THORLABS

LTS150 and LTS300
Long Travel Stages

User Guide



Original Instructions

Contents

Chaper 1 Overview 1
1.1 Introduction 1
1.2 Kinesis Software Overview 1
1.2.1 Introduction 1
1.2.2 Kinesis Server 2
1.2.3 Software Upgrades 3

Chaper 2 Safety 4
2.1 Safety Information 4
2.2 General Warnings 4

Chaper 3 Mechanical Installation 5
3.1 Unpacking 5
3.1.1 Environmental Conditions 5
3.2 Mounting to a Work Surface 6
3.2.1 General 6
3.2.2 Mounting the Stage to the Work Surface 7
3.2.3 Mounting In Multi-Axis Configurations 8
3.3 Calibration of Motor Drives 9
3.4 Mounting Equipment 9
3.5 Transportation 9

Chaper 4 Software & Electrical Installation 10
4.1 Installing Software 10
4.2 Electrical Installation 10
4.2.1 Connecting To The Supply 10
4.3 Connecting The Hardware 11
4.4 Verifying Software Operation 12
4.4.1 Initial Setup 12

Chaper 5 Standalone Operation 13
5.1 Introduction 13
5.2 Control Keypad 13
5.3 Potentiometer Operation 14
5.4 Button Operation 14
5.4.1 Homing 14
5.4.2 Go to Position 14
5.4.3 Teaching ‘Go To Position’ Values 14
5.4.4 Jogging 14
5.4.5 Switching Between Button Modes 14
5.5 Stopping the Stage 15

continued...

Chaper 6 PC Operation **16**
6.1 Introduction **16**
6.2 Using the Kinesis Software **16**
6.3 Homing Motors **17**
6.4 Changing Motor Parameters and Moving to an Absolute Position **18**
6.5 Stopping the Stage **18**
6.6 Jogging **19**
6.7 Setting Move Sequences **20**
6.8 Changing and Saving Parameter Settings **20**

Chaper 7 Software Reference 21
7.1 Introduction **21**
7.2 GUI Panel **21**
7.2.1 Keyboard Shortcuts 23
7.3 Settings Panel **24**
7.3.1 Persisting Settings to Hardware 24
7.3.2 Moves/Jogs Tab 25
7.3.3 Calibration Tab 29
7.3.4 Stage/Axis Tab 30
7.3.5 Advanced Tab 32

Appendices

Appendix A Maintenance **35**
Appendix B Specifications and Accessories **36**
Appendix C Stepper Motor Operation **38**
Appendix D Regulatory **44**
Appendix E Thorlabs Worldwide Contacts **46**

Chapter 1 Overview

1.1 Introduction

The LTS Series stages are a range of stepper-motor driven long travel stages with ranges of 150mm and 300mm. They have been designed to be light-weight, compact and robust with high perfomance over the full travel range. With a load capacity of up to 15 kg horizontally (4 kg vertically), these stages are highly suited to applications such as interferometry and M2 measurements and are compatible with our range of optomech and translation stages. Integrated magnetic limit switches allow homing as well as overdriving protection in both directions. The stages are inclusive of the drive electronics which can either be driven via a PC or can be controlled manually via the buttons and velocity potentiometer on the control key pad.



Fig. 1.1 LTS300 Long Travel Stage

1.2 Kinesis Software Overview

1.2.1 Introduction

The LTS series stages share many of the benefits of the Thorlabs range of motor controllers. These include USB connectivity (allowing multiple units to be used together on a single PC), fully featured Graphical User Interface (GUI) panels, and extensive software function libraries for custom application development.

The Kinesis software suite provides a flexible and powerful PC based control system both for users of the equipment, and software programmers aiming to automate its operation.

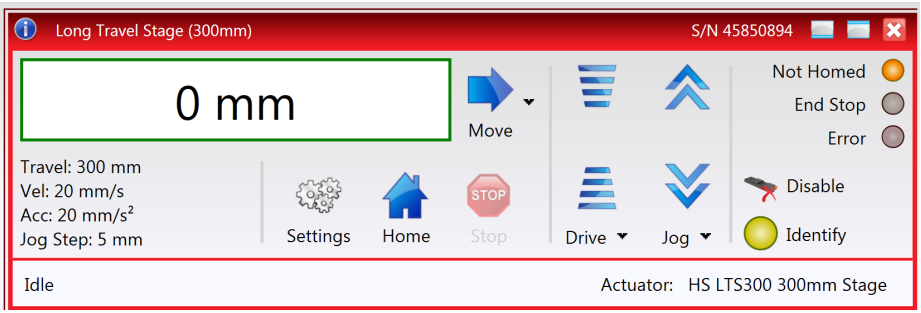
The User Interface allows full control of all settings and operating modes enabling complete 'out-of-box' operation without the need to develop any further custom software. It provides all of the necessary system software services such as generation of GUI panels, communications handling for multiple USB units, and logging of all system activity to assist in hardware trouble shooting. The Kinesis server is also used by software developers to allow the creation of advanced automated positioning applications very rapidly and with great ease.

1.2.2 Kinesis Server

Kinesis controls are re-usable compiled software components that supply both a graphical user interface and a programmable interface. Many such Controls are available for Windows applications development, providing a large range of re-usable functionality. For example, there are Controls available that can be used to manipulate image files, connect to the internet or simply provide user interface components such as buttons and list boxes.

With the Kinesis system, .Net Controls are deployed to allow direct control over (and also reflect the status of) the range of electronic controller units, including the LTS series stages. Software applications that use .Net Controls are often referred to as 'client applications'. A .Net Control is a language independent software component. Consequently the controls can be incorporated into a wide range of software development environments for use by client application developers. Development environments supported include Visual Basic, Labview, Visual C++, C++ Builder, HPVEE, Matlab, VB.NET, C#.NET and, via VBA, Microsoft Office applications such as Excel and Word.

Consider the control supplied for the LTS300 integrated stage & controller.



This Control provides a complete user graphical instrument panel to allow the stage to be manually operated, as well as a complete set of software functions (often called methods) to allow all parameters to be set and motor operations to be automated by

a client application. The instrument panel reflects the current operating state of the controller unit to which it is associated (e.g. such as motor position). Updates to the panel take place automatically when a user (client) application is making software calls into the same Control. For example, if a client application instructs the associated stage to move, the progress of that move is reflected automatically by changing position readouts on the graphical interface, without the need for further programming intervention.

The Kinesis Controls collection provides a rich set of graphical user panels and programmable interfaces allowing users and client application developers to interact seamlessly with the Kinesis hardware. Each of the Kinesis controllers has an associated .Net Control and these are described fully in the handbooks associated with the controllers.

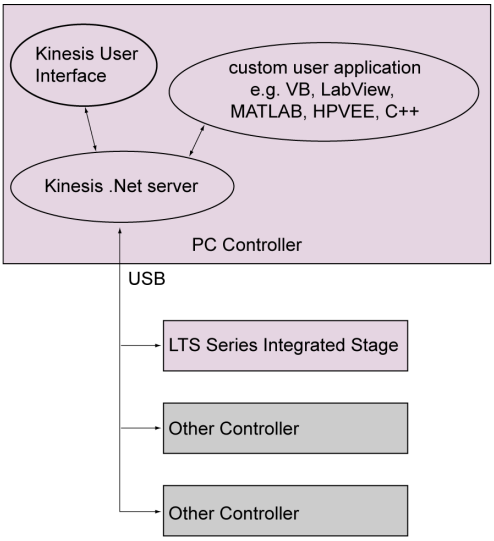


Fig. 1.2 System Architecture Diagram

Refer to the main Kinesis Software online help file, for a complete programmers guide and reference material on using the Kinesis Controls collection. This is available either by pressing the F1 key when running the Kinesis server, or via the Start menu, Start\Programs\Thorlabs\Kinesis\Kinesis Help.

1.2.3 Software Upgrades

Thorlabs operate a policy of continuous product development and may issue software upgrades as necessary.

Chapter 2 Safety

2.1 Safety Information

For the continuing safety of the operators of this equipment, and the protection of the equipment itself, the operator should take note of the **Warnings, Cautions** and **Notes** throughout this handbook and, where visible, on the product itself.

The following safety symbols may be used throughout the handbook and on the equipment itself.



Warning: Risk of Electrical Shock

Given when there is a risk of injury from electrical shock.



Warning

Given when there is a risk of injury to users.



Caution

Given when there is a risk of damage to the product.

Note

Clarification of an instruction or additional information.

2.2 General Warnings



Warning

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. In particular, excessive moisture may impair operation.

Spillage of fluid, such as sample solutions, should be avoided. If spillage does occur, clean up immediately using absorbant tissue. Do not allow spilled fluid to enter the internal mechanism.

The equipment is for indoor use only.

When running custom move sequences, or under fault conditions, the stage may move unexpectedly. Operators should take care when working inside the moving envelope of the stage.

Chapter 3 Mechanical Installation



Warning

The safety of any system incorporating this equipment is the responsibility of the person performing the installation.

3.1 Unpacking



Caution

Once removed from its packaging, the LTS stage is easily damaged by mishandling. The unit should only be handled by its base, not by the motor or any attachments to the moving platform.

Note

Retain the packing in which the unit was shipped, for use in future transportation.

3.1.1 Environmental Conditions



Warning

The safety of any system incorporating this equipment is the responsibility of the person performing the installation.

Location	Indoor use only
Maximum altitude	2000 m
Temperature range	5°C to 40°C
Maximum Humidity	Less than 80% RH (non-condensing) at 31°C

To ensure reliable operation the unit should not be exposed to corrosive agents or excessive moisture, heat or dust.

If the unit has been stored at a low temperature or in an environment of high humidity, it must be allowed to reach ambient conditions before being powered up.

The unit must not be used in an explosive environment.

3.2 Mounting to a Work Surface



Caution

When siting the unit, it should be positioned so as not to impede the operation of the control panel buttons.

Ensure that proper airflow is maintained to the unit.



Caution

Remove power from the unit before bolting or unbolting from the work surface.

3.2.1 General

When mounting the LTS stage close to other equipment, ensure that the travel of the moving platform is not obstructed. If equipment mounted on the moving platform is driven against a solid object, damage to the internal mechanism could occur. The range of travel for each model is as follows: LTS150 - 150mm, LTS300 - 300mm.

3.2.2 Mounting the Stage to the Work Surface

The LTS stage is mounted to the working surface by 1/4-20 (M6) screws (five for LTS300, three for LTS150), which fit through the base. The mounting holes are accessed from the top of the stage. Sleeves are fitted in the moving platform to allow the bolts to pass through from the top surface - see Fig. 3.1.

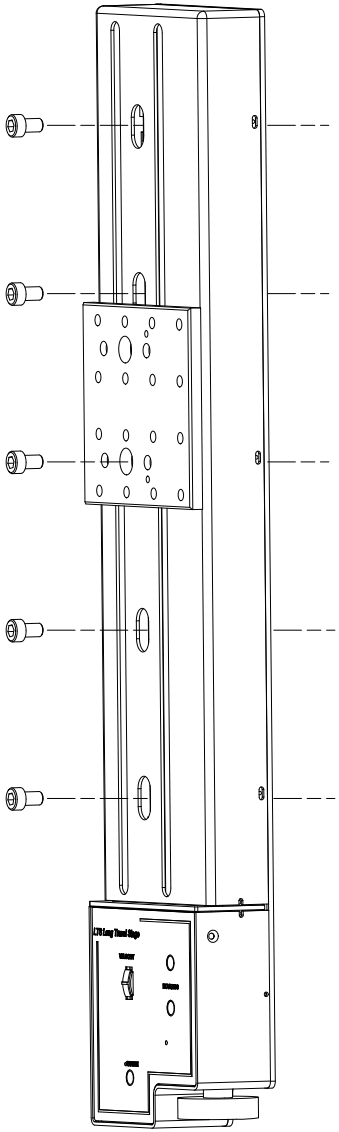


Fig. 3.1 Mounting Holes

3.2.3 Mounting In Multi-Axis Configurations

The LTS series stages can be mounted in XY configurations using the LTSP1 spacer plate. The LTSP2 and LTSP3 angle brackets allow the LTS150 and LTS300 stages respectively to be mounted vertically in Z axis configurations.

Please see the documentation supplied with the adapter plates for more details.

Caution

When mounted in a vertical (Z-axis) orientation, the maximum load capacity is 4 kg and the maximum velocity is 3 mm/sec. For safety reasons, the Max Vel parameter in the software Settings panel should be set to 3 mm/sec - see Section 7.3.2. for more details.

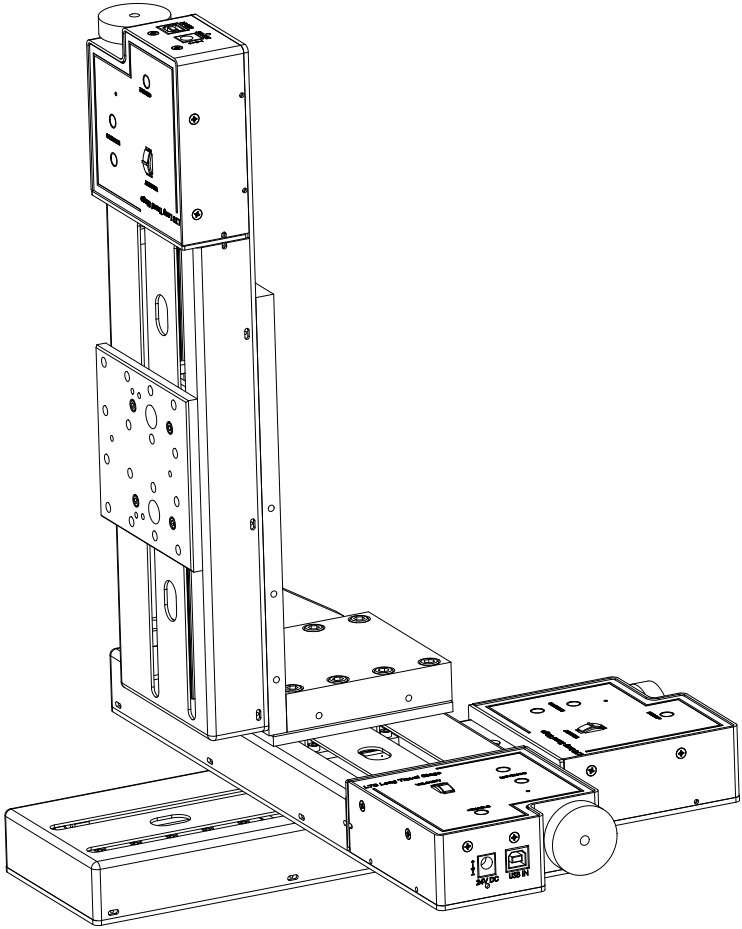


Fig. 3.2 Typical XYZ Configuration

Caution

Ensure that any devices and components attached to the moving platform are securely fastened. Incorrectly attached components could come loose when the stage is operated.

3.3 Calibration of Motor Drives

Calibration enables the server to correct for any mechanical errors inherent in the system. Mechanical components, such as the leadscrew and linkages, can be machined only within a certain tolerance, e.g. the leadscrew may be nominally 1mm but actually 1.0005mm, giving a 0.5 micron error. In practice, these errors accumulate from a number of sources, however they are repeatable and therefore, can be compensated.

During calibration, the total positional error is measured at a large number of points and these errors are stored as a look up table (LUT). The LUT is saved as a calibration file, one file for each particular stage. The file is then linked to the appropriate stage using the Kinesis software. Whenever the stage is moved, the LUT is consulted to ascertain the precise movement required to achieve the demanded position.

The use of a calibration file is optional. Without it, the repeatability and resolution of the stage are unaffected, but no compensations are made to enhance the accuracy.

Calibration files can be downloaded from the support documents section on the product web page, one file for each serial number.

Details on assigning a calibration file are contained in *Section 7.3. Calibration Tab.*

3.4 Mounting Equipment and Devices

Caution

When attaching accessories, e.g. fiber holders, to the top platform do not use long bolts that protrude into the unit as this could damage the internal mechanism. The fixing thread should be no longer than 6 mm (0.24”).

3.5 Transportation

Caution

When packing the unit for shipping, use the original packing. If this is not available, use a strong box and surround the unit with at least 100 mm of shock absorbent material.

Chapter 4 Software & Electrical Installation

4.1 Installing Software



Caution

Some PCs may have been configured to restrict the users ability to load software, and on these systems the software may not install/run. If you are in any doubt about your rights to install/run software, please consult your system administrator before attempting to install.

If you experience any problems when installing software, contact Thorlabs on +44 (0)1353 654440 and ask for Technical Support.

DO NOT CONNECT THE STAGE TO YOUR PC YET

1) Download the software from www.thorlabs.com.
2) Locate the downloaded setup.exe file and move to a suitable file location.
3) Double-click the setup.exe file and follow the on-screen instructions.

4.2 Electrical Installation

4.2.1 Connecting To The Supply



Caution

The PSU unit must be connected only to an earthed fused supply of 110 to 230V.

Use only the power supply supplied by Thorlabs, other units may not be rated to the same current.

The unit is shipped to the UK, Europe and the USA, with the appropriate power plug already fitted. When shipped to other territories the appropriate power plug must be fitted by the user. Cable identification is as follows:

Brown: Live Blue: Neutral Green/Yellow: Earth/Ground

When connecting the power and USB cables, ensure they are routed clear of the moving platform.

4.3 Connecting The Hardware

1) Perform the mechanical installation as detailed in Section 3.
2) Install the Software - see Section 4.1.
3) Using the USB cable provided, connect the stage unit to your PC.

Note

The USB cable should be no more than 3 metres in length. Communication lengths in excess of 3 metres can be achieved by using a powered USB hub).

4) Connect the stage to the power supply - see Section 4.2.1.
5) Connect the PSU to the main supply and switch 'ON'.
6) Wait for the unit to initialize (about 5 sec). Do not press any controls during this time. The ENABLE LED is lit when the unit is ready for use.
7) Windows™ should detect the new hardware. Wait while Windows™ installs the drivers for the new hardware - see the Getting Started guide for more information.

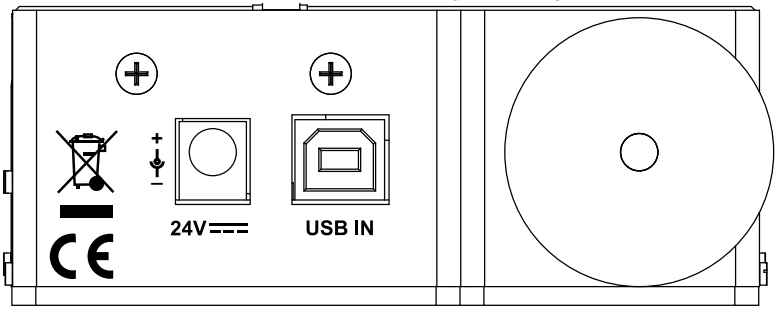


Fig. 4.1 Power and USB Connectors

4.4 Verifying Software Operation

4.4.1 Initial Setup

1) Run the Kinesis softwareand check that the Graphical User Interface (GUI) panel appears and is active.

Note

If the Kinesis software does not recognise the unit, switch OFF the power but leave the kinesis software running and the USB connected. Wait around 30 seconds then switch the power ON. Kinesis should now load the unit.

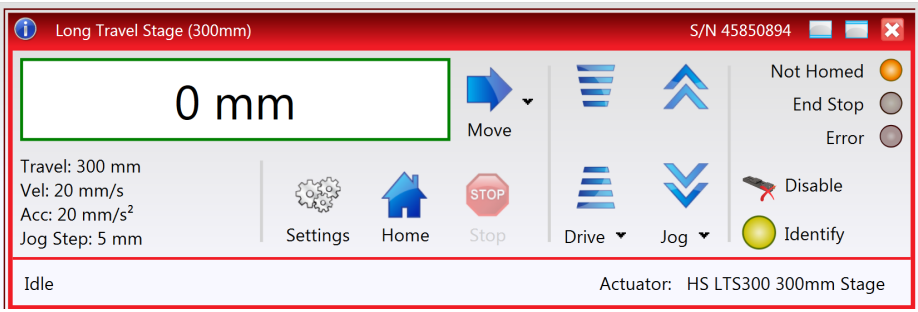


Fig. 4.2 Gui panel showing jog and ident buttons

2) Click the 'Ident' button. The POWER LED on the control keypad flashes. This is useful in multi-channel systems for identifying which driver unit is associated with which GUI.
3) Click the jog buttons on the GUI panel and check that the associated stage moves. The position display for the associated GUI should increment and decrement accordingly.

Chapter 5 Standalone Operation

5.1 Introduction

The LTS series of integrated long travel stages offer a fully featured motion control capability including velocity profile settings, limit switch handling and homing sequences. When the unit is connected to the PC, these parameters are automatically set to allow “out of the box” operation with no further “tuning” required. However, further adjustment is possible via the kinesis software - see Chapter 6.

The following brief overview explains how the top panel controls can be used to perform a typical series of motor moves, however it also may be useful to read the background on stepper motor operation contained in Appendix C.

5.2 Control Keypad

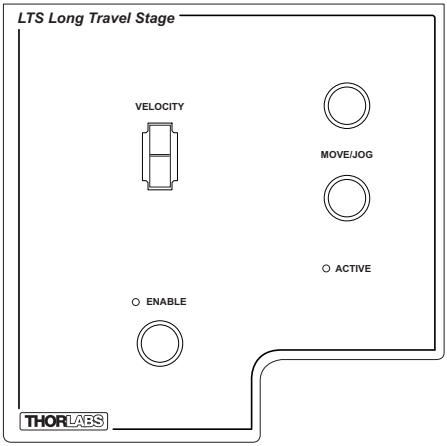


Fig. 5.1 Front Panel Controls and Indicators

MOVE Controls - These controls allow all motor moves to be initiated.

Jog Buttons - Used to jog the motors and make discrete position increments in either direction - see Section 6.6. for more details on jogging.

Slider Potentiometer - Used to drive the motor at a pre-defined speed in either forward or reverse directions for full and easy motor control - see Section 5.3.

Active LED - The Active LED will flash when the motor reaches a forward or reverse limit switch, and is lit when the motor is moving.

Enable Button - Used to enable/disable channel functionality. Disabling the channel removes the drive power and allows the motor actuator to be operated manually.

Enable LED - When the stage is enabled, this LED is lit. Furthermore, this LED will flash when the ‘Ident’ button is clicked on the Software GUI panel.

5.3 Potentiometer Operation

The potentiometer slider is sprung such that when released it returns to it's central position. In this central position the motor is stationary. As the slider is moved away from the centre, the motor begins to move. Bidirectional control of the motor is possible by moving the slider in both directions.

The velocity of this move is set in real world units (mm) in the 'Potentiometer Control Settings' parameter in the 'Advanced' settings tab - see Section 7.3.5. and is limited to a maximum of 20 mm/sec.

5.4 Button Operation

The buttons on the front of the unit can be used to control the motor in a number of ways, as described below.

5.4.1 Homing

A 'Home' move is performed to establish a datum from which subsequent absolute position moves can be measured (see Section 6.3. and Section C.2.2. for further information on the home position).

To initiate a 'Home' move, press and hold both buttons for 2 seconds.

5.4.2 Go to Position

Each button can be programmed with a different position value, such that the controller will move the motor to that position when the specific button is pressed.

This mode of operation is enabled by setting the 'Button Mode' parameter to 'Go To Position' on the Advanced settings tab - see Section 7.3. for further information.

5.4.3 Teaching 'Go To Position' Values

In addition to entering values in the Advanced Tab as described in Section 5.4.2. above, when operating in Go To Position mode it is possible from the front panel, to save the current position as the 'Go To Position' value.

To save the current position as the 'Go To Position' value, press and hold the required button for 2 seconds.

5.4.4 Jogging

The front panel buttons can also be configured to 'jog' the motor. This mode of operation is enabled by setting the 'Button Mode' parameter to 'Jogging' on the 'Advanced' settings tab - see Section 7.3. Once set to this mode, the jogging parameters for the buttons are taken from the 'Jog' parameters on the 'Move/Jogs' settings tab - see Section 7.3.

5.4.5 Switching Between Button Modes

The button mode can only be changed in the Settings panel, see Chapter 7.3.5.

5.5 Stopping the Stage

The drive channel is enabled and disabled by clicking the ‘Enable’ button on the GUI panel or the top panel of the unit. The green indicator is lit when the drive channel is enabled. Disabling the channel removes the drive power and allows the stage/ actuator to be positioned manually.

During operation, the stage can be stopped at any time by clicking the ‘Stop’ button on the GUI panel. Using this button does not remove power to the drive channel.

Chapter 6 PC Operation

6.1 Introduction

The following brief tutorial guides the user through a typical series of moves and parameter adjustments performed using the Kinesis software. It assumes that the unit is electrically connected as described in Section 4.2. and that the software is already installed - see Section 4.1.

6.2 Using the Kinesis Software

The Kinesis software application allows the user to interact with any number of hardware control units connected to the PC USB Bus. This program allows multiple graphical instrument panels to be displayed so that multiple units can be controlled. All basic operating parameters can be set through this program, and all basic operations (such as motor moves) can be initiated. Parameter settings can be saved, which simplifies system set up whenever the software is run up.

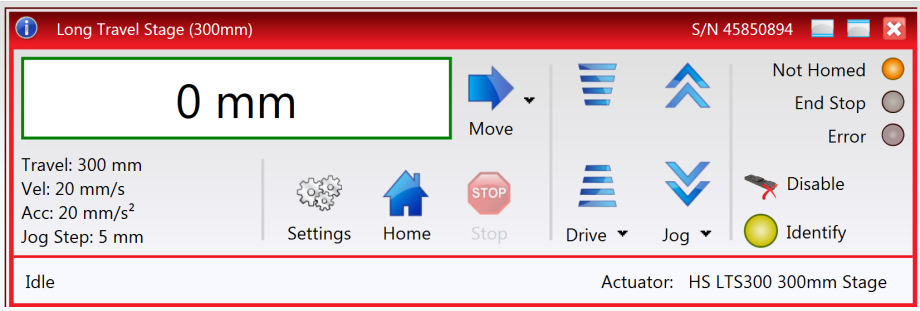


Fig. 6.1 Typical User Screen

1) Run the Kinesis software - Start/All Programs/Thorlabs/Kinesis/Kinesis.

Note

If the Kinesis software does not recognise the unit, switch OFF the power but leave the kinesis software running and the USB connected. Wait around 30 seconds then switch the power ON. Kinesis should now load the unit.

6.3 Homing Motors

Homing the motor moves the actuator to the home limit switch and resets the internal position counter to zero. The limit switch provides a fixed datum that can be found after the system has been powered up.

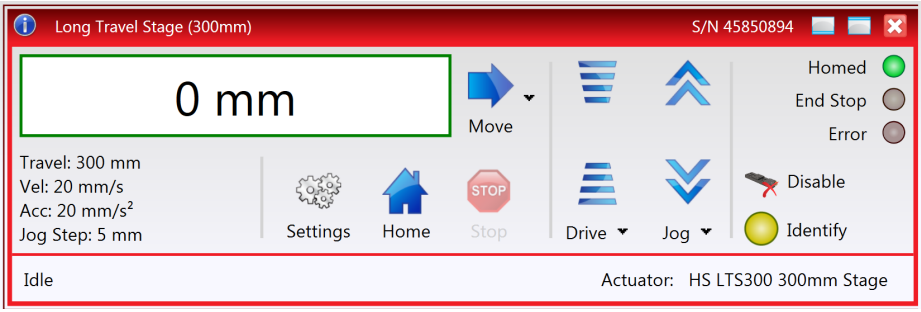


Fig. 6.2 Motor Controller Software GUI

1) Click the 'Home' button. Notice that the 'Not Homed' LED changes to 'Homed', and that the LED flashes to indicate that homing is in progress. The displayed position counts down to 0, i.e the home position.

Note

Homing can also be performed at the unit, by holding down both front panel buttons for around 2 seconds.

2) When homing is complete, the 'Homed' LED is lit as shown above.

See Appendix C, Section C.2.2. for background information on the home position.

6.4 Changing Motor Parameters and Moving to an Absolute Position

Absolute moves are measured in real world units (e.g. millimetres), relative to the Home position.

Moves are performed using a trapezoidal velocity profile (see Appendix C, Section C.1.3.). The velocity settings relate to the maximum velocities at which a move is performed, and the acceleration at which the motor speeds up from zero to maximum velocity.

1) On the GUI panel, click the Move arrow to show the Settings panel.

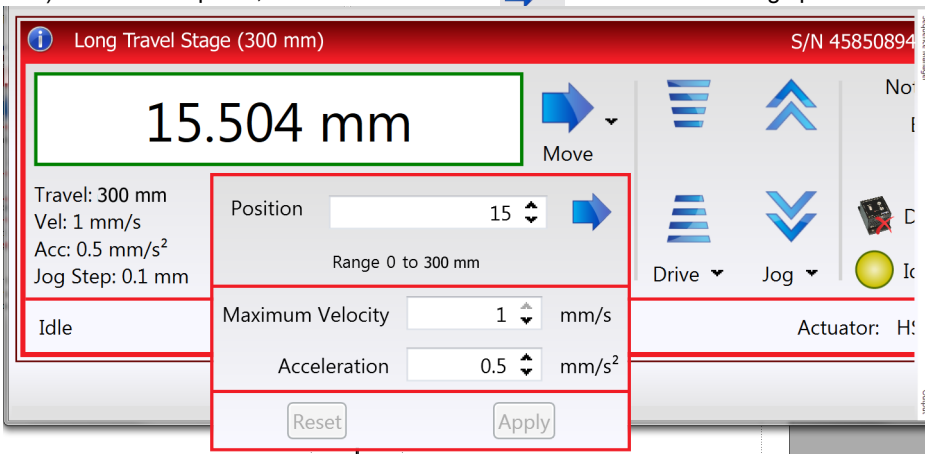


Fig. 6.3 Move Settings Panel

2) Enter the required absolute position and/or parameter values.
3) To move to the position entered click the arrow
4) Click 'Apply' to save the parameter settings and close the window, click Reset to return to the previously saved values.

6.5 Stopping the Stage

The drive channel is enabled and disabled by clicking the 'Enable' button on the GUI panel or the top panel of the unit. The green indicator is lit when the drive channel is enabled. Disabling the channel removes the drive power and allows the stage/ actuator to be positioned manually.

During operation, the stage can be stopped at any time by clicking the 'Stop' button on the GUI panel. Using this button does not remove power to the drive channel.

6.6 Jogging

During PC operation, the motor actuators are jogged using the GUI panel arrow keys. There are two jogging modes available, 'Single Step' and 'Continuous'. In 'Single Step' mode, the motor moves by the step size specified in the Step Distance parameter. If the jog key is held down, single step jogging is repeated until the button is released - see Fig. 7.3. In 'Continuous' mode, the motor actuator will accelerate and move at the jog velocity while the button is held down.

1) On the GUI panel, click the word 'Jog' 

to display the Settings panel.

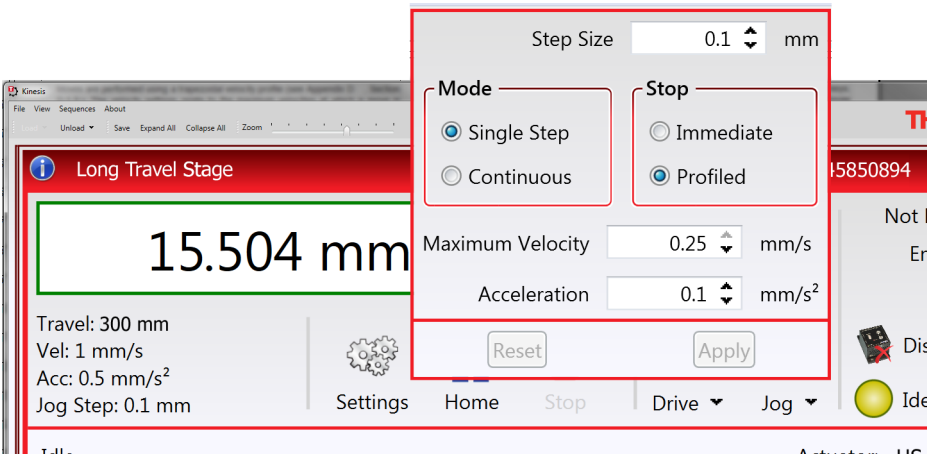


Fig. 6.4 Jog Settings Panel

2) Make parameter changes as required.

Note

In current versions of software, the 'Min Vel' parameter is locked at zero and cannot be adjusted.

3) Click 'Apply' to save the settings and close the window, click Reset to return to the previously saved values.

6.7 Setting Move Sequences

The Kinesis software allows move sequences to be programmed, allowing several positions to be visited without user intervention. For more details and instructions on setting move sequences, please see the *Kinesis Helpfile*.

6.8 Changing and Saving Parameter Settings

During operation, certain settings (e.g. max velocity, jog step size etc) can be changed as required. Other settings (e.g. PID parameter values) cannot be changed so easily. When the Kinesis Server is run up and the stage/acuator association made, suitable default settings are loaded and these values have been chosen to provide safe performance in the majority of applications. However, for applications where these settings need to be changed, a new set of Device Start Up settings', must be created which can then be applied and/or uploaded on subsequent start up. See the *Kinesis Helpfile* for more details.

Chapter 7 Software Reference

7.1 Introduction

This chapter gives an explanation of the parameters and settings accessed from the Kinesis software running on a PC.

7.2 GUI Panel

The following screen shot shows the graphical user interface (GUI) displayed when accessing the LTS controller using the Kinesis software.

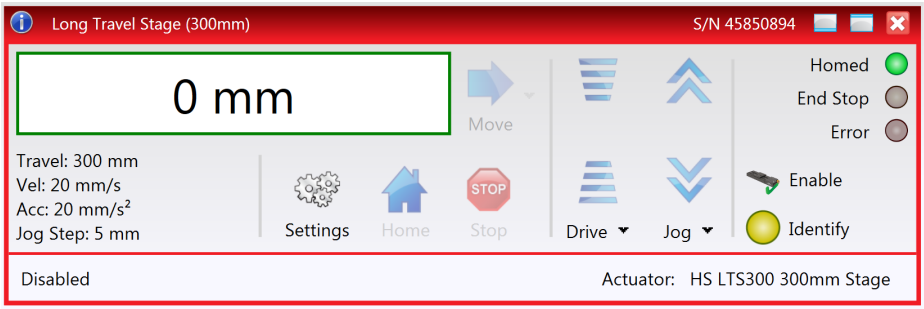


Fig. 7.1 LTS Stage Software GUI

Note

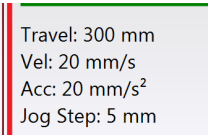
The serial number of the LTS Stage associated with the GUI panel is displayed in the top right hand corner. This information should always be provided when requesting customer support.

Position window - shows the position (in millimetres or degrees) of the motor. The motor must be 'Homed' before the display will show a meaningful value, (i.e. the displayed position is relative to a physical datum, the limit switch).



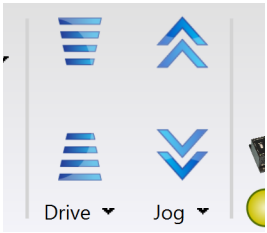


Move - Opens the settings window, so that position data and velocity parameters can be entered - see Section 6.4. Moves are performed using the current velocity parameters which can be changed in the same panel. The present settings are displayed below the window.



Velocity Parameters - the present setting for the move velocity parameters and the jog step size. The travel range of the associated stage/actuator is also displayed.

These settings can be adjusted as described previously, or by clicking the Settings button to display the settings window, see Section 7.3.2.

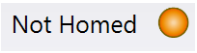


Jog Controls - used to increment or decrement the motor position. The controls comprise a bar graph and a set of jog arrows.

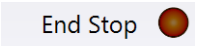
Each division of the bar graph represents a different velocity. The velocities are entered in the settings panel which is displayed by clicking 'Drive' or the small down arrow.

When the arrows are clicked, the motor is driven in the selected direction at the jog velocity, one step per click. The step size and jog velocity parameters can be changed by clicking 'Jog' or the small down arrow to display the settings panel.

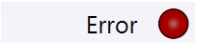
Homed/Not Homed - lit when the motor has not been 'Homed' since power up. When the home button is clicked, the caption changes to 'Homed' and the LED flashes while the home move is being performed. The LED is lit green once the move is complete.



End Stop - lit when a limit switch is activated, i.e. the motor is at its end stop.

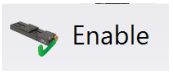


Error - lit when a fault condition occurs.

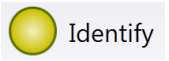


Enable/Disable - applies and removes power to the motor. With the motor enabled, only the Disable button is visible, and with the motor disabled only the Enable button is visible.

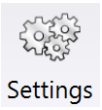




Identify - when this button is pressed, the ACTIVE LED on the front panel of the associated hardware unit will flash for a short period.



Settings - Displays the 'Settings' panel, which allows the operating parameters to be entered for the motor drive - see Section 7.3.

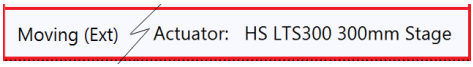


Home - sends the motor to its 'Home' position - see Appendix C Section C.2.2.





Stop - halts the movement of the motor.



Lower Display - Shows the present state of the motor, e.g. Idle, Moving, Moving EXT or Homing.

Also shows the part number of the associated actuator or stage.

7.2.1 Keyboard Shortcuts

Certain functionality can also be accessed via PC keyboard shortcuts as follows:

Jog Forwards	'Ctrl' + 'F', 'Ctrl' + '+'
Jog Backwards	'Ctrl' + 'B', 'Ctrl' + '-'
Home	'Ctrl' + 'H', 'Ctrl' + 'Home'
Stop	'Ctrl' + '0'
Jog Forward1	'LeftCtrl' + '1' (Hold to move)
Forward2	'LeftCtrl' + '2' (Hold to move)
Forward3	'LeftCtrl' + '3' (Hold to move)
Forward4	'LeftCtrl' + '4' (Hold to move)
Backward1	'RightCtrl' + '1' (Hold to move)
Backward2	'RightCtrl' + '2' (Hold to move)
Backward3	'RightCtrl' + '3' (Hold to move)
Backward4	'RightCtrl' + '4' (Hold to move)
GoTo	'Enter' (On target position box)

7.3 Settings Panel

When the 'Settings' button on the GUI panel is clicked, the 'Settings' window is displayed. This panel allows motor operation parameters such as move/jog velocities, and stage/axis information to be modified. Note that all of these parameters have programmable equivalents (refer to the *Kinesis Server helpfile* for further details.

7.3.1 Persisting Settings to Hardware

Many of the parameters that can be set for the LTS Stage can be stored (persisted) within the unit itself, such that when the unit is next powered up these settings are applied automatically. This is particularly important when the driver is being used manually in the absence of a PC and USB link. The Velocity Profile and Jogging parameters described previously are good examples of settings that can be altered and then persisted in the driver for use in absence of a PC. To save the settings to hardware, check the '*Persist Settings to the Device'* checkbox before clicking the 'OK button.



Caution

The 'Persist Settings' functionality is provided to simplify use of the unit in the absence of a PC. When the unit is connected to a PC and is operated via KinesisUser, the default KinesisServer settings will be loaded at boot up, even if the 'Persist Settings' option has been checked.

7.3.2 Moves/Jogs Tab

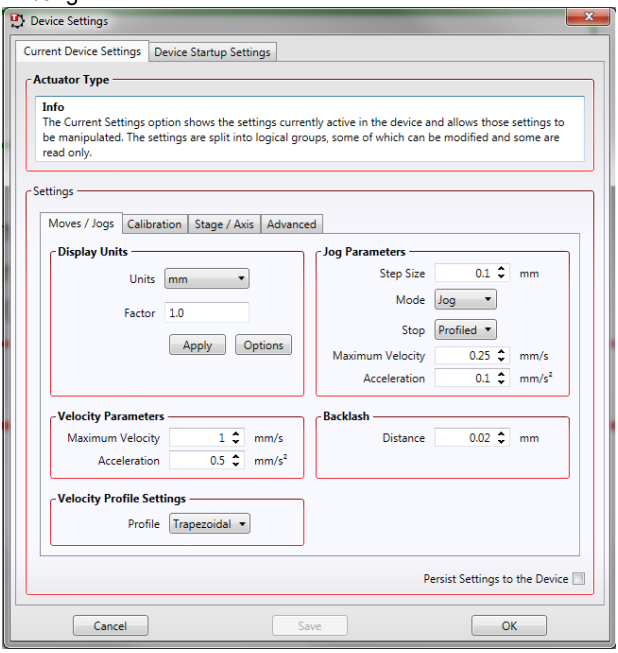


Fig. 7.2 LTS Series Stage - Move/Jog Settings

Display Units

By default, the unit will display position in real world units (mm or degrees). If required, the units can be changed to so that the display shows other positional units (cm, µm, µrad etc).

Units - the positioning units used on the GUI display.

Factor - the scaling factor associated with the selected units.

Jog Parameters

Jogs are initiated by using the 'Jog' keys on the GUI panel (see Section 6.6.), or the Jog Buttons on the front panel of the unit.

Step Size - The distance to move when a jog command is initiated. The step size is specified in real world units (mm or degrees dependent upon the stage).

Mode - The way in which the motor moves when a jog command is received (i.e. front panel button pressed or GUI panel button clicked).

There are two jogging modes available, 'Jog' and 'Continuous'. In 'Jog' mode, the motor moves by the distance specified in the Step Size parameter. If the jog key is held down, single step jogging is repeated until the button is released - see Fig. 7.3.

In ‘Continuous’ mode, the motor actuator will accelerate and move at the jog velocity while the button is held down..

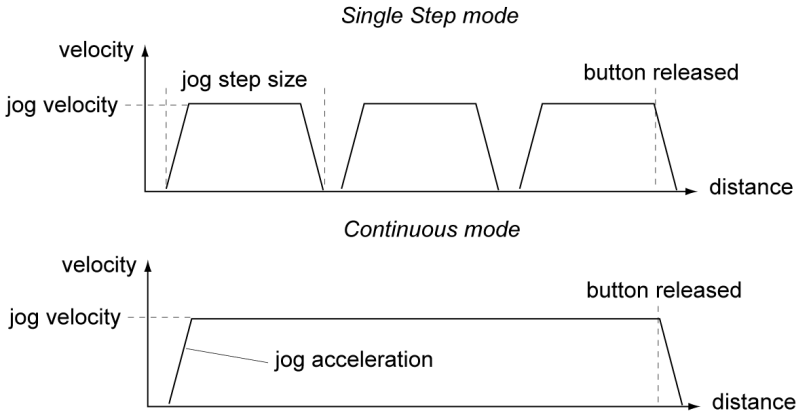


Fig. 7.3 Jog Modes

Jog - the motor moves by the distance specified in the Step Size parameter.

Continuous - the motor continues to move until the jog signal is removed (i.e. jog button is released).

Stop - the way in which the jog motion stops when the demand is removed.

Immediate - the motor stops quickly, in a non-profiled manner

Profiled - the motor stops in a profiled manner using the jog Velocity Profile parameters set above.

Maximum Velocity - the maximum velocity at which to perform a move.

Acceleration - the rate at which the velocity climbs from zero to maximum, and slows from maximum to zero.

Velocity Parameters

Moves can be initiated via the GUI panel by entering a position value after clicking on the position display box (see Section 6.4.), or by calling a software function (see the KinesisServer helpfile). The following settings determine the velocity profile of such moves, and are specified in real world units, millimetres or degrees.

Maximum Velocity - the maximum velocity at which to perform a move.

Acceleration - the rate at which the velocity climbs from zero to maximum, and slows from maximum to zero.

Note

Under certain velocity parameter and move distance conditions, the maximum velocity may never be reached (i.e. the move comprises an acceleration and deceleration phase only).

Backlash

Distance - The system compensates for lead screw backlash during reverse direction moves, by moving passed the demanded position by a specified amount, and then reversing. This ensures that positions are always approached in a forward direction. The Backlash Distance is specified in real world units (millimeters or degrees). To remove backlash correction, this value should be set to zero.

Velocity Profile Settings

To prevent the motor from stalling, it must be ramped up gradually to its maximum velocity. Certain limits to velocity and acceleration result from the torque and speed limits of the motor, and the inertia and friction of the parts it drives.

The system incorporates a trajectory generator, which performs calculations to determine the instantaneous position, velocity and acceleration of each axis at any given moment. During a motion profile, these values will change continuously. Once the move is complete, these parameters will then remain unchanged until the next move begins.

The specific move profile created by the system depends on several factors, such as the profile mode and profile parameters presently selected, and other conditions such as whether a motion stop has been requested.

Profile – This field is used to set the profile mode to either Trapezoidal or S-curve. In either case, the velocity and acceleration of the profile are specified using the *Velocity Profile* parameters on the *Moves/Jogs tab*.

The *Trapezoidal* profile is a standard, symmetrical acceleration/deceleration motion curve, in which the start velocity is always zero.

In a typical trapezoidal velocity profile, (see Fig. 7.4.), the stage is ramped at acceleration '*a*' to a maximum velocity '*v*'. As the destination is approached, the stage is decelerated at '*a*' so that the final position is approached slowly in a controlled manner.

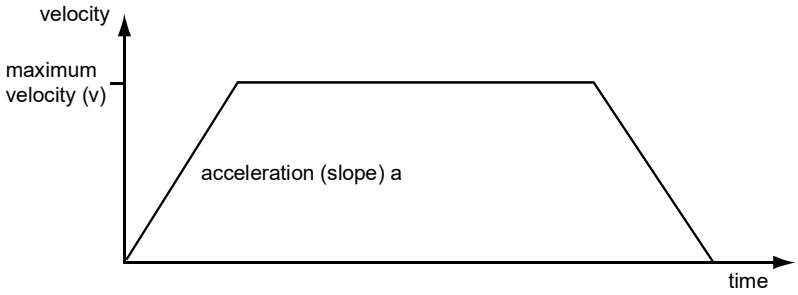


Fig. 7.4 Graph of a trapezoidal velocity profile

The *S-curve* profile is a trapezoidal curve with an additional '*Bow Value*' parameter, which limits the rate of change of acceleration and smooths out the contours of the

motion profile. The *Bow Value* is applied in mm/s^3 and is derived from the *Bow Index* field as follows:

Bow Value = $2^{(Bow\ Index\ -1)}$ within the range 1 to 262144 (Bow Index 1 to 18).

In this profile mode, the acceleration increases gradually from 0 to the specified acceleration value, then decreases at the same rate until it reaches 0 again at the specified velocity. The same sequence in reverse brings the axis to a stop at the programmed destination position.

Example

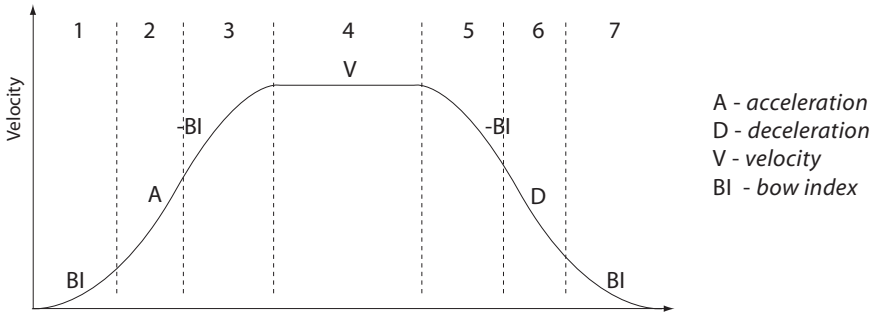


Fig. 7.5 Typical S-Curve Profile

The figure above shows a typical S-curve profile. In segment (1), the S-curve profile drives the axis at the specified Bow Index (BI) until the maximum acceleration (A) is reached. The axis continues to accelerate linearly (Bow Index = 0) through segment (2). The profile then applies the negative value of Bow Index to reduce the acceleration to 0 during segment (3). The axis is now at the maximum velocity (V), at which it continues through segment (4). The profile then decelerates in a similar manner to the acceleration phase, using the Bow Index to reach the maximum deceleration (D) and then bring the axis to a stop at the destination.

Note

The higher the Bow Index, then the shorter the BI phases of the curve, and the steeper the acceleration and deceleration phases. High values of Bow Index may cause a move to overshoot or may result in instability.

7.3.3 Calibration Tab

Note

This section is applicable only to NRT100, NRT150, LTS150, LTS300 and MLJ050 series stages, DRV013 and DRV014 actuators.

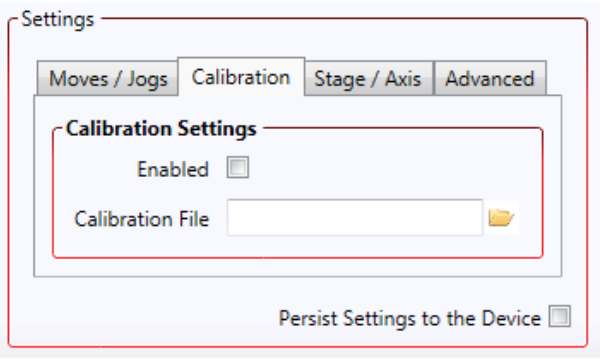


Fig. 7.6 LTS Series Stage - Calibration Settings

Calibration enables the server to correct for any mechanical errors inherent in the system. Mechanical components, such as the leadscrew and linkages, can be machined only within a certain tolerance, e.g. the leadscrew may be nominally 1mm but actually 1.0005mm, giving a 0.5 micron error. In practice, these errors accumulate from a number of sources, however they are repeatable and therefore, can be compensated.

During calibration, the total positional error is measured at a large number of points and these errors are stored as a look up table (LUT). The LUT is saved as a calibration file, one file for each particular stage. Whenever the stage is moved, the LUT is consulted to ascertain the precise movement required to achieve the demanded position.

The use of a calibration file is optional. Without it, the repeatability and resolution of the stage are unaffected, but no compensations are made to enhance the accuracy

Calibration files can be downloaded from the support documents section on the product web page, one file for each serial number.

To assign a calibration file:

1) Click the ‘Enabled’ Checkbox.
2) Click the folder icon and navigate to the location of the required calibration file.
3) Select the file so that the file name is displayed in the ‘Calibration File’ field.
4) Click OK.

7.3.4 Stage/Axis Tab

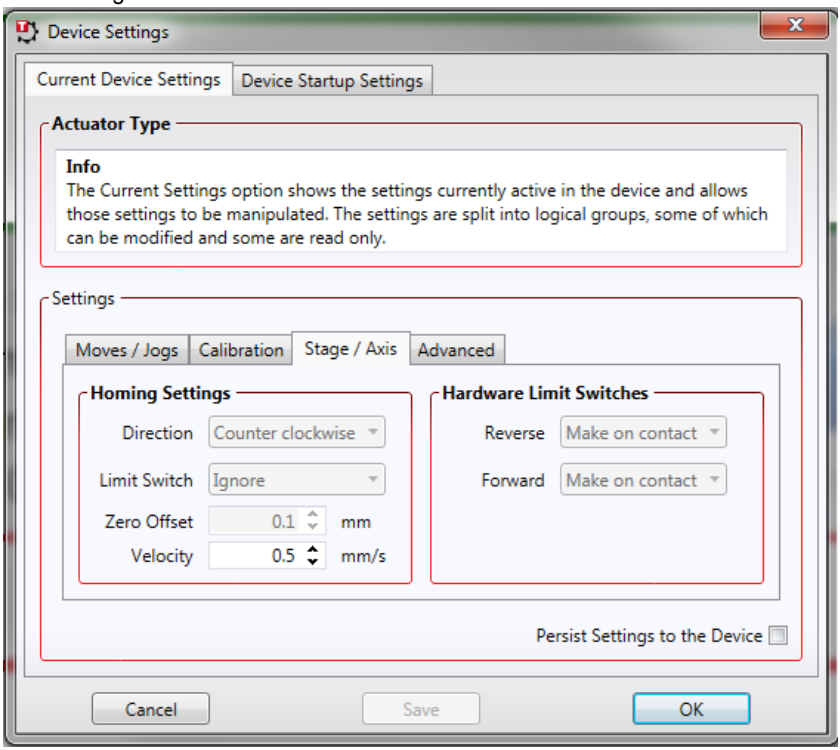


Fig. 7.7 LTS Series Stage - Stage/Axis Settings

Note

This tab contains a number of parameters which are related to the physical characteristics of the particular stage being driven. They need to be set accordingly such that a particular stage is driven properly by the system.

For LTS stages, the Kinesis software will automatically apply suitable defaults for the parameters on this tab during boot up of the software and these parameters should not normally be altered subsequently as it may adversely affect the performance of the stage. Descriptions are provided for information only.

For custom stage types not available using the Kinesis software, the stage details must be entered manually - see the software overview for more details.

Homing Settings

When homing, a stage typically moves in the reverse direction, (i.e. towards the reverse limit switch). The following settings allow support for stages with both Forward and Reverse limits.

Note

Typically, the following two parameters are set the same, i.e. both Forward or both Reverse.

Direction - the direction sense that the motor moves when homing, either *Clockwise* or *Counter Clockwise*.

Limit Switch - The hardware limit switch associated with the home position, either Ignore, *Clockwise or Counter Clockwise*.

Zero Offset - the distance offset (in mm or degrees) from the limit switch to the Home position.

Velocity - the maximum velocity at which the motors move when Homing.

For further information on the home position, see Section C.2.2.

Hardware Limit Switches

Note

The minimum velocity and acceleration/deceleration parameters for a home move are taken from the existing move velocity profile parameters.

The operation of the limit switches is inherent in the design of the associated stage or actuator. The following parameters notify the system to the action of the switches when contact is made. Select Reverse or Forward as required, then select the relevant operation.

Switch Makes - The switch closes on contact
Switch Breaks - The switch opens on contact
Ignore/Absent - The switch is missing, or should be ignored.

7.3.5 Advanced Tab

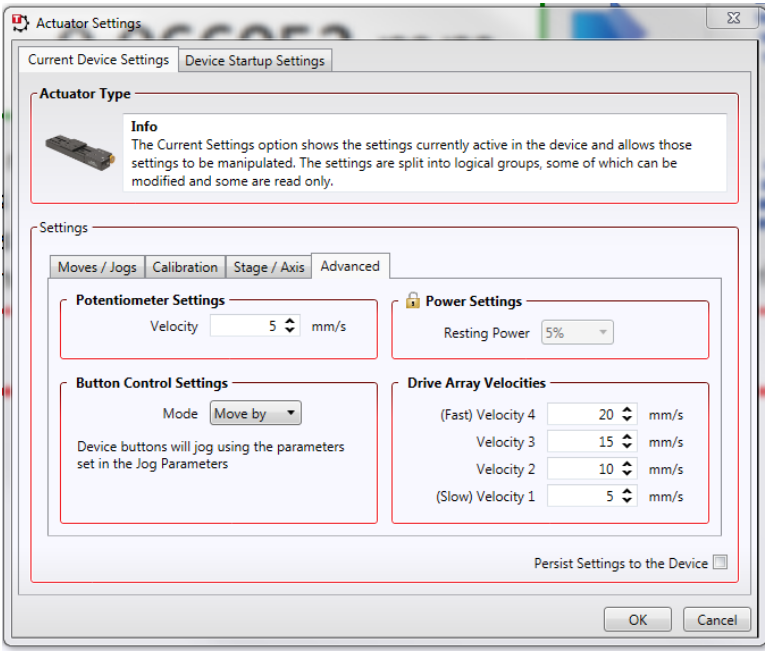


Fig. 7.8 LTS Series Stages - Advanced Settings

Potentiometer Settings

The potentiometer slider is sprung such that when released it returns to it's central position. In this central position the motor is stationary. As the slider is moved away from the centre, the motor begins to move. Bidirectional control of motor moves is possible by moving the slider in both directions. The speed of the motor increases up to the value set in the *Velocity* parameter.

The velocity profile is derived from the 'Velocity Profile' settings in the 'Move/Jogs' settings tab.

Power Settings

The LTS Stage is designed to vary the phase powers (current) in the motor coils depending on the operating state of the motor - moving or stationary. Typically, when a stepper motor is at rest it is advisable to reduce the phase (holding) currents so that the motor does not overheat. When moving, these phase currents are boosted to provide sufficient motor torque and minimise the possibility of stalling (missed steps) The moving phase powers are set automatically by the unit and cannot be adjusted.

The Resting Power is entered as a percentage of full power.

Note

The default values applied by the software have been selected based on the type of stage or actuator associated with the motor drive. Modify these values with caution (particularly the rest power) as the risk of damage to the motor due to overheating is significant.

Button Control Settings

The buttons on the front of the unit can be used either to jog the motor, or to perform moves to absolute positions.

Mode: This setting determines the type of move performed when the front panel buttons are pressed.

Move By: Once set to this mode, the move parameters for the buttons are taken from the 'Jog' parameters on the 'Move/Jogs' settings tab.

Move To: In this mode, each button can be programmed with a different position value, such that the controller will move the motor to that position when the specific button is pressed.

Note

The following parameters are applicable only if 'Move To' is selected in the 'Mode' field.

Left/Top Button Pos.: The position to which the motor will move when the top button is pressed.

Right/Lower Button Pos.: The position to which the motor will move when the bottom button is pressed.

Note

A 'Home' move can be performed by pressing and holding both buttons for 2 seconds. This function is irrespective of the 'Button Mode' setting.

Drive Array Velocities

These parameters relate to the velocity for moves initiated by the DRIVE bar graph. Each specifies a velocity to apply when the associated bar is clicked. These settings are applicable in either direction of pot deflection, i.e. 4 possible velocity settings in the forward or reverse motion directions.

Note

It is acceptable to set velocities equal to each other to reduce the number of speeds.

Appendix A Maintenance



Warning

The equipment contains no user servicable parts.

Only personnel authorized by Thorlabs Ltd and trained in the maintenance of this equipment should remove its covers or attempt any repairs or adjustments. Maintenance is limited to safety testing and cleaning as described in the following sections.

A.1 Safety Testing

PAT testing in accordance with local regulations, should be performed on a regular basis, (typically annually for an instrument in daily use).

A.2 Cleaning



Warning

Disconnect the power supply before cleaning the unit.

Never allow water to get inside the case.

Do not saturate the unit.

Do not use any type of abrasive pad, scouring powder or solvent,

e.g. alcohol or benzene.

The fascia may be cleaned with a soft cloth, lightly dampened with water or a mild detergent.

A.3 Troubleshooting

If an unexpected obstruction to the stage motion is encountered, the motor may stall and the position datum may be lost. After the obstruction has been removed, the associated channel of the controller should first be homed to re-establish a datum zero point.

In the event of a breakdown, or malfunction of the product please contact Thorlabs Tech Support. Contact details are contained in Chapter 5 .

Appendix B Specifications and Accessories

B.1 General Specifications

Parameter	Value
Controller Specifications	
Microsteps per Full Step	2048
Microsteps per Revolution of Motor	409,600 (for 200 step motor)
Motor Drive Voltage	24 V
Motor Drive Power	Up to 25 W (Peak)/ 12.5 W (Avg)
Motor Speeds	Up to 3000 RPM (200 Full Step Motor)
Stage Specifications	
Bidirectional Repeatability	< ±2 µm
Calibrated Accuracy	< ±5 µm
Backlash	2 µm
Maximum Acceleration	50 mm/sec^2 Horizontal, 5 mm/sec^2 Vertical
Maximum Horiz Velocity	50 mm/s
Maximum Vertical Velocity	3 mm/s
Velocity Stability	± 1 mm/sec
Max Load Capacity	15 kg Horizontal, 4 kg Vertical
Recommended Horizontal Load Capacity	< 12 kg
Minimum Achievable Incremental Movement	0.1 µm
Minimum Repeatable Incremental Movement	4 µm
Maximum Percentage Accuracy	LTS150 0.13 % LTS300 0.12 %
Home Location Accuracy	±0.6 µm
Pitch	LTS150 0.016° LTS300 0.022°
Yaw	LTS150 0.05° LTS300 0.06°
Construction	Aluminum with precision, recirculating linear bearings
Weight	LTS150 1.9 kg (4.8 lb) LTS300 2.5 kg (5.5 lb)

B.2 Motor Specifications

Parameter	Value
Step Angle	1.8°
Step Accuracy	5%
Rated Phase Current	0.85 A
Phase Resistance	5.4 Ohms
Phase Inductance	5.6 mH
Holding Torque	20 N.cm
Detent Torque	2.0 N.cm
Operating Temperature	-20°C to +40°C (Motor Specification Only

B.3 Parts List

Part Number	Description
LTS150 and LTS150/M	Long Travel Stage with 150 mm travel
LTS300 and LTS300/M	Long Travel Stage with 300 mm travel
LTSP1 and LTSP1/M	XY Mounting Adapter Plate
LTSP2 and LTSP2/M	Vertical (Z-axis) Mounting Plate for LTS150
LTSP3 and LTSP3/M	Vertical (Z-axis) Mounting Plate for LTS300
HA0203T	Handbook

Appendix C Stepper Motor Operation

C.1 How A Stepper Motor Works

C.1.1 General Principle

Thorlabs' actuators use a stepper motor to drive a precision lead screw.

Stepper motors operate using the principle of magnetic attraction and repulsion to convert digital pulses into mechanical shaft rotation. The amount of rotation achieved is directly proportional to the number of input pulses generated and the speed is proportional to the frequency of these pulses. A basic stepper motor has a permanent magnet and/or an iron rotor, together with a stator. The torque required to rotate the stepper motor is generated by switching (commutating) the current in the stator coils as illustrated in Fig. C.1.

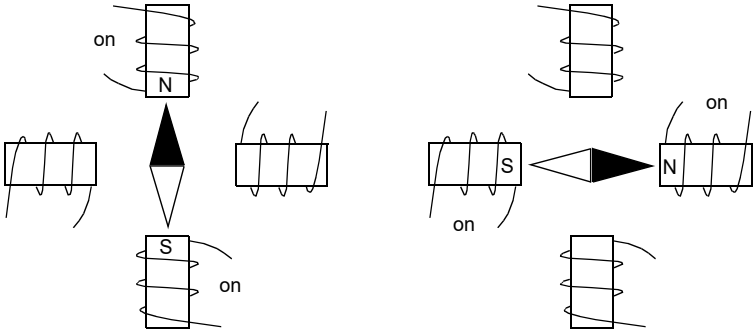


Fig. C.1 Simplified concept of stepper motor operation

Although only 4 stator poles are shown above, in reality there are numerous tooth-like poles on both the rotor and stator. The result is that positional increments (steps) of 1.8 degrees can be achieved by switching the coils (i.e. 200 steps per revolution). If the current through one coil is increased as it is decreased in another, the new rotor position is somewhere between the two coils and the step size is a defined fraction of a full step (microstep).

The size of the microstep depends on the resolution of the driver electronics. The integral driver of the LTS stages gives a smallest angular adjustment of 0.00088 degrees (i.e. 1.8/0.00088 = 2048 microsteps per full step), resulting in a resolution of 409,600 microsteps per revolution of the motor.

In practise, the mechanical resolution achieved by the system may be coarser than a single microstep, primarily because there may be a small difference between the orientation of the magnetic field generated by the stator and the orientation in which the rotor comes to rest.

C.1.2 Positive and Negative Moves

Positive and *negative* are used to describe the direction of a move. A positive move means a move from a smaller absolute position to a larger one, a negative move means the opposite.

In the case of a linear actuator, a positive move takes the platform of the stage further away from the motor.

In a rotational stage, a positive move turns the platform clockwise when viewed from above.

C.1.3 Velocity Profiles

To prevent the motor from stalling, it must be ramped up gradually to its maximum velocity. Certain limits to velocity and acceleration result from the torque and speed limits of the motor, and the inertia and friction of the parts it drives.

The system incorporates a trajectory generator, which performs calculations to determine the instantaneous position, velocity and acceleration of each axis at any given moment. During a motion profile, these values will change continuously. Once the move is complete, these parameters will then remain unchanged until the next move begins.

The specific move profile created by the system depends on several factors, such as the profile mode and profile parameters presently selected, and other conditions such as whether a motion stop has been requested. The profile mode can be set to 'Trapezoidal' or 'Bow Index' as described in Section 7.3.2.

The *Trapezoidal* profile is a standard, symmetrical acceleration/deceleration motion curve, in which the start velocity is always zero. This profile is selected when the *Bow Index* field is set to '0'.

In a typical trapezoidal velocity profile, (see Fig. C.2.), the stage is ramped at acceleration '*a*' to a maximum velocity '*v*'. As the destination is approached, the stage is decelerated at '*a*' so that the final position is approached slowly in a controlled manner.

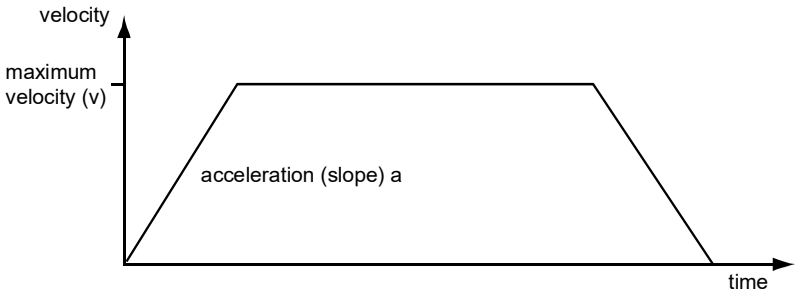


Fig. C.2 Graph of a trapezoidal velocity profile

The *S-curve* profile is a trapezoidal curve with an additional '*Bow Value*' parameter, which limits the rate of change of acceleration and smooths out the contours of the motion profile. The *Bow Value* is specified in mm/s^3 and is derived from the Bow Index field as follows:

The *Bow Value* is applied in mm/s^3 and is derived from the Bow Index field as follows:

Bow Value = 2 $^{(\text{Bow Index } -1)}$ within the range 1 to 262144 (Bow Index 1 to 18).

In this profile mode, the acceleration increases gradually from 0 to the specified acceleration value, then decreases at the same rate until it reaches 0 again at the specified velocity. The same sequence in reverse brings the axis to a stop at the programmed destination position.

Example

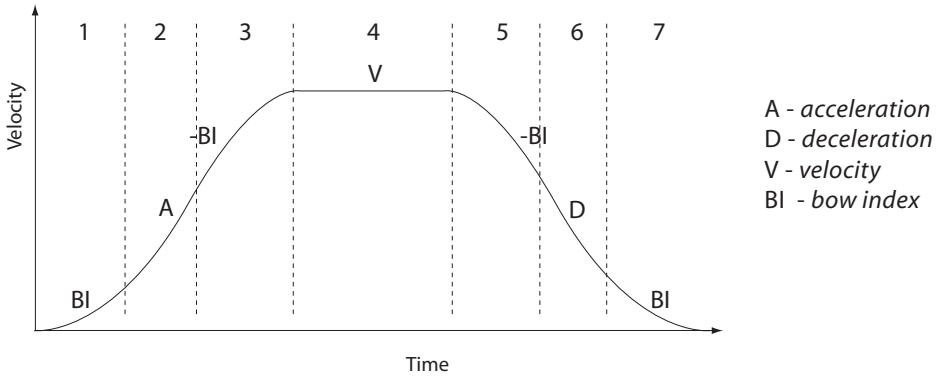


Fig. C.3 Typical S-Curve Profile

The figure above shows a typical S-curve profile. In segment (1), the S-curve profile drives the axis at the specified Bow Index (BI) until the maximum acceleration (A) is reached. The axis continues to accelerate linearly (Bow Index = 0) through segment (2). The profile then applies the negative value of Bow Index to reduce the acceleration to 0 during segment (3). The axis is now at the maximum velocity (V), at which it continues through segment (4). The profile then decelerates in a similar manner to the acceleration phase, using the Bow Index to reach the maximum deceleration (D) and then bring the axis to a stop at the destination.

Note

The higher the Bow Index, then the shorter the BI phases of the curve, and the steeper the acceleration and deceleration phases. High values of Bow Index may cause a move to overshoot.

Conversely, low values of Bow Index result in much shallower (longer duration) acceleration and deceleration curves. When these are combined with high velocities, the average power consumption increases and some heating may be apparent.

C.2 Positioning a Stage

C.2.1 General

Whenever a command is received to move a stage, the movement is specified in motion units, (e.g. millimetres). This motion unit value is converted to microsteps before it is sent to the stage. If operating the unit by the front panel (local mode) this conversion is performed internally by the controller. If operating via a PC (remote mode) then the conversion is performed by the software.

Each motor in the system has an associated electronic counter in the controller, which keeps a record of the net number of microsteps moved. If a request is received to report the position, the value of this counter is converted back into motion units.

C.2.2 Home position

When the system is powered up, the position counters in the controller are all set to zero and consequently, the system has no way of knowing the position of the stage in relation to any physical datum.

A datum can be established by sending all the motors to their 'Home' positions. The 'Home' position is set during manufacture and is determined by driving the motor until the negative limit switch is reached and then driving positively a fixed distance (zero offset). When at the Home position, the counters are reset to zero thereby establishing a fixed datum that can be found even after the system has been switched off.

See Section 6.3. for details on performing a Home move.

C.2.3 Limit Switches

A linear stage moves between two stops, and movement outside these limits is physically impossible. Linear stages can include stages that control the angle of a platform within a certain range, although the movement of the platform is not really linear but angular. Rotary stages can rotate indefinitely, like a wheel.

Linear and rotary stages both contain microswitches that detect certain positions of the stage, but they differ in the way these switches are used.

All linear stages have a –ve limit switch, to prevent the stage from accidentally being moved too far in the –ve direction. Once this switch is activated, movement stops. The switch also provides a physical datum used to find the Home position. Some linear stages and actuators also have a +ve limit switch , whereas others rely on a physical stop to halt the motion in the positive direction. A rotary stage has only one switch, used to provide a datum so that the Home position can be found.

Movement is allowed right through the switch position in either direction.

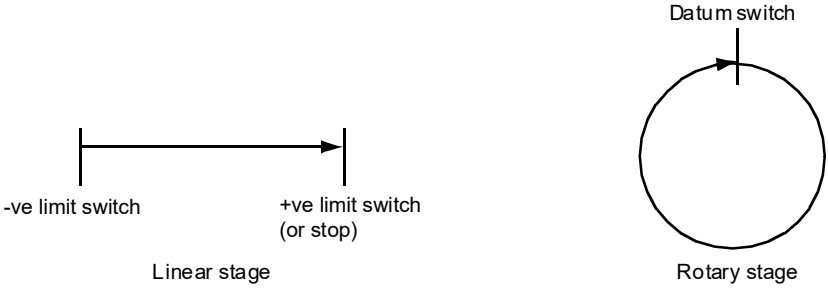


Fig. C.4 Stage limit switches

C.2.4 Minimum and Maximum Positions

These positions are dependent upon the stage or actuator to which the motors are fitted, and are defined as the minimum and maximum useful positions of the stage relative to the 'Home' position - see Fig. C.5.

The distance from the Minimum position to the Maximum position is the 'useful travel' of the stage. It is often the case that the Minimum position is zero. The Home and Minimum positions then coincide, with movement always occurring on the positive side of the Home position.

Rotary stages have effectively no limits of travel. The Minimum and Maximum positions are conventionally set to 0 and 360 degrees respectively. When the position of a rotary stage is requested, the answer will be reported as a number between 0 and 360 degrees, measured in the positive direction from the Home position.

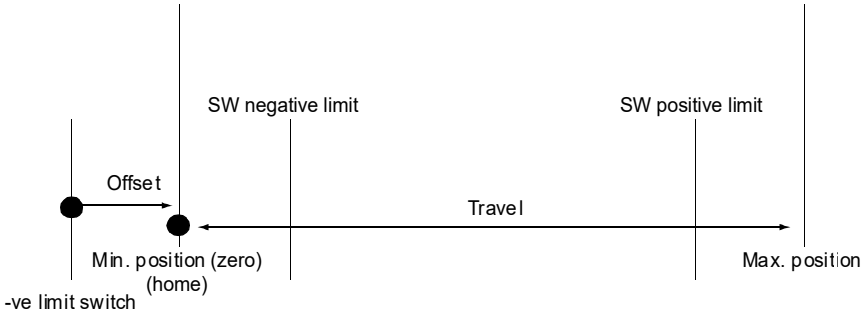


Fig. C.5 Minimum and Maximum Positions

C.2.5 Power Saving

The current needed to hold a motor in a fixed position is much smaller than the current needed to move it, and it is advantageous to reduce the current through a stationary motor in order to reduce heating. Although this heating does not harm the motor or stage, it is often undesirable because it can cause thermal movements through expansion of the metal of the stage.

For this reason, power saving is implemented by default from the software drivers.

When a motor is moving, the 'Move Power' is applied. When a motor is stationary, the 'Rest Power' is applied. See 'Phase Powers' in Section 7.3.5. for more details on these power settings.

C.3 Error Correction

C.3.1 Backlash correction

The term *backlash* refers to the tendency of the stage to reach a different position depending on the direction of approach.

Backlash can be overcome by always making the last portion of a move in the same direction, conventionally the positive direction. Consider the situation in Fig. 3.6, a *positive* move, from 10 to 20 mm, is carried out as one simple move, whereas a *negative* move, from 20 to 10 mm, first causes the stage to overshoot the target position and then move positively through a small amount.

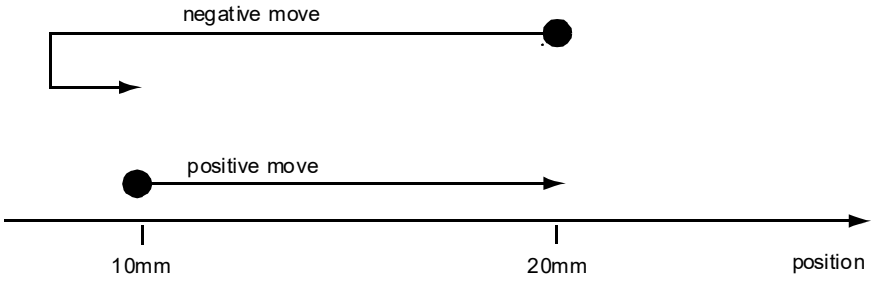


Fig. 3.6 Backlash correction

The controller has this type of 'backlash correction' enabled as its default mode of operation, but it can be overridden if the overshoot part of the move is unacceptable for a particular application.

See Section 7.3.2. for details on setting the backlash correction.

Appendix D Regulatory

D.1 Declarations Of Conformity

D.1.1 For Customers in Europe

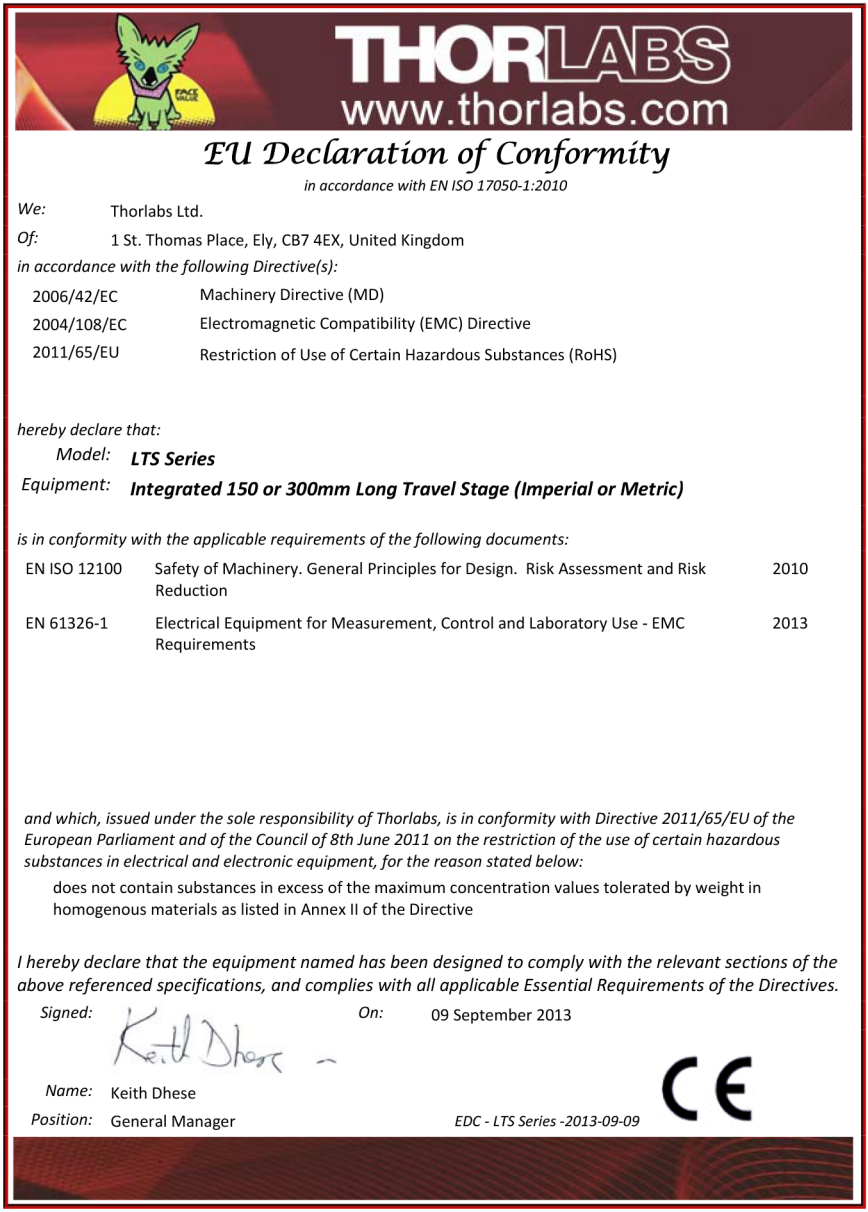
See Section D.2.

D.1.2 For Customers In The USA

This equipment has been tested and found to comply with the limits for a Class A digital device, persuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the company could void the user's authority to operate the equipment.

D.2 CE Certificate



THORLABS
www.thorlabs.com

EU Declaration of Conformity

in accordance with EN ISO 17050-1:2010

We: Thorlabs Ltd.

Of: 1 St. Thomas Place, Ely, CB7 4EX, United Kingdom

in accordance with the following Directive(s):

2006/42/EC	Machinery Directive (MD)
2004/108/EC	Electromagnetic Compatibility (EMC) Directive
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS)

hereby declare that:

Model: ***LTS Series***

Equipment: ***Integrated 150 or 300mm Long Travel Stage (Imperial or Metric)***

is in conformity with the applicable requirements of the following documents:

EN ISO 12100	Safety of Machinery. General Principles for Design. Risk Assessment and Risk Reduction	2010
EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013

and which, issued under the sole responsibility of Thorlabs, is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8th June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, for the reason stated below:

does not contain substances in excess of the maximum concentration values tolerated by weight in homogenous materials as listed in Annex II of the Directive

I hereby declare that the equipment named has been designed to comply with the relevant sections of the above referenced specifications, and complies with all applicable Essential Requirements of the Directives.

Signed: Keith Dhese *On:* 09 September 2013

Name: Keith Dhese

Position: General Manager

EDC - LTS Series -2013-09-09

CE

Chapter 5 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.



USA, Canada, and South America
Thorlabs, Inc.
sales@thorlabs.com
techsupport@thorlabs.com

UK and Ireland
Thorlabs Ltd.
sales@uk.thorlabs.com
techsupport.uk@thorlabs.com

Europe
Thorlabs GmbH
europe@thorlabs.com

Scandinavia
Thorlabs Sweden AB
scandinavia@thorlabs.com

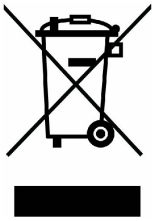
France
Thorlabs SAS
sales.fr@thorlabs.com

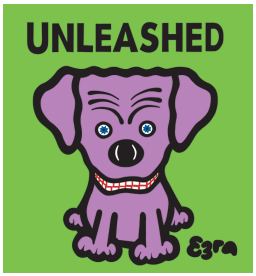
Brazil
Thorlabs Vendas de Fotônicos Ltda.
brasil@thorlabs.com

Japan
Thorlabs Japan, Inc.
sales@thorlabs.jp

China
Thorlabs China
chinasales@thorlabs.com

Thorlabs verifies our compliance with the WEEE (Waste Electrical and Electronic Equipment) directive of the European Community and the corresponding national laws. Accordingly, all end users in the EC may return "end of life" Annex I category electrical and electronic equipment sold after August 13, 2005 to Thorlabs, without incurring disposal charges. Eligible units are marked with the crossed out "wheelie bin" logo (see right), were sold to and are currently owned by a company or institute within the EC, and are not dissembled or contaminated. Contact Thorlabs for more information. Waste treatment is your own responsibility. "End of life" units must be returned to Thorlabs or handed to a company specializing in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.





THORLABS
www.thorlabs.com