 mm

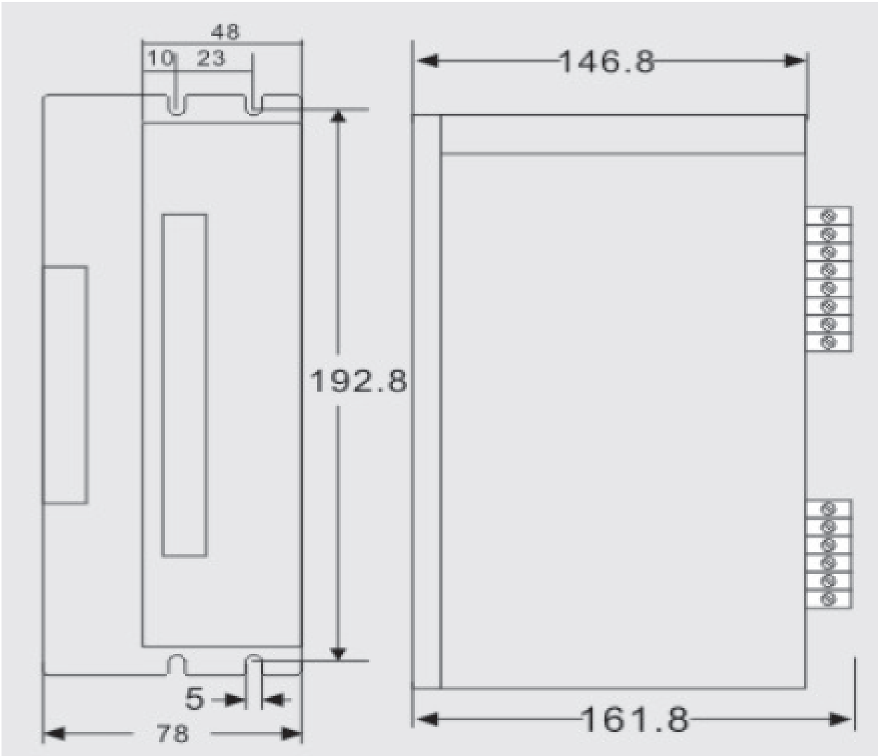

Figure 2-1 Mechanical Specifications

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 3M583 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. More detailed descriptions of the pins and related issues are presented in section 4, 5, 9.

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 μ s. 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 μ s 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, leaving room for power fluctuation and back-EMF.
AC	
U、V、W	Motor Phase U、V、W
PE	Ground terminal. Recommend connect this port to the ground for better safety.

Remark: Please note that motion direction is also related to motor-driver wiring matches. Exchanging the connections of two phases to the driver will reverse motor motion direction.

4 Connections to Stepping Motors

The connection between the driver and 3-phase stepping motors includes two different kinds of connections, namely delta-connection and star-connection. Using delta-connection, the performances of the motor under high speed condition are better, but the driver current is higher too (about 1.73 times the motor coil current); while using star-connection, the driver current equals to the motor coil current.

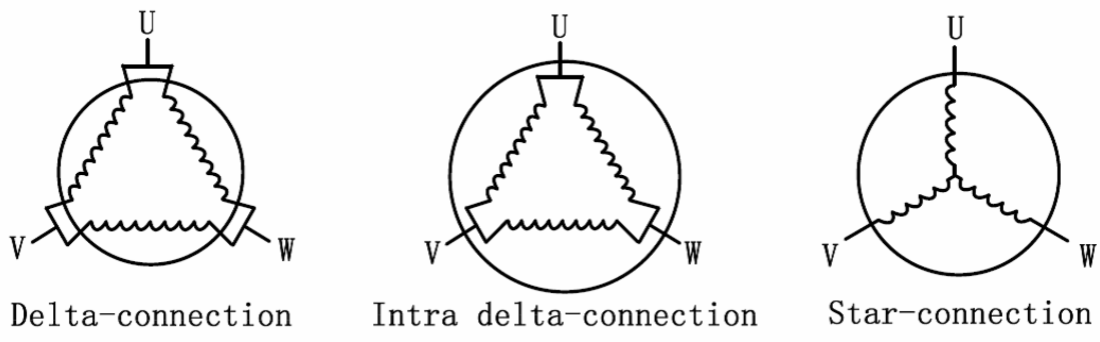

Figure 4-1 Motor connections

5 Microstep Resolution and Output Current Settings

This driver uses a 8-bit DIP switch to set microstep resolution, motor operating current and control signal mode:

5.1 Microstep Resolution Selection

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

Steps/rev.(for1.2° motor)	SW5	SW6	SW7	SW8
200	ON	ON	ON	ON
400	OFF	ON	ON	ON
1600	ON	OFF	ON	ON
3200	OFF	OFF	ON	ON
6400	ON	ON	OFF	ON
12800	OFF	ON	OFF	ON
25600	ON	OFF	OFF	ON
600	OFF	OFF	OFF	ON
1000	ON	ON	ON	OFF
1200	OFF	ON	ON	OFF
2000	ON	OFF	ON	OFF

4000	OFF	OFF	ON	OFF
5000	ON	ON	OFF	OFF
6000	OFF	ON	OFF	OFF
8000	ON	OFF	OFF	OFF
10000	OFF	OFF	OFF	OFF

5.2 Current Settings

For a given motor, higher driver current will make the motor 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. Phase current rating supplied by motor manufacturer is important in selecting driver current, however the selection also depends on leads and connections.

5.2.1 Dynamic Current Setting

The first four bits (SW1, 2, 3, 4) of the DIP switch are used to set the dynamic current. Select a setting closest to your motor's required current.

Peak current(A)	RMS(A)	SW1	SW2	SW3	SW4
2.0	**1.41**	OFF	OFF	OFF	OFF
2.4	**1.70**	ON	OFF	OFF	OFF
2.8	**1.98**	OFF	ON	OFF	OFF
3.2	**2.26**	ON	ON	OFF	OFF
3.6	**2.55**	OFF	OFF	ON	OFF
4.2	**2.97**	ON	OFF	ON	OFF
4.8	**3.39**	OFF	ON	ON	OFF
5.2	**3.68**	ON	ON	ON	OFF
5.6	**3.96**	OFF	OFF	OFF	ON
6.0	**4.24**	ON	OFF	OFF	ON
6.4	**4.53**	OFF	ON	OFF	ON
6.8	**4.81**	ON	ON	OFF	ON
7.2	**5.09**	OFF	OFF	ON	ON
7.6	**5.37**	ON	OFF	ON	ON
8.0	**5.66**	OFF	ON	ON	ON
8.3	**5.80**	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 3MA2283 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.

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.

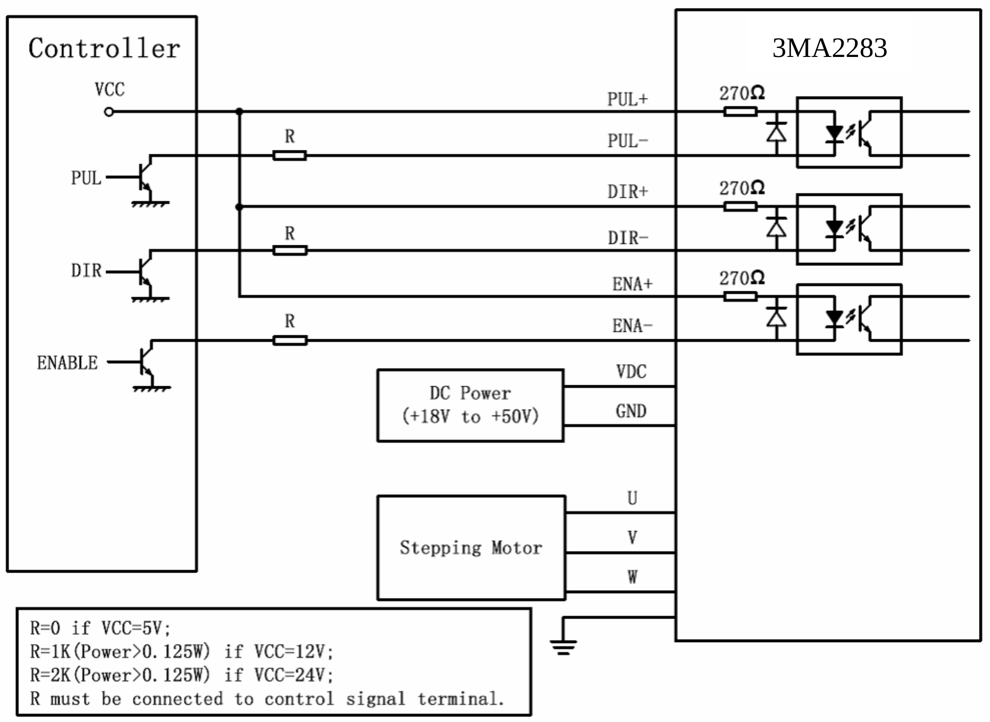

Figure 7-1: Typical connection

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:

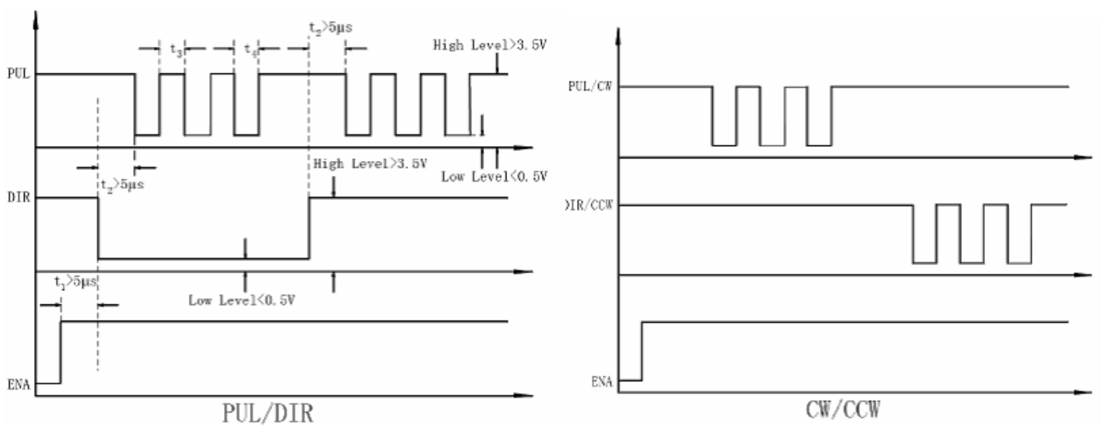

Figure 8-1: Sequence chart of control signals

Remark:

(1) t1: ENA must be ahead of DIR by at least 5 μs. 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 5 μs to ensure correct direction;

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

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

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 in case of over current which may otherwise damage the driver. **Attention:** Since there is no protection against power leads (+, -) reversal, it is critical to make sure that power supply leads correctly connected to the driver. Otherwise, the driver will be damaged instantly.

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