Software User Manual

iSS Integrated Stepper Servo Motors

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Change Log

Revision Date	Changes	Version
2012-05-18	Original Create	SM-ISS-1.0
2012-05-24	Modification	N/A

Table of Contents

Part 1　Introduction

ProTuner for iSS is a software that Leadshine developed to configure and tune iSS series stepper servo motors including iSS57-10 and iSS57-20 at the moment (more models will be added in the future). With that software, a user can configure iSS motors' output current, micro step, command type, and other parameters. It can be also used to fine-tune iSS series motors' current loop and position loop parameters.

System Requirements

To be able to install Leadshine **ProTuner for iSS Setpper Servo Motor** software, a computer should have a Windows XP/7 operation system installed, and at least 512 MB memory.

Hardware Setup

Connecting an iSS Stepper Servo Motor to a DC Power Supply

First, connect a DC power supply (20-50 VDC) to the power connectors of the iSS stepper servo motor. See Leadshine iSS Integrated Stepper Servo Motors Hardware Installation Manual for detail. If you don't have such a power supply, go to Leadshine website at http://leadshine.com/Product_Show.aspx?ID=142 to find one compatible DC regulated switching, unregulated switching, or linear power supply.

Connecting an iSS Stepper Servo Motor to a Computer

To connect a Leadshine iSS series stepper servo motor to a computer, use a Leadhsine special RS232 cable, model **Cable-Pc-i**, to the serial port of your computer. If your computer does not have a serial port, Use one USB-RS232 converting cable

Software Installation

The compressed zip file of Leadshine ProTuner for iSS stepper servo motors can be downloaded at http://www.leadshine.com/UploadFile/Down/ProTunerV1.0_iSS_Setup.zip. After the zip file is downloaded

successfully, unzip it to a local fold on your computer. From that folder, run the executable exe file, and follow the on-screen instructions to get the software installed.

Software Layout

Workspace

See the following screen shot for the layout of Leadshine iSS software interfaxe

Menus and Toolbar

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

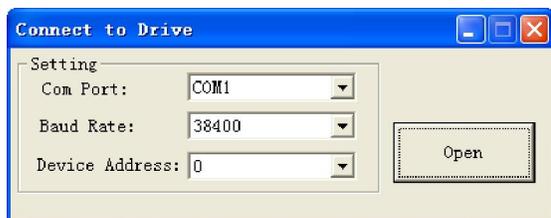| Menu	Pull Down	Toolbar	Function
Projects ->	Connect to Drive		Open a computer's serial port and connect to an iSS stepper servo motor
	Exit	-	Exit from ProTuner
Drive Settings->	Current/Position Loops		Tune the current loop, adjust the position loop parameter and perform Motion Test.
	Inputs / Outputs		Cofigure input command type, active level of the I/O signals, pulse bandwidth.
	Download to Drive		Download settings to the drive board's NVM (No-volatile Memory) of an iSS stepper servo motor
	Reset	-	Reset all configurations to default.
Motor Settings->	Motor Settings		Set micro step resolution, position error limit, and encoder resolution.
Tools->	Parameters		Download / upload configurations to / from iSS motor's drive board. It can also save configurations to a file, or restore them from a file.

	Check Errors	⚠	Check drive current / historical error(s)
Help->	About ProTuner		Display ProTuner software version and drive board firmware version

Part 2   Using Software

Project Menu

Connect to Drive

Connect to Drive window appears every time when ProTuner for iSS software is started. A connection between an iSS57 step motor and a computer can be opened by selecting the right connection serial port and clicking "Open" button. That could take a few seconds, because the software will load current drive board settings to the computer memory, from the connected iSS stepper servo motor. After connection is opened successfully, the caption of the button will be changed to "Close". The connection can be closed by clicking "Close" button.

Connect to Drive		Connect to Drive	
Setting		Setting	
Com Port: COM1		Com Port: COM1	
Baud Rate: 38400	Open	Baud Rate: 38400	Close
Device Address: 0		Device Address: 0	

Before connecting the drive, make sure:

Notice

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

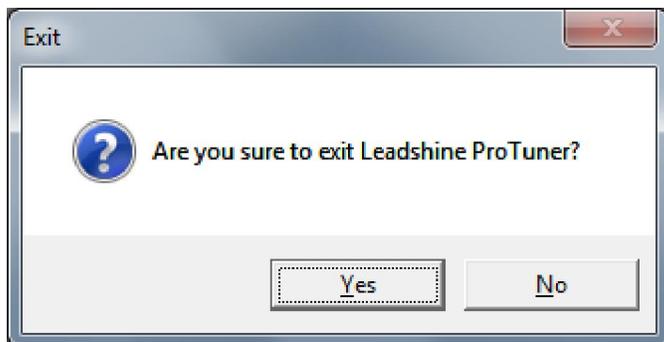2) The iSS stepper servo motor has been powered on and the green LED is turned on.

Caution

Do not connect or disconnect serial cable while drive is powered on. Otherwise, the drive's communication circuit could be damaged.
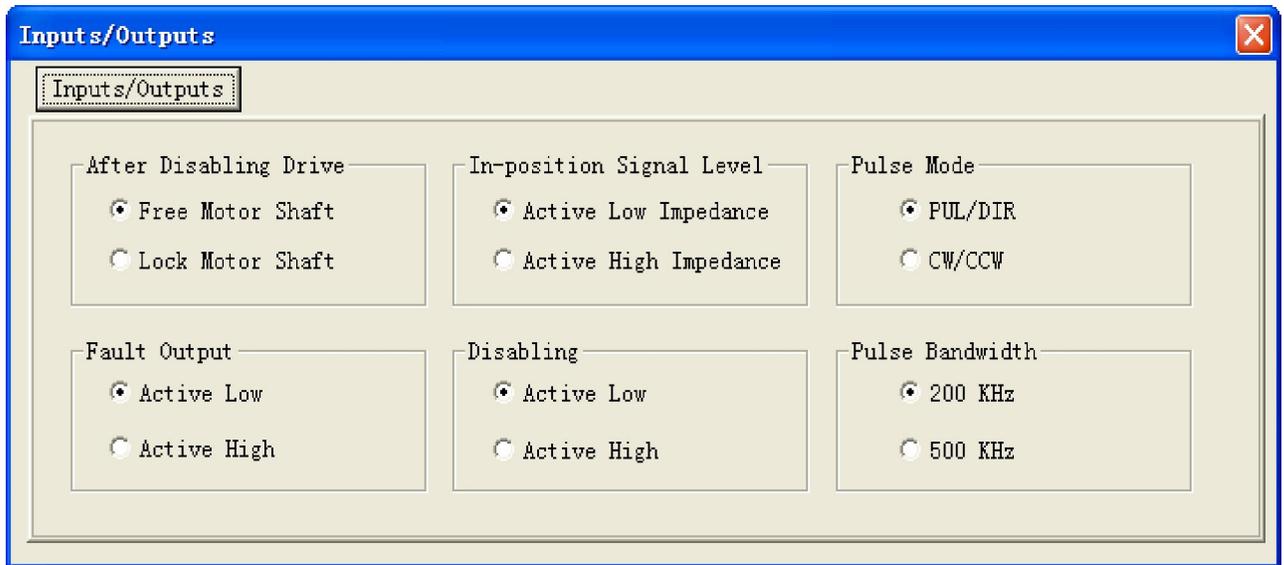
Exit

Exit window appears when **Project -> Exit** menu item is clicked. Click "**Yes**" to exit **ProTuner for iSS** software, or click "**Cancel**" button to cancel.

Drive Setting Menu

Inputs / Outputs

Click **Drive -> Inputs/Outputs** to open the I/O configuration window. You can chose to free or lock motor shaft after disabling drive, select the Pulse Active Edge, active level of In-position output, active level of fault output, active low disabling or active high disabling and pulse bandwidth.

Item	Description	Range
After Disabling Drive	Select to free or lock the motor shaft after disabling drive. If the "free motor shaft" is selected, the drive board will close all the power state after disabling drive and the motor coil current is set to zero. You can perform manual move via the "free motor shaft" selection. Otherwise, if the "lock motor shaft" is selected, the motor shaft will be locked and the motor current will be set to the value of holding current.	Free motor shaft / Lock motor shaft
In-position Signal Level	Set the active output impedance of the in-position signal. If it is active low, the impedance between PED+ and PED- is low when the target position is reached. Otherwise if it is active high, the impedance between PED+ and PED- is high when the target position is reached.	Active Low / Active High
Pulse Mode	Pulse mode of control signal. Select PUL/DIR or CW/CCW according to command type of motion controller. PUL/DIR means pulse and direction mode; CW/CCW means double pulses mode.	PUL/DIR, or CW/CCW
Fault Output	Set the active output impedance of the fault signal. If it is active low, the impedance between ALM+ and ALM- is low when the target position is reached. Otherwise if it is active high, the impedance between ALM+ and ALM- is high when the target position is reached.	Active Low / Active High
Disabling	Set active input level of disable signal.	Active Low / Active High
Pulse Bandwidth	Select the input pulse bandwidth or the maximum input frequency.	200K / 500K

Current / Position Loops

Click **Drive->Current / Position Loops** to open this window. You can adjust the current loop Kp (proportional gain) and Ki (integral gain) in this window. To test the iSS motor performance for parameter performance change, click the "**Start**" button to run the motor.
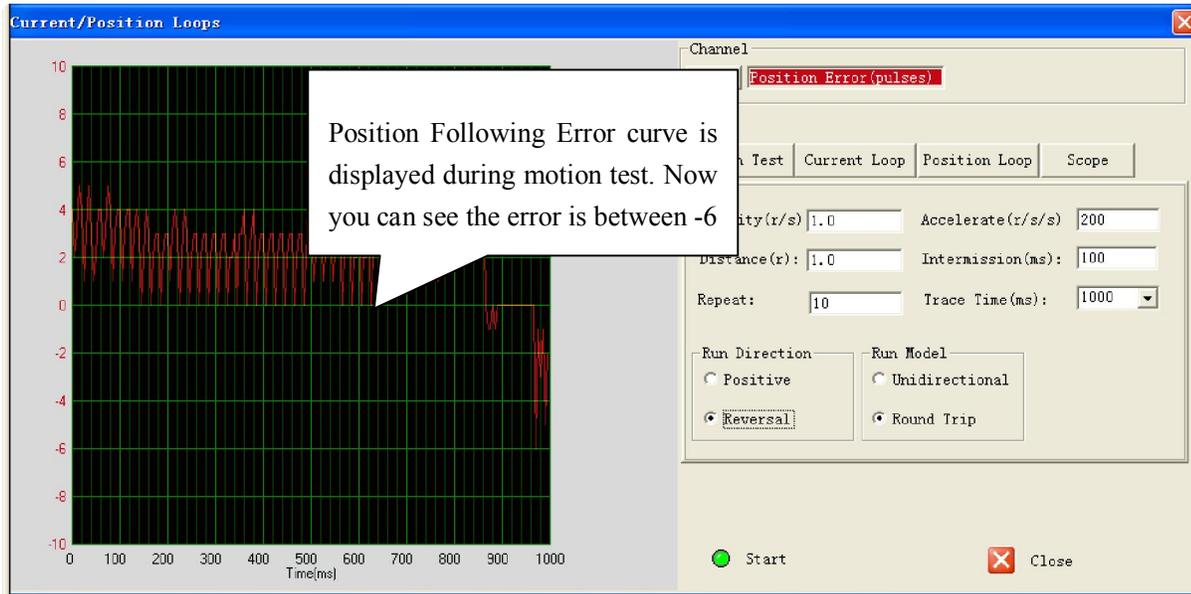
Motion Test Tab

In the Motion Test tab, you can make the motor move without an external pulse generator or motion controller. Configure the trapezoid velocity file first and then click the **Start** button.

Motion Test Tab   *(Continued)*

Item	Description	Range
Velocity (r/s)	Target velocity of Motion Test.	1– 50 rps
Accelerate (r/r/s)	Acceleration of Motion Test.	1 – 65535 r/s^2
Distance (r)	Move distance of Motion Test.	1 – 65535 r
Intermission (ms)	Interval between moves.	1 – 65535 ms
Repeat	Repeat times.	1– 65535
Run Direction	Move direction.	Positive/ Reversal
Run Model	Motion Test mode includes single direction motion or two direction Motion. Undirectional: Run in one direction, Round Trip: Run forward and back	-
Trace Time	The time to sample the position following error data.	100 - 3000 ms
Start	Click to start the Motion Test.	-
Stop	Stop the move immediately.	-
Close	Close the Current / Position Loops window	-

Current Loop Tab

Click **Current Loop** tab to open this window. The current loop parameter is related to the motor resistance and inductance.

> ⚠️ **Notice**
>
> When power-up, the drive board will perform the auto-configuration and the current loop parameters will be calculated automatically. Here, this window is just for check. It is unnecessary to the current loop parameters by your self.
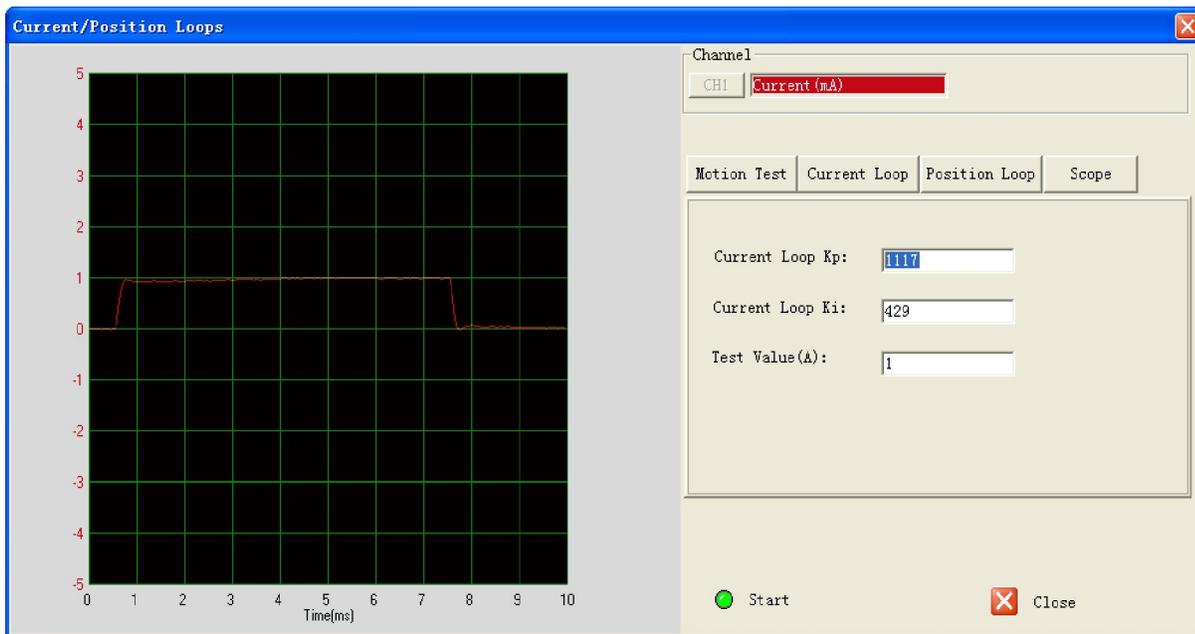
Current Loop Tab   (Continued)

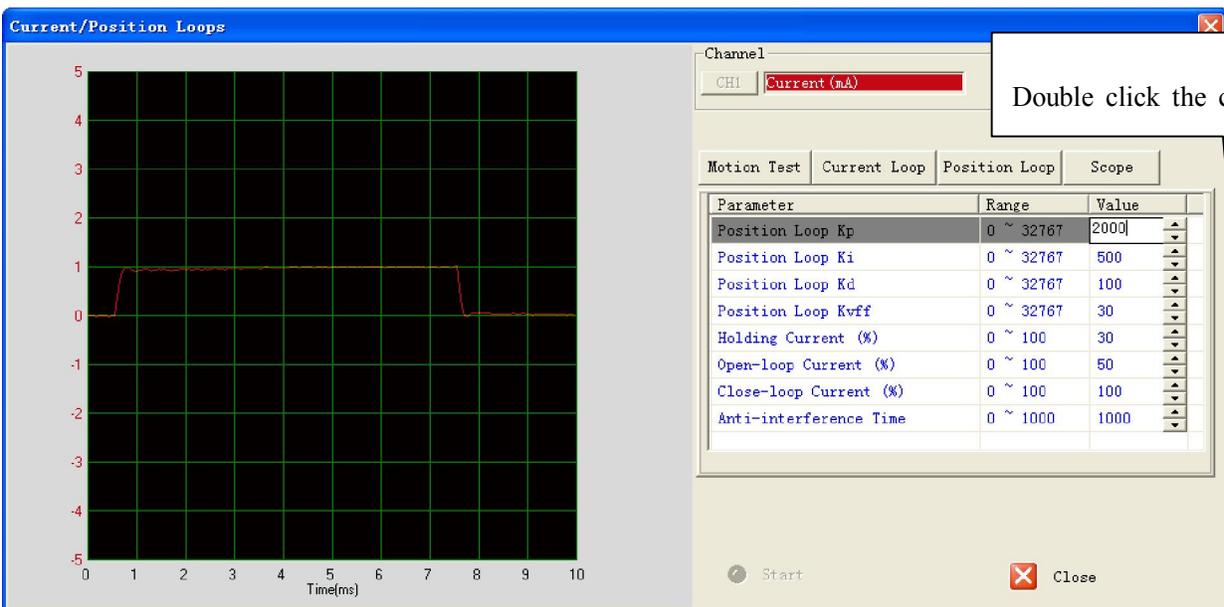| Item	Description	Range
Current Loop Kp **(Proportional Gain)**	Increase Kp to make current rise fast. Proportional Gain determines the response of the drive to current setting command. Low Proportional Gain provides a stable system (doesn't oscillate), has low stiffness, and large current error, causing poor performances in tracking current setting command in each step. Too large Proportional Gain values will cause oscillations and unstable systems.	1 – 65535
Current Loop 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 Value (A)	The current amplitude for the step response. Let this value not exceed the maximum output current of the drive.	0.5-2A
Start	Enter Kp and Ki and click this button to activate the test. A target curve (red) will be displayed on the screen for user analysis.	-

Position Loop Tab

Click **Position Loop** tab to open this window. You can adjust the position loop parameter to get lower noise or fast response of the motor. Double click the value to change the parameters.

This tab only allows you to change parameter values. For testing the performance for your changes, switch to "Motion Test" tab, and click "Start" button.

⚠ **Notice** The default values of the position loop parameters have been optimized and they should be plug-and-play for most applications. It is unnecessary to tune them when the motor runs well. It is only recommended for fine-tuning and only adjusts those parameters when you see abnormal symptoms such as loud motor noise, or motor stalls easily at high speed.

…… Continued on next page

Position Loop Tab   (Continued)

Item	Description	Range
Position Loop Kp **(Proportional Gain)**	**Position Proportional Gain**. Proportional Gain determines the response of the system to position errors. Low Proportional Gain provides a stable system (doesn't oscillate), has low stiffness, and large position errors under load. Too large Proportional Gain values will cause oscillations and unstable systems.	0 - 32767
Position Loop Ki **(Integral Gain)**	**Integral Gain**. Integral Gain helps the control system overcome static position errors caused by friction or loading. The integrator increases the output value as a function of the position error summation over time. A low or zero value for the Integral Gain may have position errors at rest (that depend on the static or frictional loads and the Proportional Gain). Increasing the Integral Gain can reduce these errors. If the Integral Gain is too large, the systems may "hunt" (oscillate at low frequency) about the desired position.	0 - 32767
Position Loop Kd **(Derivative Gain)**	**Position Derivative Gain**. Derivative Gain provides damping by adjusting the output value as a function of the rate of change of error. A low value provides very little damping, which may cause overshoot after a step change in position. Large values have slower step response but may allow higher Proportional Gain to be used without oscillation.	0 – 32767
Position Loop Kvff	**Feed-forward gain**. It speeds up the system response.	0 – 32767
Holding Current (%)	Motor current when there is no pulse applied to the drive.	0 - 100%
Open-loop Current (%)	Motor current when the drive goes into open loop control mode.	0 - 100%
Close-loop Current (%)	Motor current when the drive goes into close loop control mode.	0 - 100%
Anti-interference Time	Reserved	0 - 1000

Position Loop Tab   (Continued)

The effect of Kp, Kd, Ki and Kvff of position loop has similar functions as those parameters in normal brushless servo drives. Although their adjustable values are displayed as 0-32767, their actual adjustable ranges are limited. It is recommended to only adjust 10 - 30% from their default settings. Beyond the range, you may see an iSS57 runs abnormal, such as vibration or stall.

* Position loop Fine-Tuning Tips

Use the following table as guidance for position loop fine-tuning.

Desired Results	Actions
Faster Response, High Speed, High Torque, Smooth Move	*Increase the Kp, Kd, Kvff, Open-Loop Current and Close-loop Current*
Lower Motor Noise, Lower Motor Heating	*Decrease Kp, Kd, Kvff, Open-Loop Current and Close-loop Current*

Scope Tab

Click **Scope** tab to open this window (shown in the next image). You can monitor the position following error in the left scope window. When you use this feature from ProTuner for iSS software, you may not be able to see anything without motor load. However, when an iSS motor runs in a real application, **Scope** window can help to monitor the performance of **Position Following Error**.
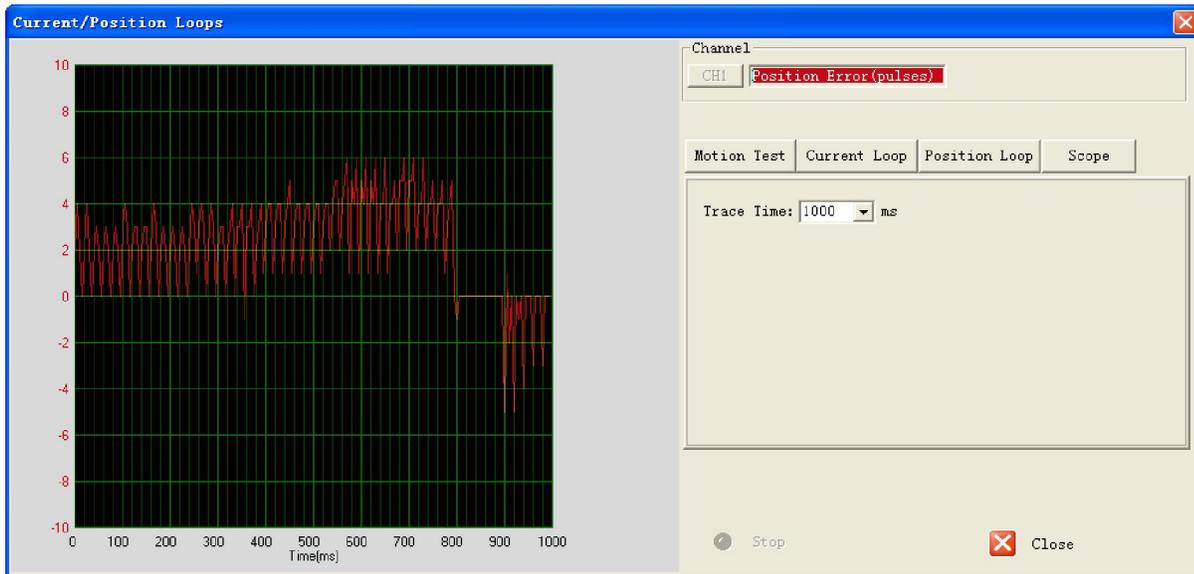
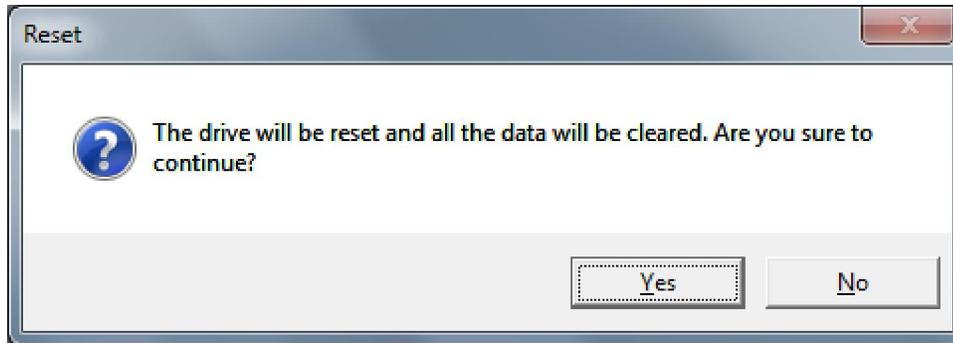| Item	Description	Range
Trace Time	Time to sample the position following error. For example, if the trace time is 1000ms, the drive board acquires the error data every 1000ms.	0 - 32767
Start	Start to monitor and display the position following error.	-
Stop	Stop monitoring.	-

Download to Drive

To permanently save those configured / tuned parameter values to the iSS stepper servo motor, you must perform "**Download to Drive**" action. Otherwise, all changes will get lost after the iSS motor is powered off.

Click **Drive Setting -> Download to Drive** menu item bring up the following warning message. Click "Yes" button to save all parameters to the drive board's non-volatile memory. Click "Cancel" button to cancel all your changes.
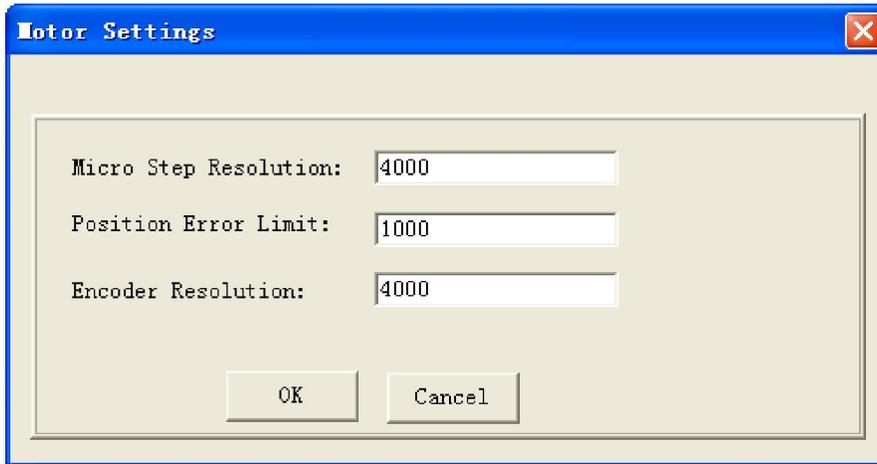
Reset

A user can click **Drive Settings -> Reset** menu item to bring up the following warning message. Click "Yes" will to reset all the settings back to default settings. Click "No" to cancel reset.

Motor Settings

Click **Drive->Motor Settings** to open this window. You can set the micro step resolution, position following error limit and encoder resolution in this window.

Item	Description	Range
Micro Step Resolution	Drive's Micro Step setting for the motor.	1 - 51200
Position Error Limit	The limit of the difference between commanded position and the actual measured position. When position following error exceeds the Position Following Error Limit in the drive, the following error protection will be activated.	0 - 65535
Encoder Resolution	The encoder lines. 4 × of the actual resolution. For example, if the encoder resolution is 1000, it is 4000. Note: Do not change the default value as it must be corresponded to the actual encoder resolution.	200 - 10000

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Motor Settings   (Continued)

In order to be able change micro step resolution, DIP switch 1, 2, and 3 of an iSS stepper servo motor must be all set to "ON" positions. Resolution can be set to any value of 200- 51200 (increased to by 200). Higher resolution Micro Step makes the motor move smoother, but requires higher motion controller frequency.

The default value of **Position Error Limit** is set it to 1000. If the application requires small position following error, reduce the **Position Error Limit**.

The "Encoder Resolution" indicates the resolution (in lines) of the integrated encoder. It is for informational and you

Tools

Parameters

Click **Tools->Parameters** to open the "**Parameters**" window.

This window lets a user read current settings from the iSS motor drive board, load parameter values to the RAM of the iSS motor drive board, open a previously saved configuration file, save the current configuration to a file, reset motor configuration, or download those settings to the iSS stepper servo motor.

Although a user can change parameter values from this window, it is recommended to use menu items in "Drive Settings" or "Motor Settings" for configuration / tuning, unless the user is sure what parameter value to set.
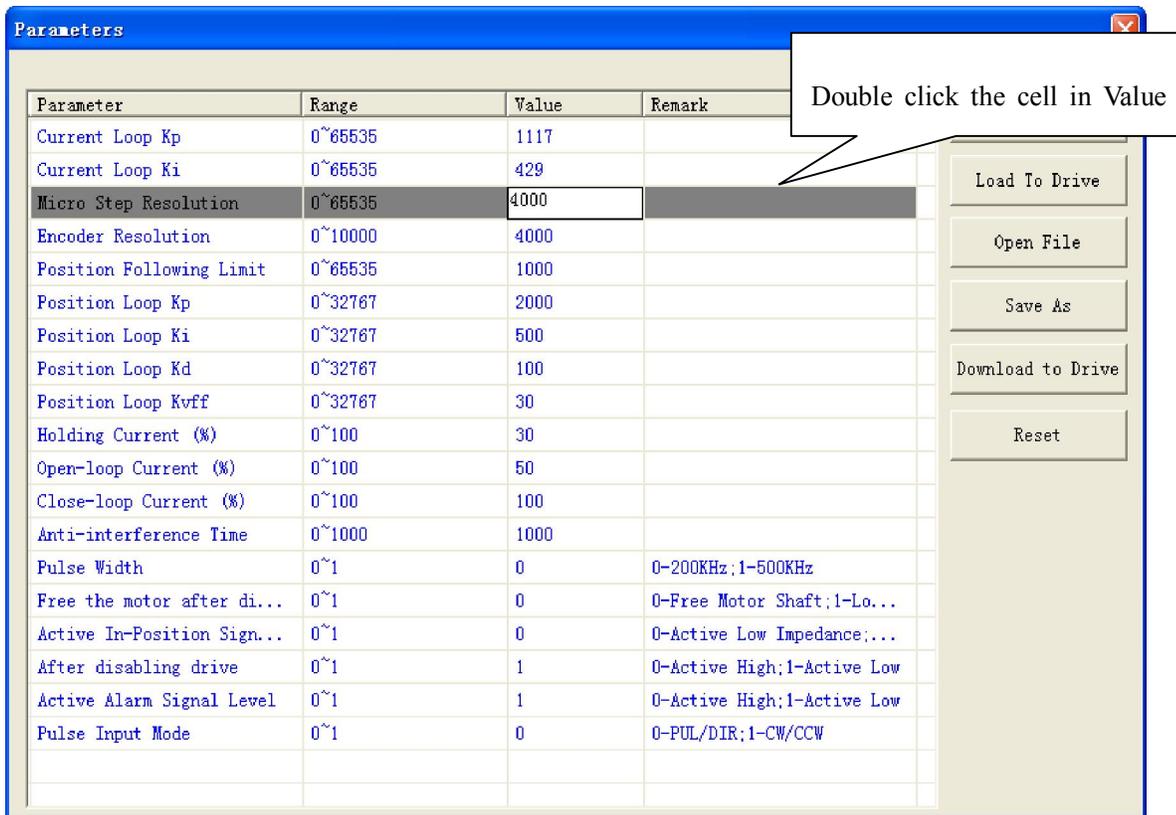
Parameter	Range	Value	Remark
Current Loop Kp	0~65535	1117	
Current Loop Ki	0~65535	429	
Micro Step Resolution	0~65535	4000	
Encoder Resolution	0~10000	4000	
Position Following Limit	0~65535	1000	
Position Loop Kp	0~32767	2000	
Position Loop Ki	0~32767	500	
Position Loop Kd	0~32767	100	
Position Loop Kvff	0~32767	30	
Holding Current (%)	0~100	30	
Open-loop Current (%)	0~100	50	
Close-loop Current (%)	0~100	100	
Anti-interference Time	0~1000	1000	
Pulse Width	0~1	0	0-200KHz;1-500KHz
Free the motor after di...	0~1	0	0-Free Motor Shaft;1-Lo...
Active In-Position Sign...	0~1	0	0-Active Low Impedance;...
After disabling drive	0~1	1	0-Active High;1-Active Low
Active Alarm Signal Level	0~1	1	0-Active High;1-Active Low
Pulse Input Mode	0~1	0	0-PUL/DIR;1-CW/CCW

Double click the cell in Value

Load To Drive
Open File
Save As
Download to Drive
Reset

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Parameters   (continued)

Functions for left side buttons are described as follows:

1) **Read Drive**: Read parameters from the drive

   Click "Read drive" button to upload all parameters from drive. Double click the value of the parameter, you can change the value.

2) **Load to Drive**: Load parameters to drive

   Click "**Load to Drive**" button to load parameter values in the current window to the iSS stepper servo motor RAM for configuration / tuning.

3) **Open File:** open a previously saved configuration file

   Click **Open File** button to open a previously saved configuration file to the "**Parameters**" window you want to load parameters from a PC file. The parameters in the software's workspace will be updated.

4) **Save File**: Save the parameters to a PC configuration file with .lsr extension

   Click **Save File** button to save the parameter of current workspace to a file. This file can be used for the other drive.

5) **Download to Drive**: Download parameters to the drive's nonvolatile memory;

   Click **Download to Drive** button to write parameter values in the current window to the iSS stepper servo motor. Read 6.2.3, "**Download to Drive**", for detail.

6) **Reset**: Restore factory settings of the drive.

   Click "**Reset**" button to reset all parameters to factory default. Read 6.2.4, "**Reset**", for detail.

Error Check

You can check the active error or the error log of the drive in this window. Type of error is shown as follows:

Item	Description
Over Current Error	Error occurs when the motor coil current exceeds the drive's current limit.
Over Voltage Error	Error occurs when the input voltage exceeds the drive's voltage limit
Position Following Error	Error occurs when the actual position following error exceeds the limit which is set in **Position Error Limit**.
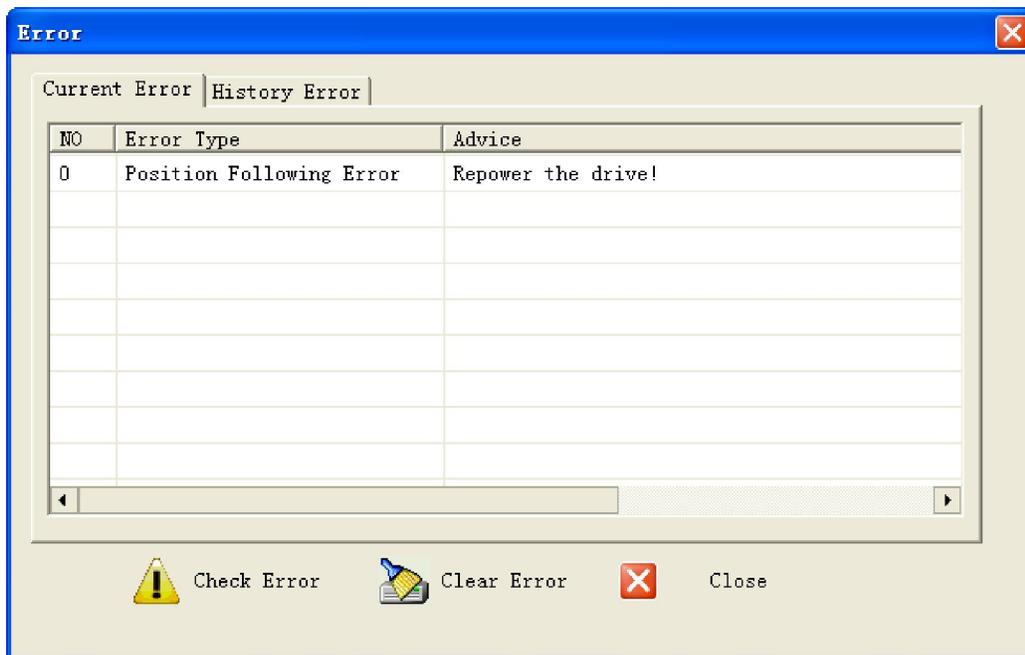
Part 3   Configuration Tips

Suggested steps to configure a iSS stepper servo motor

Usually, you can follow the fllowing steps below to configure /tune the drive board of an iSS motor from Protuner for iSS software.

1) Set "Input/Output" parameters such as pulse mode, pulse bandwidth, pulse active edge, active level of fault output, position following limit and micro step resolution for your application
2) Set "Motor Setting".
3) Adjust the position loop parameters when lower noise or fast speed is required.

Configure Current Output

When an iSS stepper servo motor runs, the output current from the drive board outputted to the motor ranges between the holding current and the close-loop current. When there is no pulse sent to the drive, it goes into idle mode and the actual output current is determined by the **holding current** percentage (similar to "idle current" of open loop stepper drives). In normal working mode, the iSS motor's drive board monitors the actual shaft position all the time. The current outputted to the motor changes dynamically based on the tracking error between the actual position and the commanded position.

By default, an iSS57 motor's holding current percentage is set to certain percentage of the peak current and the close-loop current percentage is 100%, unless you change them from Leadshine's configuration software (see software manual). Actual current outputted to the motor can be calculated as follows:

$$Holding \;\; Current \;\; = \;\; 6A \; \times Holding \;\; Current \;\; Percentage \; (\%)$$

$$MAX \;\; Close \;\; loop \;\; Current \;\; = \;\; 6A \; \times Close \;\; Loop \;\; Current \;\; Percentage \; (\%)$$

Low holding current can reduce motor heating however also reduces the holding torque which is used to lock the motor shaft at standstill. It is recommended to determine the holding current by whether or not there is big vibration at start-up and how much lock torque is required, based on your actual applications.

> ⚠️ **Caution**
> Higher holding current results higher high-speed torque. To keep the motor heating extreme low, iSS motor default holding current percentage is set to 20-40% of the maximum output current. If you can't get enough torque for in an application, try to increase that percentage. Please note that higher holding current percentage will result in higher motor heating. Try to find a balanced holding current percentage value.

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