

# User Manual

# DM1182

## 2-Phase Digital Stepper Drive



Revision 1.1

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# 1 Introduction, Features and Applications

## 1.1 Introduction

The DM1182 is a high voltage, fully digital stepper drive developed with advanced DSP control algorithm based on the latest motion control technology. It has achieved a unique level of system smoothness, providing optimal torque and nulls mid-range instability. Its motor auto-identification and parameter auto-configuration feature offers quick setup to optimal modes with different motors. Compared with traditional analog drives, DM1182 can drive a stepper motor at much lower noise, lower heating, and smoother movement. Its unique features make DM1182 an ideal choice for high requirement applications.

## 1.2 Features

- Anti-Resonance provides optimal torque and nulls mid-range instability
- Motor auto-identification and parameter auto-configuration technology, offers optimal responses with different motors
- Multi-Stepping allows a low resolution step input to produce a higher microstep output, thus offers smoother motor movement
- Microstep resolutions programmable, from full-step to 102,400. It can also be set via DIP switches.
- Soft-start with no “jump” when powered on
- Supply voltage up to +150 VAC
- Output current programmable, from 0.5A to 8.2A. It can also be set via DIP switches.
- Pulse input frequency up to 200 KHz
- TTL compatible and optically isolated input
- Automatic idle-current reduction (Reduction rate can be software configured)
- Suitable for 2-phase and 4-phase motors
- Support PUL/DIR and CW/CCW modes
- Over-voltage, Under-voltage, over-current, phase-error protections

## 1.3 Applications

Suitable for a wide range of stepper motors, from NEMA size 34 to 51. It can be used in various applications such as laser cutters, laser markers, high precision X-Y tables, labeling machines, CNC router, etc. Its unique features make the DM1182 an ideal choice for applications that require both low-speed smoothness and high speed performances.

## 2 Specifications

### 2.1 Electrical Specifications ( $T_j = 25^\circ\text{C} / 77^\circ\text{F}$ )

Parameters	DM1182			Unit
	Min	Typical	Max	
Output current	0.5	-	8.2 (5.9 RMS)	A
Supply voltage Logic	80(113)	110(155)	150(212)	VAC(VDC)
signal current	7	10	20	mA
Pulse input frequency	0	-	200	kHz
Isolation resistance	500			MΩ

### 2.2 Mechanical Specifications (unit: mm [inch], 1 inch = 25.4 mm)

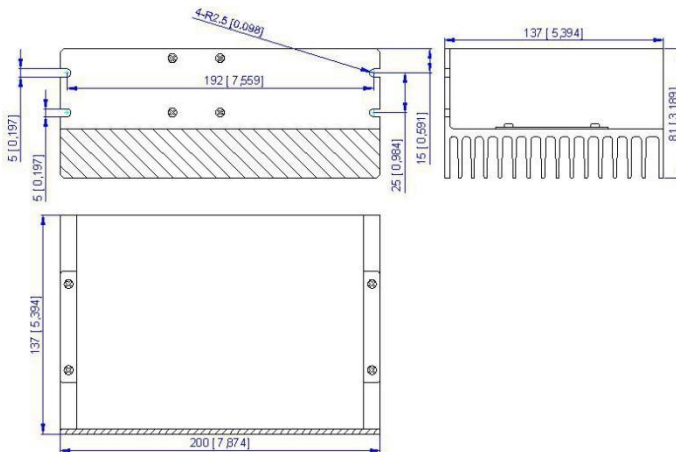


Figure 1: Mechanical specifications

### 2.3 Elimination of Heat

- DM1182's working temperature should be  $< 70^\circ\text{C}$  ( $158^\circ\text{F}$ ), and motor working temperature should be  $< 80^\circ\text{C}$  ( $176^\circ\text{F}$ );
- It is recommended to use automatic idle-current mode, which automatically reduces motor stand-still current to 60%, thus to reduce heating of DM1182 and the driven stepper motor;
- Use forced cooling method to cool the system if necessary.

## 2.4 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°C (32°F — 122°F)
	Humidity	40%RH — 90%RH
	Operating Temperature	70°C (158°F) Max
Storage Temperature	Vibration	5.9m/s <sup>2</sup> Max
		-20 — 65°C (-4°F — 149°F)
Weight	Approx. 1000g (35oz)	

## 3 Pin Assignment and Description

DM1182 can accept differential and single-ended input signals (including open-collector and PNP output). DM1182 has two connectors, connector P1 for control signals connections, and connector P2 for power and motor connections. The following tables are brief descriptions for the two connectors. More detailed descriptions of the pins and related issues are presented in section 4, 5, 10.

### 3.1 Connector P1 Configurations

Pin Function	Details
<b>PUL+</b>	Pulse signal: In single pulse (pulse/direction) mode, this input represents pulse signal, each rising or falling edge active (software configurable); 4-5V when PUL-HIGH, 0-0.5V when PUL-LOW. In double pulse mode (pulse/pulse), this input represents clockwise (CW) pulse, active both at high level and low level (software configurable). For reliable response, pulse width should be longer than 2.5μs. Series connect resistors for current-limiting when +12V or +24V used. It is same as DIR and ENA signals.
<b>PUL-</b>	
<b>DIR+</b>	DIR signal: In single-pulse mode, this signal has low/high voltage levels, representing two directions of motor rotation; in double-pulse mode (software configurable), this signal is counter-clock (CCW) pulse, active both at high level and low level (software configurable). 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 rotation direction is also related to motor-drive wiring match. Exchanging the connection of two wires for a coil to the drive will reverse motion direction.
<b>DIR-</b>	

<b>ENA+</b>	Enable signal: these two signals is used for enabling/disabling the drive. High level (NPN control signal, PNP and Differential control signals are on the contrary, namely Low level for enabling.) is used for enabling the drive, and low level is used for disabling the drive. Usually leave these two pins
<b>ENA-</b>	
<b>FAULT+</b>	FaultSignal: fault output signals. Impedance will be high between FAULT+ and FAULT- during normal operation; and low when protection is activated because of over-voltage, under-voltage, over-current, phase error protection, and over-temperature. MAX: 30VDC/ 20mA.
<b>FAULT-</b>	

### 3.2 Selecting Active Pulse Edge and Control Signal Mode

DM1182 supports PUL/DIR and CW/CCW modes and pulse actives at rising or falling edge. Default setting is PUL/DIR mode and rising edge active (NPN, and PNP control signal is on the contrary).

### 3.3 Connector P2 Configurations

Pin Function	Details
PE	Recommend connect this port to the ground for better safety.
AC	AC power supply inputs. If AC input, recommend use isolation transformers with theoretical output voltage of 80~150VAC. DC input range is 113~212VDC
AC	
A+, A-	Motor Phase A
B+, B-	Motor Phase B

## 4 Control Signal Connector (P1) Interface

DM1182 can accept differential and single-ended inputs (including open-collector and PNP output). DM1182 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 drive in interference environments. In the following figures, connections to open-collector and PNP signals are illustrated.

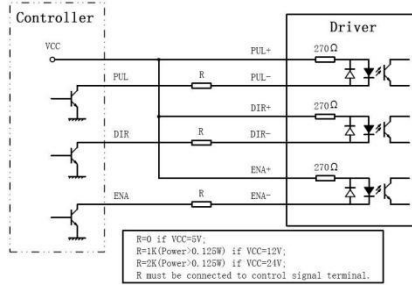


Figure 2: Connections to open-collector signal (common-anode)

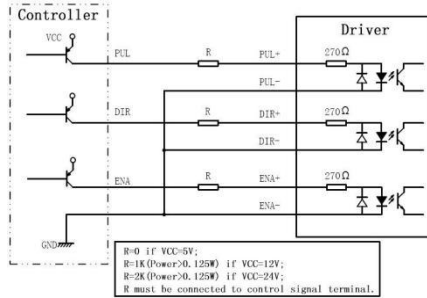


Figure 3: Connection to PNP signal (common-cathode)

## 5 Connecting the Motor

DM1182 can drive any 2-phase and 4-phase hybrid stepper motors.

### 5.1 Connections to 4-lead Motors

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

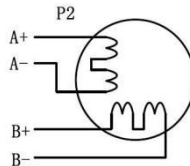


Figure 4: 4-lead Motor Connections

## 5.2 Connections to 6-lead Motors

Like 8 lead stepper 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.

### 5.2.1 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 drive output current multiply the specified per phase (or unipolar) current rating by 1.4 to determine the peak output current.

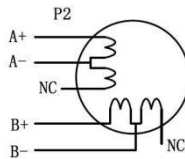


Figure 5: 6-lead motor half coil (higher speed) connections

### 5.2.2 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.

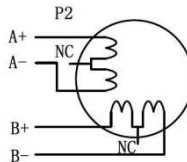


Figure 6: 6-lead motor full coil (higher torque) connections

## 5.3 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.

### 5.3.1 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.

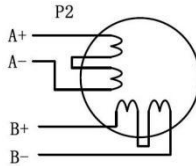


Figure 7: 8-lead motor series connections

### 5.3.2 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.

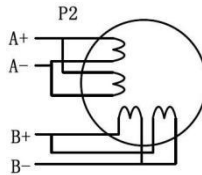


Figure 8: 8-lead motor parallel connections

**NEVER** disconnect or connect the motor while the power source is energized.

## 6 Motor Auto-Identification and Parameter Auto Configuration

In most of applications, a user can just use the **Motor auto-identification and parameter auto-configuration** feature of DM1182 to get optimal performance from a driven stepper motor. Just changes SW4 two times (on->off->on, or off->on->off) in 1 second. A DM1182 stepper drive will automatically identify the driven motor and configure related control parameters for optimum responses. **Recommend** use this function after changing the driven motor.

## 7 Power Supply Selection

DM1182 can match large and medium size stepper motors (from NEMA size 34 to 51) 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).

**Attention:** For safety and to improve reliability, it is recommended to use isolation transformer instead of directly use network source to supply the DM1182. Recommend use isolation transformers with theoretical output voltage of 80 ~ 150VAC or 113 ~ 212VDC, leaving room for power fluctuation and back-EMF. And the power of the isolation transformer should larger than 500 watts.

### 7.1 Selecting Supply Voltage

Working input voltage range of DM1182 is 80 to 150VAC or 113 to 212VDC. That should also count 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. It may also cause over-voltage protection or even drive damage. Therefore, it is recommended to choose only sufficiently high supply voltage for intended applications. It is preferable to use power supplies with theoretical output voltage of 80 ~ 130VAC or 113 ~ 183VDC, and leave 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.

## 8 Selecting Microstep Resolution and Drive Output Current

Microstep resolutions and output current are programmable via tuning software ProTuner. Resolution can be set from full-step to 102,400 steps per resolution. Drive output current can be set from 0.5A to 8.2A.

In addition to tuning with software, a user can also set the microstep resolution and output current of DM1182 through the 8-bit DIP switches, as shown below:

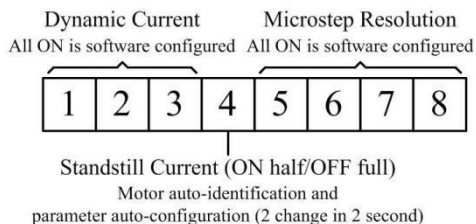


Figure 9: DIP Switches for DM1182

## 8.1 Microstep Resolution Selection

When setting with DIP switches, microstep resolution is set by SW5, 6, 7, 8 of the DIP switches as shown in the following table:

Microstep	Steps/rev.(for 1.8° motor)	SW5	SW6	SW7	SW8
1 to 512	Default/Software configured	ON	ON	ON	ON
1	200 (when not configured with software)	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

## 8.2 Current Setting

For a given motor, higher drive output current will make the motor output more torque, but at the same time causes more heating in the motor and drive. Therefore, output current is usually set to value which will not overheat for long time operation. Since parallel and serial connections of motor coils will significantly cause changes in inductance and resistance, a user should set drive output current based on motor phase current, motor leads and connection methods. Phase current rating supplied by motor manufacturer is important in selecting drive output current. However, the selection also depends on number of motor leads and connection type.

When it's not in software configured mode, the first three bits (SW1, 2, 3) of the DIP switches are used to set the dynamic output current. Select a setting closest to your motor's required current.

### 8.2.1 Soft- Start

When power-up or reset by the ENA signal, DM1182 slowly increases the motor coil current until it reaches to the setting value, eliminating the sudden motor move, or ‘jump’. This process will take about 100ms to reach the designed output current. So, the motion controller should not send pulse inputs to DM1182 in 100ms when it is powered up. Otherwise, the motor would lose step or be stalled.

#### Dynamic current setting

Peak Current	RMS Current	SW1	SW2	SW3
Default/Software configured (0.5 to 8.2A)		OFF	OFF	OFF
2.2A	1.6A	ON	OFF	OFF
3.2A	2.3A	OFF	ON	OFF
4.2A	3.2A	ON	ON	OFF
5.2A	3.7A	OFF	OFF	ON
6.3A	4.4A	ON	OFF	ON
7.2A	5.2A	OFF	ON	ON
8.2A	5.9A	ON	ON	ON

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

### 8.3 Stand-still current setting

SW4 is used for setting stand-still current purpose. SW4 OFF means that the stand-still current is software configured. SW4 ON means that stand-still current is set to be the same as the selected dynamic current (full current).

When SW4 if off (software configured), by default, the stand-still current is automatically reduced to 60% of the selected dynamic output current, which will be reached in two seconds after the last pulse. This will reduce motor heating up to 36% ( $P=I_2^2R$ ) of the motor heating in working mode.

**Stand-still current reduction percentage and effective time can be configured from PC tuning software, ProTuner.**

## 9 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 centimeters (or 4 inches). Otherwise the disturbing signals generated by motor will easily disturb pulse direction signals, causing motor position error, system instability and other failures.
- When 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 drive.

## 10 Typical Connection

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

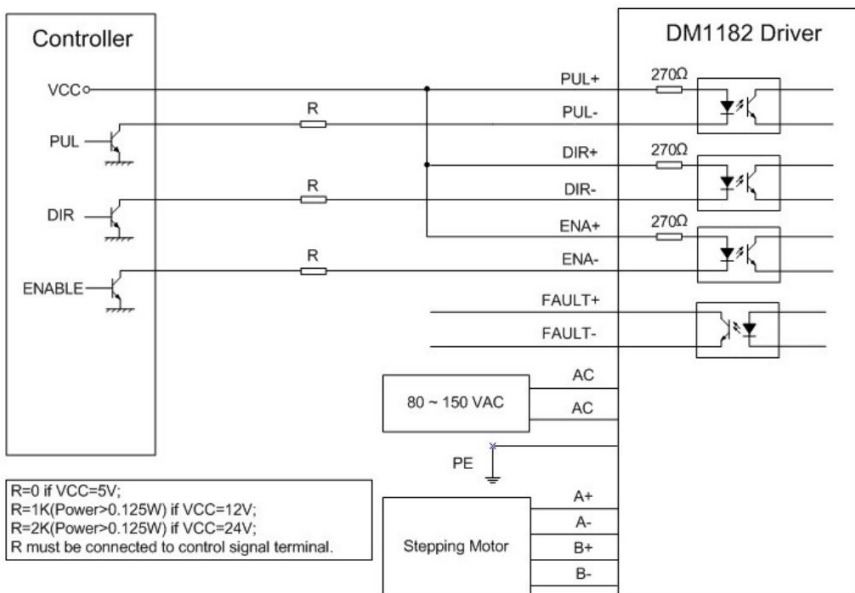


Figure 9: Typical connection

## 11 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:

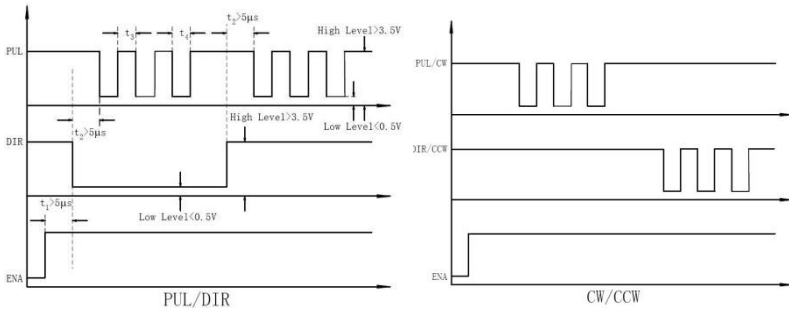


Figure 10: Sequence chart of control signals

### Remark:

- $t_1$ : ENA must be ahead of DIR by at least 100ms due to soft-start feature of DM1182. Usually, ENA+ and ENA- are NC (not connected). See “Connector P1 Configurations” for more information.
- $t_2$ : DIR must be ahead of PUL active edge by  $5\mu s$  to ensure correct direction;
- $t_3$ : Pulse width not less than  $2.5\mu s$ ;
- $t_4$ : Low level width not less than  $2.5\mu s$ .

## 12 Protection Functions

To improve reliability, DM1182 incorporates some built-in protection functions. There are two LED lights built-in with DM1182. The green LED light indicates DM1182 works properly. The red LED light indicates what protection has been activated. How many times the red light flashes in a 3-second period tells what protection has been activated. Because only one protection message can be displayed by the red LED light, what error to indicate is determined by DM1182’s protection priorities. See the following **Protection Indications** table for displaying priorities.

### 12.1 Over-current Protection

When continuous current exceeds the limit or in case of short circuit between motor coils or between motor coil and ground, over-current protection will be activated. The red LED light will flash once in a 3-second period.

### 12.2 Over-voltage Protection

When power supply voltage exceeds  $200 \pm 1$  VAC, over-voltage protection will be activated. The red LED light will flash twice once in a 3-second period.

### 12.3 Under-voltage Protection

When power supply voltage is under  $63 \pm 1$  VAC, under-voltage protection will be activated. The red LED will flash three times once in a 3-second period.

### 12.4 Phase Error Protection



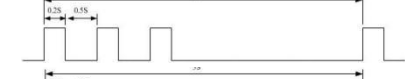


When motor power lines are not connected or connected wrong, phase error protection will be activated and the red LED light will flash four times in a 3-second period.

### 12.5 Over temperature Protection

When a DM1182 drive's temperature reaches to  $75^{\circ}\text{C}$  ( $167^{\circ}\text{F}$ ), over temperature protection will be activated. The red LED light will flash five times in a 3-second period.

**Attention:** When above protections are active, the motor shaft will be free or the red LED will be turned on. Reset DM1182 to make it function properly by repowering and removing a protection or protections. Since there is no protection against power leads ( + , - ) reversal, it is critical to make sure that power supply leads are correctly connected to driver. Otherwise, the driver will be permanently damaged.

### 12.6 Protection Indications

Priority	Time(s) of ON	Sequence wave of RED LED	Description
1 <sup>st</sup>	1		Over-current protection
2 <sup>nd</sup>	2		Over-voltage protection
3 <sup>rd</sup>	3		Under-voltage protection
4 <sup>th</sup>	4		Phase error protection
5 <sup>h</sup>	5		Over-temperature protection

## 13 Frequently Asked Questions

In the event that a DM1182 stepper drive doesn't work properly, the first step is to identify whether the problem is electrical or mechanical in nature. Next, a user should isolate the control system components with a problem. As part of this process, a user needs to disconnect all the individual components that make up your system, and diagnose which one is causing the malfunction. It is important to document each step in a troubleshooting process. You may need the documentation to refer late. Also, if you will need assistance from Leadshine, these details will help our technical support staffs in the process of determining the cause of the symptom.

Many of the problems that affect motion control systems can be traced to electrical noise, controller software errors, or mistake in wiring. For problems listed in the following table, they can be easily identified and solved.

### Problem Symptoms and Possible Causes

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