

# User's Manual

For

# DM422C

CE 

## Fully Digital Stepping Drive

Version 1.0

©2009 All Rights Reserved

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



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

Leadshine reserves the right to make changes without further notice to any products herein to improve reliability, function or design. Leadshine 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.

Leadshine'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 Leadshine's terms and conditions of sales, the user of Leadshine's products in life support or aircraft applications assumes all risks of such use and indemnifies Leadshine against all damages.



**Leadshine Technology Co., Ltd.**

3/F, Block 2, Nanyou Tianan Industrial Park, Nanshan Dist, Shenzhen, China

T: (86)755-26434369

F: (86)755-26402718

Web site: [www.leadshine.com](http://www.leadshine.com) E-Mail: [sales@leadshine.com](mailto:sales@leadshine.com)

©2009 by Leadshine Technology Company Limited.  
All Rights Reserved

## Table of Contents

|                                                                 |   |
|-----------------------------------------------------------------|---|
| 1. Introduction, Features and Applications .....                | 1 |
| Introduction .....                                              | 1 |
| Features .....                                                  | 1 |
| Applications .....                                              | 1 |
| 2. Specifications .....                                         | 2 |
| Electrical Specifications .....                                 | 2 |
| Mechanical Specifications.....                                  | 2 |
| Elimination of Heat .....                                       | 2 |
| Operating Environment and other Specifications.....             | 3 |
| 3. Pin Assignment and Description .....                         | 3 |
| Connector P1 Configurations .....                               | 4 |
| Selecting Active Pulse Edge and Control Signal Mode .....       | 4 |
| Connector P2 Configurations .....                               | 4 |
| 4. Control Signal Connector (P1) Interface.....                 | 5 |
| 5. Connecting the Motor.....                                    | 5 |
| Connections to 4-lead Motors .....                              | 6 |
| Connections to 6-lead Motors .....                              | 6 |
| Half Coil Configurations .....                                  | 6 |
| Full Coil Configurations.....                                   | 6 |
| Connections to 8-lead Motors .....                              | 7 |
| Series Connections .....                                        | 7 |
| Parallel Connections.....                                       | 7 |
| 6. Power Supply Selection .....                                 | 8 |
| Regulated or Unregulated Power Supply .....                     | 8 |
| Multiple Drives .....                                           | 8 |
| Selecting Supply Voltage.....                                   | 8 |
| 7. Selecting Microstep Resolution and Drive Output Current..... | 9 |
| Microstep Resolution Selection .....                            | 9 |
| Current Settings.....                                           | 9 |

|                                                  |    |
|--------------------------------------------------|----|
| Dynamic current setting .....                    | 10 |
| Standstill current setting .....                 | 10 |
| 8. Wiring Notes .....                            | 10 |
| 9. Typical Connection.....                       | 11 |
| 10. Sequence Chart of Control Signals .....      | 11 |
| 11. Protection Functions .....                   | 12 |
| Over-current Protection.....                     | 12 |
| Over-voltage Protection .....                    | 12 |
| Phase Error Protection.....                      | 13 |
| Protection Indications.....                      | 13 |
| 12. Frequently Asked Questions.....              | 13 |
| Problem Symptoms and Possible Causes.....        | 14 |
| 13. Professional Tuning Software ProTuner.....   | 15 |
| Introduction .....                               | 15 |
| Software Installation .....                      | 15 |
| Connections and Testing .....                    | 19 |
| RS232 Interface Connection .....                 | 19 |
| Testing the Stepping System .....                | 19 |
| Software Introduction.....                       | 20 |
| ProTuner Main Window .....                       | 20 |
| Com Config Window .....                          | 21 |
| Tuning .....                                     | 21 |
| Anti-Resonance Introduction .....                | 24 |
| Procedure for Achieving Optimum Performance..... | 25 |
| APPENDIX .....                                   | 29 |
| Twelve Month Limited Warranty .....              | 29 |
| Exclusions .....                                 | 29 |
| Obtaining Warranty Service .....                 | 29 |
| Warranty Limitations.....                        | 29 |
| Contact Us.....                                  | 30 |

## 1. Introduction, Features and Applications

### Introduction

The DM422C is a versatility fully digital stepping Drive based on a DSP with advanced control algorithm. The DM422C is the next generation of digital stepping motor controls. It brings a unique level of system smoothness, providing optimum torque and nulls mid-range instability. Motor self-test and parameter auto-setup technology offers optimum responses with different motors and easy-to-use. The driven motors can run with much smaller noise, lower heating, smoother movement than most of the Drives in the markets. Its unique features make the DM422C an ideal solution for applications that require low-speed smoothness. Compared to the DM432C, the DM422C has smaller size and lower cost.

### Features

- ┆ Anti-Resonance, provides optimum torque and nulls mid-range instability
- ┆ Motor self-test and parameter auto-setup technology, offers optimum responses with different motors
- ┆ Multi-Stepping allows a low resolution step input to produce a higher microstep output for smooth system performance
- ┆ Microstep resolutions programmable, from full-step to 102,400 steps/rev
- ┆ Supply voltage up to +36 VDC
- ┆ Output current programmable, from 0.3A to 2.2A
- ┆ Pulse input frequency up to 75 KHz
- ┆ TTL compatible and optically isolated input
- ┆ Automatic idle-current reduction
- ┆ Suitable for 2-phase and 4-phase motors
- ┆ Support PUL/DIR and CW/CCW modes
- ┆ Over-voltage, over-current, phase-error protections

### Applications

Suitable for a wide range of stepping motors, from NEMA frame size 14 to 23. It can be used in various kinds of machines, such as laser cutters, laser markers, high precision X-Y tables, labeling machines, and so on. Its unique features make the DM422C an ideal solution for applications that require low-speed smoothness.

## 2. Specifications

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

| Parameters            | DM422C |         |               |      |
|-----------------------|--------|---------|---------------|------|
|                       | Min    | Typical | Max           | Unit |
| Output current        | 0.3    | -       | 2.2 (1.6 RMS) | A    |
| Supply voltage        | +20    | +24     | +36           | VDC  |
| Logic signal current  | 7      | 10      | 16            | mA   |
| Pulse input frequency | 0      | -       | 75            | kHz  |
| Isolation resistance  | 500    |         |               | MΩ   |

### Mechanical Specifications ( unit: mm [inch] )

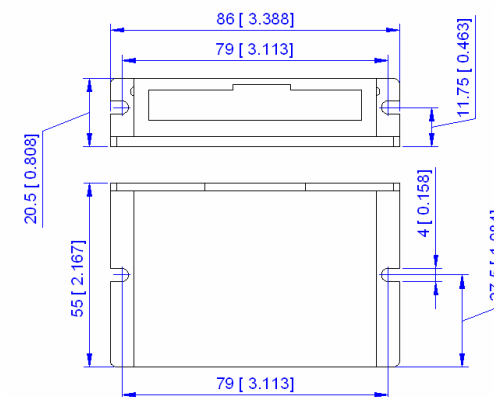
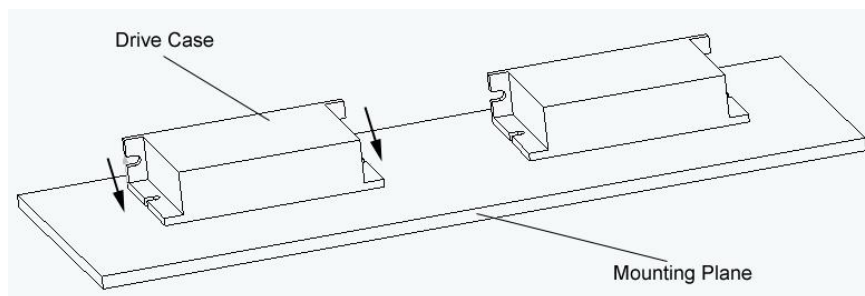


Figure 1: Mechanical specifications

### Elimination of Heat

- ┆ Drive's reliable 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, namely current automatically reduce to 60% when motor stops, so as to reduce Drive heating and motor heating;
- ┆ The Drive must be mounted vertically to maximize heat sink area as shown in the following picture. Use forced cooling method to cool the system if necessary.



**Important NOTE:** The driver must be mounted vertically onto a plate or a heat sinking to maximize heat sink area as shown in the above picture. Please use additional heat sinking or cool fan if necessary.

### Operating Environment and other Specifications

| Cooling               | Natural Cooling or Forced cooling |                                         |
|-----------------------|-----------------------------------|-----------------------------------------|
| Operating Environment | Environment                       | Avoid dust, oil fog and corrosive gases |
|                       | Ambient Temperature               | 0°C — 50°C (32°F — 122°F)               |
|                       | Humidity                          | 40%RH — 90%RH                           |
|                       | Operating Temperature             | 70°C (158°F) Max                        |
|                       | Vibration                         | 5.9m/s <sup>2</sup> Max                 |
| Storage Temperature   | -20°C — 65°C (-4°F — 149°F)       |                                         |
| Weight                | Approx. 100g (3.5274oz)           |                                         |

### 3. Pin Assignment and Description

The DM422C 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.

### Connector P1 Configurations

| Pin Function | Details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PUL          | <b>Pulse signal:</b> 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 7.5μs. Series connect resistors for current-limiting when +12V or +24V used. The same as DIR and ENA signals.                                                                             |
| DIR          | <b>DIR signal:</b> 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. |
| OPTO         | Opto-coupler power supply, and the typical voltage is +5V. Series connect resistors (at the PUL, DIR, ENA terminals) for current-limiting when +12V or +24V used.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| ENA          | <b>Enable signal:</b> This signal is used for enabling/disabling Drive. High level for enabling the Drive and low level for disabling the Drive. Usually left <b>UNCONNECTED (ENABLED)</b> .                                                                                                                                                                                                                                                                                                                                                                                                              |

### Selecting Active Pulse Edge and Control Signal Mode

The DM422C supports PUL/DIR and CW/CCW modes and pulse active at rising or falling edge. See more information about these settings in Section 13. Default setting is PUL/DIR mode and rising edge active.

### Connector P2 Configurations

| Pin Function | Details                                                                |
|--------------|------------------------------------------------------------------------|
| +Vdc         | Power supply, 20~36 VDC, Including voltage fluctuation and EMF voltage |
| GND          | Power Ground.                                                          |
| A+, A-       | Motor Phase A                                                          |
| B+, B-       | Motor Phase B                                                          |

## 4. Control Signal Connector (P1) Interface

The DM422C uses opto-couplers to increase noise immunity and interface flexibility. If the opto-couplers' supply voltage is higher than +5V, a current-limiting resistor needs to be connected at each command signal terminal to prevent overheating the opto-couplers. In the following figures, connections to open-collector and differential controller are illustrated.

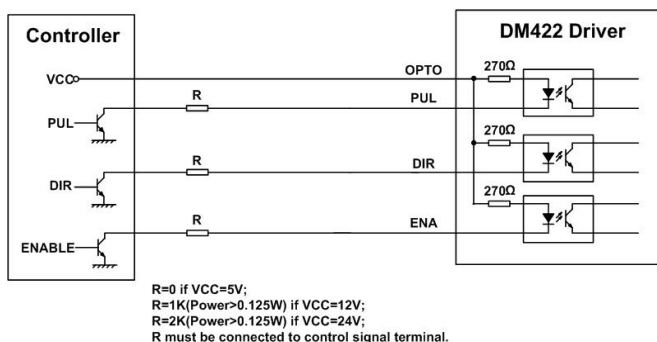


Figure 2: Connections to open-collector signal (common-anode)

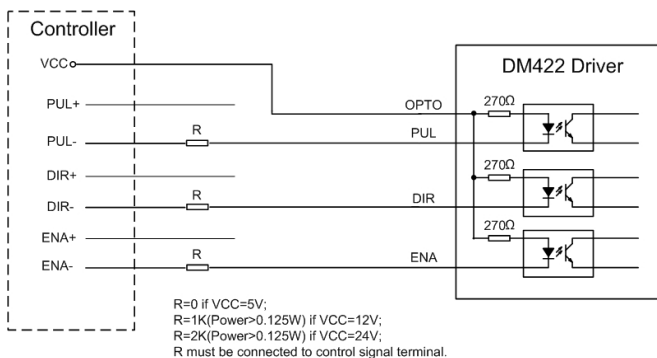


Figure 3: Connections to differential control signal

## 5. Connecting the Motor

The DM422C can drive any 2-phase and 4-phase 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 Drive output current, multiply the specified phase current by 1.4 to determine the peak output current.

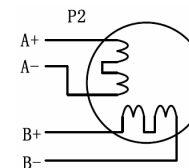


Figure 4: 4-lead Motor Connections

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

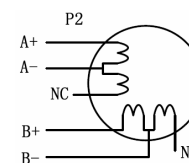


Figure 5: 6-lead motor half coil (higher speed) connections

### 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.

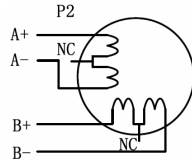


Figure 6: 6-lead motor full coil (higher torque) connections

## 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.

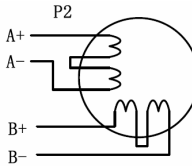


Figure 7: 8-lead motor series connections

### 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.

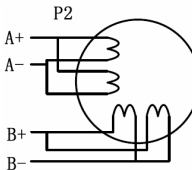


Figure 8: 8-lead motor parallel connections

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

## 6. Power Supply Selection

The DM422C can match medium and small size stepping motors (from NEMA frame size 14 to 23) 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.

**Note: MEANWELL DRP-240-24(24VDC, 240Watt power supply) must be selected in order to make the whole system comply with UL standards for safety.**

### 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. 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-Drive 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 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.

### Multiple Drives

It is recommended to have multiple Drives 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 Drives. Instead, please connect them to power supply separately.

### Selecting Supply Voltage

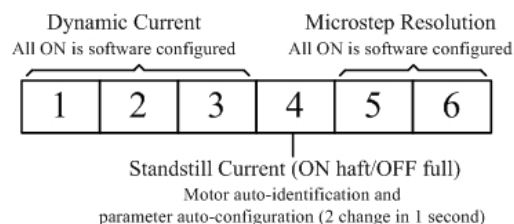
The power MOSFETs inside the DM422C can actually operate within +20 ~ +40VDC, including power input fluctuation and back EMF voltage generated by motor coils during motor shaft deceleration. Higher supply voltage can increase motor torque at higher speeds, thus helpful for avoiding losing steps. However, higher voltage may cause bigger motor vibration at lower speed, and

it may also cause over-voltage protection or even Drive 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 +20 ~ +36VDC, leaving room for power fluctuation and back-EMF.

## 7. Selecting Microstep Resolution and Drive Output Current

Microstep resolutions and output current are programmable, the former can be set from full-step to 102,400 steps/rev and the latter can be set from 0.3A to 2.2A. See more information about **Microstep and Output Current Setting** in Section 13.

However, when it's not in software configured mode, this Drive uses a 6-bit DIP switch to set microstep resolution, and motor operating current, as shown below:



### Microstep Resolution Selection

When it's not in software configured mode, microstep resolution is set by SW5, 6 of the DIP switch as shown in the following table:

| Microstep | Steps/rev.(for 1.8°motor)   | SW5 | SW6 |
|-----------|-----------------------------|-----|-----|
| 1 to 512  | Default/Software configured | ON  | ON  |
| 8         | 1600                        | OFF | ON  |
| 16        | 3200                        | ON  | OFF |
| 32        | 6400                        | OFF | OFF |

### Current Settings

For a given motor, higher Drive current will make the motor to output more torque, but at the same time causes more heating in the motor and Drive. 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 Drive output current depending on motor phase current, motor leads and connection methods. Phase current rating supplied by motor manufacturer is important in selecting Drive current, however the selection also depends on leads and connections.

When it's not in software configured mode, 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

| Peak Current                              | RMS Current | SW1 | SW2 | SW3 |
|-------------------------------------------|-------------|-----|-----|-----|
| Default/Software configured (0.3 to 2.2A) |             | ON  | ON  | ON  |
| 0.5A                                      | 0.35 A      | OFF | ON  | ON  |
| 0.7A                                      | 0.50 A      | ON  | OFF | ON  |
| 1.0A                                      | 0.71 A      | OFF | OFF | ON  |
| 1.3A                                      | 0.92 A      | ON  | ON  | OFF |
| 1.6A                                      | 1.13 A      | OFF | ON  | OFF |
| 1.9A                                      | 1.34 A      | ON  | OFF | OFF |
| 2.2A                                      | 1.56 A      | OFF | OFF | OFF |

**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 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  $P=I^2 \cdot R$ ) of the original value. If the application needs a different standstill current, please contact Leadshine.

## 8. Wiring Notes

- I In order to improve anti-interference performance of the Drive, it is recommended to use twisted pair shield cable.

- I 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.
- I If a power supply serves several Drives, separately connecting the Drives is recommended instead of daisy-chaining.
- I 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 9.

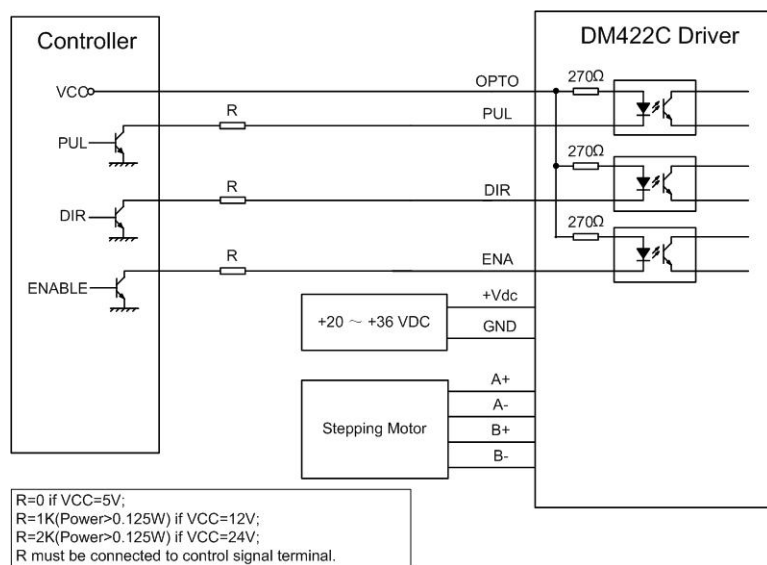


Figure 9: Typical connection

## 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:

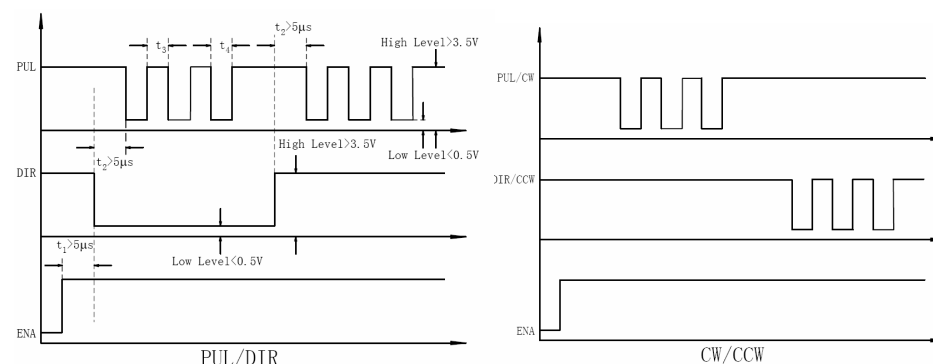


Figure 10: Sequence chart of control signals

### 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 7.5μs;
- d) t4: Low level width not less than 7.5μs.

## 11. Protection Functions

To improve reliability, the Drive incorporates some built-in protection functions. The DM422C uses one RED LED to indicate what protection has been activated. The periodic time of RED is 3 s (seconds), and how many times the RED turns on indicates what protection has been activated. Because only one protection can be displayed by RED LED, so the Drive will decide what error to display according to their priorities. See the following **Protection Indications** table for displaying priorities.

### Over-current Protection

Over-current protection will be activated when continuous current exceeds 16A or in case of short circuit between motor coils or between motor coil and ground, and RED LED will turn on once within each periodic time (3 s).

### Over-voltage Protection

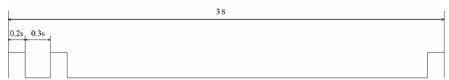
When power supply voltage exceeds  $42 \pm 1$  VDC, protection will be activated and RED LED will turn on twice within each periodic time (3 s).

## Phase Error Protection

Motor power lines wrong & not connected will activate this protection. RED LED will turn on four times within each periodic time (3 s).

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

## 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> | 4             |  | Phase error protection  |

## 12. Frequently Asked Questions

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

| 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                                  |
| <b>Motor rotates in the wrong direction</b> | The Drive is disabled                                   |
|                                             | Motor phases may be connected in reverse                |
| <b>The Drive in fault</b>                   | DIP switch current setting is wrong                     |
|                                             | Something wrong with motor coil                         |
| <b>Erratic motor motion</b>                 | Control signal is too weak                              |
|                                             | Control signal is interfered                            |
|                                             | Wrong motor connection                                  |
|                                             | Something wrong with motor coil                         |
| <b>Motor stalls during acceleration</b>     | Current setting is too small, losing steps              |
|                                             | Current setting is too small                            |
|                                             | Motor is undersized for the application                 |
|                                             | Acceleration is set too high                            |
| <b>Excessive motor and Drive heating</b>    | Power supply voltage too low                            |
|                                             | Inadequate heat sinking / cooling                       |
|                                             | Automatic current reduction function not being utilized |
|                                             | Current is set too high                                 |

## 13. Professional Tuning Software ProTuner

### Introduction

This section will provide an overview of connection and basic setup instructions for Leadshine's digital stepping Drive DM422C using the **ProTuner** software. These instructions will walk you through the following steps necessary to start up your Drive and motor. This section is intended for setting up the Drive with the **ProTuner**.

### Software Installation

The **ProTuner** is windows based setup software for tuning all the Leadshine's digital Drives includes stepping Drive DM422C. It can run in windows systems, including Win95/Win98/WindowsNT/Windows 2000/Windows XP. And the selected PC should have 1 serial port at least for communicating with the Drive.

Double click "ProTuner\_All\_Setup\_V1.0.exe" to begin installing the **ProTuner**. See Figure 11. Click **Next** to enter the "License Agreement" window. See Figure 12.

**Note:** **ProTuner\_All\_Setup\_V1.0.exe** can be used for all Leadshine digital drives. User can get it from either Leadshine CD or website. Please get the latest version from <http://www.leadshine.com>.

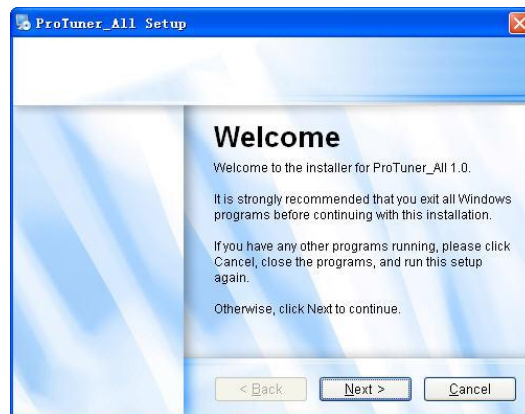


Figure 11: Begin to install the ProTuner

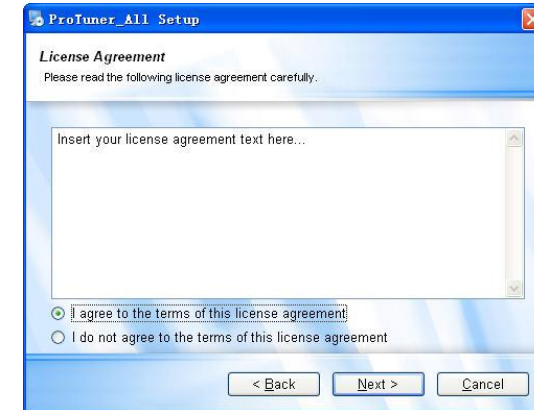


Figure 12: License agreement

Choose "I agree to the terms of this license agreement" and click **Next** to continue installation. The user can enter user's information in the following window. See Figure 13. After entering the user's information, click **Next** to select installation folder, where you would like to install the **ProTuner**. See Figure 14.

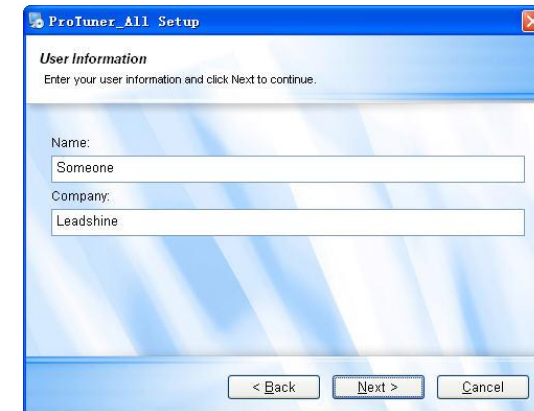


Figure 13: User's information settings

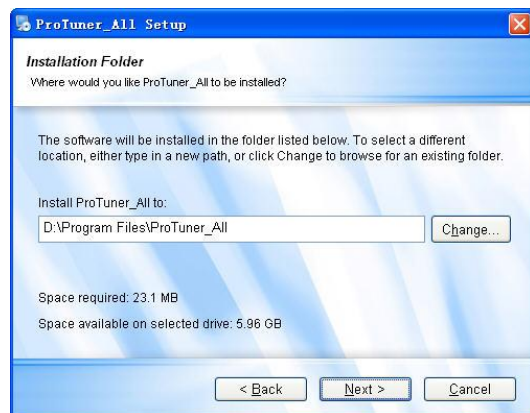


Figure 14: Installation folder settings

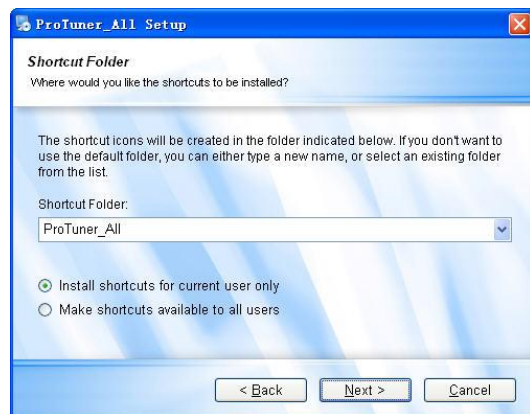


Figure 15: Shortcut folder setting

Set the “Shortcut Folder” in Figure 15 and continue to install the **ProTuner** by following Figure 16 and Figure 17. An **Installation Successful** window will appear if the **ProTuner** is installed successfully. See Figure 18.

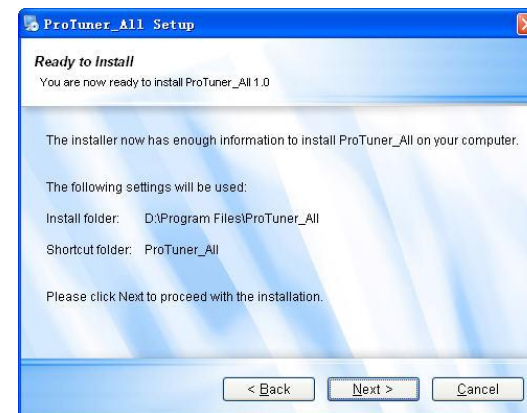


Figure 16: Installation information summarization

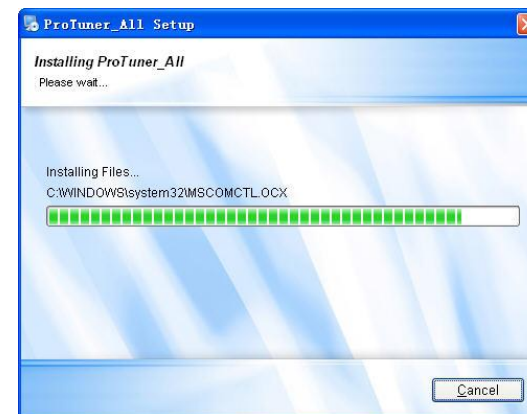


Figure 17: Installing the ProTuner

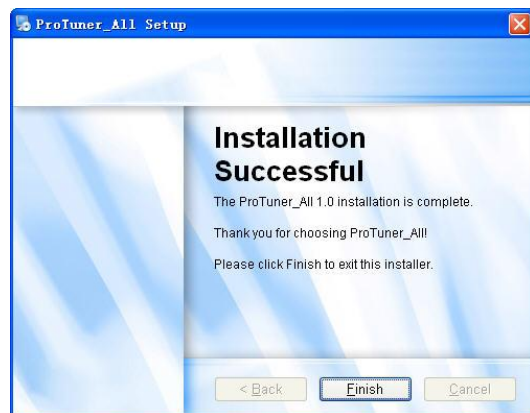


Figure 18: Finish installation

## Connections and Testing

Connect the stepping system according to the contents in previous sections and connect the PC to the Drive as the following figure.

### RS232 Interface Connection

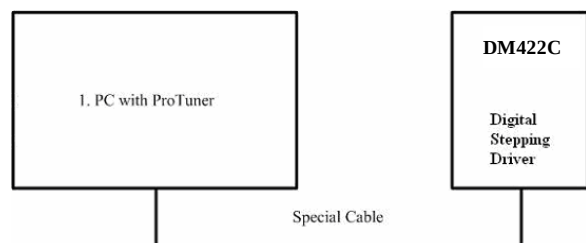


Figure 19: RS232 interface connection

## Testing the Stepping System

Turn on the power supply, the green (Power) LED will light. The DM422C has default parameters stored in the Drive. If the system has no hardware and wirings problem, the motor should be locked and the Drive should be ready.

If the red LED immediately turns on (flickers), then check power supply, the motor, motor wirings

and try again. Open the tuning software **ProTuner** and check Drive status by clicking **Err\_check**. If it's **Phase Error**, check the motor, motor wirings and try again. If it still doesn't work after you followed all of the previous steps, please contact us at [tech@leadshine.com](mailto:tech@leadshine.com).

If the RED LED is OFF and the motor is normal, then you can start to tune the servo with **ProTuner**. However, we recommend you see the following contents before starting tuning.

## Software Introduction

### ProTuner Main Window



Figure 20: ProTuner

### Ø Option

The user can choose three drop-down menus by clicking “**Option**”, including **Com Config**, **SaveToDrive** and **Exit**.

- 1 **Com Config**: Configure Com communication interface.
- 1 **SaveToDrive**: Download the current parameter settings to the Drive.

I **Exit:** Exit the **ProTuner**.

## Com Config Window



Figure 21: RS232 communication configuration window

**Serial Port:** Select the serial communication port to which the Drive is connected. The factory default setting is COM1.

**Baud Rate:** Select the communication baud rate. The factory default setting is 38400.

Click **Open** button to establish a connection with the specified settings. When connecting, you can choose **SaveToDrive** to download the current parameter settings to the Drive, or to upload the stored Drive settings into the **ProTuner** by clicking **Tuning > Position Loop** on the menu bar.

## Tuning

The user can choose one or two drop-down menu(s) by clicking **Tuning**, including **CurrentLoop** and **SystemConfig**.

I **CurrentLoop:** In Current Tuning window, the user can tune the **Kp (Proportional Gain)** and **Ki (Integral Gain)** of Drive's current loop to optimize responses with different motors. Start/Restart a Step Response test to get an optimum response.

**Kp: Proportional Gain.** Proportional Gain determines the response of the Drive to current setting command. Low Proportional Gain provides a stable system (doesn't oscillate), has low stiffness, and large current error, causing poor performances in tracking current setting command in each step like Figure 23. Too large Proportional Gain values will cause oscillations and unstable systems.



Figure 22: Current Tuning window

**Ki: Integral Gain.** Integral Gain helps the Drive to overcome static current errors. A low or zero value for the Integral Gain may have current errors at rest. Increasing the Integral Gain can reduce the error. If the Integral Gain is too large, the systems may “hunt” (oscillate) about the desired position.

**Start** button: The user can start a Step Response test by clicking this button. Start/Restart a Step Response test to get an optimum response like Figure 22, and remember to save the settings to the Drive when finish tuning. See Figure 24.



Figure 23: Kp=2346, Ki=0 (poor performances)

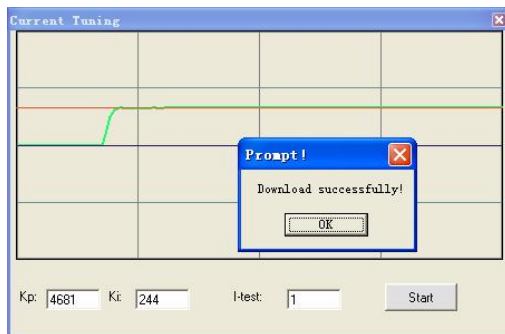


Figure 24: Finish tuning and save setting to the Drive

### Notes:

However, if the user does not want to tune the current loop after changing a different stepping motor, then **Motor self-test and parameter auto-setup** technology of the DM422C can replace manual tuning the Drive with **ProTuner**. Just changes SW4 two times in 1 second, and then the Drive will auto-identify the new motor and auto-configure related control parameters for optimum responses.

**Recommend** use this function after changing the driven motor.

### 1 SystemConfig:

In **SystemConfig** window, the user can configure Peak Current, Microstep, Command Type, Active Edge, and eliminate motor resonance. A built-in pulse generator can be used for test during tuning. See Picture 25.

**PeakCur: Peak Current.** The value is the peak current to the selected motor and can be set from 0.1 to 3.2 A. The user can set the peak current with **ProTuner** or DIP switches, see more information about setting output current of the Drive in section 5 “**Connecting the Motor**” and section 7 “**Selecting Microstep Resolution and Drive Output Current**”.

**MicroStep: Microstep Resolution.** The value is Drive’s microstep resolution setting and can be set from 1 to 512. The user can set the microstep with **ProTuner** or DIP switches, See more information about setting output current of the Drive in section 7 “**Selecting Microstep Resolution and Drive Output Current**”.

**StepAngle: Step Angle.** The Drive will auto detect the **Step Angle** of the driven motor.

**CommandType: Command Type** of control signal, including PUL/DIR and CW/CCW. Set this parameter according to **Command Type** of motion controller.

**ActiveEdge: Active Edge.** The user can set the triggered edge of pulse command signal in this panel. When the Drive works in CW/CCW mode, no matter what level is at fixed level terminal, the Drive can works properly.

### Anti-Resonance Introduction

Step motors are highly resonant, which results in vibration and ringing. The ringing utilizes a large fraction of the motor's available torque – thereby wasting performance. Furthermore, at mid-range velocities, the resonance can become so severe that the motor loses synchronization and stalls. The DM422C Drive provides robust anti-resonance control to stop the vibrations and maintain equilibrium. This feature requires that the Drive be configured with respect to the total inertia in the system. If set improperly, the effectiveness of the feature may be diminished.

The user can invoke or disable the feature by setting **Amp** and **Phase** values in **SystemConfig** window. **Amp** and **Phase** values all zero is to disable the feature, otherwise is to invoke the feature. It should be enabled unless the system configuration either does not need it or cannot tolerate it. A system with loose couplings or viscous loading generally does not need this feature. If a system has compliant (springy) coupling and is absent appreciably viscosity, it may not respond well to the active, anti-resonant loop in the drive. The anti-resonant feature is not designed to damp such a 4<sup>th</sup> order system. If the application of anti-resonance results in degradation or instability, it should be disabled.

**1<sup>st</sup> ResonanceArea: Parameters for 1<sup>st</sup> resonance area.** Usually between 0.6rps and 1.2rps.

**Amp1** is Amplitude adjustment for 1<sup>st</sup> resonance area.

**Phase1** is Phase adjustment for 1<sup>st</sup> resonance area. The user can enter a value directly in the text box or move the slider bar back and forth to get an optimum value.

**LowerLimit** is the **Lower Limit** of the 1<sup>st</sup> resonance area, and the user can capture this value when finds it during move the slider bar of internal pulse generator.

**UpperLimit** is the **Upper Limit** of the 1<sup>st</sup> resonance area. Default **Amp1** and **Phase1** values are zero.

**2<sup>nd</sup> ResonanceArea: Parameters for 2<sup>nd</sup> resonance area.** Usually between 1.2rps and 2.4rps. Default **Amp2** and **Phase2** values are zero.

**3<sup>rd</sup> ResonanceArea: Parameters for 3<sup>rd</sup> resonance area.** Usually between 2.4rps and 4.8rps. Default **Amp3** and **Phase3** values are 128.

**Start/Stop** button: The user can start/Stop a motion test by clicking this button.

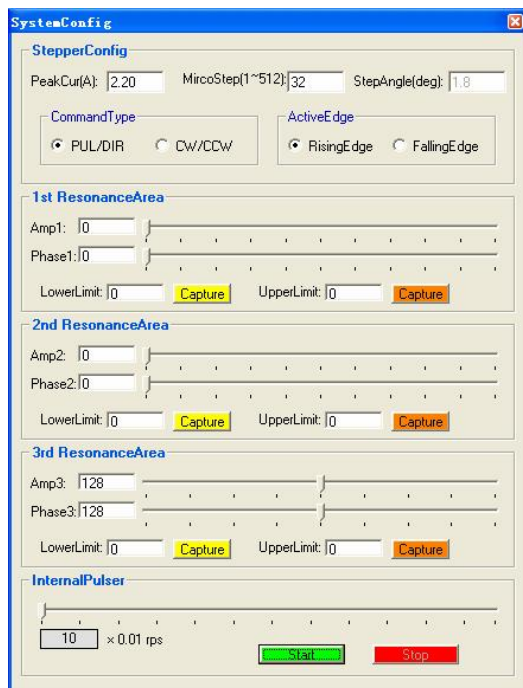


Figure 25: SystemConfig window

### Procedure for Achieving Optimum Performance

**Step 1:** Start the motion test by clicking **Start/Stop** button. Find the **Lower Limit** values and **Upper Limit** values for each resonance area by slightly moving the slider bar of internal pulse generator back and forth, and capture these values for anti-resonance algorithm by clicking **Capture** buttons. See Figure 26.

**Step 2:** Run the motor at the given test speed and verify the motor smoothness. You may find a better smoothing value by slightly moving the slider bars of **AMP(s)** and **Phase(s)** back and forth.

It is very important to make the **AMP(s)** and **Phase(s)** adjustments at the proper test speeds with an unloaded motor. Running at an incorrect test speed will not excite the motor at its peak resonance,

making it more difficult to find proper adjustment values. Optimum **AMP(s)** and **Phase(s)** values may be a little different between running the tests with an unloaded motor and a load motor.

Please remember to click **SavetoDrive** to download the final parameter settings to the Drive when finish tuning. See Figure 27.

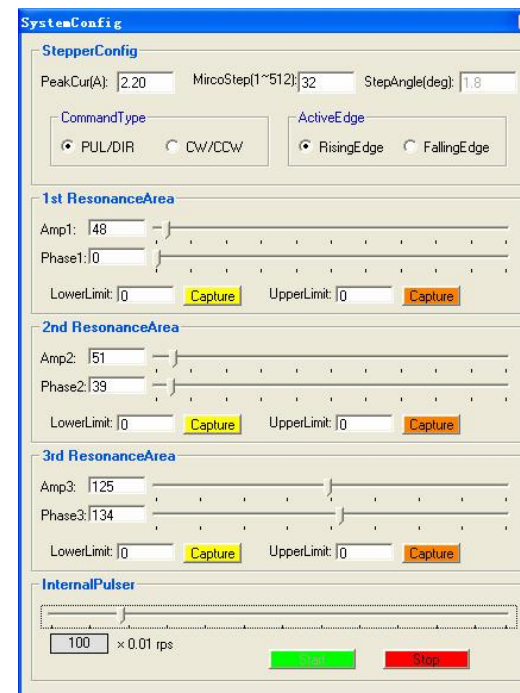


Figure 26: Anti-resonance tuning

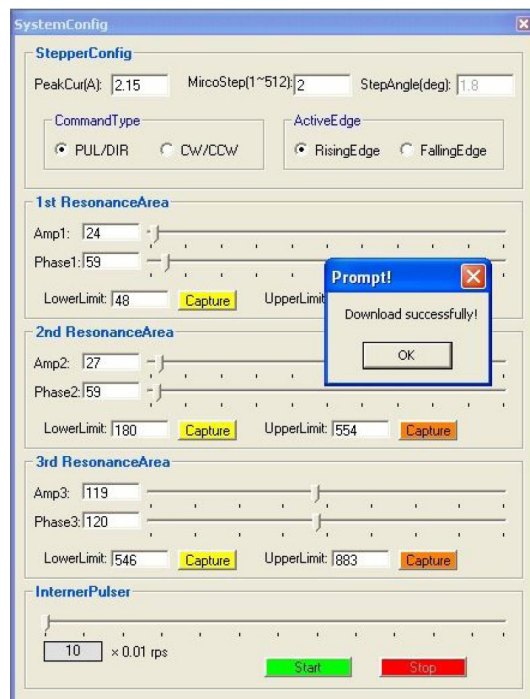


Figure 27: Finishing tuning and download parameter settings to the Drive

## Ø Err\_check

- Error Check:** This window shows both the present status of each error event and their history. Current error event(s) can be reset by clicking **Erase Current Err!** button, and all error events can be reset by clicking **Erase All!** button. List of the last ten drive faults. #0 being the most recent, #9 is the oldest. See Figure 28.

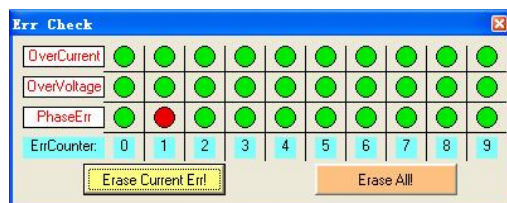


Figure 28: Error check window

**OverCurrent: Over-current Protection.** Protection will be activated when continuous current

exceeds 16A.

**OverVoltage: Over-voltage Protection.** When power supply voltage exceeds  $42 \pm 1$  VDC, protection will be activated.

**PhaseErr: Phase Error Protection.** Motor power lines wrong & not connected will activate this protection.

**ErrCounter:** Displays current error(s) and current error history.

**Erase Current Err!:** Erase Current Err button. The user can clear current error(s) by clicking this button.

**Erase All!:** Erase All! button. The user can clear all error(s) including error history by clicking this button.

## Ø About

The user can choose two drop-down menus by clicking “About”, including **Product Information** and **Contact Us**.

- Product Information** window: Shows some product information about ProTuner.
- Contact Us** window: Shows some contact information about Leadshine.



Figure 29: Product information

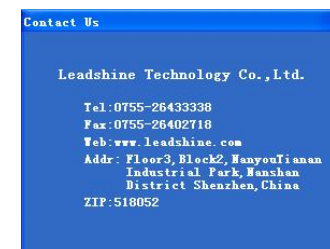


Figure 30: Contact information

## APPENDIX

### Twelve Month Limited 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, a returned material authorization number (RMA) must be obtained from customer service at e-mail: [tech@leadshine.com](mailto:tech@leadshine.com) before returning product for service. Customer shall prepay shipping charges for products returned to Leadshine for warranty service, and Leadshine shall pay for return of products to customer.

### Warranty Limitations

Leadshine makes no other warranty, either expressed or implied, with respect to the product. Leadshine specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. Some jurisdictions do not allow limitations on how long and implied warranty lasts, so the above limitation or exclusion may not apply to you. However, any implied warranty of merchantability or fitness is limited to the 12-month duration of this written warranty.

### Shipping Failed Product

If your product fail during the warranty period, 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. Send failed product to distributor in your area or: Leadshine Technology Co., Ltd. 3/F, Block 2, Nanyou Tianan Industrial Park, Nanshan Dist, Shenzhen, China. Also enclose information regarding the circumstances prior to product failure.

## Contact Us

### China Headquarters

**Address:** 3/F, Block 2, Nanyou Tianan Industrial Park, Nanshan District Shenzhen, 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) and [vic@leadshine.com](mailto:vic@leadshine.com).

### Leadshine Hong Kong

**Address:** Rm 3, 9/F, Block E, Wah Lok Industrial Center, 31-41 Shan Mei St., Fo Tan, Shatin, Hong Kong

**Tel:** 852-2952-9114

**Fax:** 852-2952-9395

**Email:** [hk\\_sales@leadshine.com](mailto:hk_sales@leadshine.com).

### Leadshine U.S.A

**Address:** 25 Mauchly, Suite 318 Irvine, California 92618

**Tel:** 1-301-433-3780

**Fax:** 1-301-637-2718

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

**Email:** [usa\\_sales@leadshine.com](mailto:usa_sales@leadshine.com) and [cli@leadshine.com](mailto:cli@leadshine.com).