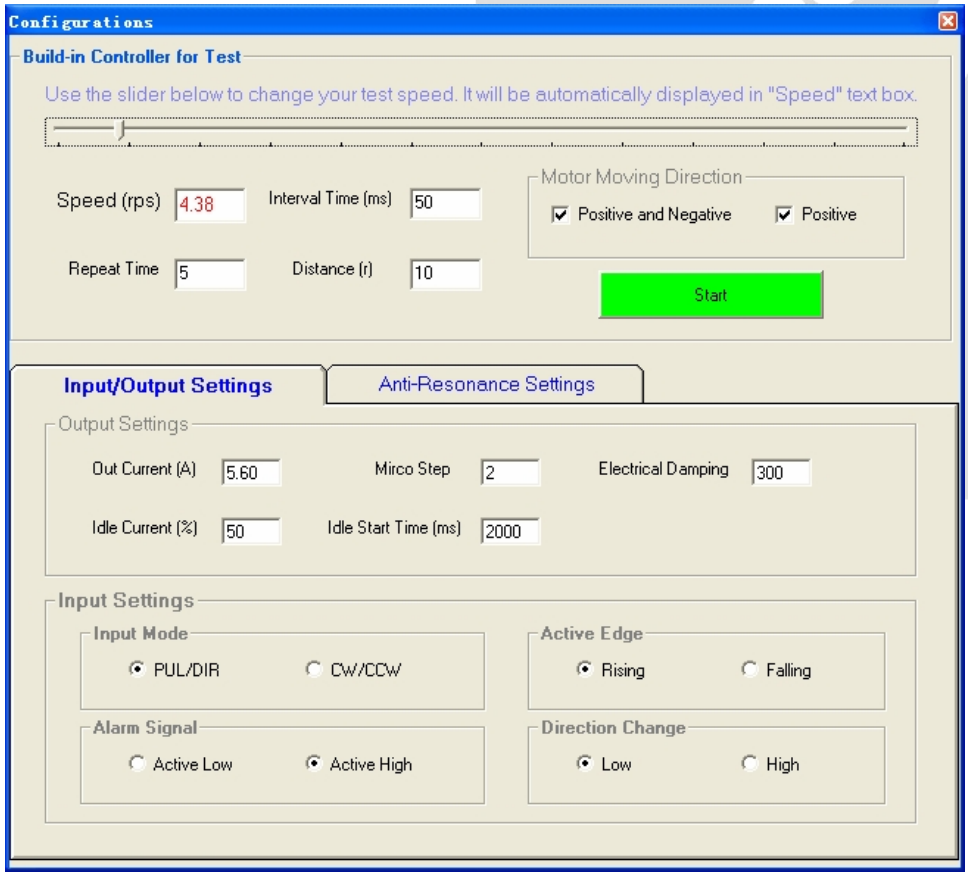
Software Operational Manual

Digital Stepper Drive DM1182



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Change Log

Revision Date	Changes	Version
2012-04-01	Original Create	SM-DM-R20120401

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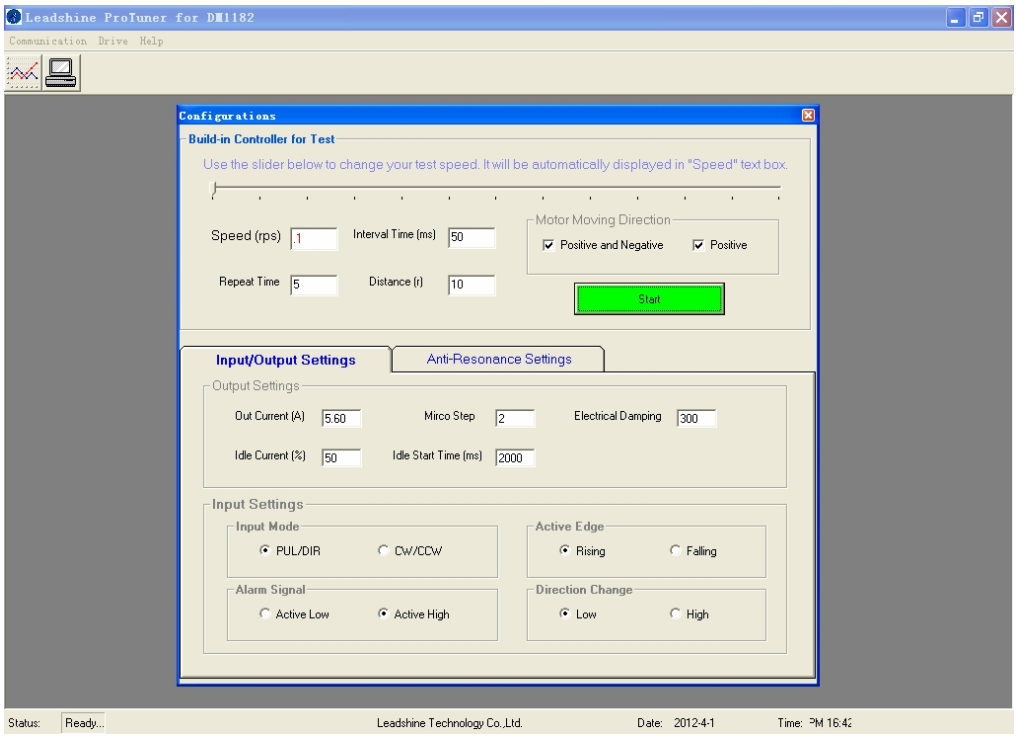
Introduction

The ProTuner is a software tool designed to configure and tune the Leadshine digital stepper drive DM1182. The user can configure the drive's output current, micro step, command type, tune the current loop and adjust the anti-resonance parameters in this software.

Workspace



Menu

Toolbar

Configuration Window

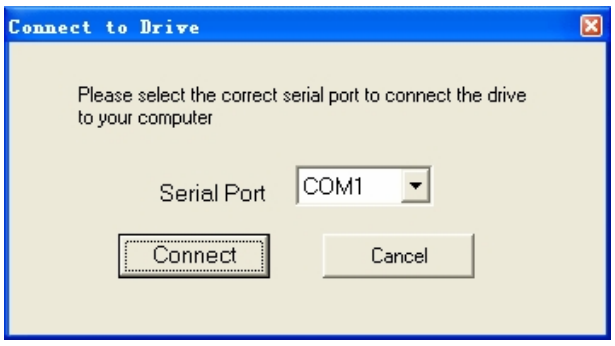
Menus and Toolbar

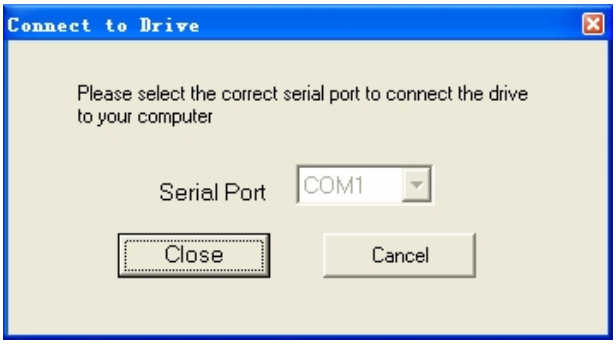
Menus and toolbars are at the top of the workspace. You can click menu bar to view the pull-down menu. The toolbar below offers the most frequency used commands.

Menu	Pull Down	Toolbar	Function
Communication ->	Connect to Drive	-	Open the serial port and connect to drive
	Exit	-	Exit from ProTuner
Drive ->	Current Loop		Tune the current loop parameter to make the drive match to the stepper motor
	Configurations		Set the command type, active edge/level of the I/O signal, micro step resolution, idle-current and adjust the anti-resonance parameters.
	Download to Drive	-	Download data to the drive's nonvolatile memory
	Reset	-	Restore all factory parameters
About->	User Manual on Web	-	Click to view DM1182 user manual
	Software Manual on Web	-	Click to view DM1182 operational manual
	About Leadshine ProTuner…	-	Software information

Using the Software

Connecting Drive





Connect to Drive window appears every time you open ProTuner. You can also open it by clicking **Conmmunication>Connect To Driv**e when the software is open. Select the serial port and click on the **Connect** button. The software will try to connect to the drive and read the settings. It may take several minutes. Please wait.

Notice

Before connecting the drive, please make sure:

1) The RS232 cable .has been connected between the drive and PC serial port.

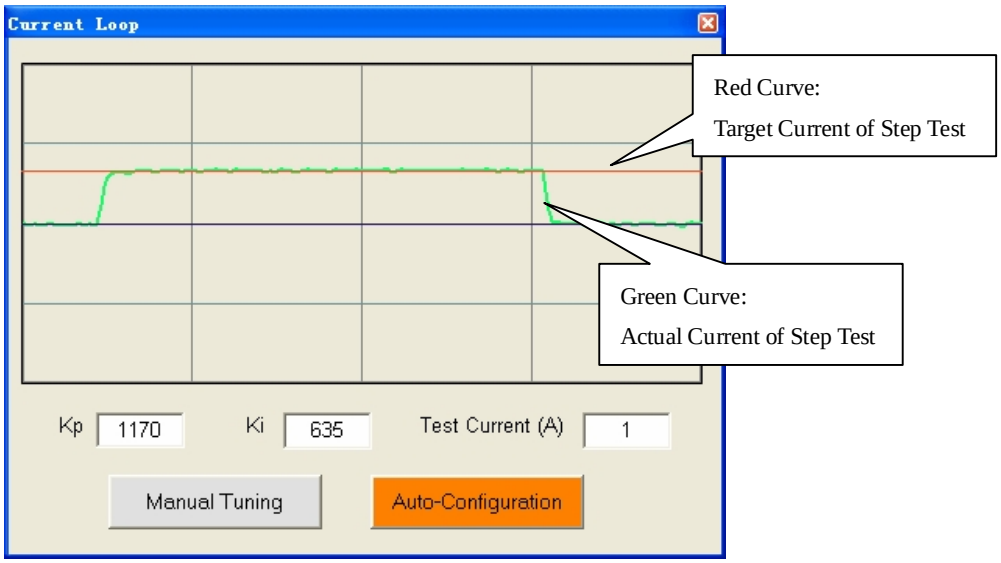
2) Power has been applied to the drive and the green LED is turned on.

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. The drive's communication circuit may be damaged.

Current Loop Tuning Window

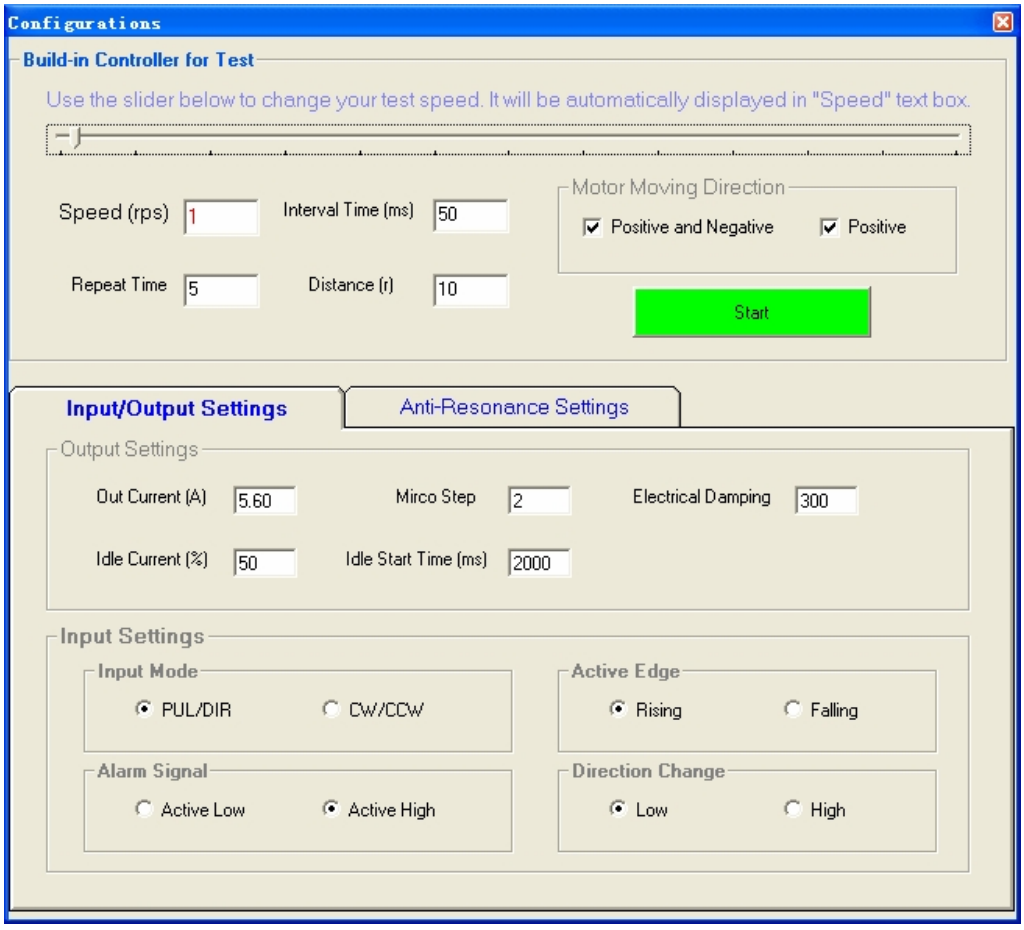


Click **Drive->Current Loop** to open the current loop tuning window. You can adjust the Kp (proportional gain) and Ki (integral gain) in this window. These parameters should be tuned before normal operation.

Item	Description	Range
Kp (Proportional Gain)	Increase 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 unstable systems.	1 – 65535

Ki (Integral Gain)	Adjust Ki 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 Current	The current amplitude for the step response. Let this value not exceed the maximum output current of the drive.	0.5 – 5.0A
Manual Tuning	Enter Kp and Ki and click this button to activate the test. A target curve (red) and an actual curve (green) will be displayed on the screen for user analysis.	-
Auto-configuration	Click this button to activate auto-configuration. The Kp and Ki will be tuned automatically.	-

Configurations Window



Click **Drive->Configurations** to open the **Configuration** window. This window includes Built-in **Motion Controller for self-test**, the **Input/Output Settings** tab and the **Anti-resonance Settings** tab. You can make the motor move by the built-in motion controller. In the **Input/Output Settings** Tab, you can set Output Current, Micro Step, Idle Current, Electronic Damping, Command Type and active level/edge of I/O signals. In the **Anti-resonance Settings** tab, you can adjust the anti-resonance parameters to reduce the motor vibration/noise.

Input/Output Settings tab

You can set Output Current, Micro Step, Idle Current, Electronic Damping, Command Type and active level/edge of I/O signals.

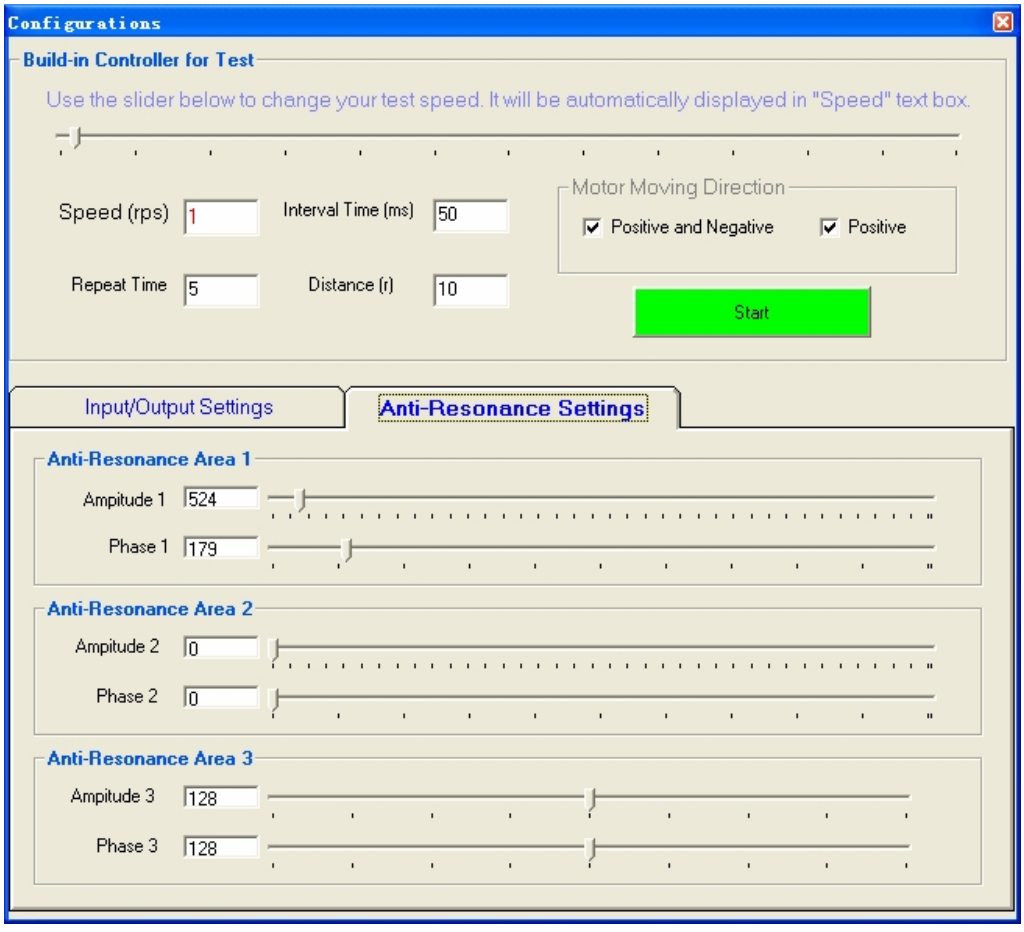
Notice

1. DIP switch must be in Default mode (SW1=off, SW2=off, SW3=off) to allow current change.
2. DIP switch must be in Default mode (SW4=on, SW5=on, SW6=on, SW7=on) to allow Micro Step change.

Item	Description	Range
Out Current	Drive's output current for the motor. It should be less than 1.4 times of the motor's related current. **Note**: The DIP switch setting must be in default mode as follows to allow current change. SW1 = off, SW2 = off, SW3 = off	0.5-7.8A
Micro Step	Drive's Micro Step setting for the motor. **Note**: The DIP switch setting must be in **Default** mode as follows to allow Micro Step change. SW4 = on, SW5 = on, SW6 = on, SW7 = on	1-512
Idle Current	Idle current percentage when there is no pulse sent to the drive. It is only active when SW4 is OFF. When SW4 is on, the motor current keep as Out Current after motor stop.	10%-100%
Idle Start Time	The time when there is no pulse applied to the drive. The drive goes into idle state after this time. Ignore it if SW4 is on.	1-5S
Electronic Damping	Adjust this parameter to improve the drive's high speed performance. The optimal value depends on the system.	1-6000
Input Mode	Command type or pulse input mode of control signal. PUL/DIR means pulse and direction mode; CW/CCW means double pulses mode.	PUL/DIR CW/CCW
Active Edge	Pulse active edge. The motor shaft moves one micro step for each active edge.	Rising /Falling

Direction Change	Change the motor direction. It is only active in PUL/DIR command mode. Please note that the actual direction is also related to the motor coil connection.	(High)Positive /(Low)Negative
Alarm Signal	Set active impedance for the alarm (fault) signal. Active High means high output impedance and Active Low means low output impedance.	Active Low /Active High

Anti-resonance Settings tab



You can adjust the anti-resonance parameters in this window. The built-in controller can be assist anti-resonance tuning and self test.

Item	Description	Range
Anti-Resonance Area 1	It is usually between 0.6 to 1.2 RPS.	-

Amplitude 1	Amplitude adjustment for the 1st anti-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
Phase 1	Phase adjustment for the 1st anti-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 – 1608
Anti-Resonance Area 2	It is usually between 1.2 to 2.4 RPS.	-
Amplitude 2	Amplitude adjustment for the 2nd anti-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
Phase 2	Phase adjustment for the 2nd anti-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 – 1608
Anti-Resonance Area 3	It is usually between 2.4 to 4.8 RPS.	-
Amplitude 3	Amplitude adjustment for the 3rd anti-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 – 256
Phase 3	Phase adjustment for the 3rd anti-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 – 256

Built-in Controller for Self-test

If there is no pulse generator or motion controller in hand, you can use the built-in controller to make the motor move. Note that it can only offer simple motion and does not represent the actual performance of using a motion controller.

Item	Description	Range
Speed	Display the current speed when you move the slider.	0-20 RPS
Acceleration	Acceleration of Built-in Controller. Unit: Revolution / S^2	1-500
Distance	Moving distance. Unit: Revolution	1-655
Interval Time	Interval between the positive and negative move. Unit: millisecond	1-10000
Repeat	Repeat times.	1-65535
Motor Moving Direction	If it is positive, the motor moves only in positive direction. If it is positive and negative, the motor moves in both positive and negative direction.	-
Start	Click to start the motion.	

Configuring the Drive

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

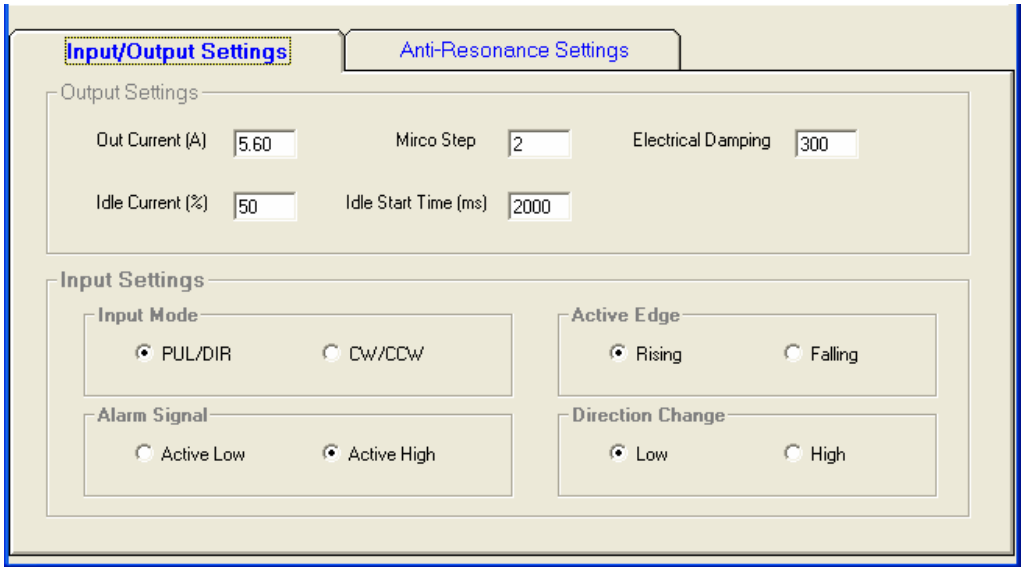
1) Configure Input/Output settings like output current, micro step and input mode according to the motor and application.
2) Tune the current loop parameters Kp (proportional gain) and Ki (integral gain) with the connected motor.
3) Tune the anti-resonance parameters to reduce motor vibration/noise if necessary.
4) Adjust the electronic damping when the high speed performance is not good.

Notice

The motor must be connected to the drive before trying to configure the drive.

Configure Input/Output Settings

Click **Drive->Configuration** to open the **Configuration** window. You can configure the input and output settings in the **Input/Output Setting** tab.



In most application, it is only required to the output current, micro step and input mode. Usually, the motor manufacturer states the RMS (root mean square) current in datasheet. Please refer to the hardware installation manual for how to set the output current.

Notice

1. DIP switch must be in Default mode (SW1=off, SW2=off, SW3=off) to allow current change.
2. DIP switch must be in Default mode (SW4=on, SW5=on, SW6=on, SW7=on) to allow Micro Step change.

High resolution Micro Step makes the motor move more smoothly. Low Micro Step resolution reduces the high frequency requirement to the controller. See the DM drives hardware installation manual for more information for how to select the Micro Step.

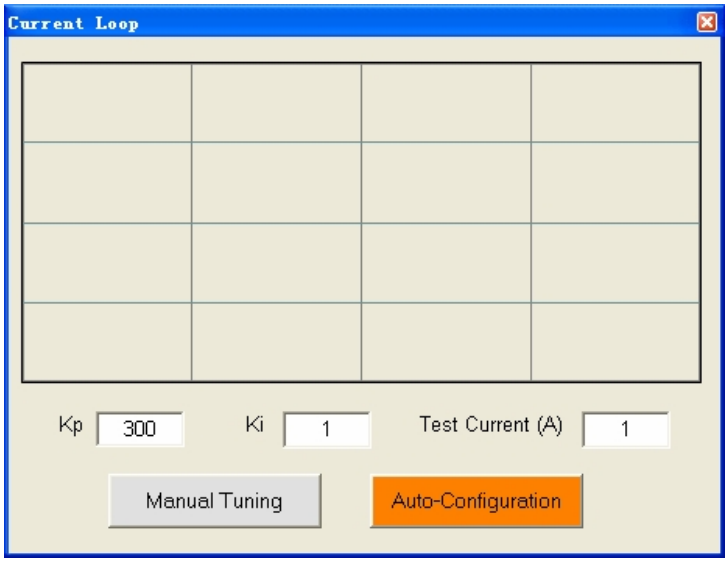
Current Loop Tuning

The current loop of DM1182 needs to be tuned for the best performance of DM1182r. The factory value may not suitable for the driven motor. Incorrect value may cause low motor torque or motor stall or high motor noise. Below is the tuning procedure based a 8.5Nm motor with 110VAC power input.

Notice

Before trying to tune the current loop parameters, don't forget connect the motor to the drive.

Step 1: Set **Test Current** 1 and start the tuning with small **Kp** and "zero" **Ki**. Here we set **Kp**=300 and **Ki**=1.

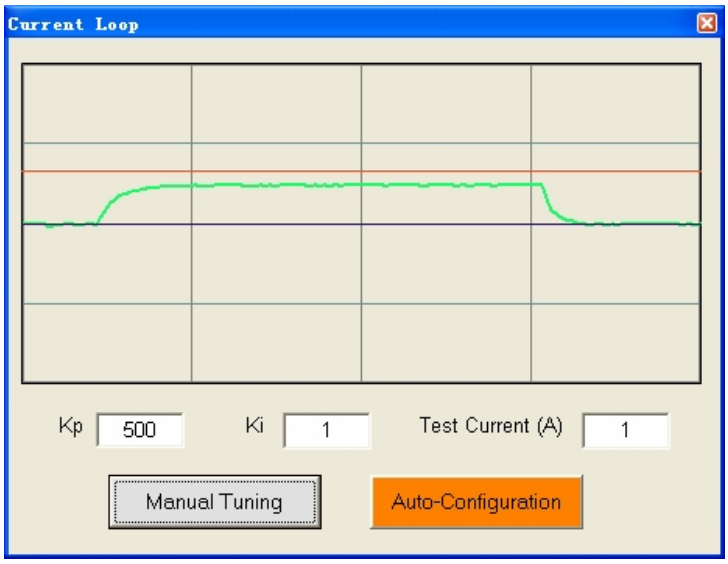


Initial Value

Kp = 300

Ki =1

Step 2: Click the **Manual Tuning** button and the plot window will show two curves. The red curve is target current and the green curve is actual current. There is large gap between them in the scope. It indicates that a large **Kp** needs to be introduced.

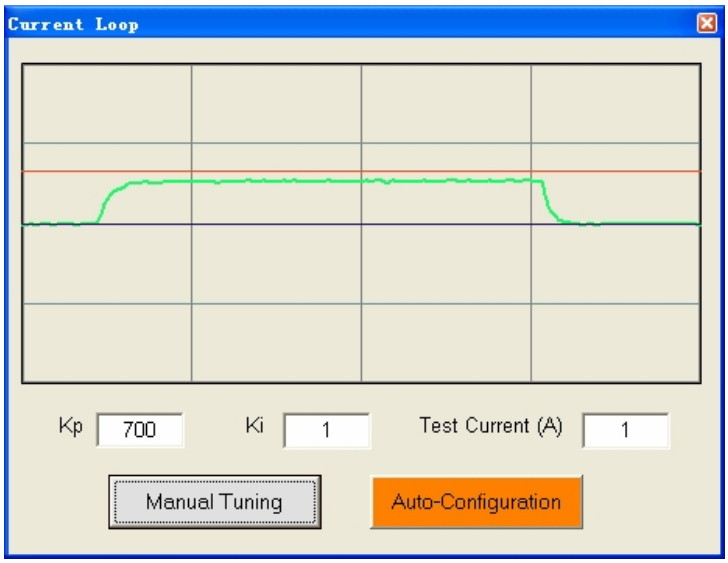


Start Test:

Kp = 500

Ki = 1

Step 3: Increase **Kp** to 700 and click **Manual Tuning**. The gap between target value and actual value is smaller but a higher **Kp** is still needed.

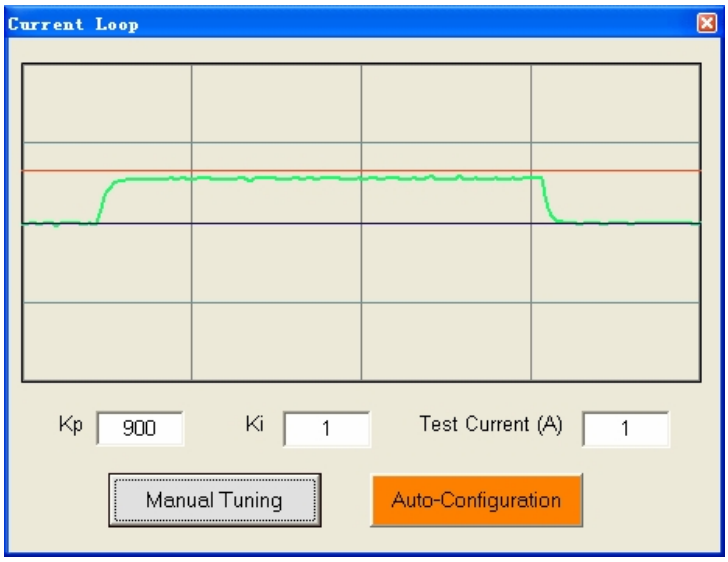


↑ Proportional Gain:

Kp = 700

Ki = 1

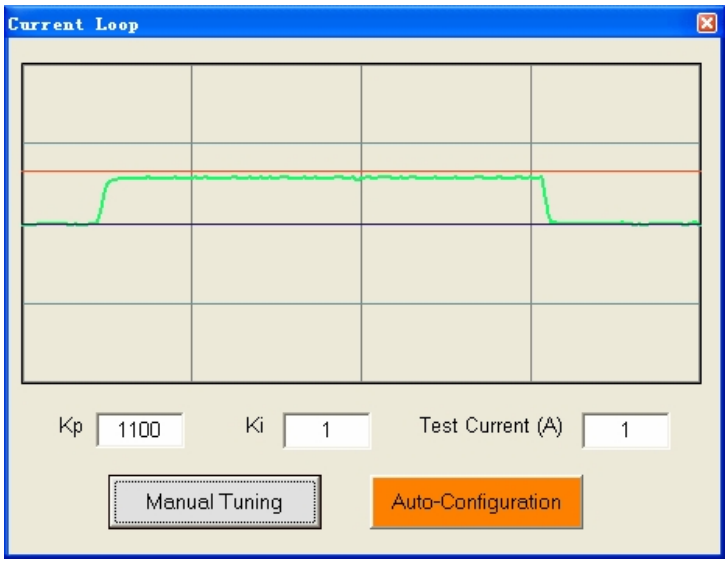
Step 3: Give **Kp** 900, 1100, 1300 and click **Manual Tuning,** respectively. The green curve is getting more and more close to the red curve. Over-shoot is obvious when we increase **Kp** to 1300. It indicates that you need to stop increasing Kp and back off. Our purpose is to make the green curve (the actual current) a little higher than the red curve (the target). So we decrease Kp to 1200 until the actual value is exactly over the target value.



↑ Proportional Gain:

Kp =900

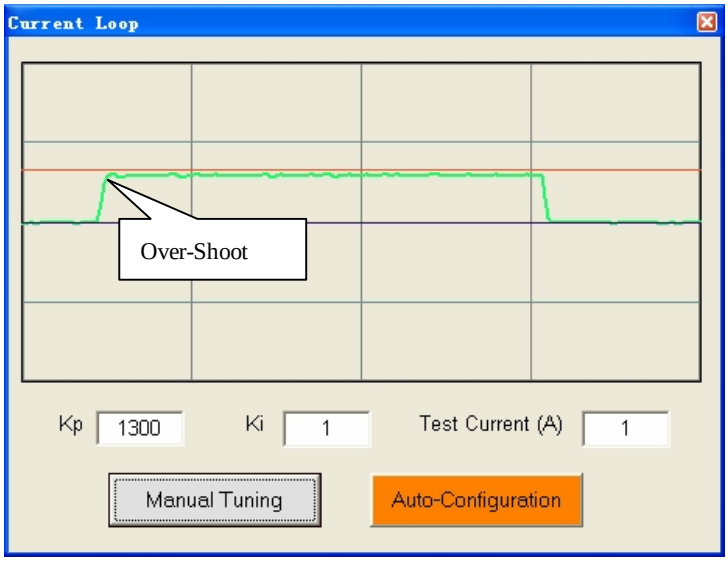
Ki = 1



↑ Proportional Gain:

Kp = 1100

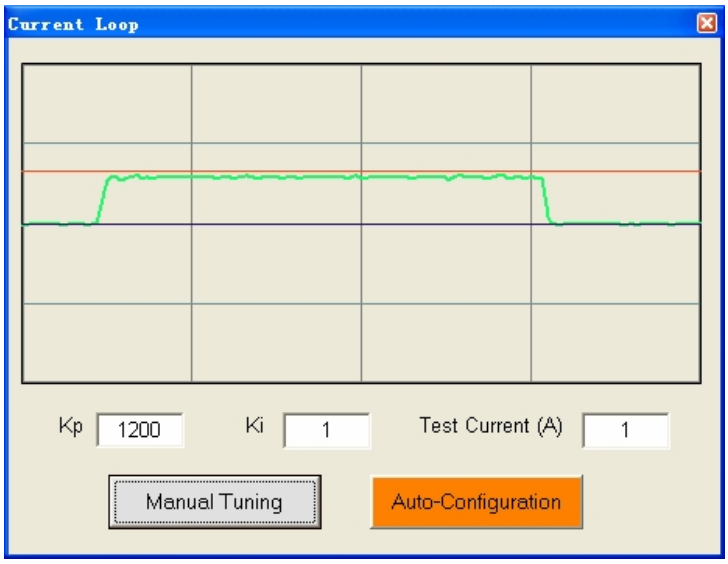
Ki = 1



↑ Proportional Gain:

Kp =1300

Ki = 1

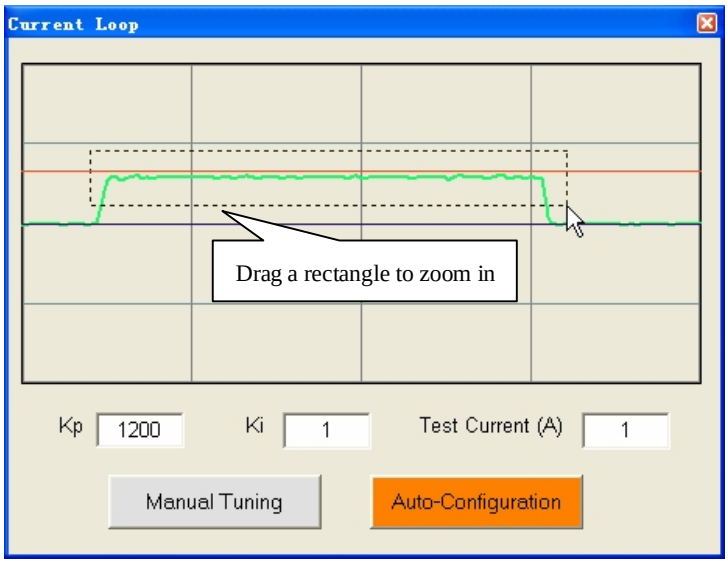


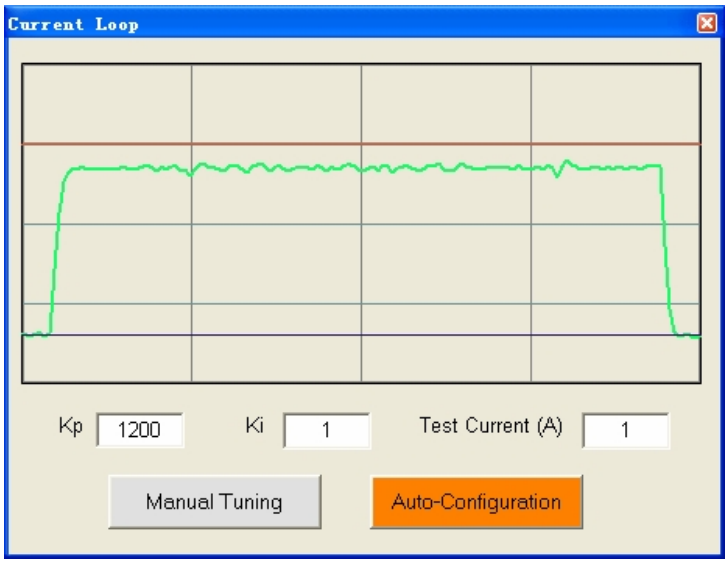
↓ Proportional Gain:

Kp =1200

Ki = 1

Step 4: Now the **Kp** is relatively good enough. But there is still 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 **Ki** to reduce the "gap" or steady error at the constant part. It follows the same procedure as **Kp**. High **Ki** causes big vibration, system lag and makes the performance worse. The following figures show how to tune the integral gain.

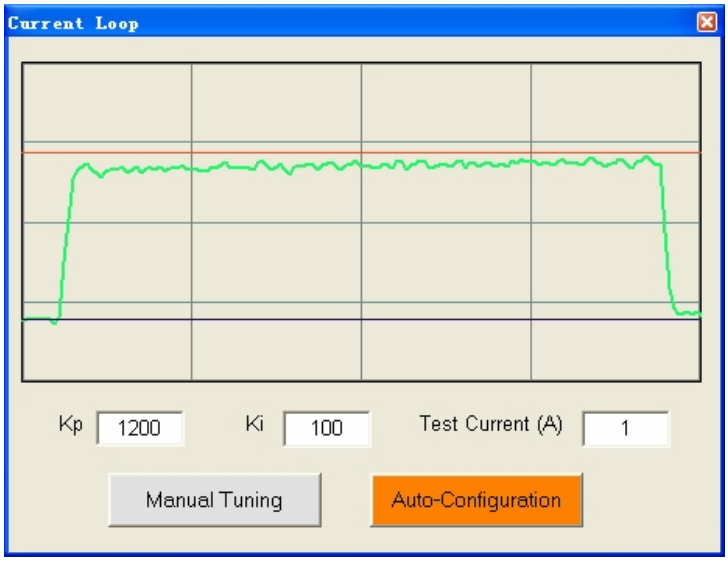




Zero Integral Gain:

Kp =1200

Ki = 1



↑ Integral Gain:

Kp =1200

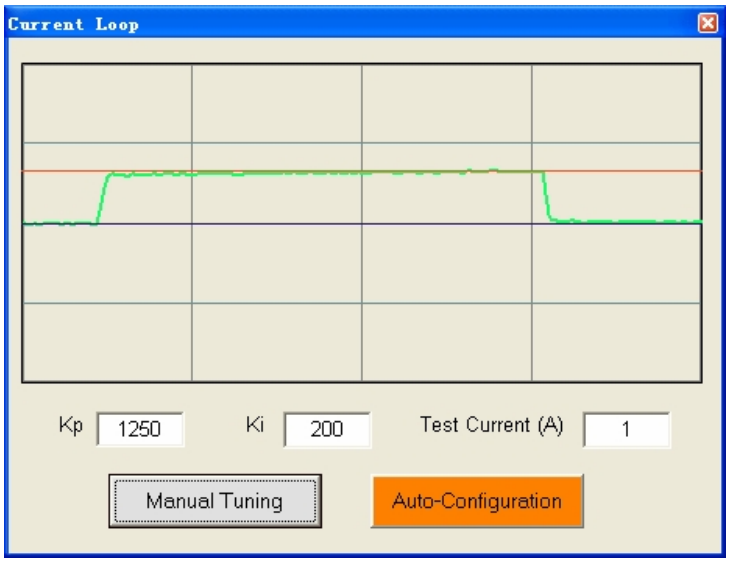
Ki = 100

↑ Integral Gain:

Kp =1200

Ki = 150

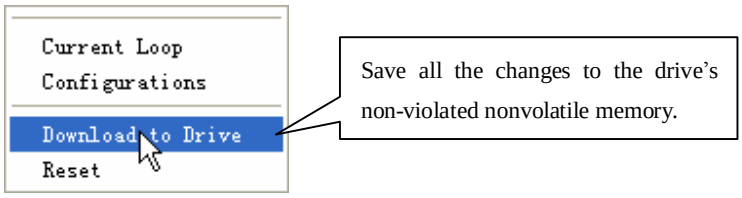
Step 5: The current loop tuning is basically finished. You can continue to adjust Kp and Ki for better performance. Now the updated **Kp** and **Ki** is just stored in the driver's RAM. They will be lost when we power off the driver. **Don't forget to click Drive->Download To Drive to store the changed value to the drive's nonvolatile memory.**



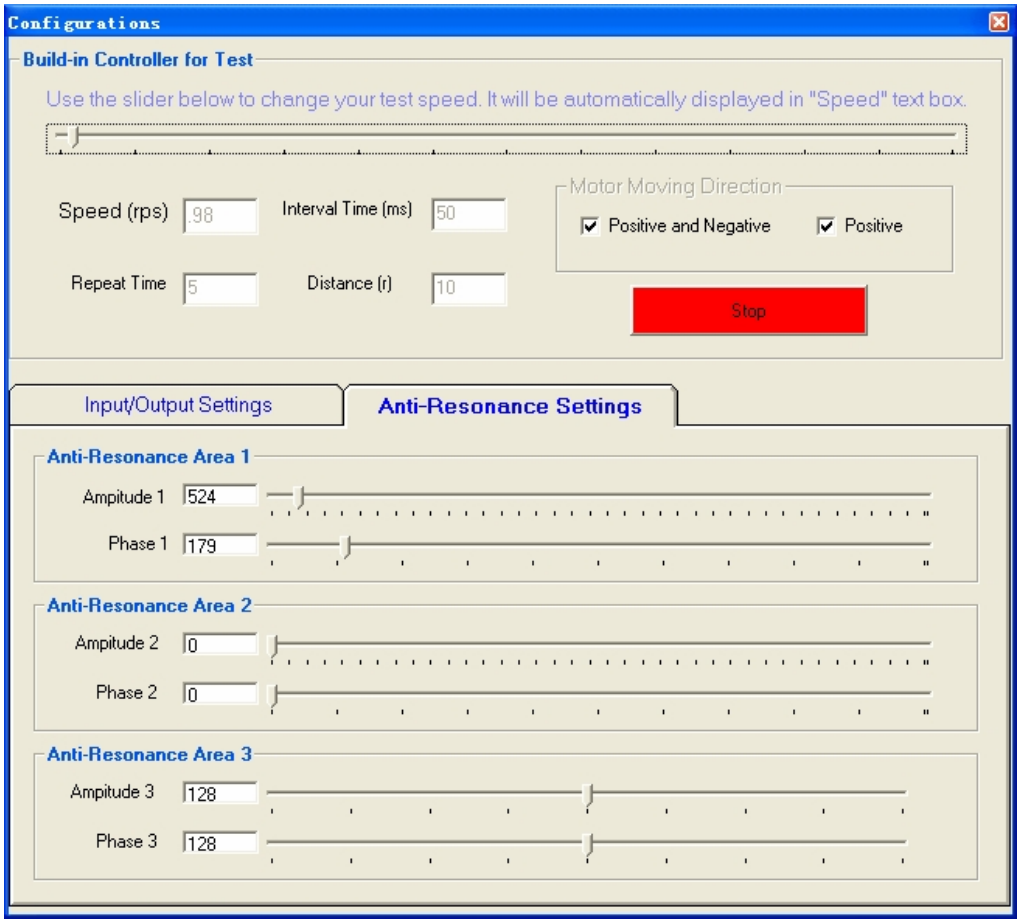
Further Adjustment:

Kp =1250

Ki = 200



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 synchronization and stalls. The EM 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.

Notice

1. For most of the application, it is not needed to tune 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 anti-resonance area 1 and 2 has obvious effect.

Step 1: Start the motion test by clicking **Start/Stop** button. Find a resonance speed by slightly moving the slider bar of internal pulse generator back and forth. You can also use the arrow keys to adjust the speed precisely.

Step 2: Run the motor 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.

It is very important to make the **Amplitude** and **Phase** 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

Amplitude and **Phase** values may be a little different between running the tests with an unloaded motor and a load motor.

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 resonance area 1. The resonance area 2 is 1.2-2.4 RPS and the resonance area 3 is 2.4 4.8 RPS.

For example, we find a resonance speed at 0.98 rps. We begin to move the **Amplitude 1** 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->Download To Drive** to save all the parameters to nonvolatile memory.

Adjusting Electronic Damping

The factory setting for the electronic damping is 300. If the motor is easily stalled and generates odd noise at middle speed, you can try other values such as 500, 1500, 2000, 2500.

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