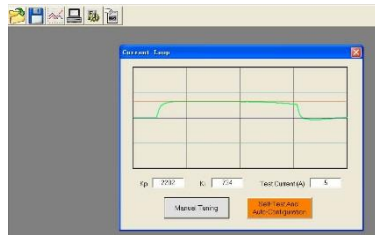# Software Operation Manual
For DM805-AI
A Digital Stepper Drive With
Analogue 0-5V Input

V1.0-150324

(March 2015)

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1. INTRODUCTION AND THE FUNCTIONS

Introduction

The ProTuner is a software tool designed to configure and tune our DMD & DM series digital stepper drives including DM805-AI. The user can tune the current loop and adjust the anti-resonance parameters via this software.

Work Platform

After installing the software and open it, the software is displayed as follows.
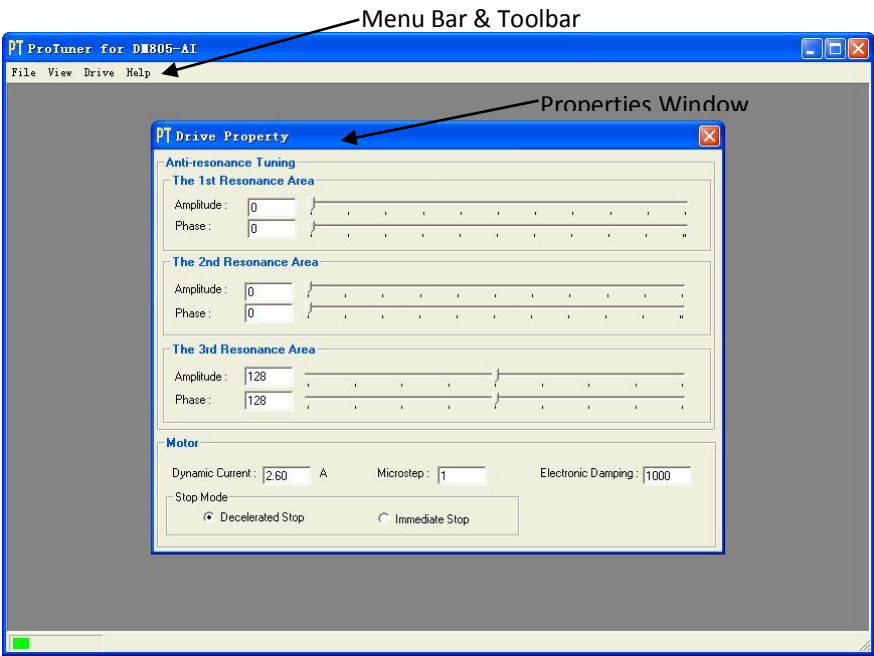
Menus and Toolbar

Menus and toolbar are at the top of the workspace. You can click menu bar to view pull-down menu. The toolbar below offers the most frequency used commands.

Menu	Drop-down Menu	Function
File ->	Open	Open a file
	Save As	Save as a file
	Exit	Exit the software
View->	Error Log	Check the drive error log.
	Drive Information	DM805-AI specification
Drive ->	Connect To Drive	Connect to drive
	Current Loop Tuning	Configure current loop parameters Proportional Gain & Ki and test.
	Properties	Set drive properties like I/O logic, motor parameters.
	Offset	Check analog and potentiometer offset.
	Save to Drive	Save all data to drive
	Restore Factory Setting	Restore factory settings
Help->	About	Software Information

2. HOW TO USE THE SOFTWARE

Open a file

If you want to load the configuration data from a file in the PC, click on the File->Open. The parameters in the software's workspace will be updated.

Save as a file

Click Drive->Save As to save the data in current workspace to a file and rename it.

Connecting Drive

Connect to Drive window appears every time when you open ProTuner. Select the serial port, leave the baud rate as default 38400 and click on the Open button. The software will connect to the drive and read the settings. It may take several minutes.

Before connecting the drive, please make sure:
1) The RS232 cable .has been connected between the drive and PC serial port;
2) Power has been applied to the drive and the green LED is on.

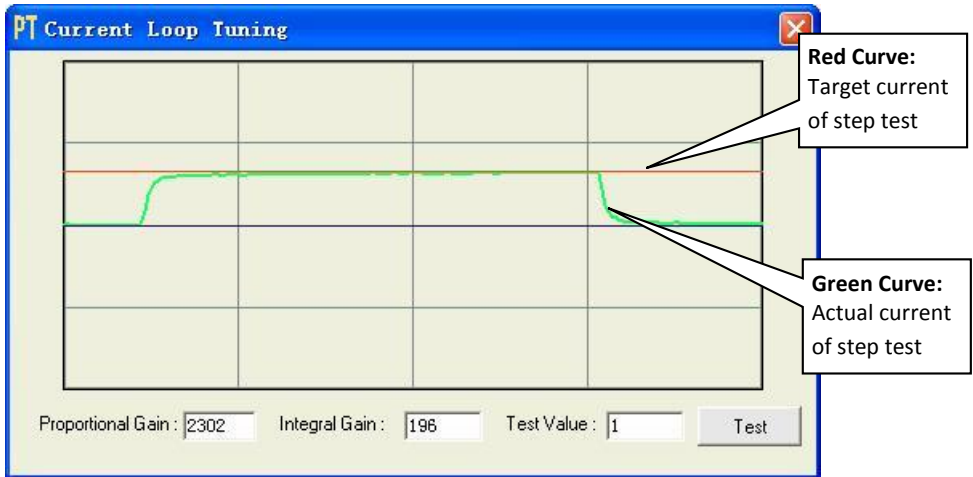**Notice**

The motor is no need to connect to the drive if you just want to change the parameters but not tuning.

⚠ **Caution**

 Do not connect or disconnect serial cable when drive is powered on. The drive's communication circuit may be damaged.

Current Loop Tuning Window

It is used to configure current loop parameters according to different motor. In the tuning window, user can set proportional gain, integral gain and test value.

Red Curve: Target current of step test

Green Curve: Actual current of step test

Proportional Gain : 2302   Integral Gain : 196   Test Value : 1   Test

NOTES: After finishing the input of the number, don't forget to hit the "Enter" key in the keyboard to confirm new value.

| Item	Description	Range
Proportional Gain	Increase Proportional Gain (Kp) to make current rise fast. 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. Too large Proportional Gain values will cause oscillations and make the system unstable.	1 – 65535
Integral Gain	Adjust this parameter to reduce the steady error. 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.	1 – 65535
Test Value	The current amplitude for the step response. This value should not exceed the maximum output current of the drive.	0.5 – 5A
Test Button	Click this button to activate the test. A target curve (red) and an actual curve (green) will be displayed on the screen for user's analysis.	-

Properties Window

The user can set the drive's anti-resonance parameters, output current, microstep, electronic damping and stop mode according the motor and application.

NOTES: Microstep setting is only effective in Pulse/Direction mode.

Item	Description	Range
The 1st Resonance Area	It is usually between 0.6 to 1.2 RPS.	-
The 2nd Resonance Area	It is usually between 1.2 to 2.4 RPS.	-
The 3rd Resonance Area	It is usually between 2.4 to 4.8 RPS.	-
Amplitude	Amplitude adjustment for anti-resonance tuning. 0 - 3500 for the 1st, 2nd resonance area and 0 -256 for the 3rd 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.	0 -3500 or 0- 256

Phase	Phase adjustment for anti-resonance tuning. The user can enter a value directly in the text box or move the slider bar back and forth to get an optimum value.	0-1608 or 0-256
Dynamic Current	Drive's output current setting according to the motor. It should be less than the motor's related current * 1.414 **Note**: The DIP switch setting must be SW1 = off, SW2 = off, SW3 = off if you want to set this parameter in ProTuner.	0.5 - 7.0 A
MicroStep	Drive's Microstep setting for the motor. **Note 1**: The DIP switch setting must be SW5 = off, SW6 = off, SW7 = off, SW8 = off if you want to set this parameter in ProTuner. **Note 2**: The microstep is effective only in Pulse/Direction mode.	1 - 512
Electronic Damping	Adjust this parameter to improve the drive's high speed performance. The optimal value depends on the system.	0 - 6000
Stop Mode	The motor stops immediately when a stop command is applied to the drive if this parameter is immediate stop. Otherwise the motor stops with acceleration set by the Accel/Ramp or Decel/LoSpeed potentiometers.	-

Offset
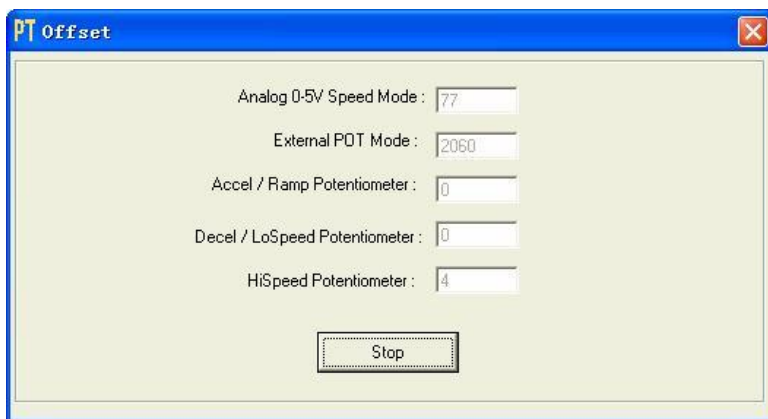
It is used to check the offset of the potentiometers and analog input in factory. The user can ignore it.

Save to Drive

After the drive's configuration and tuning is done, you need to click Drive->Save To Drive to save the data to drive's nonvolatile memory. Otherwise the data will not be lost after power-off.

Restore Factory Setting

This command is used to restore the factory data when the drive is out of control or the user want to do that.

3. HOW TO CONFIGURE THE DRIVE

If it is the first time setup, you can follow the steps below to configure the drive.

1) Set motor's parameters like dynamic current, Microstep and stop mode according to the motor's application.

2) Tune the current loop parameters with the connected motor.

3) Tune the anti-resonance parameters if necessary.

4) Adjust the electronic damping when the high speed performance is not good.

⚠ Notice	1. The motor must be connected to the drive before trying to configure the drive.
	2. After finishing the input of the number, don't forget to hit the "Enter" key in the keyboard to confirm new value

Set Motor Parameters

Click **Drive->Properties** to open the Property window. You can set the motor's dynamic current, microstep and stop mode.

The motor's dynamic current is related to the RMS current. Usually, the motor manufacturer states the RMS (root mean square) current in the datasheet. Please refer to the hardware installation manual for how to set the dynamic current.

⚠️ **Notice**	The DIP switch setting must be put as SW1 = off, SW2 = off, SW3 = off, if you want to set Default/software configured current parameter in ProTuner Properties Window

The microstep is so important and is ONLY effective in Pulse and Direction command mode. High resolution microstep makes the motor move more smoothly. Low microstep resolution reduces the high frequency requirement to the controller.

⚠️ **Notice**	1. The DIP switch setting must be put as SW5= off, SW6= off, SW7= off, SW8= off, if you want to set Default/software configured microstep parameter in ProTuner Properties Window 2. The microstep is effective only in Pulse/Direction mode

The motor stops in the acceleration set by the potentiometer. If the application needs fast stop, please click Immediate Stop.

Tuning Current Loop

The current loop parameter on DM805-AI stepper drive needs to be tuned before normal operation in order to optimise the responses with different motors. Otherwise motor will be easily stalled or howls WHEN it is powered up. Below example is the tuning process of DM805-AI with a NEMA 23 motor at 24VDC supply voltage.

Step 1: Set **Test Current** 1 and start the tuning with small **Proportional Gain** and "zero" **Integral Gain**. Here we set **Proportional Gain**=500.
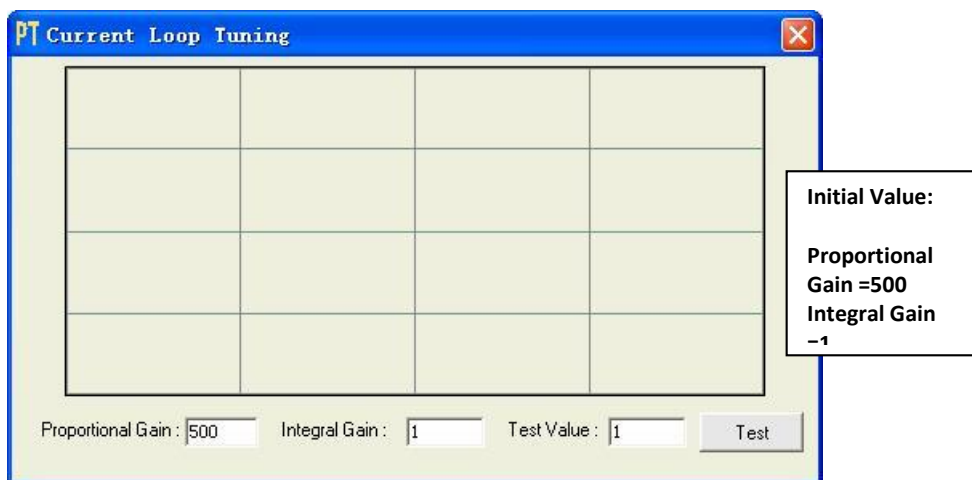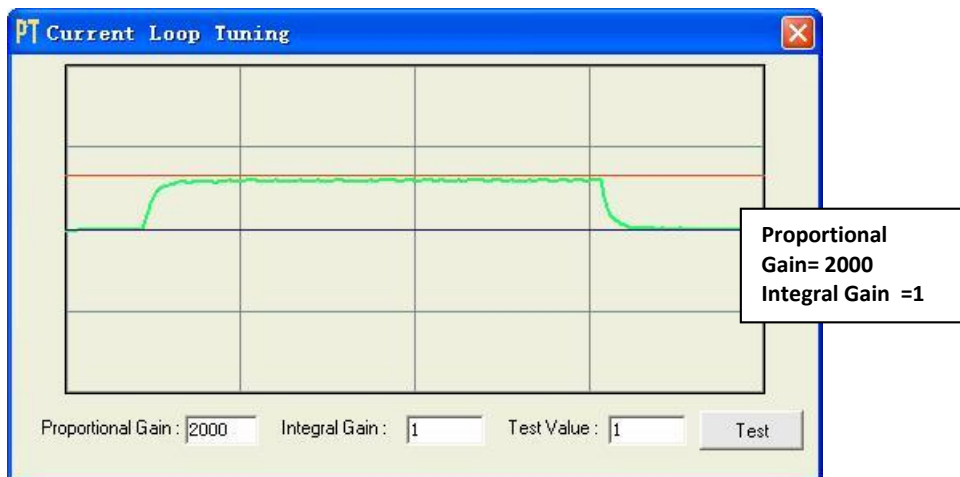

Step 2: Click the **Test** button and the plot window will show two curves. The red curve is "target current" and the green curve is "actual current". There is a big gap between them in the scope. It indicates that a larger **Proportional Gain** needs to be introduced.
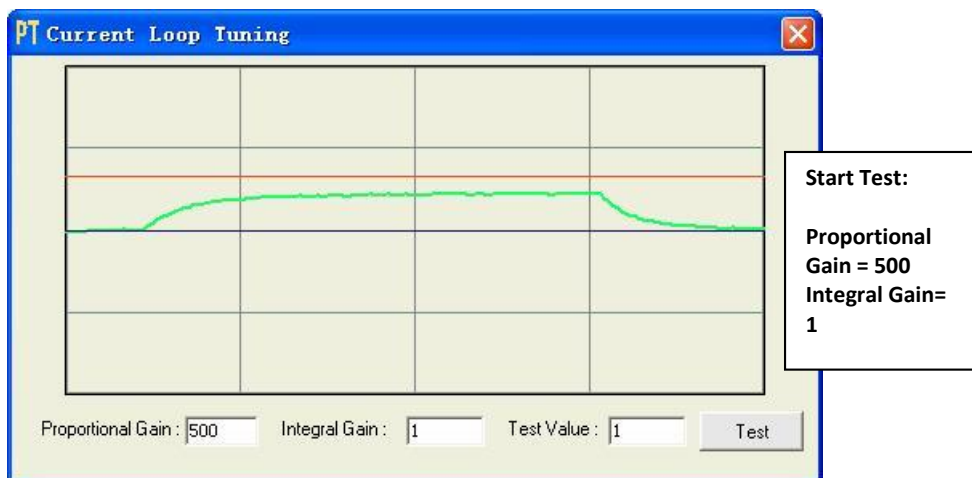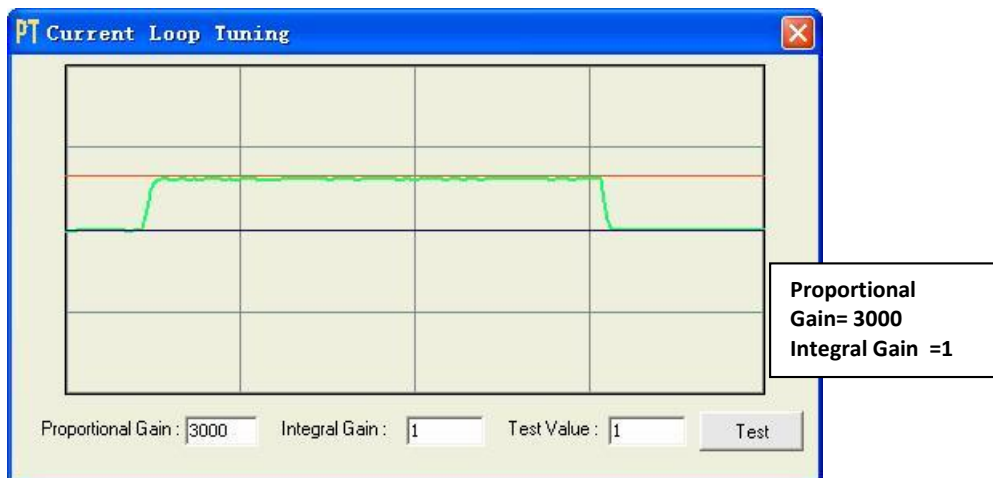
Step 3: Increase **Proportional Gain** to 1000 and click **Start**. The gap between target value and actual value is smaller but a higher **Proportional Gain** is still needed.

> **Proportional Gain= 1000 Integral Gain = 1**
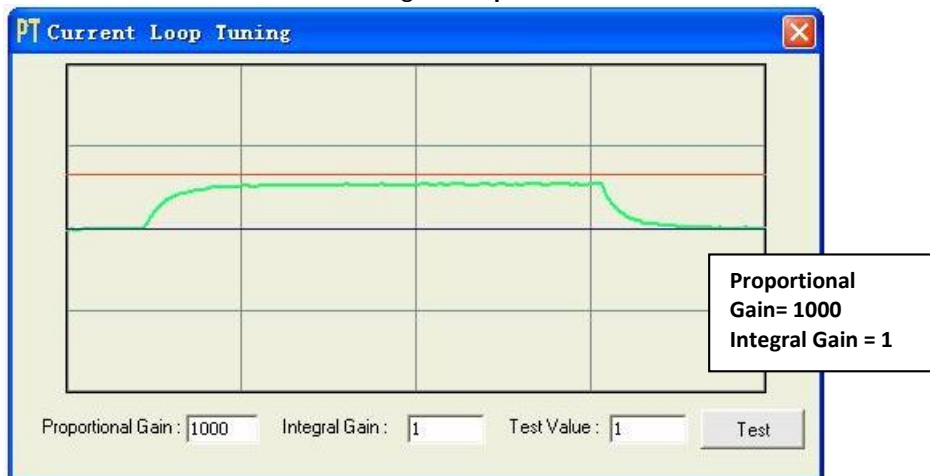
Step 3: Give **Proportional Gain** 2000, 3000, 4000 and click **Test** button, respectively. The green curve is getting closer and closer to the red curve. Over-shoot is obvious when we increase **Proportional Gain** to 4000. It indicates that you need to stop increasing **Proportional Gain** and back off. Our purpose is to make the green curve (the actual current) a little higher than the red curve (the target). So we decrease **Proportional Gain** to 3700 until the actual value is exactly over the target value.

> **Proportional Gain= 2000 Integral Gain =1**

Proportional
Gain= 3000
Integral Gain =1

Over -shoot

Proportional
Gain= 4000
Integral Gain =1

Proportional
Gain= 3700
Integral Gain =1
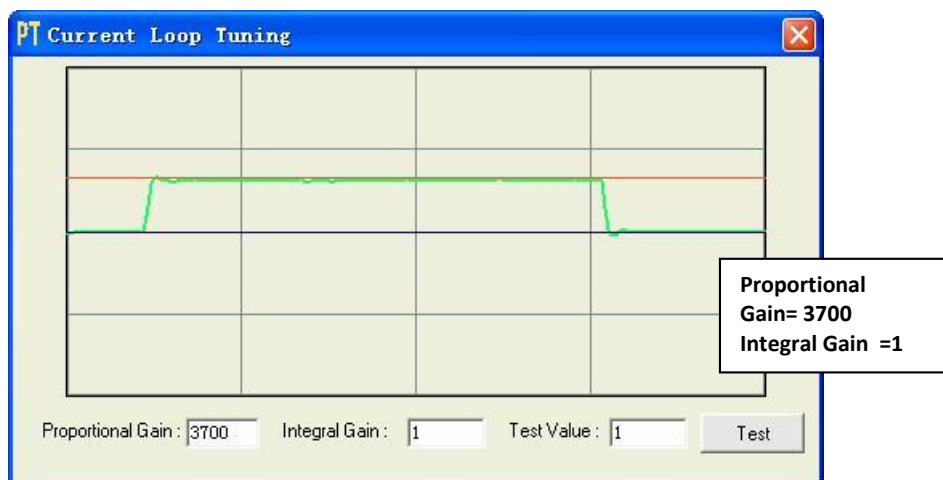
Step 4: Now the **Proportional Gain** is relatively good enough. But there is still some gap between the green curve and the red curve when we use the mouse to zoom in the green curve. So we need to introduce **Integral Gain** to reduce the "gap" or steady error at the constant part. It follows the same procedure as **Proportional Gain**. High **Proportional Gain** causes big vibration, system lag and makes the performance worse. The following figures show how to tune the **Integral gain**.

Drag a triangle to zoom in

Zero Integral Gain:
Proportional Gain
=3700
Integral Gain =1

↑ Integral Gain:
Proportional Gain
=3700
Integral Gain =200

↑ Integral Gain:
Proportional Gain
=3700
Integral Gain =400
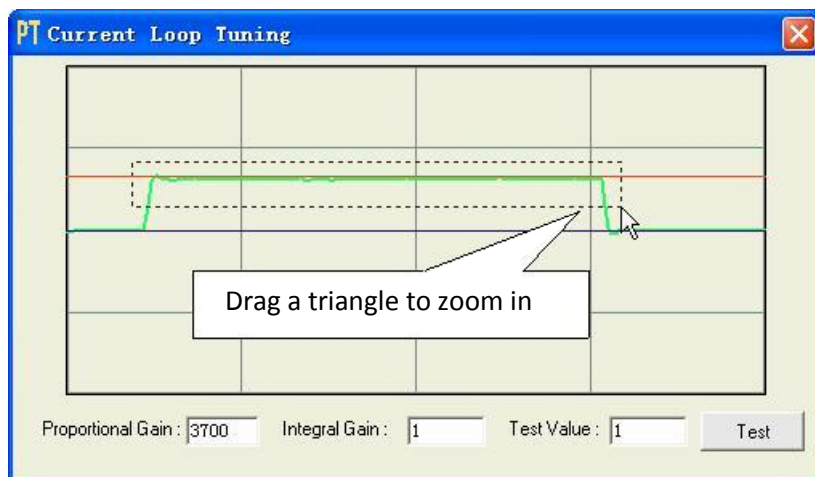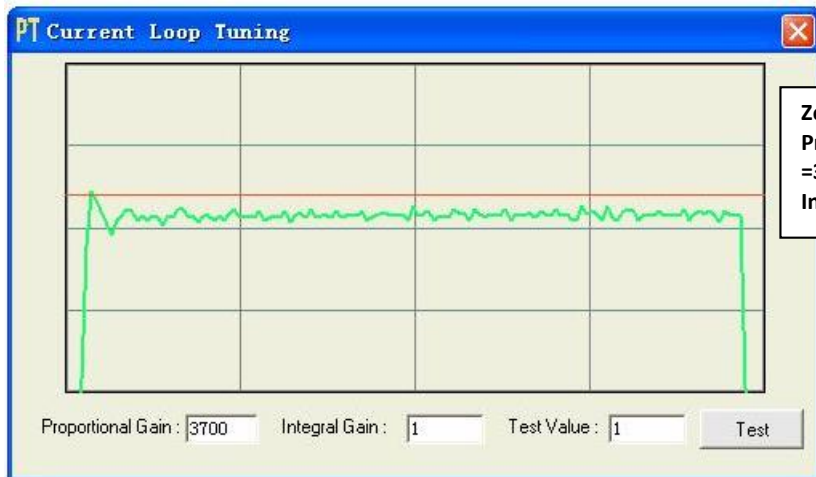
Step 5: The current loop tuning is basically finished. You can continue to adjust Proportional Gain and Integral Gain for better performance. Now the updated Proportional Gain and Integral Gain is just stored in the drive's RAM. The data will be lost when we power off the drive. **Don't forget to click Drive->Save To Drive to store the changed value to the drive's EEPROM.**

Further
adjustment:
Proportional Gain
=3500
Integral Gain =300

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Connect To Drive
Current Loop Tuning
Property
Offset
Save To Drive
Restore Factory Setting
```

Save all the changes to the drive's non-violated, non-volatile memory.
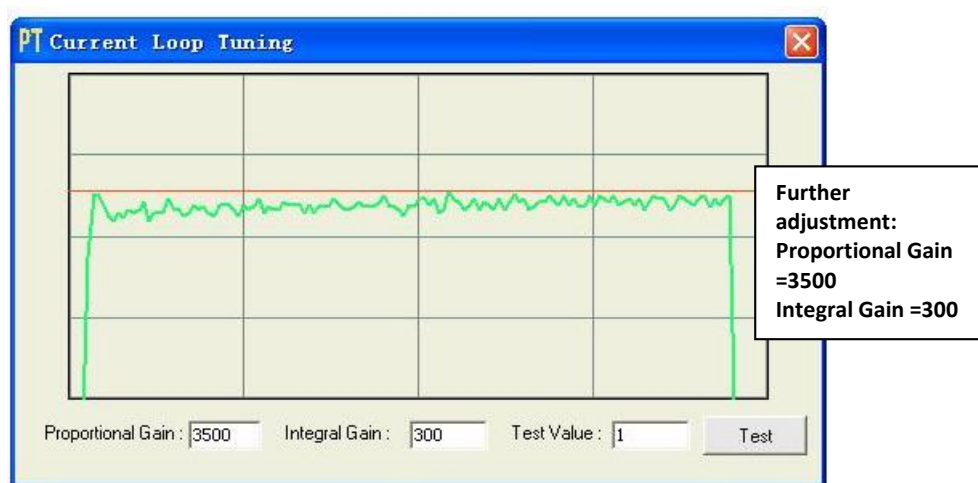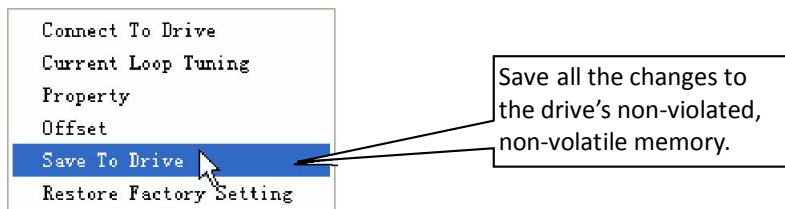
Anti-resonance Tuning

Stepper 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 looses synchronisation and stalls. The DM805-AI digital stepper 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 it is set improperly, the effectiveness of the feature may be diminished.

⚠ **Notice**

1. For most of the application, it is not needed to tune DM805-AI stepper drive's anti-resonance parameters. We only recommend the advance user to use this function as it is a boring process.

2. In most of the case, only the tuning of the 1st and 2nd anti-resonance area has the obvious effects

Step 1: Connect the drive as follows and configure it in Low/High Speed mode by set SW7 = OFF and SW8 = ON. As the Speed input is connected to Signal GND, the motor speed is determined by the LoSpeed potentiometer and it can be adjusted from 0RPS to 5RPS.

Step 2: Start to run the motor by activating the Run/Stop input. Find a resonance speed by slightly adjusting the LoSpeed parameter CW and CCW

Step 3: Keep the motor running at the resonance speed and verify the motor smoothness. You may find a better smoothing value by slightly moving the slider bars of **Amplitude** and **Phase** back and forth. If the motor speed is 0.6-1.2RPS, you should tune the Amplitude and Phase at the 1st resonance area. The 2nd resonance area is 1.2-2.4 RPS and the 3rd resonance area is 2.4 4.8 RPS.

⚠ Notice

1. You can calculate the motor speed roughly as follows

$$Speed(RPS) = 5 \pm 0.01(RPS) \times \frac{Turns \quad of \quad LoSpeed \quad Potentiometer}{25 Turns}$$

2. It is very important to make the **Amplitude** and **Phase** adjustments at the resonance speed

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For example, we find a resonance speed at 0.98 rps. We begin to move the Amp1 slider forth and the motor vibration and noise became lower and lower. Finally we find the move is the smoothest when **Amplitude 1** is 3300. The motor vibration and noise increase if **Amplitude 1** exceeds 3300. Then we follow the same procedure to search the best point for **Phase 1**. See Figure 26. Anti-resonance tuning is done.

Step 4: Click **Drive->Save To Drive** to save all the parameters to DM805-AI stepper drive's non-volatile memory

Adjusting Electronic Damping

The factory setting for the electronic damping is 1000. If the motor is easily stalled and generates odd noise at middle speed, you can try other values such as 500, 1500, 2000, 2500.