KDC101
DC Servo Motor Driver

User Guide



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Chapter 1 Safety

1.1 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.

Shock Warning

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.

1.2 General Warnings

Warnings

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 absorbent tissue. Do not allow spilled fluid to enter the internal mechanism.

Caution

If your PC becomes unresponsive (e.g due to an operating system problem, entering a sleep state condition, or screen saver operation) for a prolonged period, this will interrupt communication between the Software and the hardware, and a communications error may be generated. To minimize the possibility of this happening it is strongly recommended that any such modes that result in prolonged unresponsiveness be disabled before the software is run. Please consult your system administrator or contact Thorlabs technical support for more details.

Chapter 2 Introduction and Overview

2.1 Introduction

The K-Cube® DC Servo Controller (KDC101) is a new very compact single channel controller/driver for easy manual and automatic control of DC Servo motors. This driver has been designed to operate with a variety of lower powered DC brushed motors (up to 15 V/2.5 W operation) equipped with encoder feedback. The KDC101 has been optimized for 'out of the box' operation with the Thorlabs range of Z9 DC motor equipped opto-mechanical products, however highly flexible software settings and closed loop tuning also supports operation with a wide range of third party DC Servo motors and associated stages/actuators.

Although compact in footprint, this unit offers a fully featured motion control capability including velocity profile settings, limit switch handling, “on the fly” changes in motor speed and direction, control over the closed loop PID parameters and, for more advanced operation, adjustment of settings such as lead screw pitch and gearbox ratio, allowing support for many different actuator configurations.

For convenience the footprint of this unit has been kept to a minimum, measuring only 60 x 60 x 47mm (2.36" x 2.36" x 1.85") and with the facility to directly mount to the optical table close to the motorized device - convenient when manually adjusting motor positions using the top panel controls (velocity control wheel). Table top operation also allows minimal drive cable lengths for easier cable management.



Fig. 2.1 K-Cube DC Servo Motor Driver

USB connectivity provides easy 'Plug and Play' PC controlled operation - multiple units can be connected to a single PC via standard USB hub technology or by using

the new K-Cube Controller Hub (see Section 2.2) for multi-axis motion control applications. Coupling this with one of our user friendly software applications allows the user to get up and running with complex move sequences in a short time. For example, all relevant operating parameters are set automatically by the software for Thorlabs stages and actuators. Advanced custom motion control applications and sequences are also possible using the extensive ActiveX® programming environment also supplied. This programming library is compatible with many development tools such as LabVIEW, Visual Basic, Visual C++, C++ Builder, LabWindows/CVI, MATLAB and Delphi.

The KDC101 DC Servo Controller can be operated from the front panel (see Chapter 4) or from a PC (see Chapter 5). It is fully compatible with Thorlabs' Kinesis® and XA software applications. This manual describes the use of the KDC101 controller with Thorlabs' Kinesis software. For more information about operation using Thorlabs' XA software please refer to the XA User Guide.

2.2 Power Supply Options

A single wall plug supply KPS201* for powering a single K-Cube Driver is available.

*The previous-generation KPS101 power supply is also compatible and can be used to power a single K-Cube Driver.

For multiple cube systems, a 3-channel (KEH3) or 6-channel (KEH6) K-Cube Controller Hub are offered. Previous generation 3- and 6-channel controllers (KCH301 and KCH601, respectively) may also be used, but are no longer available for individual purchase. These products have been designed specifically with multiple K-Cube operation in mind in order to simplify issues such as cable management, power supply routing, multiple USB device communications and different optical table mounting scenarios.

The K-Cube Controller Hub comprises a slim base-plate type carrier with electrical connections located on the upper surface to accept the K-Cubes.

Internally the Controller Hub contains a fully compliant USB 2.0 hub circuit to provide communications for all K-Cubes – a single USB connection to the Controller Hub is all that is required for PC control. The Controller Hub also provides power distribution for the K-Cubes, requiring only a single power connection.

2.3 Kinesis PC Software Overview

The KDC101 DC Servo Controller is fully compatible with Thorlabs' Kinesis and XA software applications. The remainder of this manual describes the use of the controller with Kinesis software. For information about operation using Thorlabs' XA software, please refer the XA User Guide.

2.3.1 Introduction

The K-Cube range of controllers share many of the benefits. 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. It is this Kinesis server 'engine' that is used by software developers to allow the creation of advanced automated positioning applications very rapidly and with great ease. The Kinesis server is described in more detail in Section 2.3.2

Caution

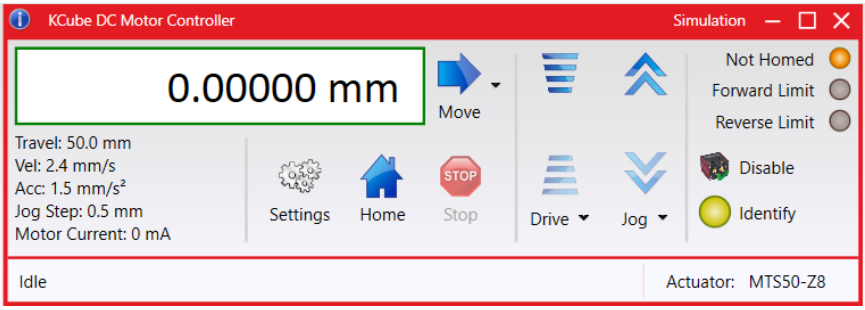
On start up, wait until the top panel display has stopped flashing before running the Kinesis software.

2.3.2 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 Stepper Driver K-Cube. 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 .Net Control supplied for the K-Cube DC driver unit.



This Control provides a complete user graphical instrument panel to allow the motor unit 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 stepper motor Control to move a motor, 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 system online help or the handbooks associated with the controllers.

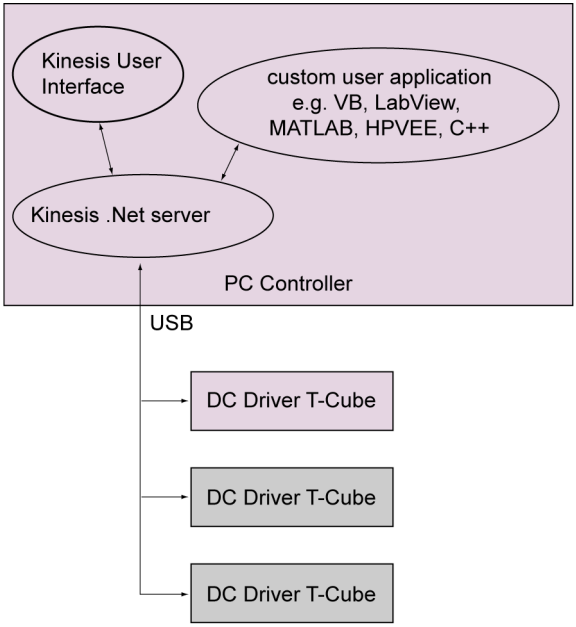


Fig. 2.2 System Architecture Diagram

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.

2.3.3 Software Upgrades

Thorlabs operate a policy of continuous product development and may issue software upgrades as necessary for bug fixes and support for new features. We recommend all users to download the latest version of Kinesis software and use the included firmware update utility. Failure to do this could result in stages not being recognized by the latest controllers.

Chapter 3 Getting Started

3.1 Install the Software

Caution

If your PC becomes unresponsive (e.g due to an operating system problem, entering a sleep state condition, or screen saver operation) for a prolonged period, this will interrupt communication between the Kinesis Software and the hardware, and a communications error may be generated. To minimize the possibility of this happening it is strongly recommended that any such modes that result in prolonged unresponsiveness be disabled before the Kinesis software is run. Please consult your system administrator or contact Thorlabs technical support for more details.

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.

3.2 Mechanical Installation

3.2.1 Environmental Conditions

Warning

Operation outside the following environmental limits may adversely affect operator safety.

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.

3.2.2 Mounting Options

The K-Cube DC Driver is shipped with a baseplate, for use when fitting the unit to a breadboard, optical table or similar surface.

For multiple cube systems, a 3-channel (KEH3) or 6-channel (KEH6) K-Cube Controller Hub are offered. Previous generation 3- and 6-channel controllers (KCH301 and KCH601, respectively) may also be used, but are no longer available for individual purchase. See Section 2.2 for further details. Full instructions on the fitting and use of the controller hub are contained in the handbook available at www.thorlabs.com

Caution

When siting the unit, it should be positioned so as not to impede the operation of the controls on the top panel.

3.2.3 Using the Baseplate

The baseplate must be bolted to the worksurface before the K-Cube is fitted, as shown below. The K-cube is then located on two dowels in the baseplate and secured by two clips.

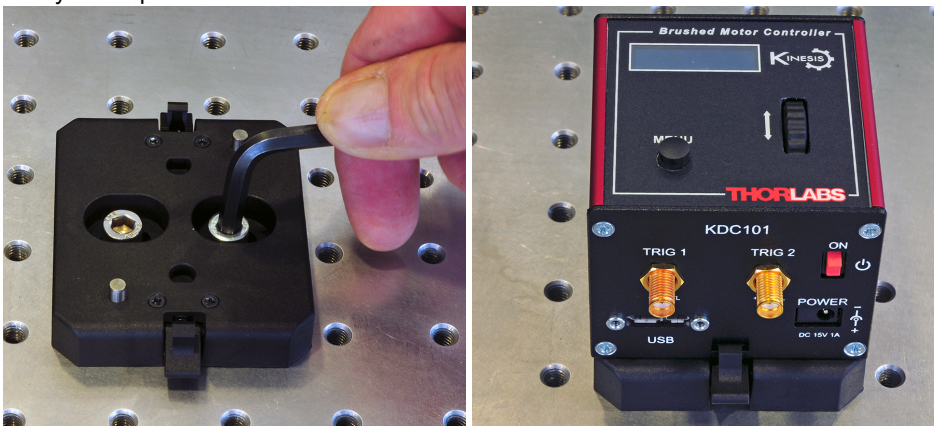


Fig. 3.1 Using The Baseplate

3.3 Electrical Installation

3.3.1 Rear Panel

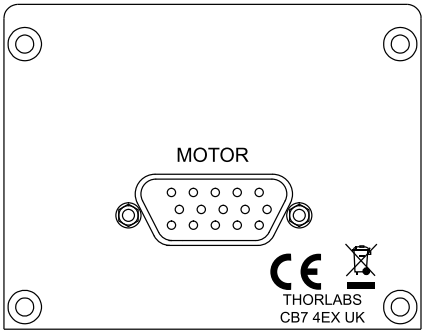


Fig. 3.2 Rear Panel Connections

The unit is supplied with a 15 pin D-type connector as shown above, which is compatible with all new Thorlabs DC servo motor actuators (refer to Appendix G for details of pin outs).

Caution

DO NOT connect a motor actuator while the K-Cube is powered up.

Only use motor drive cables supplied by Thorlabs, other cables may have incompatible wiring.

3.3.2 Front Panel

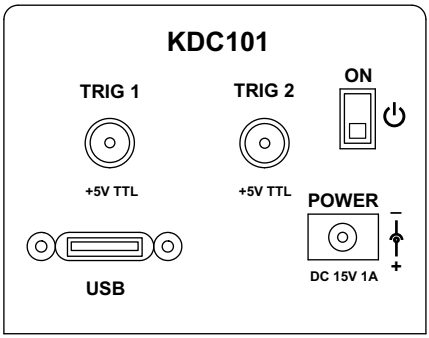


Fig. 3.3 Front Panel Connections

Shock Warning

The unit must be connected only to a DC supply of 15V, 1A regulated. Connection to a supply of a different rating may cause damage to the unit and could result in injury to the operator.

POWER - A Standard 3.5 mm front panel jack connector for connecting the unit to a regulated DC power supply of 15 V, 1A - 2.66A.

A single way wall plug KPS201* supply for powering a single Driver K-Cube is available.

*The previous-generation KPS101 power supply is also compatible.

USB - USB port for system communications.

Note

The USB cable length should be no more than 3 metres unless a powered USB hub is being used.

ON - Power ON/Standby switch. When in the ON position, the unit is fully powered up. When the switch is turned to the Standby position, the unit initiates a controlled power down sequence, saving all user-adjustable parameters to non-volatile memory before turning off the power. For the first few seconds, the shutdown can be cancelled by turning the switch on again, in which case the unit will save the parameters but will remain powered up. In a powered down (Standby) state, the logic circuits are powered off and the unit will draw only a small quiescent current. The switch should always be used to power down the unit.

TRIG 1 and TRIG 2 - SMA connectors for use with external trigger input and output signals (5V TTL levels). The function is set to trigger IN or OUT via the settings panel - see Section 6.3.4

3.4 Connect the Hardware

1) Perform the mechanical installation as detailed in Section 3.2
2) Install the software.

Caution

During items (3) to (6) the instructions should be followed strictly in the order stated. Problems may occur if the process is not performed in the correct sequence. DO NOT connect a motor actuator while the K-Cube is powered up.

3) Connect the Controller 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 DC servo motor actuator to the Controller unit - see Section 3.3.1

Caution

During item (5) ensure the power supply unit is isolated from the mains before connecting to the K-Cube unit. Always power up the K-Cube unit by connecting its power supply to the mains. DO NOT connect the K-Cube unit to a 'live' external power supply. Doing so (i.e. "hot plugging") carries the risk of PERMANENT damage to the unit. Similarly, to power down the unit, disconnect the power suply from the mains before disconnecting the K-Cube unit.

5) Connect the Controller unit to the power supply - see Section 3.3.2
6) Connect the PSU to the main supply.
7) Switch 'ON' the unit using the switch on the front panel.

The unit takes about 5 seconds from power application until warm up is finished, during which time the following screens are displayed.

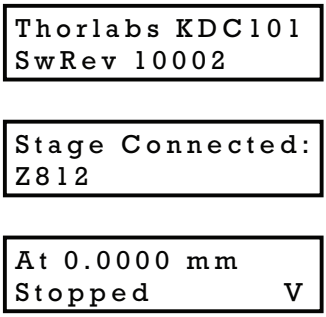


Fig. 3.4 Start Up Display

8) Windows® should detect the new hardware. Wait while Windows® installs the drivers for the new hardware.

Note

If any problems are encountered during the connection and power up process, power cycle the unit, which should clear the error.

3.5 Stage Identification

Most of the stages compatible with the KDC101 controller are fitted with an identification device. On power-up the KDC101 reads the stage identification and loads the correct operating parameters associated with the stage. When the controller is used with kinesis software, the type of stage is also reported to the GUI. However, some legacy stages are not fitted with an identification device. For correct operation these must be selected manually after power up.

If, on power-up, the controller is able to determine the type of the stage connected, it will load the operating parameters associated with that stage and the OLED display will show "Stage connected: <type of stage>", as shown in Fig. 3.4. In this scenario, no further action needs to be taken.

If, however, the stage is not fitted with an ID (e.g. Z925BV, CR1-Z7) the user can manually select the correct stage and persist the setting. To facilitate this, the OLED display menu contains a menu option called "Select stage". For stages that are not fitted with an ID resistor, the user needs to use the "Select stage" menu option and manually identify the stage connected to the controller - see Section 4.4.11 for further details. This only needs to be done once: on subsequent power-ups the controller will assume that the stage type has not changed, unless it detects a stage that is fitted with an ID resistor. To indicate that the stage type is assumed rather than identified, the OLED power-up display screen will show "Stage persisted: <stage type> (No ID)" to warn the user that the type of the stage is only assumed and may not be correct.

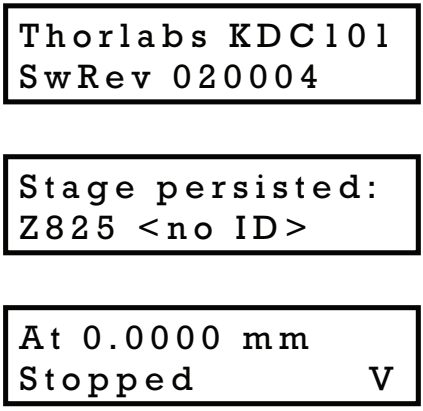


Fig. 3.5 Start Up Display - No Stage ID

3.6 Verifying Software Operation

3.6.1 Initial Setup

1) Ensure power is applied to the unit, then switch the unit ON using the switch on the front panel.
2) Wait until the power up sequence is complete, then run the Kinesis Software and check that the Graphical User Interface (GUI) panel appears and is active.

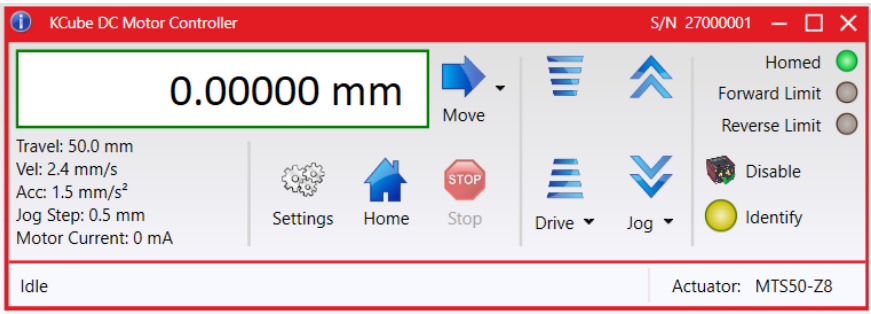


Fig. 3.6 Gui Panel Showing Jog and Ident buttons

3) Check that the actuator type is displayed in the GUI panel.
4) Click the 'Ident' button. The digital display on the top panel of the associated controller flashes. This is useful in multi-channel systems for identifying which channel is associated with which GUI.
5) Click the jog buttons on the GUI panel and check that the motor or axis connected to the DC Driver K-Cube moves. The position display for the associated GUI should increment and decrement accordingly.

Follow the tutorial steps described in Chapter 5 for further verification of operation.

Chapter 4 Standalone Operation

4.1 Introduction

The DC Driver K-Cube has been designed specifically to operate with the extensive range of Thorlabs DC motorized opto-mechanical products. The unit offers a fully featured motion control capability including velocity profile settings, limit switch handling, homing sequences and, for more advanced operation, adjustment of settings such as lead screw pitch and gearbox ratio, allowing support for many different actuator configurations. These parameters can be set via the Kinesis Server software - see Chapter 5. Furthermore, many of these parameters are automatically set to allow “out of the box” operation with no further “tuning” required.

The following brief overview explains how the front panel controls can be used to perform a typical series of motor moves. It is assumed that the unit has already been installed and configured for the particular actuator or stage to which it is associated - see Chapter 3 for more details.

4.2 Control Panel

4.2.1 Overview

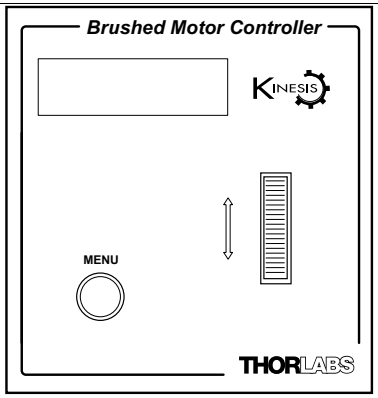


Fig. 4.1 Panel Controls and Indicators

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

Velocity Wheel - Used to drive the motor at a varying speed in either forward or reverse directions for full and easy motor control - see Section 4.3

Digital Display - The display shows the menu options and settings, accessed via the menu button - see Section 4.4 When the Ident button on the associated GUI panel is clicked, the display will flash for a short period.

MENU - used to access the settings menu - see Section 4.4 Also used to stop a move when the stage is in motion.

4.2.2 Digital Display - Operating Mode

During normal operation, the digital display shows the current position (in millimeters or degrees) and the current state of the motor (Stopped or Moving). If the stage being driven has been homed, the display will also show ‘Homed’.

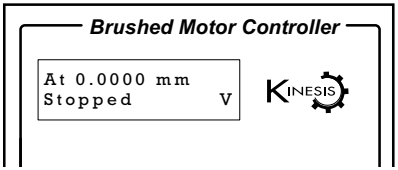


Fig. 4.2 Digital Display - Normal Operation

For rotation stages, the position display will be restricted to the "Equivalent Angle" display mode (see Section 6.3.6 for more details), so the position displayed will always be a positive number between 0 and 360 degrees. If set to Total Angle in the settings panel, the LED display will still show the equivalent 0 to 360° value but the GUI screen will show the total rotation.

4.3 Velocity Wheel Operation

The velocity wheel is a sprung potentiometer, such that when released it returns to it’s central position. In this central position the motor is stationary. Different types of move can be initiated by the wheel, depending on its mode setting. The mode can be set either via the GUI Settings panel, see Section 6.3.4 or via the top panel display menu, see Section 4.4 The various operating modes are described in Section 4.3.1 to Section 4.3.3

4.3.1 Homing

A ‘Home’ move is performed to establish a datum from which subsequent absolute position moves can be measured (see Section 5.3 and Section J.2.2 for further information on the home position).

To initiate a ‘Home’ see Section 4.4.3

4.3.2 Go to Position

In ‘Go To Position’ mode, two preset position values can be specified, such that the motor moves to position 1 when the wheel is moved down and to position 2 when it is moved up. These ‘taught’ positions can be set through the software GUI - see Section 6.3.4 or via the display menu, see Section 4.4.7

This mode of operation is enabled by setting the 'Wheel Mode' to 'Go To Position' through the software GUI - see Section 6.3.4 or via the display menu, see Section 4.4.5

Note for Rotation Stage Users

If the current absolute position is outside the 0 to 360 degree range, then "go to position" will result in a move to the correct angular position within the same 0..360 degree full turn "segment". This means that the move will always stay in the current full turn segment, and from this point of view it is not always the quickest position move. For example, if you are at 350 degrees and you enter a "go to" position of 10 degrees, the stage will rotate anticlockwise 340 degrees and not clockwise 20 degrees.

4.3.3 Jogging

The top panel wheel can also be configured to 'jog' the motor. This mode of operation is enabled by setting the 'Wheel Mode' parameter to 'Jogging' through the software GUI - see Section 6.3.4 or via the display menu, see Section 4.4.5

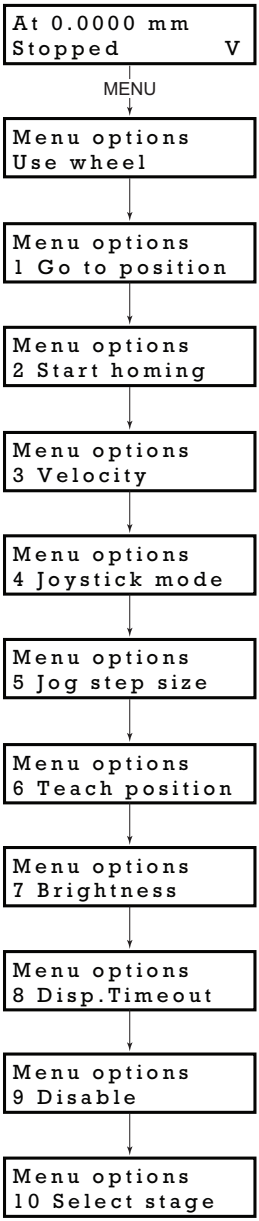
Once set to this mode, the jogging parameters for the wheel are taken from the 'Jog' parameters on the 'Move/Jogs' settings tab - see Section 6.3.2 or via the display menu, see Section 4.4.6

4.3.4 Velocity Moves

Lastly, the wheel can be used to initiate a move at a specified velocity. As the wheel is moved away from the centre, the motor begins to move. Bidirectional control of the motor is possible by moving the wheel in both directions. The speed of the motor increases by discrete amounts as a function of wheel deflection, up to a maximum as set in through the software GUI - see Section 6.3.4 or via the display menu, see Section 4.4.4 The move stops when the wheel is returned to its centre position.

4.4 Settings Menu

4.4.1 Overview



Press the MENU button

Use the wheel to scroll through the menu options
Press the MENU button to enter a particular option

Move the stage to an absolute position - see Section 4.4.2

Move the stage to the Home position - see Section 4.4.3

Set the Max Velocity - see Section 4.4.4

Set the joystick wheel mode - see Section 4.4.5

Set the Jog Step Size - see Section 4.4.6

Set the teach positions - see Section 4.4.7

Set the display brightness - see Section 4.4.8

Set the display timeout - see Section 4.4.9

Disable the wheel - see Section 4.4.10

Select the stage type connected - see Section 4.4.11

4.4.2 Menu Option - Go to position

This mode is used to move to an absolute position.

Press the MENU button, then use the wheel to scroll through the menu options.

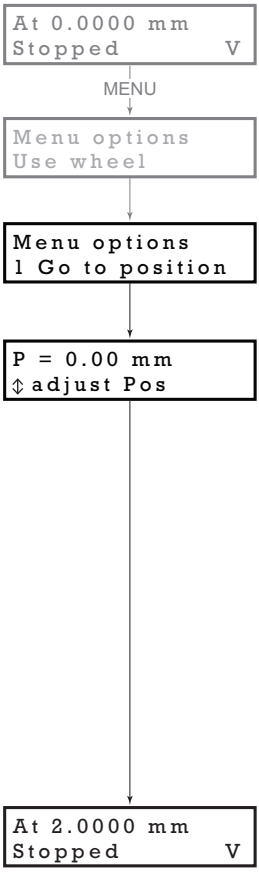
Press the MENU button to enter the Go to positions option.

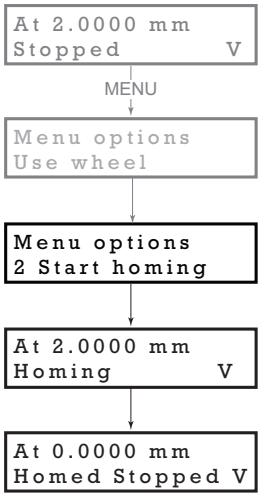
Use the wheel to adjust the position value, (within the travel range for linear stages, or 0 to 360 ° for rotation stages) then press the MENU button to store the selection.

Note for rotation stages. If the current absolute position is outside the 0 to 360 degree range, then "go to position" will result in a move to the correct angular position within the same 0..360 degree full turn "segment". This means that the move will always stay in the current full turn segment, and from this point of view it is not always the quickest position move. For example, if you are at 350 degrees and you enter a "go to" position of 10 degrees, the stage will rotate anticlockwise 340 degrees and not clockwise 20 degrees.

The stage moves to the position entered, and the display shows the change in position.

To stop the move, press the MENU button.





4.4.3 Menu Option - Start homing

This mode is used to home the stage.

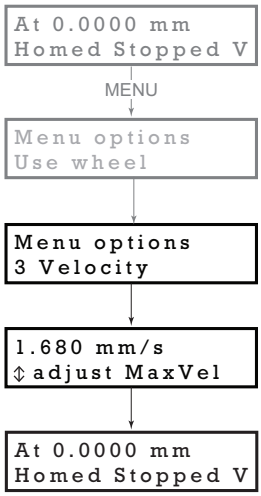
Press the MENU button, then use the wheel to scroll through the menu options.

Press the MENU button to enter the Start Homing option.

The display shows a decreasing position count while the stage is homing.

Once homing is complete, the display shows the position at 0.0000 mm and 'Homed' is displayed.

To stop the move, press the MENU button.



4.4.4 Menu Option - Velocity

This mode is used to move to set the max velocity.

Press the MENU button, then use the wheel to scroll through the menu options.

Press the MENU button to enter the Velocity option.

Use the wheel to adjust the max velocity, e.g. 0.168 mm/s, then press the MENU button to store the setting.

Subsequent moves will be performed at the velocity entered.

4.4.5 Menu Option - Joystick Mode

This mode is used to set the operating mode of the joystick wheel.

Press the MENU button, then use the wheel to scroll through the menu options

Press the MENU button to enter the Joystick mode option. Use the wheel to scroll through the options, then press MENU when the required option is displayed.

In *Velocity control mode*, deflecting the wheel starts a move with the velocity proportional to the deflection. The maximum velocity (i.e. velocity corresponding to the full deflection of the joystick wheel) is set in the preceding *3 Velocity* option. The move will stop when the wheel is released.

In *Jog to positions mode*, deflecting the wheel starts a move from the current position to one of the two predefined "teach" positions. The teach positions are specified in option *6 Teach Position*.

In *Jog in steps mode*, deflecting the wheel initiates a jog move, using the parameters specified by the *3 Velocity* and *5 Jog step size* options. Keeping the wheel deflected repeats the move automatically after the current move has completed.

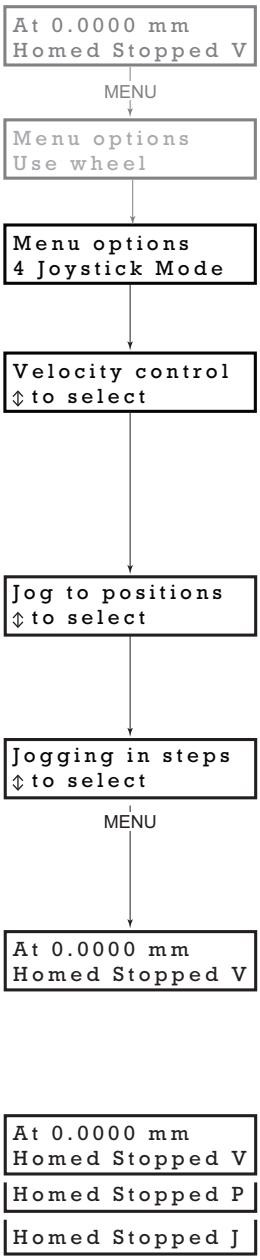
Use the wheel to display the required option, then press MENU to store the selection and return to the main display.

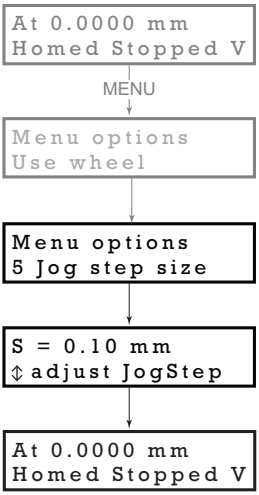
The selected mode is indicated at the right hand side of the bottom line:

V = Velocity mode

P = Jog to position mode

J = Jog in steps mode





4.4.6 Menu Option - Jog Step Size

This mode is used to set the jog step size.

Press the MENU button, then use the wheel to scroll through the menu options.

Press the MENU button to enter the Jog step size option.

Use the wheel to adjust the step size, e.g. 0.10 mm, then press the MENU button to store the selection.

When *Jog in steps* mode is selected in the *Joystick mode* option (see Section 4.4.5), subsequent moves will be performed at the step size entered.

4.4.7 Menu Option - Teach Position

This mode is used to set the teach positions, used when the *Joystick mode* option is set to *Jog to positions* mode - see Section 4.4.5

To set Teach Position 1...

Move the stage to the position to use as teach position 1.

Press the MENU button, then use the wheel to scroll through the menu options.

Press the MENU button to enter the Teach position option.

Use the wheel to select P1, then press the MENU button to store the current position as teach position 1 and return to the main display.

To set Teach Position 2...

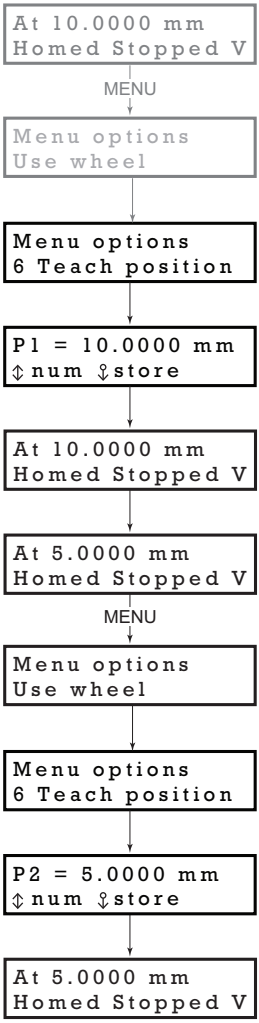
Move the stage to the position to use as teach position 2.

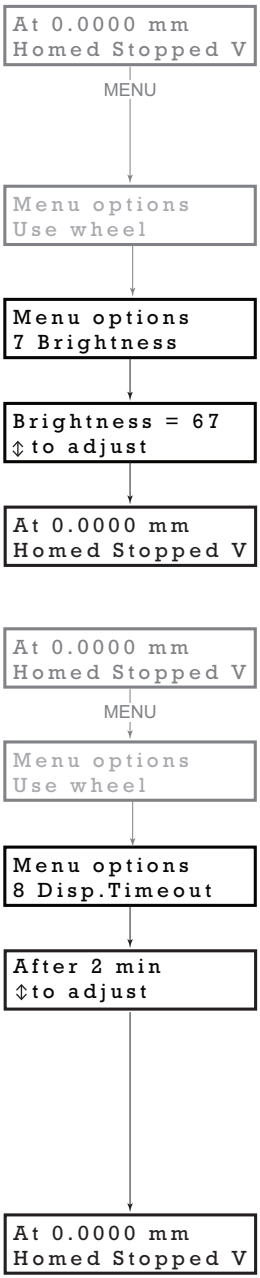
Press the MENU button, then use the wheel to scroll through the menu options.

Press the MENU button to enter the Teach position option.

Use the wheel to select P2, then press the MENU button to store the current position as teach position 2 and return to the main display.

When *Jog to position* mode is selected in the *Joystick mode* option (see Section 4.4.5), a downwards deflection of the wheel moves the stage to position 1, and an upwards deflection moves to position 2.





4.4.8 Menu Option - Brightness

In certain applications, it may be necessary to adjust the brightness of the LED display. The brightness is set as a value from 0 (Off) to 100 (brightest). The display can be turned off completely by entering a setting of zero, however, pressing the MENU button on the top panel will temporarily illuminate the display at its lowest brightness setting to allow adjustments. When the display returns to its default position display mode, it will turn off again.

Press the MENU button, then use the wheel to scroll through the menu options.

Press the MENU button to enter the Brightness option.

Use the wheel to adjust the brightness, then press the MENU button to store the selection and return to the main display.

4.4.9 Menu Option - Disp.Timeout

'Burn In' of the display can occur if it remains static for a long time. To prevent this, the display is automatically dimmed after a specified time interval.

Press the MENU button, then use the wheel to scroll through the menu options.

Press the MENU button to enter the Disp.Timeout option.

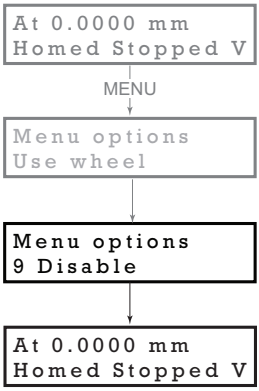
The time out interval is specified in minutes in the range 1 to 480. The adjustment is done in steps of 1 minute if the timeout is between 1 to 10 minutes, 10 minute steps between 10 minutes and 1 hour, and 30 minute steps above, up to a maximum of 480 minutes. After 480 minutes there is an option for Never.

The dim level can only be adjusted via the Settings panel - see Section 6.3.4

Press the MENU button to store the selection and return to the main display.

4.4.10 Menu Option - Disable

In certain applications, it may be advantageous to disable the wheel to remove the possibility of unwanted motion due to accidental movement of the wheel.



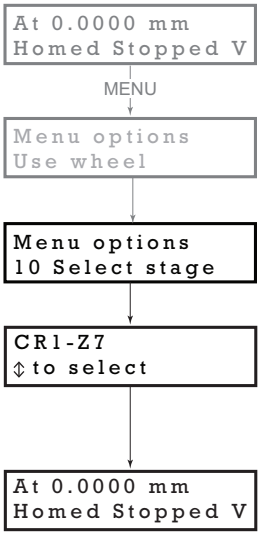
Press the MENU button, then use the wheel to scroll through the menu options.

Press the MENU button to enter the Disable option.

Press the MENU button to store the selection and return to the main display.

4.4.11 Menu Option - Select Stage

Most of the stages compatible with the KDC101 controller are fitted with an identification device. On power-up the KDC101 reads the stage identification and loads the correct operating parameters associated with the stage. However, some legacy stages are not fitted with an identification device. For correct operation these must be selected manually after power up.



Press the MENU button, then use the wheel to scroll through the menu options.

Press the MENU button to enter the Select stage option.

Use the wheel to scroll to the required option:

CR1-Z7, Z806, Z812, Z825, Z906, Z912, Z925, MTS50-Z8, MTS25-Z8, MTS50-Z9, MTS25-Z9, PRM1-Z8, PRM1-Z9, CR1-Z6, Z625, Z612 and Z606.

Press MENU to store the selection and return to the main display.

Chapter 5 PC Operation - Tutorial

5.1 Introduction

The following brief tutorial guides the user through a typical series of moves and parameter adjustments performed using the PC based software. It assumes that the unit is electrically connected as shown in Section 3.3.1 and that the software is already installed - see Section 3.1 For illustration purposes, it also assumes that a Z925B motor is connected to the 'Motor' connector on the rear panel.

Caution

If your PC becomes unresponsive (e.g due to an operating system problem, entering a sleep state condition, or screen saver operation) for a prolonged period, this will interrupt communication between the Kinesis Software and the hardware, and a communications error may be generated. To minimize the possibility of this happening it is strongly recommended that any such modes that result in prolonged unresponsiveness be disabled before the Kinesis software is run. Please consult your system administrator or contact Thorlabs technical support for more details.

Caution

On start up, wait until the top panel POWER led is lit bright green before running the Kinesis software.

For information about operation using Thorlabs' XA software, please refer the XA User Guide.

5.2 Using the Kinesis Software

Caution

Thorlabs often releases updated firmware for bug fixes and support for new features. We recommend all users to download the latest version of Kinesis software and use the included firmware update utility. Failure to do this could result in stages not being recognized by the latest controllers.

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.

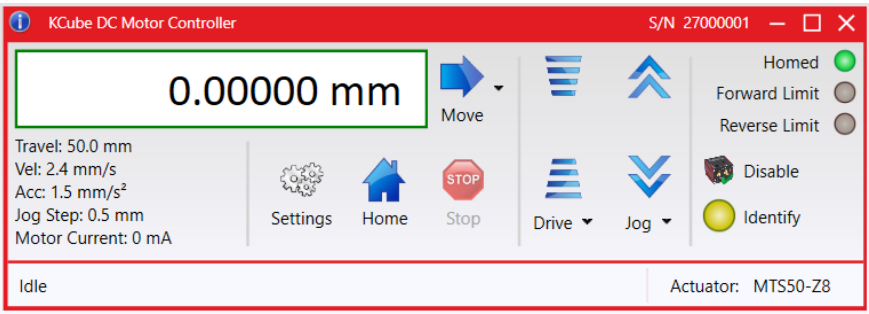


Fig. 5.1 Typical User Screen

Caution

On start up, wait until the top panel display has stopped flashing before running the software.

1) Power up the hardware, and wait until the display has stopped flashing, then run the Kinesis software - Start/All Programs/Thorlabs/Kinesis/Kinesis.
2) Notice how the actuator type, associated automatically in at start up is displayed in the 'Settings' window. See Section 5.8 and Section 6.3 for further details on the parameter values shown in the 'Settings' display.

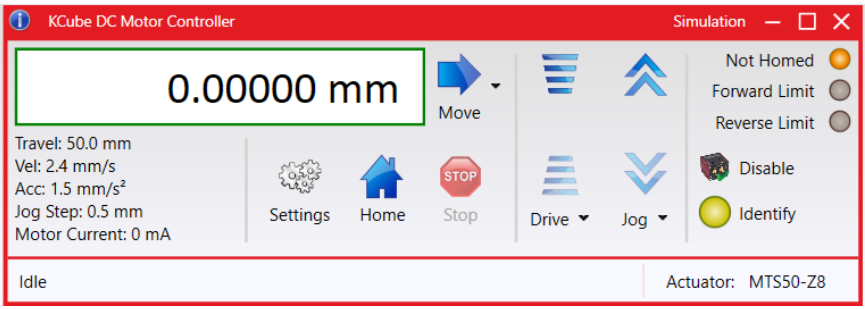


Fig. 5.2 DC Driver K-CubeSoftware GUI

5.3 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.

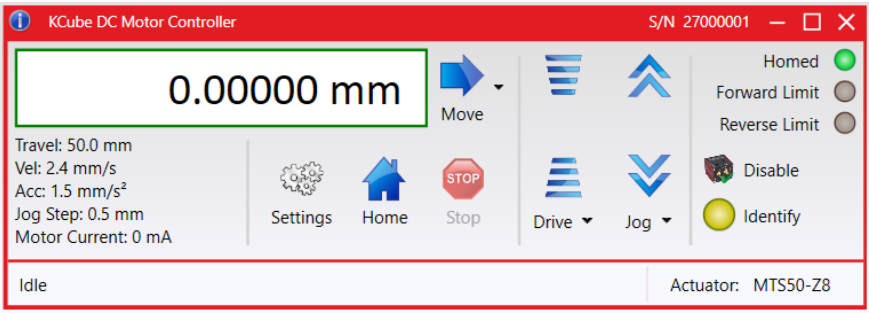


Fig. 5.3 DC Driver K-Cube Software GUI

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 000.000, i.e the home position.

Note

After homing, shaft relaxation may cause a small position offset to be displayed. This relates only to one or two encoder counts and is not significant in terms of 'real world' positioning.

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

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

5.4 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 J , Section J.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.

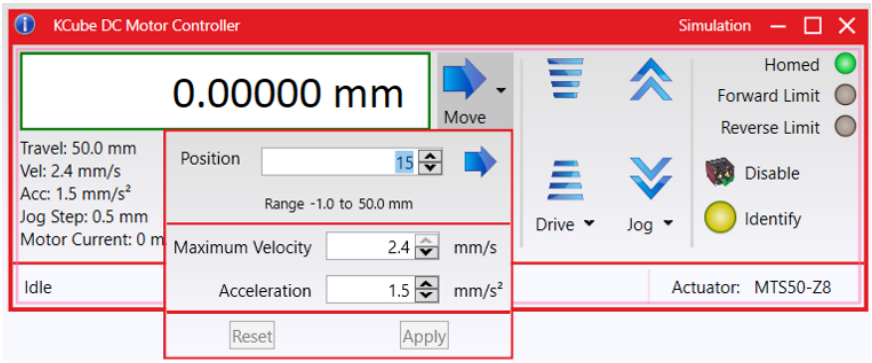


Fig. 5.4 Move Settings Panel

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.

5.5 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. 6.3. 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 'Settings' button to display the Settings panel.

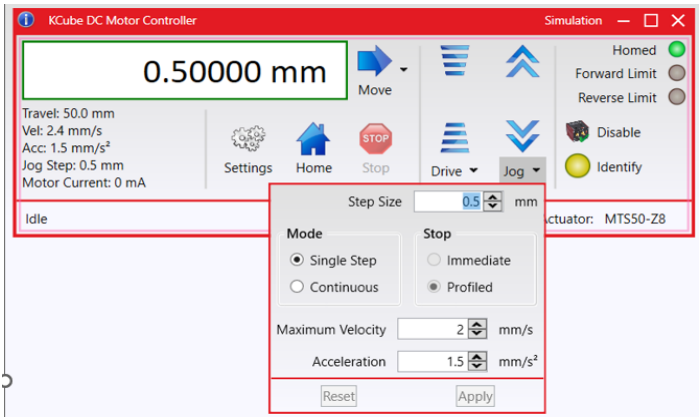


Fig. 5.5 Settings Panel - Move/Jogs Tab

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.

5.6 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*.

5.7 Changing and Saving Parameter Settings

During operation, certain settings (e.g. move 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/actuator association made, suitable default settings are loaded and these values have been chosen to proved 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.

5.8 Stage/Axis Tab

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

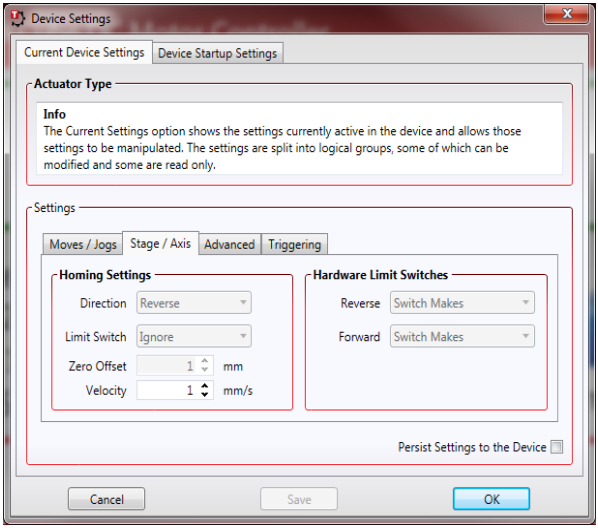


Fig. 5.6 Stage/Axis Tab

These parameters were set automatically when the server automatically applied suitable defaults during boot up. These parameters should not be altered for pre-defined Thorlabs stages and actuators, as it may adversely affect the performance of the stage.

For third party stage types not available using the software, these stage details must be entered manually.

Individual parameters are described in Section 6.3

Chapter 6 Software Reference

6.1 Introduction

This chapter gives an explanation of the parameters and settings accessed from the Kinesis software running on a PC. For information on the methods and properties which can be called via a programming interface, see Appendix J .

6.2 GUI Panel

The following screen shot shows the graphical user interface (GUI) displayed when accessing the DC Driver K-Cube using the Kinesis software.

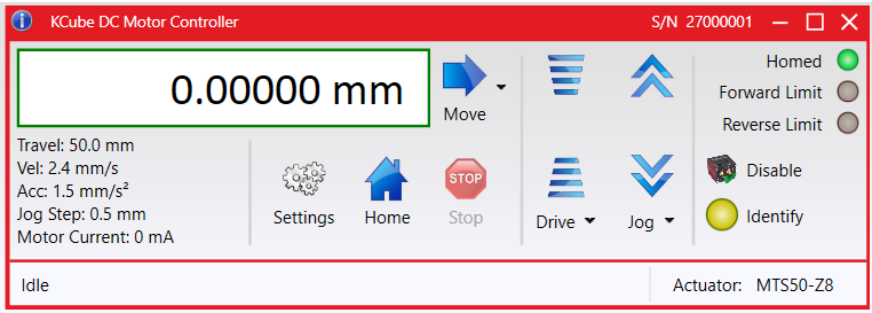


Fig. 6.1 DC Driver K-Cube Software GUI

Note

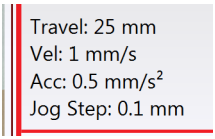
The serial number of the Stepper Driver K-Cube associated with the GUI panel is displayed in the top right hand corner. This information should always be provided when requesting customer support.



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).

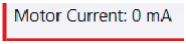


Move - Opens the settings window, so that position data and velocity parameters can be entered - see Section 5.4 Moves are performed using the current velocity parameters which can be changed in the same panel. The present settings are displayed below the window.

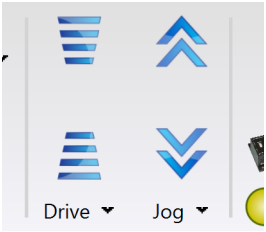


Velocity Parameters - the present setting for the move velocity parameters and the jog step size. The travel range of the associated stage/actuator is also displayed.

These settings can be adjusted as described previously, or by clicking the Settings button to display the settings window, see Section 6.3.2



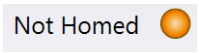
Motor Current - Displays the current being sent to the motor.



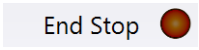
Jog Controls - used to increment or decrement the motor position. The controls comprise a bar graph and a set of jog arrows.

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.

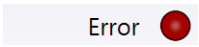
When the arrows are clicked, the motor is driven in the selected direction at the jog velocity, one step per click. The step size and jog velocity parameters can be changed by clicking 'Jog' or the small down arrow to display the settings panel.



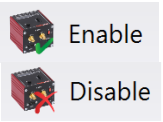
Homed/Not Homed - Lit when the motor has not been 'Homed' since power up. When the home button is clicked, the caption changes to 'Homed' and the LED flashes while the home move is being performed. The LED is lit green once the move is complete.



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



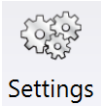
Error - Lit when a fault condition occurs.



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 6.3

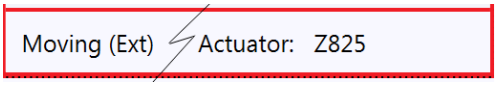
Home - Sends the motor to its 'Home' position - see Appendix J Section J.2.2



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.

6.2.1 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)

6.3 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 accessible through the functions on this Control (refer to the *Kinesis API helpfile* for further details).

6.3.1 Persisting Settings to Hardware

Many of the parameters that can be set for the Stepper Driver K-Cube 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 the Kinesis software, the default settings will be loaded at boot up, even if the 'Persist Settings' option has been checked.

6.3.2 Moves/Jogs Tab

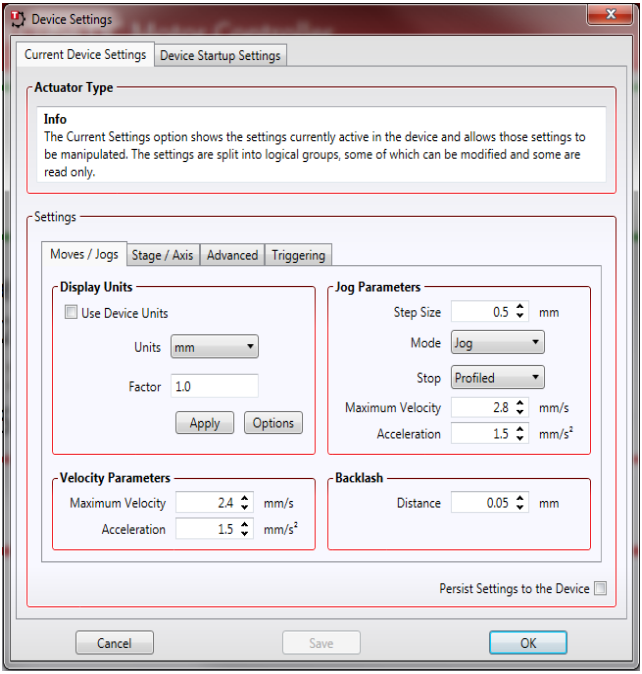


Fig. 6.2 DC Driver K-Cube - Move/Jog Settings

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). If *Use Device Units* is checked, then the GUI will display in device units.

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 5.5), or the Velocity Wheel on the top 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. top panel wheel is turned 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. 6.3. In 'Continuous' mode, the motor actuator will accelerate and move at the jog velocity while the button is held down.

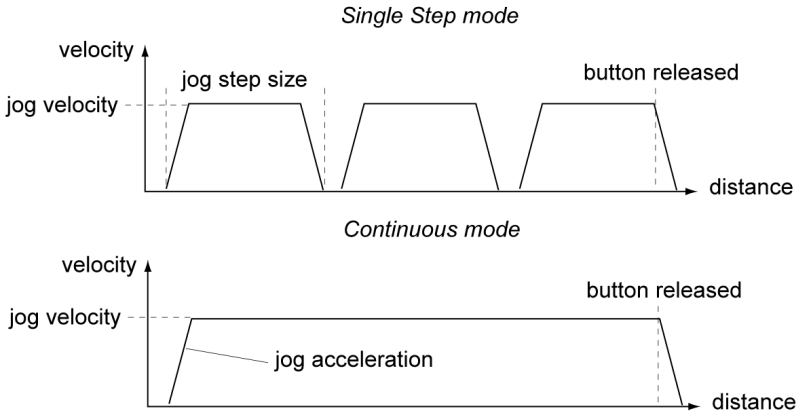


Fig. 6.3 Jog Modes

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 5.4), or by calling a software function (see the *Kinesis API 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.

6.3.3 Stage/Axis Tab

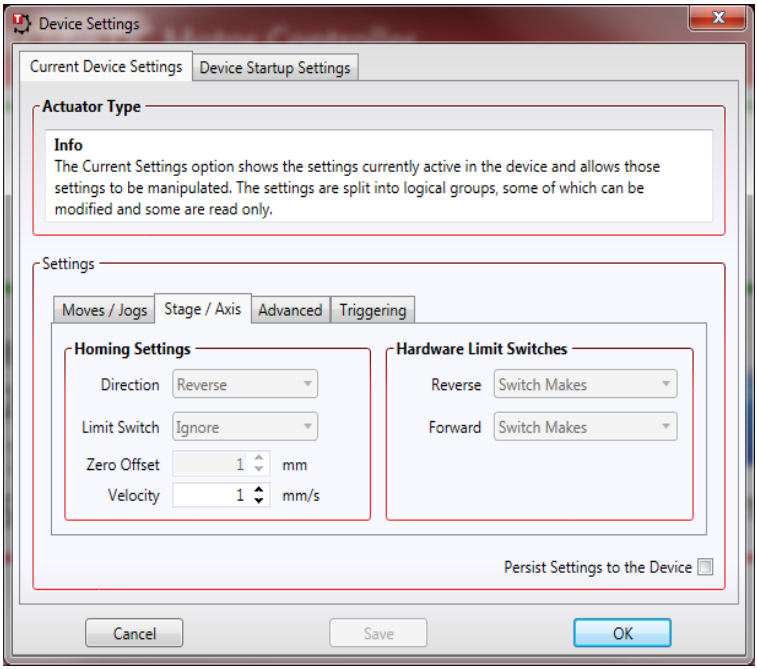


Fig. 6.4 DC Driver K-Cube - Stage/Axis Settings

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 Thorlabs stages, the Kinesis software will automatically apply suitable defaults for the parameters on this tab during boot up of the software and these parameters cannot 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.

Home 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 to move when homing, either *Forward* or *Reverse*.

Limit Switch - The hardware limit switch associated with the home position, either *Forward HW or Reverse HW*.

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 J.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 Rev Switch or Fwd Switch 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.

6.3.4 Advanced Tab

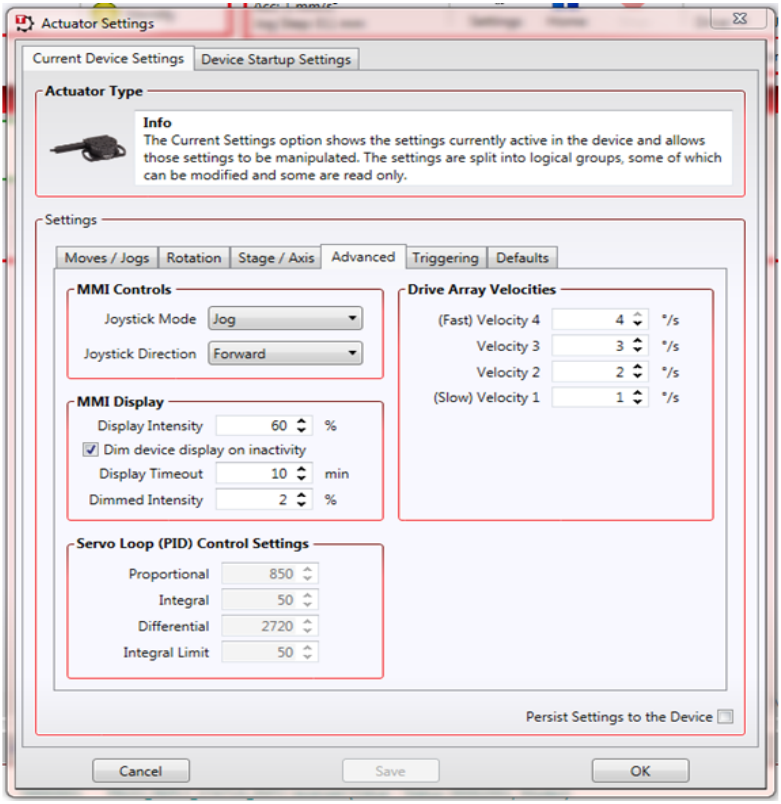


Fig. 6.5 DC Driver K-Cube - Advanced Settings

MMI Controls

The velocity wheel is sprung such that when released it returns to it's central position. In this central position the motor is stationary. As the wheel is moved away from the center, the motor begins to move; the speed of this movement increases as the wheel deflection is increased. Bidirectional control of motor moves is possible by moving the wheel in both directions.

Joystick Mode

Velocity Control - Deflecting the wheel starts a move with the velocity proportional to the deflection. The maximum velocity (i.e. velocity corresponding to the full deflection of the joystick wheel) and acceleration are set in the *Max Wheel Vel.* and *Wheel Accn.* parameters.

Jog - Deflecting the wheel initiates a jog move, using the parameters specified by the Move/Jogs tab. Keeping the wheel deflected repeats the move automatically after the current move has completed.

Move To Position - Deflecting the wheel starts a move from the current position to one of the two predefined "teach" positions. The teach positions are specified in the *Preset Position 1* and *Preset Position 2* parameters, and are measured in number of steps from the home position.

Joystick Direction

The direction of a move initiated by the velocity wheel is specified as follows:

Forwards - Upwards rotation of the wheel results in a positive motion (i.e. increased position count).

Note. The following option applies only when the Wheel Mode is set to Velocity Control. If set to Position Jogging or Go to Position Mode, the following option is ignored.

Backwards - Upwards rotation of the wheel results in a negative motion (i.e. decreased position count).

MMI Display

In certain applications, it may be necessary to adjust the brightness of the LED display on the top of the unit. The brightness is set in the *Display Intensity* parameter, as a value from 0 (Off) to 100 (brightest). The display can be turned off completely by entering a setting of zero, however, pressing the MENU button on the top panel will temporarily illuminate the display at its lowest brightness setting to allow adjustments. When the display returns to its default position display mode, it will turn off again.

Furthermore, 'Burn In' of the display can occur if it remains static for a long time. To prevent this, the display is automatically dimmed after the time interval specified in the *Display Timeout* parameter has elapsed. The time interval is specified in minutes in the range 1 to 480. The dim level is set in the *Dimmed Intensity* parameter, as a percentage of full brightness from 0 (Off) to 10 (brightest) but is also limited by the *Display Intensity* parameter if this is lower. These settings are only visible and active if the *Dim device display on inactivity* box is checked.

Servo Loop (PID) Control Settings

The DC Driver K-Cube implements a full servo control loop for motor velocity and position control. The loop response to demanded position moves is determined via Proportional, Integration and Derivative settings. These settings can be altered using the 'Servo Loop (PID) Control Settings' parameters.

Proportional – This parameter makes a change to the output which is proportional to the positional error value. A high proportional gain results in a large change in the output for a given error. It accepts values in the range 0 to 32767.

Integral – This parameter accelerates the process towards the demanded position, ensuring that the positional error is eventually reduced to zero. If set too high, the output can overshoot the demand value. Under a constant torque loading, the static position error is zero. It accepts values in the range 0 to 32767.

Derivative – This term provides the 'damping' force proportional to the rate of change of the position error, thereby decreasing the overshoot which may be caused by the integral term. However, the differential term also slows down system response.

It accepts values in the range 0 to 32767.

Integral Limit – This term sets a maximum limit for the integration term to prevent an excessive build up over time of the restoring force. It accepts values in the range 0 to 32767.

Note

The default values programmed into the Kinesis software will give acceptable motor performance in most cases. These PID parameters are set according to the stage or actuator type associated with the driver.

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.

6.3.5 Triggering Tab

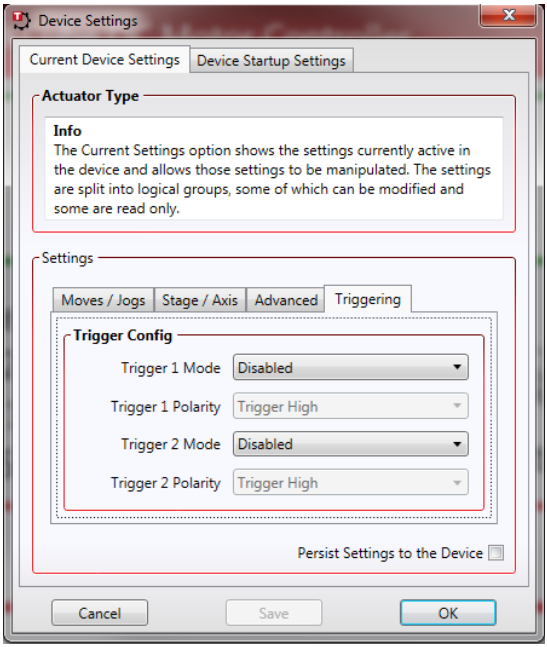


Fig. 6.6 Stepper Driver K-Cube - Triggering Settings

Triggering Introduction

The K-Cube motor controllers have two bidirectional trigger ports (TRIG1 and TRIG2) that can be used to read an external logic signal or output a logic level to control external equipment. Either of them can be independently configured as an input or an output and the active logic state can be selected High or Low to suit the requirements of the application. Electrically the ports output 5 Volt logic signals and are designed to be driven from a 5 Volt logic.

When the port is used in the input mode, the logic levels are TTL compatible, i.e. a voltage level less than 0.8 Volt will be recognized as a logic LOW and a level greater than 2.4 Volt as a logic HIGH. The input contains a weak pull-up, so the state of the input with nothing connected will default to a logic HIGH. The weak pull-up feature allows a passive device, such as a mechanical switch to be connected directly to the input.

When the port is used as an output it provides a push-pull drive of 5 Volts, with the maximum current limited to approximately 8 mA. The current limit prevents damage when the output is accidentally shorted to ground or driven to the opposite logic state by external circuity.

Warning: do not drive the TRIG ports from any voltage source that can produce an output in excess of the normal 0 to 5 Volt logic level range. In any case the voltage at the TRIG ports must be limited to -0.25 to +5.25 Volts.

Input Trigger Modes

When configured as an input, the TRIG ports can be used as a general purpose digital input, or for triggering a relative, absolute or home move. When used for triggering a move, the port is edge sensitive. In other words, it has to see a transition from the inactive to the active logic state (Low->High or High->Low) for the trigger input to be recognized. For the same reason a sustained logic level will not trigger repeated moves. The trigger input has to return to its inactive state first in order to start the next trigger. The mode is set in the *Trig 1 Mode* and *Trig 2 Mode* parameters as follows:

Disabled - The trigger IO is disabled

IN - GPI - General purpose logic input (read through status bits using the LLGetStatusBits method).

IN - Relative Move - Input trigger for relative move.

IN - Absolute Move - Input trigger for absolute move.

IN - Home - Input trigger for home move.

Output Trigger Modes

When the *Trigger 1 Mode* and *Trigger 2 Mode* parameters are configured as outputs, the TRIG ports can be used as a general purpose digital output, or to indicate motion status or to produce a trigger pulse at configurable positions as follows:

OUT GPO - General purpose logic output.

OUT - In Motion - Trigger output active (level) when motor 'in motion'. The output trigger goes high (5V) or low (0V) (as set in the Trig 1. Polarity and Trig. 2 Polarity parameters) when the stage is in motion.

OUT - At Max Velocity - Trigger output active (level) when motor at 'max velocity'.

OUT - At Position Steps Fwd - Trigger output active (pulsed) at pre-defined positions moving forward. Only one Trigger port at a time can be set to this mode. See Trigger Out Position Steps for further details.

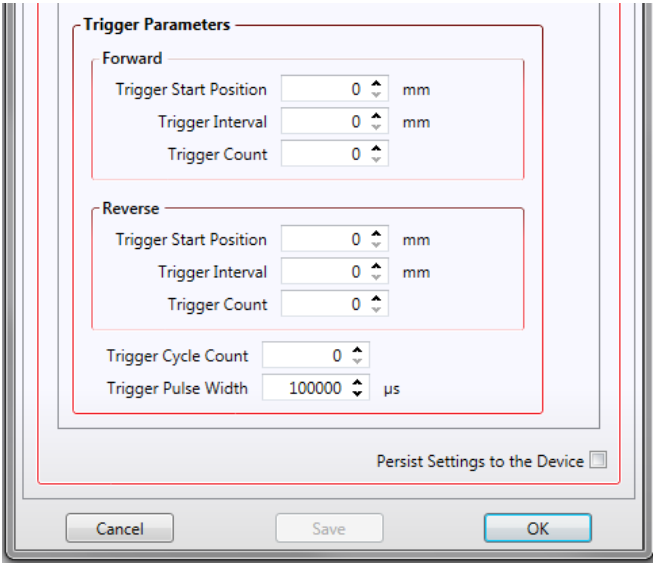
OUT - At Position Steps Rev - Trigger output active (pulsed) at pre-defined positions moving backwards. Only one Trigger port at a time can be set to this mode. See Trigger Out Position Steps for further details.

OUT - At Position Steps Both - Trigger output active (pulsed) at pre-defined positions moving forwards and backward. Only one Trigger port at a time can be set to this mode. See Trigger Out Position Steps for further details.

Trigger Out Position Steps

Note

If the trigger mode is not set to one of the three position step modes described previously, then the following parameters are not applicable and will be hidden.



As soon as a position triggering mode is selected on either of the TRIG ports, the port will assert the inactive logic state, set in the Trigger Polarity parameters.

As the stage moves in its travel range and the actual position matches the position set in the Trigger Start Position parameter, the TRIG port will output its active logic state. The active state will be output for the length of time specified by the Trigger Pulse Width parameter, then return to its inactive state and schedule the next position trigger point at the Trigger Start Position value plus the value set in Trigger Interval parameter.

Thus when this second position is reached, the TRIG output will be asserted to its active state again. The sequence is repeated the number of times set in the Trigger Count parameter.

When the number of pulses set in the Trigger Count parameter has been generated, the trigger engine will schedule the next position to occur at the position specified in the Reverse Trigger Start Position parameter. The same sequence as the forward direction is now repeated in reverse, except that the Reverse setting parameters apply. When the number of pulses has been output, the entire forward-reverse sequence will repeat the number of times specified by Trigger Cycle Count

parameter. This means that the total number of pulses output will be Trigger Cycle Counts x (Forward Trigger Count + Reverse Trigger Count).

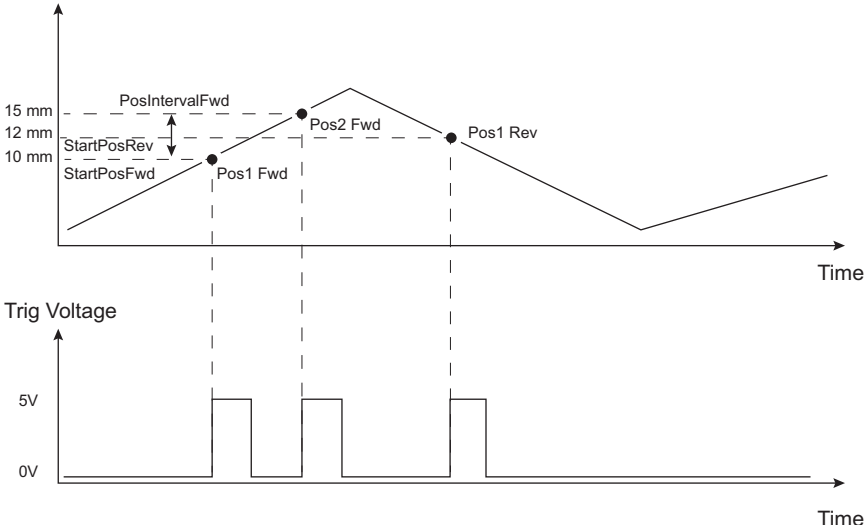


Fig. 6.7 Position Steps Triggering

Example for a move from 0 to 20 mm and back.

In forward direction: The first trigger pulse occurs at 10 mm (StartPosFwd), the next trigger pulse occurs after another 5 mm (PosIntervalFwd), the stage then moves to 20 mm.

In reverse direction: The next trigger occurs when the stage gets to 12 mm.

Note that position triggering can only be used on one TRIG port at a time, as there is only one set of position trigger parameters.

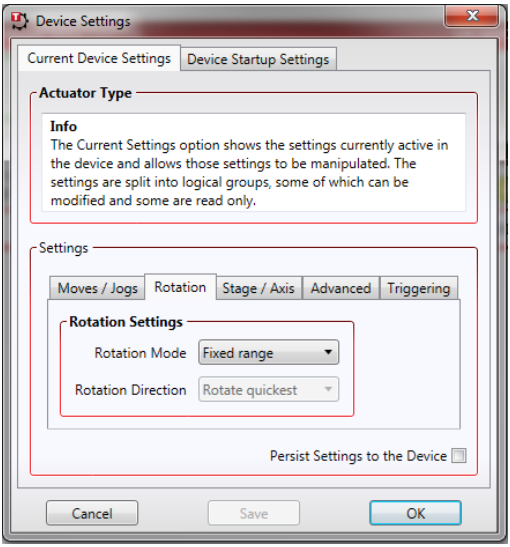
Trigger Polarity

The polarity of the trigger pulse is specified in the *Trigger 1 Polarity* and *Trigger 2 Polarity* parameters as follows:

Trigger High - The active state of the trigger port is logic HIGH 5V (trigger input and output on a rising edge).

Trigger Low - The active state of the trigger port is logic LOW 0V (trigger input and output on a falling edge).

6.3.6 Rotation StagesTab



Rotation Mode

This setting relates to the way in which the angular position is displayed on the GUI panel. There are three options:

Fixed Range - The angular rotation is limited to 360° i.e. one revolution.

Equivalent Angle – The maximum displayed position is 359.99°. If a stage is driven past the 360° rotation point, the display reverts back to zero and counts up to 360° again.

Total Angle – The total angular rotation is displayed, e.g. for a movement of two full rotations plus 10°, the display will show 730°.

Note. The following parameters are applicable only if the Rotation Mode is set to 'Equivalent Angle'.

Rotation Direction

This setting specifies the move direction. There are three options:

Rotate Forwards – The move is performed in a positive direction

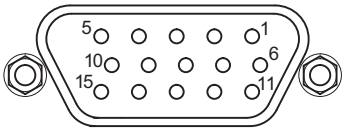
Rotate Reverse - The move is performed in a negative direction

Rotate Quickest - The move is performed in the quickest direction

Appendix G Rear Panel Connector Pinout Detail

G.1 Rear Panel Motor Control Connector

The 'Motor' connector provides connection to the DC servo motor actuator. The pin functions are detailed in Fig. G.1



Pin	Description	Pin	Description
1	Ground	9	Resistive Identification
2	Forward Limit Switch*	10	5V Encoder Supply
3	Reverse Limit Switch*	11	Encoder Channel A
4	Not Connected	12	Not Connected
5	Motor -	13	Encoder Channel B
6	Not Connected	14	Digital Identification I/O
7	Motor +	15	Digital Identification GND
8	Not Connected		

* For third part actuators, the action of the limit switch on contact (i.e. switch open or switch close) is set in the settings panel, see Section 6.3.3

Fig. G.1 MOTOR I/O Connector Pin Identification

Caution

DO NOT connect a motor actuator while the K-Cube is powered up.

Only use motor drive cables supplied by Thorlabs, other cables may have incompatible wiring.

Please contact tech support for details on use with Thorlabs legacy Z6 series DC Servo Motors.

Appendix H Preventive Maintenance

Warning

The equipment contains no user serviceable parts. There is a risk of electrical shock if the equipment is operated with the covers removed. 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.

H.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).

H.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.

Appendix I Specifications and Associated Products

I.1 Specifications

Parameter	Value
Motor Output	
Motor Drive Voltage	±12 to ±15 V (Depending on Supply)
Motor Drive Current	150 mA (Cont) >250 mA (peak)
Motor Drive Type	8-bit Sign/Magnitude PWM
Control Algorithm	Digital PID Filter (16bit)
Position Feedback: Quadrature Encoder (QEP) Input	5 V Single Ended
Encoder Feedback Bandwidth	750 kHz
Position Counter	32-bit
Operating Modes	Position, Velocity
Velocity Profile	Trapezoidal
Motor Drive Connector (15 Way D-Type)	
Motor Drive Outputs	+ve & -ve
Quadrature Encoder (QEP) Input	Single Ended
Limit Switch Inputs	Forward, Reverse (+ Common Return)
Encoder Supply	5 V
Front Panel Controls	
Sprung Potentiometer Wheel	Bidirectional Velocity Control, Forward/Reverse Jogging or Position Presets
Input Power Requirements	
Voltage	15 V Regulated DC
Current	500 mA (peak)
General Data	
Housing Dimensions (W x D x H) Excluding Buttons and Baseplate	60 x 60 x 47 mm (2.36" x 2.36" x 1.8")
USB Connector Type	USB 3.0
USB Connection Speed	USB 1.1 Full Speed (12 Mbps)
Weight	170 g (6.0 oz)

Recommended Motor Requirements	
Peak Power	2.5 W
Rated Current	10 mA to 200 mA (Nominal)
Motor Type	Brushed DC
Coil Resistance	5 to 50 Ω
Coil Inductance	250 to 1500 mH
Position Control	Closed loop Encoder

I.2 Associated Products

Product Name	Part Number
6 mm DC Servo Motor Actuator, 1/4”-80	Z906
6 mm DC Servo Motor Actuator, 1/4”-80, Vacuum Rated	Z906V
12 mm Motorized Actuator, 1/4”-80,	Z912
12 mm Motorized Actuator, 3/8” Barrel Attachment	Z912B
12 mm DC Servo Motor Actuator, 1/4”-80, Vacuum Rated	Z912V
12 mm DC Servo Motor Actuator, Vacuum Rated, 3/8” Barrel Attachment	Z912BV
25 mm DC Servo Motor Actuator, 3/8” Barrel Attachment,	Z925B
25 mm DC Servo Motor Actuator, Vacuum Rated, 3/8” Barrel Attachment	Z925BV
3-Channel K-Cube Controller USB Hub	KEH3[a]
6-Channel K-Cube Controller USB Hub	KEH6[b]
Single Way Power Supply	KPS201[c]

a. The previous-generation KCH301 3-Channel K-Cube Controller USB Hub is also compatible.
b. The previous-generation KCH601 6-Channel K-Cube Controller USB Hub is also compatible.
c. The previous-generation KPS101 power supply is also compatible.

Appendix J DC Motor Operation - Background

J.1 How A DC Motor Works

J.1.1 General Principle

A DC motor works by converting electric power into mechanical energy (movement). This is achieved by forcing current through a coil and producing a magnetic field, which in turn, spins the motor.

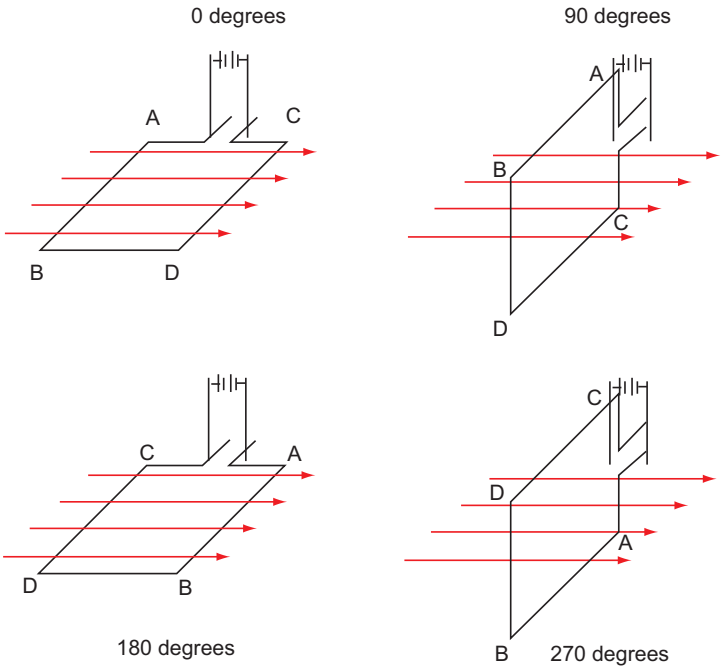


Fig. J.1 DC Motor Operation

To describe the operation of a DC motor, consider the single coil example shown above. In this diagram, current is forced through the coil via sliding contacts (brushes) that are connected to the voltage source. The brushes are located on the end of the coil wires and make a temporary electrical connection with the DC supply. When current is flowing, a magnetic field is set up as shown.

At 0° rotation, the brushes are in contact with the voltage source and current is flowing. The current that flows through the wire from A to B interacts with the magnetic field and produces an upward force. The current that flows from C to D has a similar effect, but because the flow is in the opposite direction with respect to the magnetic field, the force is in the downward direction.

Both forces are of equal magnitude. At 180°, the same phenomenon occurs, but segment A-B is forced down and C-D is forced up. In the 90° and 270° positions, the brushes are not in contact with the voltage source and no force is produced. In these two positions, the rotational kinetic energy of the motor keeps it spinning until the brushes regain contact. In reality, DC motors have several such coils, wound onto an armature, which produces a more even torque. The magnetic field is provided by an electromagnet.

J.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.

J.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 motion employed is described by a trapezoidal velocity profile, reflecting the shape of the velocity *vs.* time graph (see Fig. J.2.), thereby driving the stage to its destination as quickly as possible, without causing it to stall or lose steps.

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.

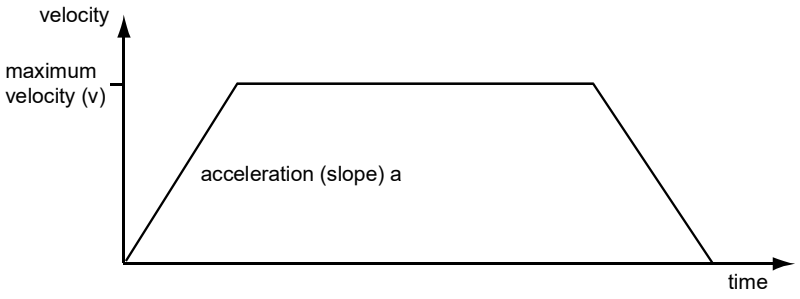


Fig. J.2 Graph of a Trapezoidal Velocity Profile

J.2 Positioning a Stage

J.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 encoder counts before it is sent to the stage 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 encoder counts moved. If a request is received to report the position, the value of this counter is converted back into motion units.

J.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 5.3 for details on performing a Home move.

J.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 can contain micro switches 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 - see Fig. J.3. 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 (such as the ZST range of actuators), 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

.

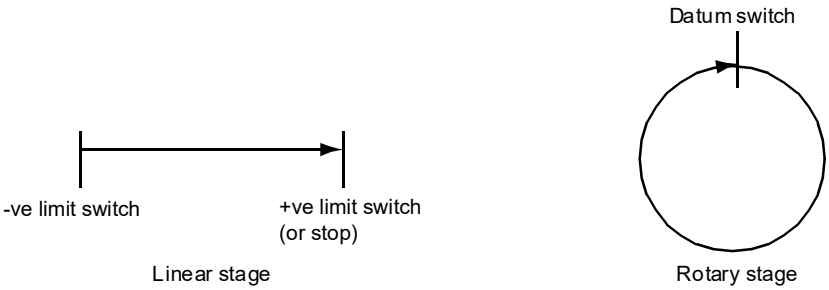


Fig. J.3 Stage Limit Switches

J.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. J.4.

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.

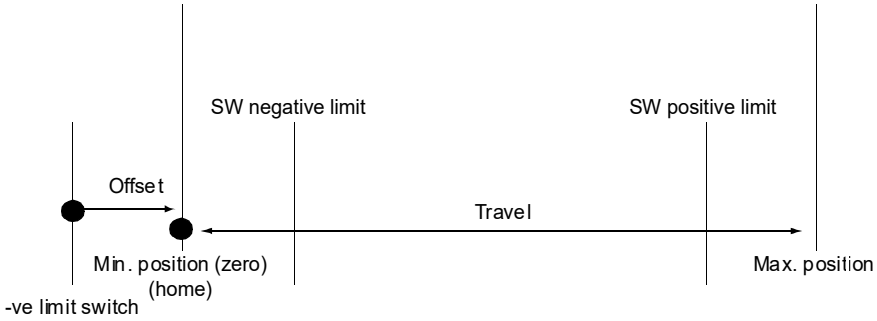


Fig. J.4 Minimum and Maximum Positions

J.3 Error Correction

J.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. J.5, 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.

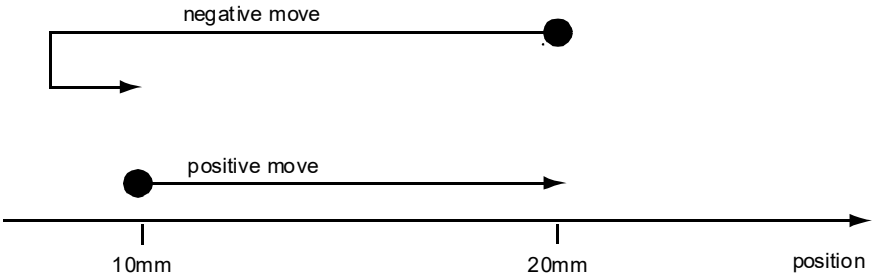


Fig. J.5 Backlash Correction

The particular stage selection will usually have 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 Chapter 6 Software Reference, Move/Jogs Tab for details on setting the backlash correction.

Appendix K Regulatory

K.1 Declarations Of Conformity

K.1.1 For Customers in Europe

See Section K.2

K.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, pursuant 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.

K.2 Certificate of Conformity

THORLABS
www.thorlabs.com

EU Declaration of Conformity

in accordance with EN ISO 17050-1:2010

We: Thorlabs Ltd.

Of: 204 Lancaster Way Business Park, Ely, CB6 3NX, UK

in accordance with the following Directive(s):

2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2011/65/EU + 2015/863	Restriction of Use of Certain Hazardous Substances (RoHS)

hereby declare that:

Model: ***KDC101***

Equipment: ***Kinesis Brushed Motor Controller***

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

EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013
EN 63000	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances	2018

and which, issued under the sole responsibility of Thorlabs, is/are 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:* 29 July 2021

Name: Keith Dhese

Position: General Manager

EDC - KDC101 -2021-07-29

CE

Appendix L 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.



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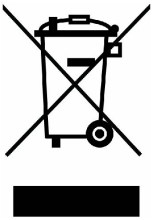
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Thorlabs verifies our compliance with the WEEE (Waste Electrical and Electronic Equipment) directive of the European Community and the corresponding national laws. Accordingly, all end users in the EC may return "end of life" Annex I category electrical 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.





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