

*User Manual*

# EM532MINI

Digital Microstep Drive



Revision 1.0

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## Notice

Read this manual carefully before any assembling and using. Incorrect handling of products in this manual can result in injury and damage to persons and machinery. Strictly adhere to the technical information regarding installation requirements.

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## Record of Revisions

| <b>Revision</b> | <b>Date</b> | <b>Description of Release</b> |
|-----------------|-------------|-------------------------------|
| 1.0             | Sept, 2021  | Initial Version               |

# Table of Contents

|  |           |
|--|-----------|
| <b>1. Introductions.....</b>                                 | <b>1</b>  |
| 1.1 Features.....  | 1         |
| 1.2 Applications.....  | 1         |
| <b>2. Specifications.....</b>                                | <b>1</b>  |
| 2.1 Electrical Specifications.....                           | 1         |
| 2.2 Environment.....   | 2         |
| 2.3 Mechanical Specifications.....                           | 2         |
| 2.4 Elimination of Heat.....                                 | 2         |
| <b>3. Connection Pin Assignments and LED Indication.....</b> | <b>3</b>  |
| 3.1 P1 - Control Connector and Fault Output.....             | 3         |
| 3.2 P2 - Power Connector.....                                | 3         |
| 3.3 P3 - Motor Connector.....                                | 4         |
| 3.4 Indicator Light.....                                     | 4         |
| <b>4. Control Signal and Fault Output.....</b>               | <b>4</b>  |
| 4.1 Control Signal Connection.....                           | 4         |
| 4.2 Fault output connection.....                             | 4         |
| <b>5. Motor Connection.....</b>                              | <b>5</b>  |
| 5.1 Connections of 4-lead Motor.....                         | 5         |
| 5.2 Connections of 6-lead Motor.....                         | 5         |
| 5.2.1 Half Coil Configuration.....                           | 5         |
| 5.2.2 Full Coil Configuration.....                           | 6         |
| 5.3 Connections of 8-lead Motor.....                         | 6         |
| 5.3.1 Series Connection.....                                 | 6         |
| 5.3.2 Parallel Connection.....                               | 6         |
| <b>6. Power Supply Selection.....</b>                        | <b>7</b>  |
| 6.1 Regulated or Unregulated Power Supply.....               | 7         |
| 6.2 Power Supply Sharing.....                                | 7         |
| 6.3 Selecting Supply Voltage.....                            | 7         |
| <b>7.DIP Switch Configurations.....</b>                      | <b>8</b>  |
| 7.1 Output Current Configuration           (SW1-3).....      | 8         |
| 7.2 Idle Current Configuration           (SW4).....          | 8         |
| 7.3 Micro Step Configuration           (SW5-8).....          | 8         |
| <b>8. Wiring Notes.....</b>                                  | <b>9</b>  |
| <b>9. Typical Connection.....</b>                            | <b>9</b>  |
| <b>10. Sequence Chart of Control Signals.....</b>            | <b>10</b> |
| <b>11. Protection Functions.....</b>                         | <b>11</b> |
| <b>12. Troubleshooting.....</b>                              | <b>12</b> |
| <b>13. Warranty.....</b>                                     | <b>13</b> |
| <b>14. Contact Us.....</b>                                   | <b>13</b> |

## 1. Introductions

The EM532MINI is a digital stepper drive with simple design and easy setup. By implementing Leadshine advanced stepper control technology, this stepper drive is able to power 2-phase and 4 phase stepper motors smoothly with optimal torque and low motor heating & noise. Its operating voltage is 18-50VDC and it can output up to 3.2A current. All the micro step and output current are done via DIP switches. Therefore, the EM532MINI are ideal choices for applications requiring simple step & direction control of NEMA11, 14, 16, 17 stepper motors.

### 1.1 Features

- Anti-Resonance for optimal torque, extra smooth motion, low motor heating and noise
- Motor auto-identification and parameter auto-configuration for optimal torque from wide-range motors
- Step & direction (PUL/DIR) control
- Multi-Stepping for smooth motor movement
- Optically isolated inputs
- Input voltage 18-50VDC
- 16 selectable micro-step resolutions of 200-25, 600 via DIP switches
- 8 selectable output current settings of 0.4 – 3.2A via DIP switches
- Soft-start with no “jump” when powered on
- Pulse input frequency up to 1M Hz.
- Automatic idle-current reduction
- Protections for over-voltage and over-current

### 1.2 Applications

The EM532MINI stepper drive are designed to power 2 phase (1.8°) or 4-phase (0.9°) NEMA11, 14, 16, 17 hybrid stepper motors. It can be easily adopted in many industries (CNC, medical, automation, packaging...), such as X-Y tables, engraving machines, labeling machines, mills, plasma, laser cutters, pick and place devices, and so on. Its excellent performance, simple design, and easy setup make it ideal for many step & direction control type applications.

## 2. Specifications

### 2.1 Electrical Specifications

| Parameters              | EM532MINI     |         |               |      |
|-------------------------|---------------|---------|---------------|------|
|                         | Min           | Typical | Max           | Unit |
| Output Current          | 0.4 (0.3 RMS) | -       | 3.2 (2.3 RMS) | A    |
| Supply Voltage          | 18            | 24 / 36 | 50            | VDC  |
| Logic signal current    | 7             | 10      | 16            | mA   |
| Pulse input frequency   | 0             | -       | 1             | MHz  |
| MINImal pulse width     | 0.5           | -       | -             | μS   |
| MINImal direction setup | 1             | -       | -             | μS   |
| Isolation resistance    | 100           |         |               | MΩ   |

## 2.2 Environment

| Cooling               | Natural Cooling or Forced cooling |   |
|-----------------------|-----------------------------------|---|
| Operating Environment | Environment                       | Avoid dust, oil fog and corrosive gases |
|                       | Ambient Temperature               | 0°C — 65°C (32°F - 149°F)               |
|                       | Humidity                          | 40%RH—90%RH                             |
|                       | Operating Temperature             | 0°C — 50°C (32°F - 122°F)               |
|                       | Vibration                         | 10-50Hz / 0.15mm                        |
| Storage Temperature   | -20°C — 65°C (-4°F - 149°F)       |   |
| Weight                | Approx. 90g (3.5 oz)              |   |

## 2.3 Mechanical Specifications

(unit: mm [1inch=25.4mm])

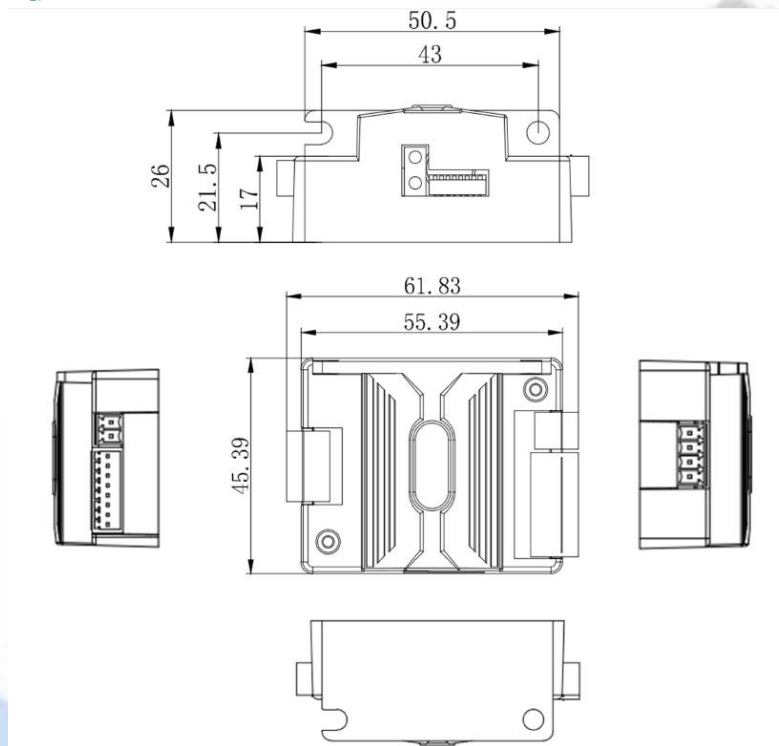


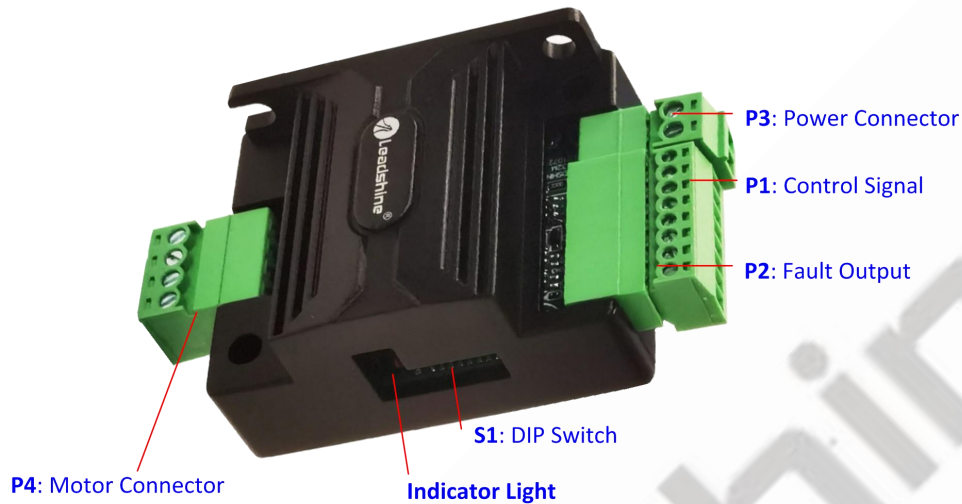
Figure 1: Mechanical specifications

**\* Side mounting recommended for better heat dissipation**

## 2.4 Elimination of Heat

- EM532MINI reliable working temperature should be < 60°C (140°F)
- It is recommended to mount the drive vertically to maximize heat sink area. Use forced cooling method to cool if necessary.

### 3. Connection Pin Assignments and LED Indication



The EM532MINI has 3 terminal block connectors P1, P2 and P3, 1 DIP switch selectors S1. P1 is for control signal and fault output connections, P2 is for power connection, P3 is for motor connection.

#### 3.1 P1 - Control Connector and Fault Output

| PIN   | Details   |
|-------|---|
| PUL+  |   |
| PUL-  | <u>Pulse and Direction Connection:</u> (1) Optically isolated, high level 4.5-5V, low voltage 0-0.5V. (2) Maximum 1 MHz input frequency. (3) Pulse width of 0.5 $\mu$ s or longer. (4) DIR signal requires advance PUL signal 1 $\mu$ s at least. (5) When the control voltage is 24V, 2K resistors are required.         |
| DIR+  |   |
| DIR-  |   |
| ENA+  | <u>Enable Connection:</u> Optional. (1) Optically isolated, differential. (2) Disable the drive by 4.5-5.0V input connection; enable the drive by 0-0.5 VDC connection(default no connection). (3) ENA signal requires advance DIR signal 200ms at least. (4) When the control voltage is 24V, a 2K resistor is required. |
| ENA-  |   |
| ALM + | <u>Fault Output Connection:</u> Optional. (1) Maximum 24V/100mA output when over-voltage and over-current error protections activated. (2) Sinking or sourcing. (3) The resistance between ALM+ and ALM- is low impedance as default, and will change to high when the drive goes into error protection.                  |
| ALM-  |   |



**Notes:** (1) shield cables are required for P1; (2) don't tie P1&P2 cables and P3 cables together.

#### 3.2 P2 - Power Connector

| Pin  | Details  |
|------|--|
| GND  | Connect to power supply ground connection.                         |
| +VDC | 18-50 VDC, power supply positive connection. Suggest 24 or 36 VDC. |



**Warning:** Don't plug/unplug P3 or P4 connector to avoid drive damage or injury while powered on.

### 3.3 P3 - Motor Connector

| PIN | Details                  |
|-----|--------------------------|
| A+  | Connect to motor A+ wire |
| A-  | Connect to motor A- wire |
| B+  | Connect to motor B+ wire |
| B-  | Connect to motor B- wire |

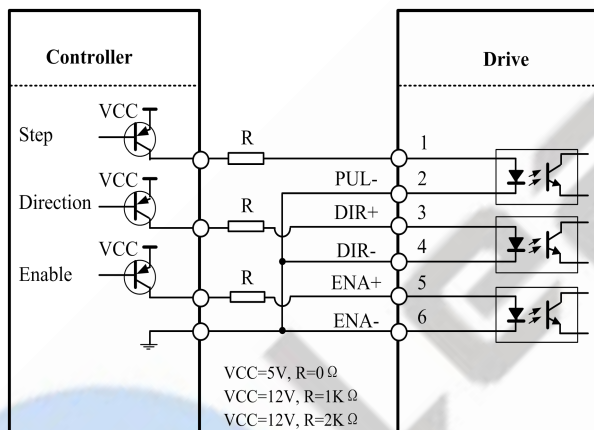
### 3.4 Indicator Light

There are two lights for EM532MINI. The GREEN one is the power indicator which will be always on generally. The RED one is a protection indicator which will flash 1-2 times in a 3-second period, when protection enabled for a EM532MINI. Different number of flashes indicates different protection type (read section 11 for detail).

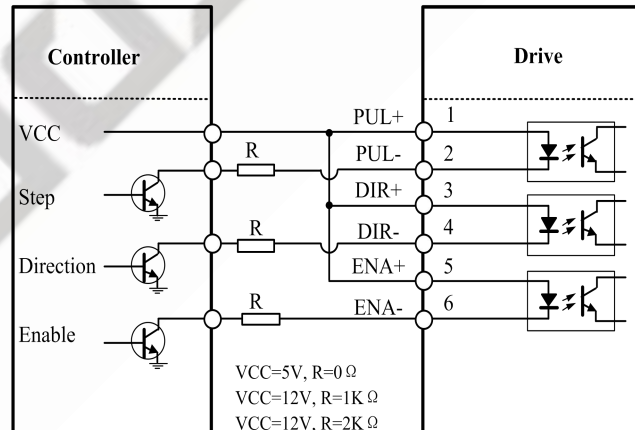
## 4. Control Signal and Fault Output

### 4.1 Control Signal Connection

The EM532MINI can accept differential or single-ended control signals (pulse, direction, and enable) in open-collector or PNP connection through the P1 connector (figure 2). It is recommend to add an EMI line filter between the power supply and the drive to increase noise immunity for the drive in interference environments.



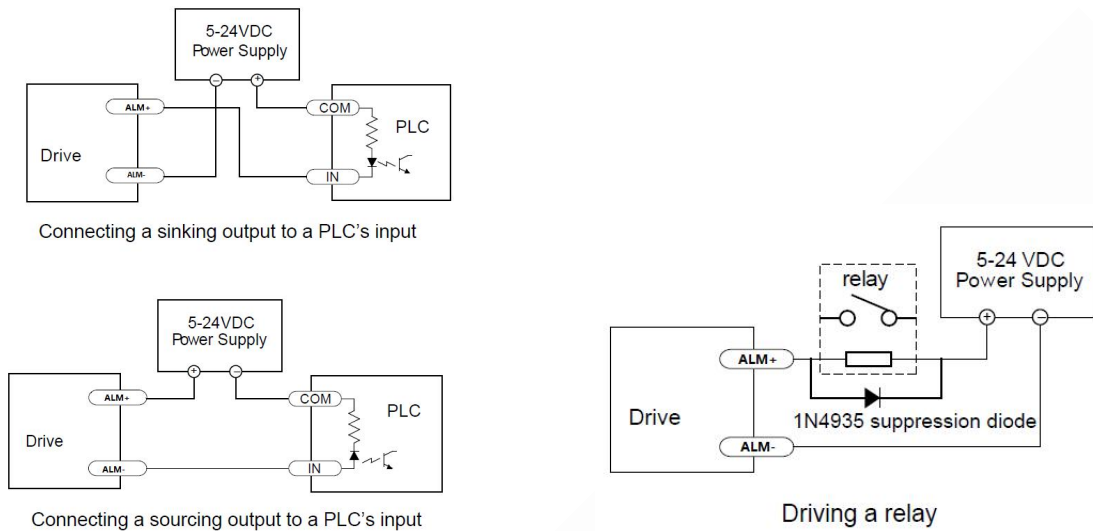
**Figure 3** Connections to open-collector signals  
(Common-anode)



**Figure 4** Connections to PNP signals  
(Common-cathode)

### 4.2 Fault output connection

When over voltage or over current protection happens, EM532MINI red status LED light will blink and the impedance state between ALM+ and ALM- will change (from low to high or high to low depending on configuration) and can thus be detected. Fault output connection is optional, and it can be connected either in sinking or sourcing.



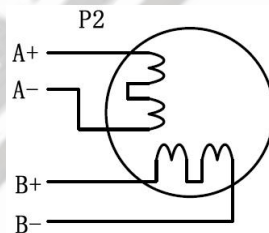
**Figure 5** Fault Output Connections

## 5. Motor Connection

The EM532MINI can drive 2-phase and 4-phase bipolar hybrid stepper motors with 4, 6, or 8 wires.

### 5.1 Connections of 4-lead Motor

The 4 lead motors are the least flexible and easy to connect. And the Speed – torque of motor depends on winding inductance. The output current from drive that multiply the specified phase current by 1.4 to determine the peak output current.



**Figure 6:** 4-lead Motor Connections

### 5.2 Connections of 6-lead Motor

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

#### 5.2.1 Half Coil Configuration

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.



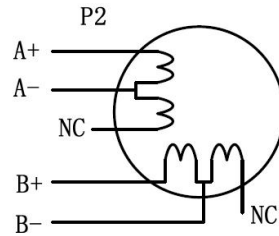


Figure 7: 6-lead motor half coil (higher speed) connections

### 5.2.2 Full Coil Configuration

The full coil configuration on a six lead motor should be used in applications where higher torque at lower speed 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.

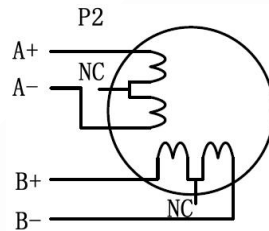


Figure 8: 6-lead motor full coil (higher torque) connections

## 5.3 Connections of 8-lead Motor

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 Connection

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

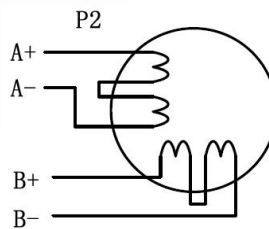


Figure 9: 8-lead motor series connections

### 5.3.2 Parallel Connection

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 phase (or unipolar) current rating by 1.96,

or the bipolar current rating by 1.4, to determine the peak output current.

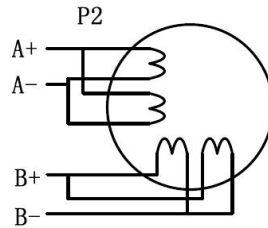


Figure 10: 8-lead motor parallel connections

## 6. Power Supply Selection

The EM532MINI can power medium and small size stepping motors (frame size from NEMA11 to 17) made by Leadshine or other motor manufacturers. To get 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.

### 6.1 Regulated or Unregulated Power Supply

Both regulated and unregulated power supplies can be used to supply the drive. However, unregulated power supplies are preferred due to their ability to withstand current surge and fast response for current change. If you prefer to a regulated power supply, it is suggested to choose such a power supply specially designed for stepper/servo controls such as Leadshine LSP series (<http://www.leadshine.com/producttypes.aspx?producttype=regulated-switching>). Or, in the case when only normal switching power supplies are available, it is important to use "OVERSIZE" high current output rating power supplies (for example, using a 4A power supply for 3A stepper motor) to avoid problems such as current clamp. 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 drive 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.

### 6.2 Power Supply Sharing

Multiple EM532MINI drives can share one power supply to reduce cost, if that power supply has enough power capacity. To avoid cross interference, connect each stepper drive directly to the shared power supply separately. To avoid cross interference, DO NOT daisy-chain connect the power supply input pins of the Drivers. Instead connect them to power supply separately.

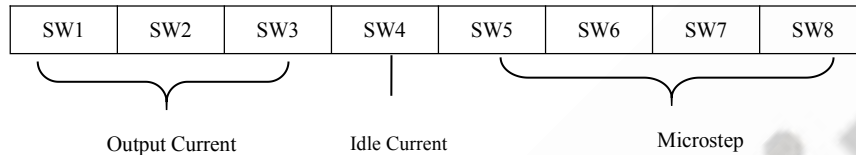
### 6.3 Selecting Supply Voltage

The EM532MINI is designed to operate within 18-50VDC voltage input. When selecting a power supply, besides voltage from the power supply power line voltage fluctuation and back EMF voltage generated during motor deceleration needs also to be taken into account. Ideally it is suggested to use a power supply with the output voltage of 24VDC or 36VDC, leaving room for power line voltage fluctuation and back-EMF.

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 drive damage. Therefore, it is suggested to choose only sufficiently high supply voltage for intended applications.

## 7. DIP Switch Configurations

The EM532MINI has 8-bit DIP Switch to configure output current, microstep resolution and idle current



### 7.1 Output Current Configuration (SW1-3)

The EM532MINI has 8 output current settings which can be configured through DIP switch SW1, SW2 and SW3.

For a given stepper motor, as normal setting the output current to 1.4 times of motor phase current, will make it output larger torque, but at the same time cause more heating for both the motor and drive. Therefore, it is suggested to set a output current (peak of sinusoidal) to no more than 1.2 times the stepper motor's (for 4-lead motor) phase current to prevent overheating .

| Peak Current | RMS Current | SW1 | SW2 | SW3 |
|--------------|-------------|-----|-----|-----|
| 0.4A         | 0.29A       | ON  | ON  | ON  |
| 0.8A         | 0.57A       | OFF | ON  | ON  |
| 1.2A         | 0.86A       | ON  | OFF | ON  |
| 1.6A         | 1.14A       | OFF | OFF | ON  |
| 2.0A         | 1.43A       | ON  | ON  | OFF |
| 2.4A         | 1.71A       | OFF | ON  | OFF |
| 2.7A         | 1.93A       | ON  | OFF | OFF |
| 3.2A         | 2.29A       | OFF | OFF | OFF |

### 7.2 Idle Current Configuration (SW4)

SW4 is used to set motor idle current percentage. At OFF position it means the standstill current is set to be 50% of the selected output current. At ON position it means standstill current is set to be 90%.

### 7.3 Micro Step Configuration (SW5-8)

Each EM532MINI has 16 micro step settings which can be configured through DIP switch SW5, SW6, SW7,SW8. See the following table for detail.

| Microstep | Steps/rev.(for 1.8°motor) | SW5 | SW6 | SW7 | SW8 |
|-----------|---------------------------|-----|-----|-----|-----|
| 1         | 200                       | 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 |
| 30  | 6000  | ON  | ON  | OFF | OFF |
| 40  | 8000  | OFF | ON  | OFF | OFF |
| 50  | 10000 | ON  | OFF | OFF | OFF |
| 100 | 20000 | OFF | OFF | OFF | OFF |

## 8. Wiring Notes

- In order to improve anti-interference performance of the drive, 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 10 cm at least, otherwise the disturbing signals generated by motor will easily disturb pulse direction signals, causing motor position error, system instability and other failures.
- If only one power supply serves multiple EM532MINI drives, separately connecting the drives to the power supply is recommended instead of daisy-chaining.
- It is prohibited to pull and plug connector P2 while the drive 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.

## 9. Typical Connection

A complete stepping system should include stepping motor, stepping drive, power supply and controller (pulse generator). A typical connection is shown as figure 11.

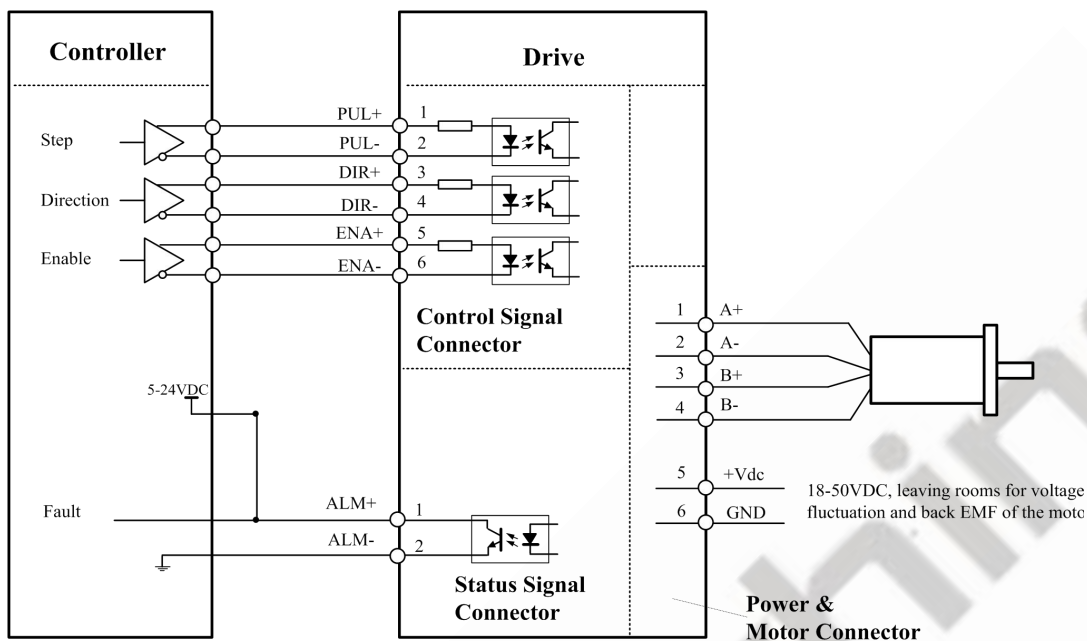


Figure 11: Typical connection

## 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:

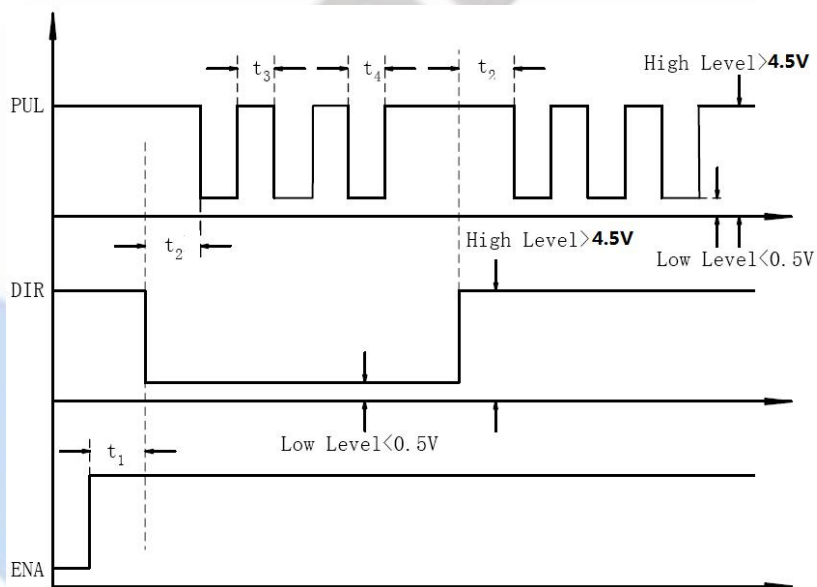




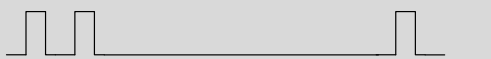
Figure 12: Sequence chart of control signals

### Remark:

- $t_1$ : ENA must be ahead of DIR by 200ms at least. Usually, ENA+ and ENA- are NC (not connected). See "Connector P1 Configurations" for more information.
- $t_2$ : DIR must be ahead of PUL effective edge by  $1\mu s$  to ensure correct direction;
- $t_3$ : Pulse width not less than  $0.5\mu s$ ;
- $t_4$ : Low level width not less than  $0.5\mu s$ .

## 11. Protection Functions

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

| Priority        | Time(s) of Blink | Sequence wave of red LED  | Description  |
|-----------------|------------------|---|--|
| 1 <sup>st</sup> | Always on        |  | The drive was short-circuited or burned out.                                       |
| 1 <sup>st</sup> | 1                |  | Over-current protection activated when peak current exceeds the limit.             |
| 2 <sup>nd</sup> | 2                |  | Over-voltage protection activated when drive working voltage is greater than 52VDC |

When above protections are active, the motor shaft will be free or the red LED blinks. Reset the drive by repowering it to make it function properly after removing above problems.

## 12. Troubleshooting

In the event that your drive 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

| Trouble                                     | Solution Measures   |
|---|---|
| <b>Motor is not rotating</b>                | No power, to start power supply   |
|   | Pulse/revolution setting is wrong   |
|   | DIP switch current setting is wrong   |
|   | Fault condition exists or the drive is disabled   |
| <b>Motor rotates in the wrong direction</b> | Motor phases may be connected in reverse  |
|   | Maybe the pulse mode is CW&CCW, or the control signal is 24V without connected 2K resistor.                           |
| <b>Red light blinking</b>                   | Red light blinks 1 time or always on, try not to connect the motor and restart the power supply                       |
|   | Red light blinks 2 times, check the power voltage and restart the power supply  |
| <b>Erratic motor motion</b>                 | Current setting is too small, losing steps  |
|   | Wrong motor connection or has broken circuit in motor coil.   |
|   | The current of the control signals is not in the range of 7-15mA  |
|   | Control signals don't meet the requirements of <a href="#">chapter 10</a> , check the waveform of the control signals |
| <b>Motor stalls or loss steps</b>           | Output current of the drive is too small or motor torque is not enough  |
|   | Acceleration is set too high  |
|   | Power supply voltage too low  |
|   | Modify the activated edge value in the ProTuner or the control signal is interfered with.                             |
| <b>Excessive motor and drive heating</b>    | Inadequate heat sinking / cooling   |
|   | Automatic current reduction function not being utilized   |
|   | Reduce output current   |

## 13. Warranty

### Twelve Month Warranty

Leadshine Technology Co., Ltd. warrants its products against defects in materials and workmanship for a period of 12 months from shipment out of factory. During the warranty period, Leadshine will either, at its option, repair or replace products which proved to be defective.

### Exclusions

The above warranty does not extend to any product damaged by reasons of improper or inadequate handlings by customer, improper or inadequate customer wirings, unauthorized modification or misuse, or operation beyond the electrical specifications of the product and/or operation beyond environmental specifications for the product.

### Obtaining Warranty Service

To obtain warranty service, please contact your seller to obtain a returned material authorization number (RMA) before returning product for service.

### Shipping Failed Products

If your product fail during the warranty period, please contact your seller for how and where to ship the failed product for warranty or repair services first, you can also e-mail customer service at [tech@leadshine.com](mailto:tech@leadshine.com) to obtain a returned material authorization number (RMA) before returning product for service. Please include a written description of the problem along with contact name and address.

## 14. Contact Us

### China Headquarter

**Address:** 15-20/F, Block B, Nanshan I Valley, No.3185, Shahe West Road, Nanshan District, Shenzhen, Guangdong, 518055, China

**Web:** <http://www.leadshine.com>

### Sales Hot Line:

**Tel:** 86-755-2643 4369 (for All)

86-755-2641-7674 (for Asia, Australia, Africa areas)

86-755-2640-9254 (for Europe, America areas)

**Fax:** 86-755-2640-2718

**Email:** [sales@leadshine.com](mailto:sales@leadshine.com).

### Technical Support:

**Tel:** 86 755-2641-8447 and 86-755-2647-1129

**Fax:** 86-755-2640-2718

**Email:** [tech@leadshine.com](mailto:tech@leadshine.com).

### Leadshine U.S.A

**Address:** 26050 Towne Centre Dr. Foothill Ranch, CA 926 USA

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