KSC101

K-Cube Solenoid Controller

APT User Guide

Original Instructions

Contents

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

Chapter 2 Overview and Setup

2.1 Introduction

The K-Cube Solenoid Controller (KSC101) is a new very compact single channel controller for easy manual and automated control of solenoid operated shutters, and other such devices. Designed to operate 15V solenoid actuated devices, this mini controller is fully featured, possessing an embedded DSP processor to provide a multitude of flexible operating modes.

Embedded software functionality allow this unit to be used to control solenoid devices manually (using panel buttons), automatically with DSP timed operation, or via external trigger signals for operation with third party equipment. A trigger out connection allows multiple K-Cube controllers to be connected together for multi-channel 'synchronized' operation.

For convenience the footprint of this unit has been kept to a minimum, measuring only 60mm x 60mm x 47mm (2.4" x 2.4" x 1.8") and with the facility to directly mount to the optical table. The manual controls for this unit are conveniently located on the upper surface such as the 'Mode' and 'Enable' buttons. The Mode button allows the various operating modes to be selected easily and the Enable button is used to initiate manual or automatic operation of the solenoid controller output. There is also a safety key switch and interlock plug fitted to this compact unit for use in laser safety applications.

Fig. 2.1 K-Cube Solenoid Controller with Baseplate

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 the very user friendly apt™ software (supplied) allows the user to very quickly get up and running with complex operating sequences in a short space of time. Custom 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.

In the remainder of this handbook, operation of the unit is described for both top panel and PC operation. Tutorial sections (Chapter 4 and Chapter 5) provide a good initial understanding on using the unit and reference section (Chapter 6) covers all operating modes and parameters in detail.

2.2 Power Options

A single way wall plug KPS201* supply 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.

As a further level of convenience when using the new K-Cube Controllers Thorlabs also offers the 3-channel and 6-channel K-Cube Controller Hubs (KCH301 and KCH601). 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 APT PC Software Overview

2.3.1 Introduction

As a member of the APT range of controllers, the KSC101 Solenoid Driver K-Cube shares many of the associated software benefits. This includes 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 APT software suite supplied with all APT controllers provides a flexible and powerful PC based control system both for users of the equipment, and software programmers aiming to automate its operation.

For users, the APTUser (see Section 2.3.2.) and APTConfig (see Section 2.3.3.) utilities allow full control of all settings and operating modes enabling complete 'out-of-box' operation without the need to develop any further custom software. Both utilities are built on top of a sophisticated, multi-threaded ActiveX 'engine' (called the APT server) which provides all of the necessary APT 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 APT server 'engine' that is used by software developers to allow the creation of advanced automated positioning applications very rapidly and with great ease. The APT server is described in more detail in Section 2.3.4.

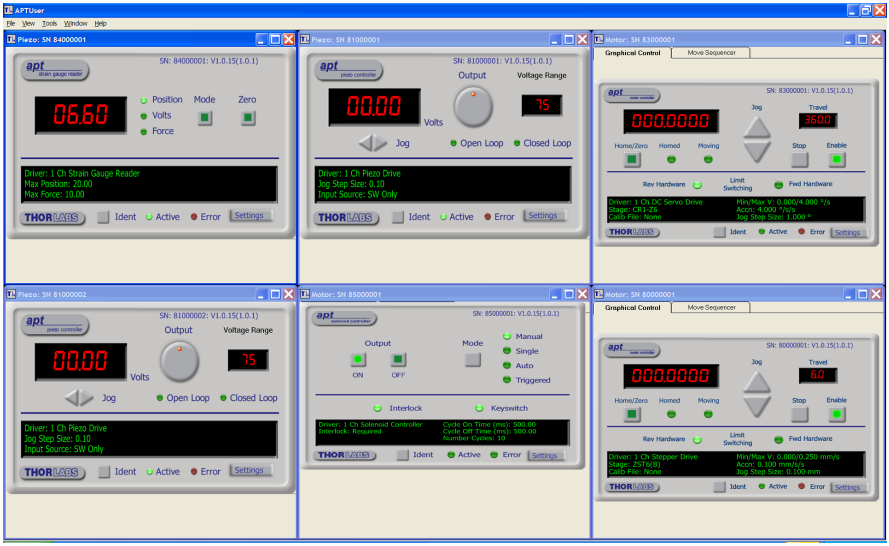
Aside

ActiveX®, a Windows®-based, language-independent technology, allows a user to quickly develop custom applications that automate the control of APT system hardware units. Development environments supported by ActiveX® technology include Visual Basic®, LabView™, Borland C++ Builder, Visual C++, Delphi™, and many others. ActiveX® technology is also supported by .NET development environments such as Visual Basic.NET and Visual C#.NET.

ActiveX controls are a specific form of ActiveX technology that provide both a user interface and a programming interface. An ActiveX control is supplied for each type of APT hardware unit to provide specific controller functionality to the software developer. See Section 2.3.4. for further details.

2.3.2 APTUser Utility

The APTUser application allows the user to interact with a number of APT hardware control units connected to the host PC. This program displays multiple graphical instrument panels to allow multiple APT units to be controlled simultaneously.



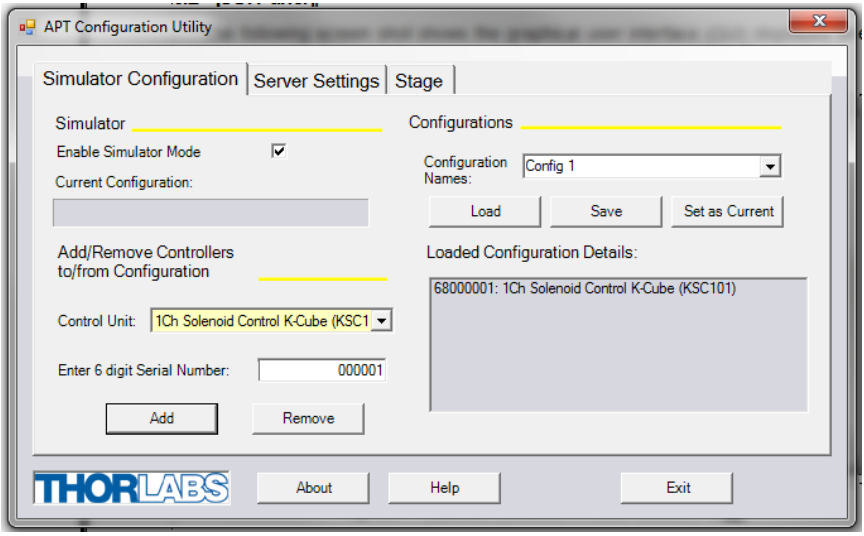
All basic operating parameters can be altered and, similarly, all operations (such as manual or automatic solenoid operation) can be initiated. Settings and parameter changes can be saved and loaded to allow multiple operating configurations to be created and easily applied.

For many users, the APTUser application provides all of the functionality necessary to operate the APT hardware without the need to develop any further custom software. For those who do need to further customise and automate usage of the Solenoid Controller K-Cube, this application illustrates how the rich functionality provided by the APT ActiveX server is exposed by a client application.

Use of the APT User utility is covered in the PC tutorial (Chapter 5) and in the APTUser online help file, accessed via the F1 key when using the APTUser utility.

2.3.3 APT Config Utility

There are many system parameters and configuration settings associated with the operation of the APT Server. Most can be directly accessed using the various graphical panels, however there are several system wide settings that can be made 'off-line' before running the APT software. These settings have global effect; such as switching between simulator and real operating mode, associating mechanical stages to specific motor actuators and incorporation of calibration data.



The APTConfig utility is provided as a convenient means for making these system wide settings and adjustments. Full details on using APTConfig are provided in the online help supplied with the utility.

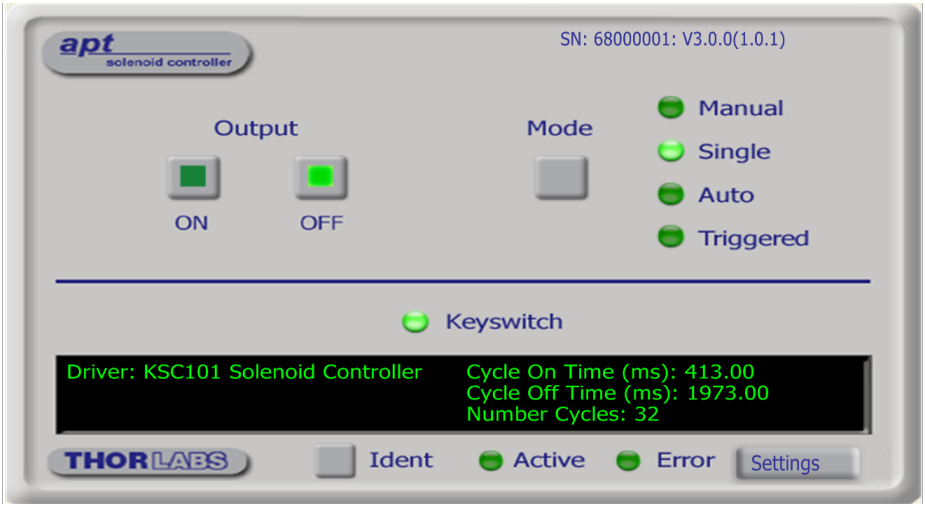
Use of the APT Config utility is covered in the PC tutorial (Chapter 5) and in the APTConfig online help file, accessed via the F1 key when using the APTConfig utility.

2.3.4 APT Server (ActiveX Controls)

ActiveX 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 APT system, ActiveX Controls are deployed to allow direct control over (and also reflect the status of) the range of electronic controller units, including the Solenoid Driver K-Cube. Software applications that use ActiveX Controls are often referred to as 'client applications'. Based on ActiveX interfacing technology, an ActiveX Control is a language independent software component. Consequently ActiveX 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 ActiveX Control supplied for the K-Cube Solenoid Controller unit.



This Control provides a complete user graphical instrument panel to allow the 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 operation to be automated by a client application. The instrument panel reflects the current operating state of the controller unit to which it is associated (such as Interlock state). Updates to the panel take place automatically when a user is operating the unit manually.

The APT ActiveX Controls collection provides a rich set of graphical user panels and programmable interfaces allowing users and client application developers to interact seamlessly with the APT hardware. Each of the APT controllers has an associated ActiveX Control and these are described fully in system online help or the handbooks associated with the controllers. Note that the APTUser and APTConfig utilities take advantage of and are built on top of the powerful functionality provided by the APT ActiveX Server (as shown in Fig. 2.2).

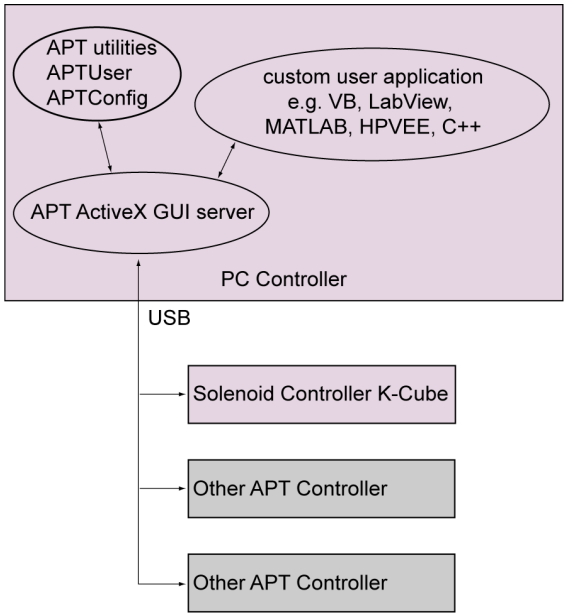


Fig. 2.2 System Architecture Diagram

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

2.3.5 Software Upgrades

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

Chapter 3 Getting Started

3.1 Install The Software

Note

When operating via a PC, direct user interaction with the solenoid controller is accomplished through intuitive graphical user interface panels (GUIs), which expose all key operating parameters and modes. The multitasking software architecture ensures that the graphical control panels always remain live, showing all current hardware activity.

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 CONTROLLER TO YOUR PC YET

1) Go to Services/Downloads at www.thorlabs.com and download the software.
2) Run the .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 Solenoid Controller is shipped with a baseplate, for use when fitting the unit to a breadboard, optical table or similar surface - see Section 3.2.3.

For multiple cube systems, a 3-channel and 6-channel K-Cube Controller Hub (KCH301 and KCH601) are also available - 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 control panel.
Ensure that proper airflow is maintained to the unit.

3.2.3 Using the Baseplate

The baseplate is supplied with magnets for quick positioning on an optical worksurface. For more secure positioning, it can 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.

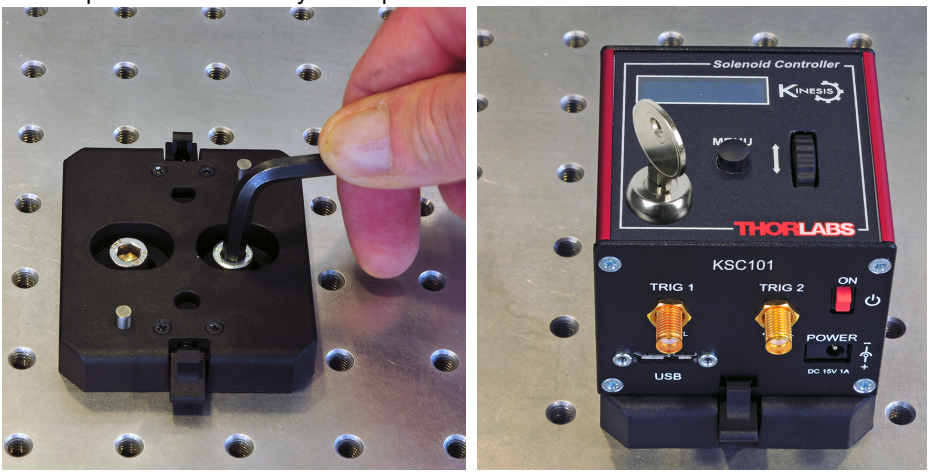


Fig. 3.1 Using The Baseplate

3.3 Electrical Installation

3.3.1 Rear Panel

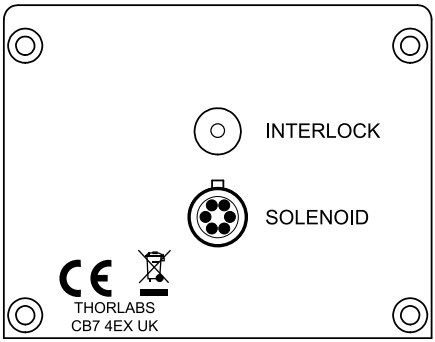


Fig. 3.2 Rear Panel Connections

The solenoid is connected via the 6-way Hirose connector, which is compatible with all Thorlabs solenoid-actuated shutters (refer to Appendix A for details of pin outs).

The unit also features an Interlock connector, for use in laser safety applications - see Section 3.4.2.

Caution

DO NOT connect/disconnect the interlock jackplug with power applied to the unit.

3.3.2 Front Panel

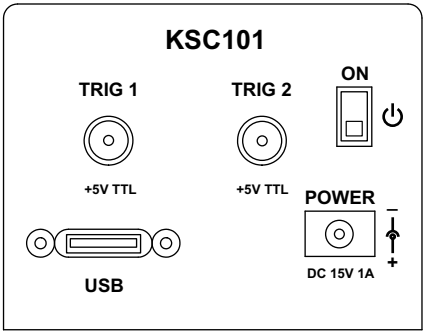


Fig. 3.3 Front Panel Power Supply onnections

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). TRIG1 is set to trigger IN and TRIG2 to trigger OUT.

3.4 Connect The Hardware

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

Caution

During items (3) to (6) the instructions should be followed in the order stated. Problems may occur if the process is not performed in the correct sequence.

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 solenoid to the Controller unit - see Section 3.3.1..

Caution

During item (5) ensure the power switch on the top panel of the unit is switched off before connecting power to the K-Cube. Always power up the K-Cube unit by its ON switch. 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, turn the power switch off before disconnecting the power supply.

5) Connect the Controller unit to the power supply - see Section 3.3.
6) Connect the INTERLOCK jack plug - seeSection 3.4.2.
7) Connect the PSU to the main supply.
8) Turn ON the key switch.
9) 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.

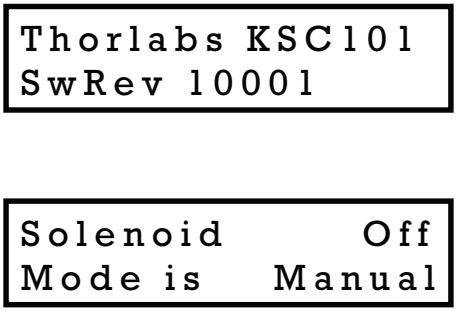


Fig. 3.4 KSC101 start up screens

10) 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.

3.4.1 Using an External Trigger

To use the external trigger, the unit must be set to *Triggered* mode - see Section 4.4.2.

The K-Cube solenoid 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. By default, TRIG 1 is configured as an input and TRIG 2 as an output. The active logic state can be selected High or Low to suit the requirements of the application. In this way, the shutter can be opened and closed in relation to the duty cycle of the trigger input signal.

Electrically the ports output 5 Volt logic signals and are designed to be driven from a 5 Volt logic. The unit must be primed (i.e. the top panel wheel has been moved up or GUI panel output ON) before the unit can respond to the external trigger.

Warning

In external triggering mode, the shutter is opened and closed under control of an external logic signal, connected to the SMA input marked "TRIG IN" on the rear panel.

The 'TRIG IN' SMA defaults to logic LOW, when the external input is open circuit (disconnected). However, the way in which the unit responds when the 'TRIG IN' connector is open circuit differs depending on whether the trigger is set to Active High or Active Low. This is particularly important in applications where a shutter is used to enable or disable a laser light source.

When set to Active Low, the shutter will open immediately if the top panel wheel is moved up (or GUI panel output selected ON).

When set to Active High, the trigger is disabled when the external input is open circuit (disconnected).
The top panel wheel must be moved up (or GUI panel output selected ON) for the shutter opening to be enabled, so a disconnected input in itself cannot cause the shutter to open. However, understanding this feature is particularly important for customers using the KSC101 cube in an application where the shutter opening due to a disconnected EXT TRIG input can have safety implications.

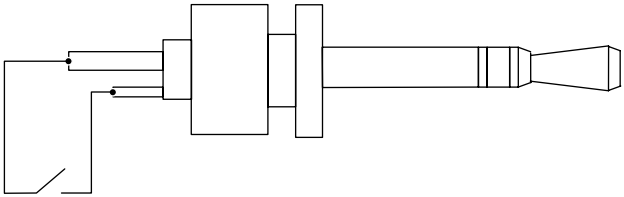
3.4.2 Using the Safety Interlock

To comply with laser safety regulations, the Solenoid Controller K-Cube is fitted with a remote INTERLOCK connector located on the rear panel (see Fig. 3.2). A short circuit must be applied across the terminals of this connector before the unit can be enabled.

Caution

If it is controlled externally, the INTERLOCK contact is taking the solenoid drive current. This current is dependent upon the solenoid being driven but could as high as 2A peak.

An INTERLOCK jack plug is supplied with the unit to close this connection. Alternatively, the contact can be controlled externally; the user can use a custom 3.5mm jackplug connected to a remote actuated (normally open) switch (e.g. an open door indicator), which must be closed before the unit can operate. See Fig. 3.5 for wiring details.



Switched short circuit between
tip and center connection

Fig. 3.5 Remote actuated interlock wiring

Caution

DO NOT connect/disconnect the interlock jackplug with power applied to the unit.

If the unit is being operated in a trigger mode, the interlock controls the output of the master unit in the normal way. However, if the interlock is removed from the master unit, the slave unit will still function unless its interlock is also removed.

3.5 Verifying Software Operation

3.5.1 Initial Setup

1) Install the APT software as detailed in Section 3.1.
2) Connect the Controller to the solenoid (see Section 3.3.1.) and the PC, then switch ON. Wait several seconds for the system to settle.

3) Run the APTUser utility and check that the Graphical User Interface (GUI) panel appears and is active.

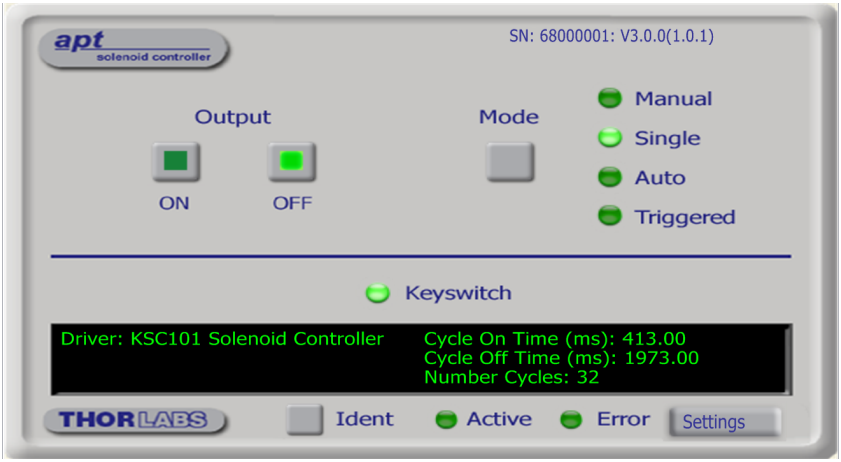


Fig. 3.6 Solenoid controller Gui panel

4) Click the 'Ident' button. The LED display on the control 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 'Mode' button until the 'Manual' LED is lit, then Click the ON and OFF Output buttons and check that the solenoid connected to the Solenoid Controller K-Cube responds.

Follow the tutorial steps described in Chapter 4 for further verification of operation.

Note

The 'APT Config' utility can be used to set up simulated hardware configurations and place the APT Server into simulator mode. In this way it is possible to create any number and type of simulated (virtual) hardware units in order to emulate a set of real hardware. This is a particularly useful feature, designed as an aid to application program development and testing. Any number of 'virtual' control units are combined to build a model of the real system, which can then be used to test the application software offline.

If using real hardware, ensure that Simulator Mode is disabled. If using a simulated setup, enable Simulator Mode and set up a 'Simulated Configuration' - see Section 5.3. or the *APTConfig* helpfile for detailed instructions.

Chapter 4 Standalone Operation

4.1 Introduction

The K-Cube Solenoid Controller (KSC101) is a compact single channel controller for easy manual and automated control of solenoid operated shutters, and other such devices. Designed to operate 15V solenoid actuated devices, this mini controller is fully featured, possessing an embedded DSP processor to provide a multitude of flexible operating modes.

Embedded software functionality allows this unit to be used to control solenoid devices manually (using panel buttons), automatically with DSP timed operation, or via external trigger signals for operation with third party equipment. A trigger out connection allows multiple K-Cube controllers to be connected together for multi-channel 'synchronized' operation.

The following brief overview explains how the top panel controls can be used.

4.2 Control Panel

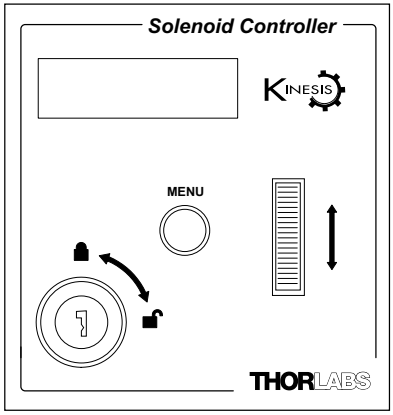


Fig. 4.1 Top Panel Controls and Indicators

Wheel - Used to open and close the solenoid when in manual or single operating modes - 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.

Keyswitch - A key-operated enable switch.

4.2.1 Digital Display - Operating Mode

During normal operation, the digital display shows the current state of the solenoid, On or Off, together with the operating mode - see Section 4.3.

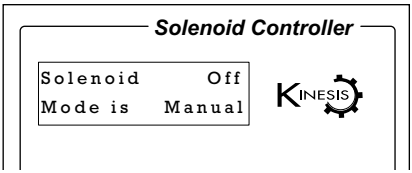


Fig. 4.2 Digital Display - Normal Operation

4.3 Operating Modes

Manual - In this mode, operation of the solenoid is via the top panel wheel. Move the wheel up to open the solenoid (ON) and down to close (OFF).

Single - In this mode, the solenoid will open each time the top panel wheel is moved up. The ON time is entered in the 'Settings' menu - see Section 4.4. If the top panel wheel is moved down, the solenoid will close (turn OFF) and the time entered in the ON Time parameter is ignored.

Auto - In this mode, the solenoid will open and close continuously after the top panel wheel is moved up. The ON and OFF times, and the number of cycles performed, are those entered in the 'Settings' menu - see Section 4.4.

Trigger - The K-Cube solenoid 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. By default, TRIG 1 is configured as an input and TRIG 2 as an output. The active logic state can be selected High or Low to suit the requirements of the application.

In Trigger mode, an ON pulse on the front panel TRIG BNC input will open the shutter, which will remain open until an OFF signal is detected. In this way, the shutter can be opened and closed in relation to the duty cycle of the trigger input signal.

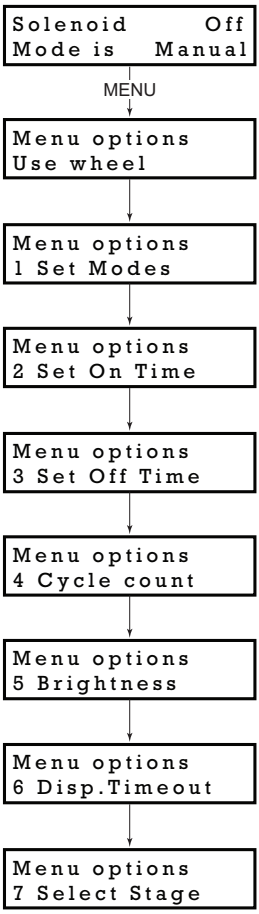
The unit must be primed (i.e. the top panel wheel moved up or GUI panel output selected ON) before the unit can respond to the external trigger.

In all modes of operation, moving the wheel down while the solenoid is enabled will turn the solenoid OFF.

Caution

The last used MODE setting is remembered automatically between power cycles and the unit powers up automatically in the last used operating mode.

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

Set the operating mode - see Section 4.4.2.

Set the time that the solenoid is On - see Section 4.4.3.

Set the time that the solenoid is Off - see Section 4.4.4.

Set the number of cycles - see Section 4.4.5.

Set the display brightness - see Section 4.4.6.

Set the display time out period - see Section 4.4.7.

Select the solenoid type - see Section 4.4.8.

4.4.2 Menu Option - Set Modes

This option is used to move to an absolute position.

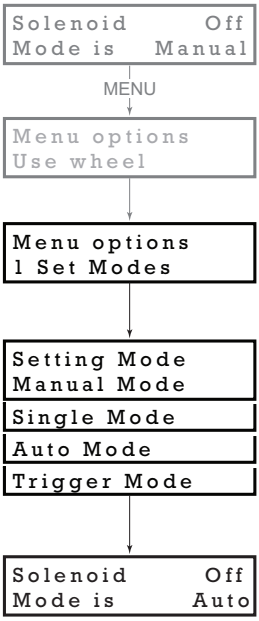
Press the MENU button, then use the wheel to scroll through the menu options.

Press the MENU button to enter the Set Modes option.

Use the wheel to adjust the mode as required.

See Section 4.3. for details of each operating mode.

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



4.4.3 Menu Option - Set ON Time

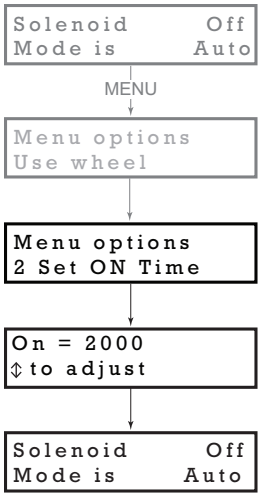
This mode is used to set the time the solenoid is ON, (i.e. the shutter/ solenoid is open) when operating in Single or Auto mode.

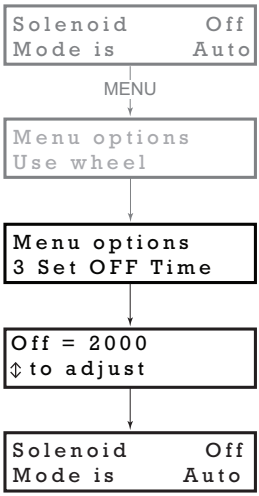
Press the MENU button, then use the wheel to scroll through the menu options.

Press the MENU button to enter the ON Time option.

Use the wheel to adjust the time which the solenoid is ON (activated). The range is 100ms to 100s in 1 ms steps.

Press the MENU button to save the setting and return to the operating display.





4.4.4 Menu Option - Set OFF Time

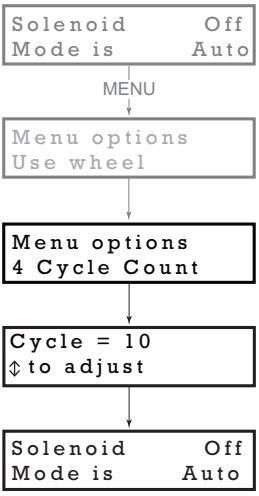
This mode is used to set the time the solenoid is OFF, (i.e. the shutter/ solenoid is closed) when operating in Auto mode.

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

Press the MENU button to enter the OFF Time option.

Use the wheel to adjust the time which the solenoid is OFF (deactivated). The range is 100ms to 100s in 1 ms steps.

Press the MENU button to save the setting and return to the operating display.



4.4.5 Menu Option - Cycle Count

This mode is used to set the number of OPEN/CLOSE cycles, when operating in Auto mode.

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

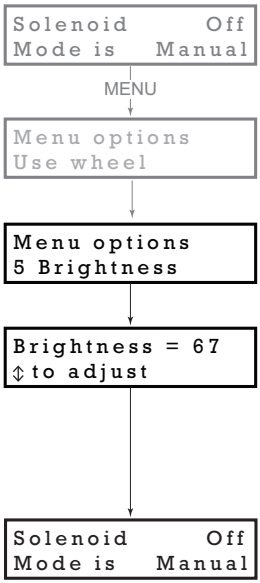
Press the MENU button to enter the Cycle Count option.

Use the wheel to adjust the number of Open/Close cycles (0 to 1,000,000) to perform when the unit is operating in 'Auto' mode . If set to '0' the unit cycles indefinitely

Press the MENU button to save the setting and return to the operating display.

4.4.6 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.

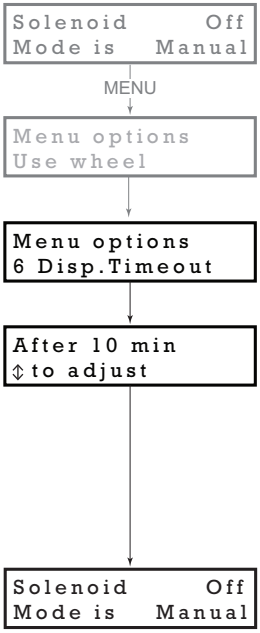
Press the MENU button to enter the Brightness option.

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

4.4.7 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.

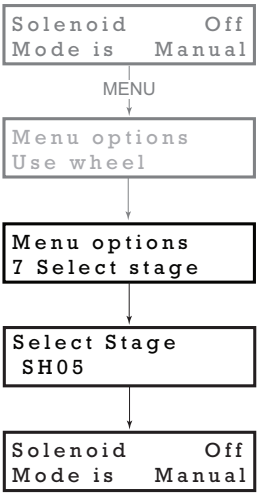
The time out interval is specified in minutes in the range 1 to 480. The adjustment is done in steps of 1 minute if the timeout is between 1 to 10 minutes, 10 minute steps between 10 minutes and 1 hour, and 30 minute steps above, up to a maximum of 480 minutes. After 480 minutes there is an option for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

The dim level can only be adjusted via the Settings panel - see Section 6.3.2.

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

4.4.8 Menu Option - Select Stage

For correct operation the solenoid type being driven must be selected to enable default operating parameters to be loaded. At this time, the only solenoid devices available are the SH05 and SH1. Both of these devices are driven by selecting the SH05 option. Other solenoid devices will be available in the future.



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. .

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

4.5 Operation From The Top Panel

The following brief tutorial guides the user through a typical series of operations.

4.5.1 Preparation

1) Connect a solenoid actuated device (e.g. a Thorlabs SH05 Shutter) to the 'SOLENOID' connector on the rear panel of the unit.
2) Connect the INTERLOCK jack plug - see Section 3.4.2.
3) Connect the unit to a +15V DC power supply unit (PSU) - see Section 3.3.2.
4) Connect the unit to the PC USB bus
5) Switch ON the power to the PSU.
6) Turn ON the keyswitch.

4.5.2 Manual Mode

1) Select Manual mode (see Section 4.4.2.).
2) Move the wheel upwards. The SH05 shutter opens.
3) Move the wheel down. The SH05 shutter closes.

4.5.3 Single Mode

1) Select Single mode (see Section 4.4.2.).
2) Move the wheel upwards. The SH05 shutter opens for the time set in the ON time menu option, (see Section 4.4.3.) then closes. If the wheel is moved down before the ON time is completed, the SH05 shutter closes and the remaining ON time is ignored..

4.5.4 Auto Mode

1) Select Auto mode (see Section 4.4.2.).
2) Move the wheel upwards. The SH05 shutter begins to open and close. Unless the default settings have been changed, the following settings apply:

   ON (Open) time: 1s

   OFF (Closed time: 1s

   Number of Cycles: 0 (i.e. infinite)

   See Section 4.4. for more information on these settings.
3) Move the wheel down. The SH05 shutter closes.
4) Turn OFF the keyswitch.
5) Switch OFF the power to the PSU.

Chapter 5 PC Operation - Tutorial

The following brief tutorial guides the user through a typical series of moves and parameter adjustments performed using the PC based APT software.

5.1 Preparation

1) Connect a solenoid actuated device (e.g. a Thorlabs SH05 Shutter) to the 'SOLENOID' connector on the rear panel of the unit.
2) Connect the INTERLOCK jack plug - see Section 3.4.2..
3) Connect the unit to a +15V DC power supply unit (PSU) - see Section 3.3.2.
4) Connect the unit to the PC USB bus.
5) Switch ON the power to the PSU.
6) Turn ON the keyswitch.

5.2 Using the APT User Utility

The APT User.exe application allows the user to interact with any number of APT hardware control units connected to the PC USB Bus (or simulated via the APTConfig utility). This program allows multiple graphical instrument panels to be displayed so that multiple APT units can be controlled. All basic operating parameters can be set through this program, and all basic operations (such as operating the solenoid/ shutter) can be initiated. Hardware configurations and parameter settings can be saved, which simplifies system set up whenever APT User is run up.

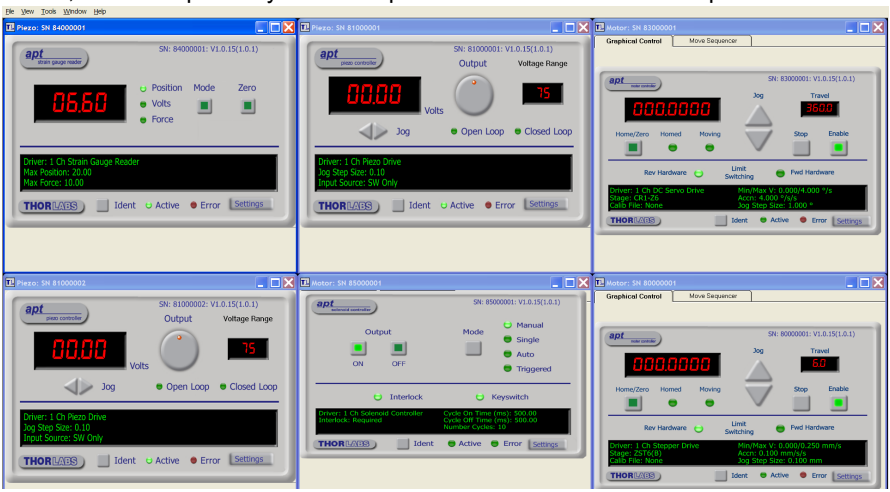


Fig. 5.1 Typical APT User Screen

1) Run the APT User program - Start/Programs/Thorlabs/APT/APT User.
2) The PC detects the hardware connected to the USB bus and the GUI panel for the Solenoid Controller is displayed. For an explanation of the GUI panel - see Section 6.2. For further details on the parameter values shown in the 'Settings' display - see Section 6.3.

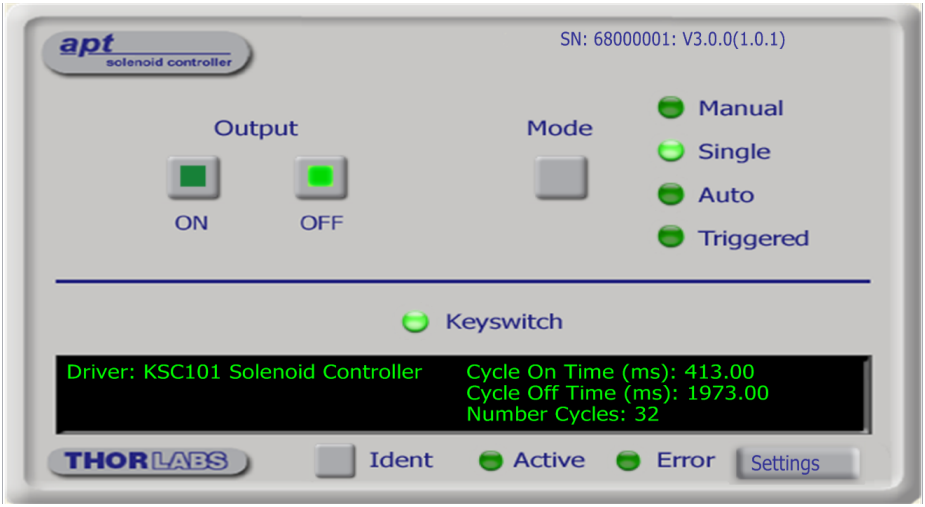


Fig. 5.2 Solenoid Controller K-Cube Software GUI

The APT User utility will be used throughout the rest of this tutorial to interface with the Solenoid Controller K-Cube.

5.2.1 Setting Manual Mode

1) Press the Mode button until the Manual LED is lit.
2) Press the ON button. The SH05 shutter opens.
3) Press the OFF button. The SH05 shutter closes.

5.2.2 Setting Auto Mode

1) Press the Mode button to until the Auto LED is lit.
2) Press the ON button. The SH05 shutter begins to open and close. Unless the default settings have been changed, the following settings apply:

   ON (Open) time: 1s

   OFF (Closed) time: 1s

   Number of Cycles: 0 (i.e. infinite)

   See Section 6.3.1. for more information on these settings.
3) Press the OFF button. The SH05 shutter closes.

5.3 Creating a Simulated Configuration Using APT Config

The 'APT Config' utility can be used to set up simulated hardware configurations and place the APT Server into simulator mode. In this way it is possible to create any number and type of simulated (virtual) hardware units in order to emulate a set of real hardware. This is a particularly useful feature, designed as an aid learning how to use the APT software and as an aid to developing custom software applications 'offline'.

Any number of 'virtual' control units can be combined to emulate a collection of physical hardware units For example, an application program can be written, then tested and debugged remotely, before running with the hardware.

To create a simulated configuration proceed as follows:

1) Run the APT Config utility - Start/All Programs/Thorlabs/APT/APT Config.
2) Click the 'Simulator Configuration' tab.

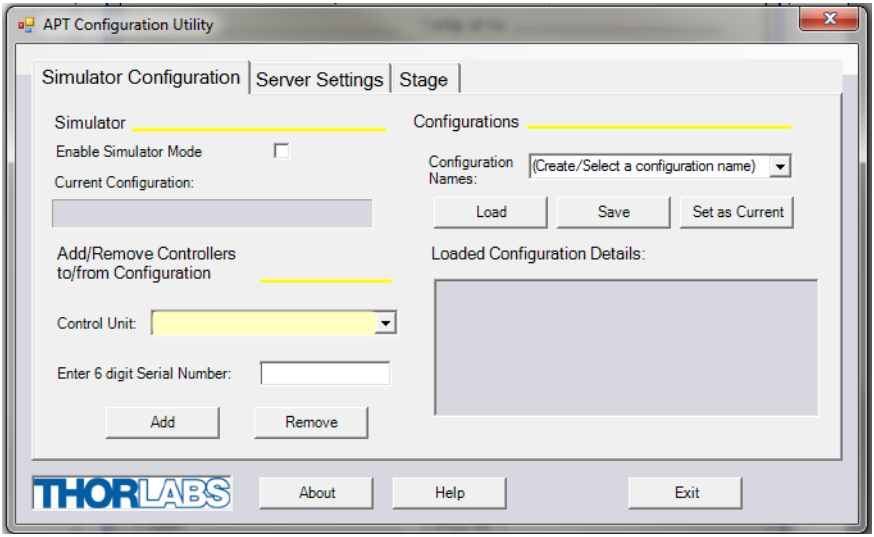
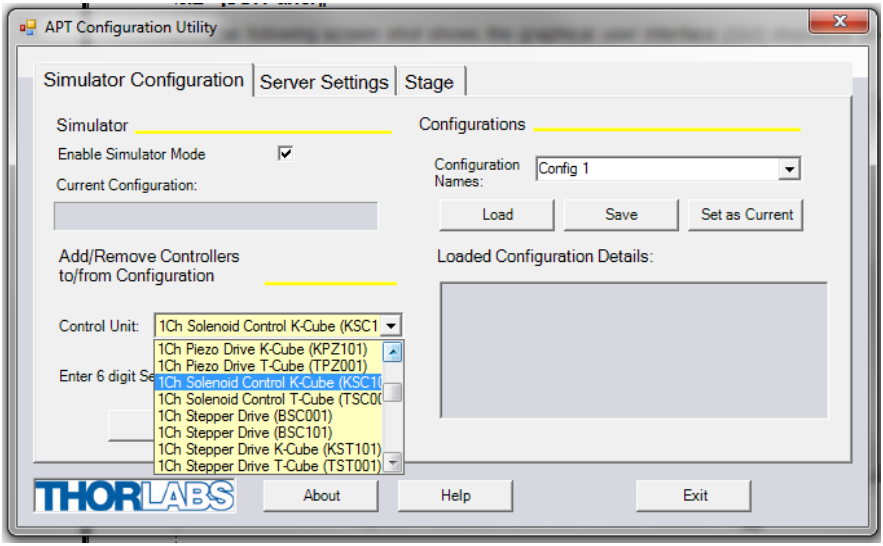


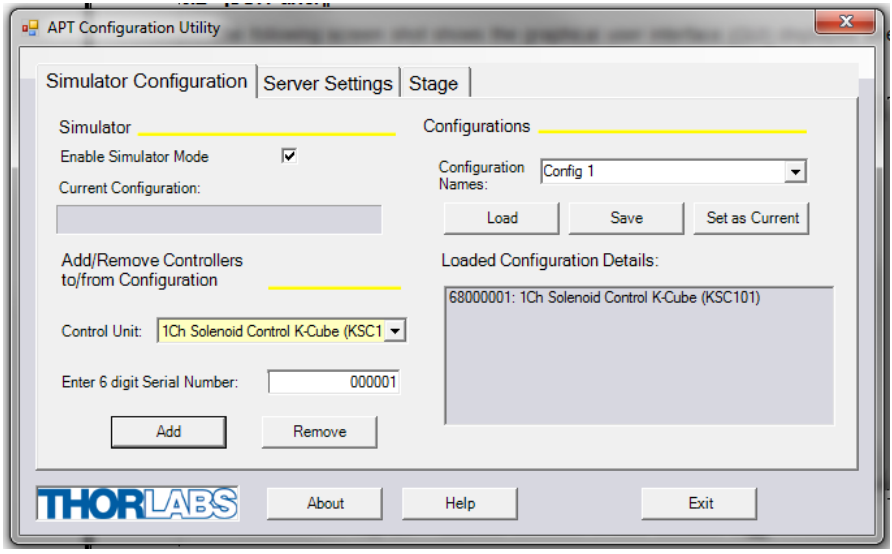
Fig. 5.3 APT Configuration Utility - Simulator Configuration Tab

3) Enter a name, e.g. 'Config1' in the Configuration Names field.

4) In the 'Simulator' field, check the ‘Enable Simulator Mode’ box. The name of the most recently used configuration file is displayed in the 'Current Configuration' window.



5) In the ‘Control Unit’ field, select ‘1 Ch Solenoid Controller K-Cube (KSC101)’.



6) In the 'Enter 6 digit serial number' field, enter the serial number of your K-Cube Solenoid Controller.

Note

Each physical APT hardware unit is factory programmed with a unique 8 digit serial number. In order to simulate a set of 'real' hardware the Config utility allows an 8 digit serial number to be associated with each simulated unit. It is good practice when creating simulated configurations for software development purposes to use the same serial numbers as any real hardware units that will be used. Although serial numbers are 8 digits (as displayed in the 'Load Configuration Details' window), the first two digits are added automatically and identify the type of control unit.

The prefixed digits relating to the Solenoid Controller K-Cube are:

68xxxxxx - 1 Ch Solenoid Controller K-Cube

7) Click the 'Add' button.
8) Repeat items (1) to (7) as required. (A unit can be removed from the configuration by selecting it in the 'Loaded Configuration Details' window and clicking the 'Remove' button or by right clicking it and selecting the 'Remove' option from the pop up window).
9) Click 'Save'.
10) Click 'Set As Current' to use the configuration.

5.4 Introduction To Solenoid Controller Programming

The ActiveX functionality for the Solenoid Controller K-Cube is accessed via the APTMotor Control Object, and provides the functionality required for a client application to control a number of K-Cube Solenoid Controller units.

Every hardware unit is factory programmed with a unique 8-digit serial number. This serial number is key to operation of the APT Server software and is used by the Server to enumerate and communicate independently with multiple hardware units connected on the same USB bus.

The serial number must be allocated using the *HWSerialNum* property, before an ActiveX control can communicate with the hardware unit. This can be done at design time or at run time.

The methods for the K-Cube Solenoid Controller unit can then be used to operate the solenoid device, and perform activities such as switching between operating modes.

Please see the *APTServer* Helpfile for more information

Chapter 6 Software Reference

6.1 Introduction

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

6.2 GUI Panel

The following screen shot shows the graphical user interface (GUI) displayed when accessing the Solenoid Controller K-Cube using the APTUser utility.

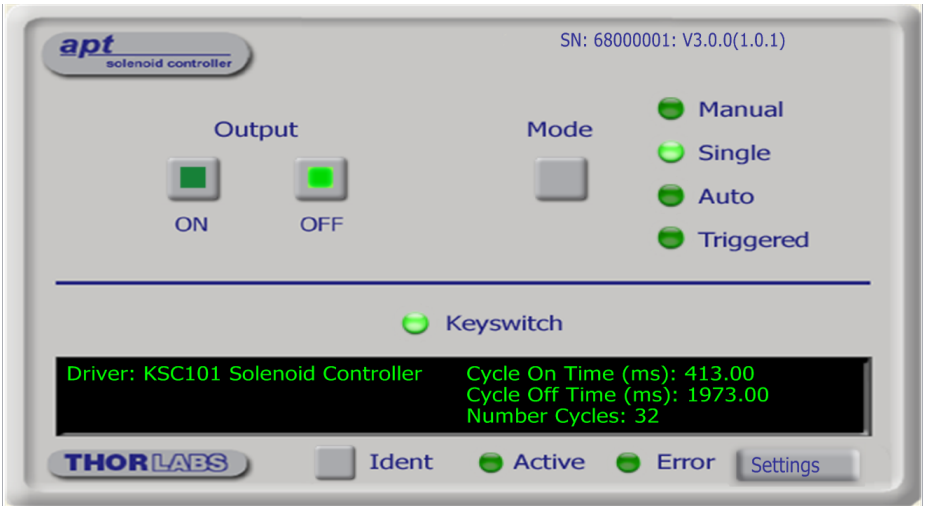


Fig. 6.1 Solenoid Controller K-Cube Software GUI

Note

The serial number of the Solenoid Controller K-Cube associated with the GUI panel, the APT server version number, and the version number (in brackets) of the embedded software running on the unit, are displayed in the top right hand corner. This information should always be provided when requesting customer support.

Output - these buttons are used to open and close the solenoid-actuated device. The action of these buttons is dependent upon the operating mode selected - see 'Mode'.

Mode - this button sets the operating mode of the unit as follows:

Manual - In this mode, operation of the solenoid is via the top panel wheel, or by the 'Output' buttons on the GUI panel.

Single - In this mode, the solenoid will open and close each time the top panel wheel is moved, or the 'Output ON' button on the GUI panel is clicked. The ON and OFF times are entered in the 'Settings' panel - see Section 6.3.

Auto - In this mode, the solenoid will open and close continuously after the top panel wheel is moved, or the 'Output ON' button on the GUI panel is clicked. The ON and OFF times, and the number of cycles performed, are those entered in the 'Settings' panel - see Section 6.3.

Triggered - In Triggered mode, a rising edge (logic high) on rear panel TRIG IN BNC input will open the shutter, which will remain open until a falling edge (logic low) is detected. In this way, the shutter can be opened and closed in relation to the duty cycle of the trigger input signal. The unit must be primed (i.e. the top panel wheel has been moved up) before the unit can respond to the external trigger.

In all modes of operation, pressing the ENABLE button (or GUI panel OFF button) while the unit is "enabled" will disable the solenoid.

Keyswitch LED - Lit when the key-operated enable switch is turned on.

Settings display - shows the name of the associated K-Cube together with the following user specified settings:

Cycle On Time (ms) - The time which the solenoid is activated (i.e. the shutter/ solenoid is open) 100ms to 100s

Cycle Off Time (ms) - The time which the solenoid is de-activated (i.e. the shutter/ solenoid is closed) 100ms to 100s.

Number Cycles - The number of Open/Close cycles to perform when the unit is operating in 'Auto' mode 1 to 1,000,000. If set to '0' the unit cycles indefinitely.

Settings button - Displays the 'Settings' panel, which allows the operating parameters to be entered - see Section 6.3.

Ident - when this button is pressed, the top panel display of the associated hardware unit will flash for a short period.

Active - not used.

Error - not used.

6.3 Settings Panel

When the 'Settings' button on the GUI panel is clicked, the 'Settings' window is displayed. This panel allows operating parameters, e.g. On and OFF times, to be modified. Note that these parameters also have programmable equivalents accessible through the ActiveX methods and properties on this Control (refer to the *Programming Guide* in the *APTServer helpfile* for further details and to Section 2.3.4. for an overview of the APT ActiveX controls).

6.3.1 Settings Tab

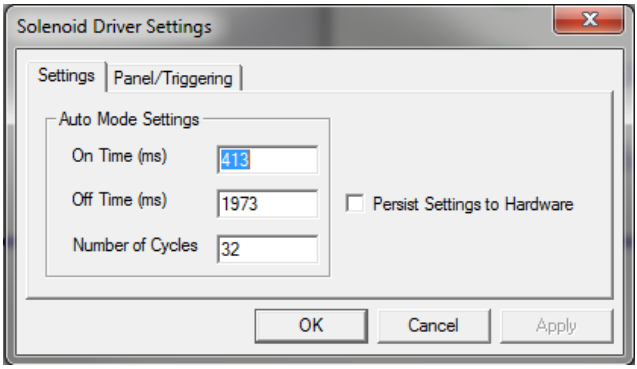


Fig. 6.2 Solenoid Controller - Settings

Auto Mode Settings

On Time (ms) - The time which the solenoid is activated (i.e. the shutter/ solenoid is open) 100ms to 100s in 1 ms steps.

Off Time (ms) - The time which the solenoid is de-activated (i.e. the shutter/ solenoid is closed) 100ms to 100s in 1 ms steps.

Number of Cycles - The number of Open/Close cycles (0 to 1,000,000) to perform when the unit is operating in 'Auto' mode. If set to '0' the unit cycles indefinitely.

Note

If operating in 'Triggered' mode with the *Number of Cycles* parameter set to '0', then the solenoid ON and OFF times are defined respectively by the HIGH and LOW values of the trigger pulse.

Persist Settings to Hardware

The parameters described above, together with the 'Mode' parameter set via the GUI panel, 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 unit is being used manually in the absence of a PC and USB link. To save the settings to hardware, check the 'Persist Settings to Hardware' checkbox before clicking the 'OK button.

6.3.2 Panel/Triggering Tab

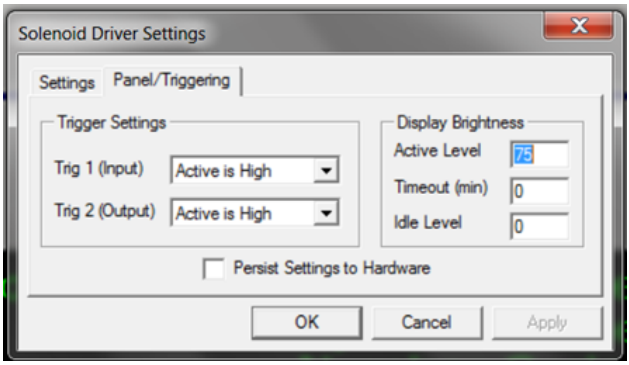


Fig. 6.3 Solenoid Controller - Panel/Triggering

Display Brightness

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 *Active Level* 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 *Timeout (min)* parameter has elapsed. The time interval is specified in minutes in the range 0 (never dimmed) to 480. The dim level is set in the *Idle Level* parameter, as a value from 0 (Off) to 10 (brightest) but is also limited by the *Active Value* parameter if this is lower.

Triggering Introduction

The K-Cube solenoid controllers have two trigger ports that can be used to read an external logic signal or output a logic level to control external equipment. TRIG1 is preconfigured as an input and TRIG2 as an output. The active logic state can be selected High or Low to suit the requirements of the application. Electrically, TRIG2 outputs a 5 Volt logic signal and TRIG1 is designed to be driven from a 5 Volt logic.

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-down, so the state of the input with nothing connected will default to a logic LOW.

The output 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.

Triggering Settings

The polarity of the trigger pulse is specified in the *Trig 1 (Input)* and *Trig 2(Output)* parameters as follows:

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

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

Persist Settings to Hardware - Many of the parameters that can be set for the Solenoid 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 trigger parameters described here 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 Hardware' 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 APTUser, the default APTServer settings will be loaded at boot up, even if the 'Persist Settings' option has been checked.

Appendix A Rear Panel Connector Pinout Details

A.1 Rear Panel SOLENOID Connector

The 'SOLENOID' connector provides connection to the shutter, or other solenoid actuated device. The pin functions are detailed in Fig. A.1.

Pin	Description
1	Opto Anode (12V limited to 20mA)
2	Shutter Coil 15V Pulse, 10V steady state (0.4A max)
3	Shutter Coil Ground (When ON) Open CCT (When OFF)
4	Opto Cathode Ground
5	Opto Emitter Ground
6	Opto Collector (2.5V)

Fig. A.1 SOLENOID Connector Pin Identification

A.2 Trigger In and Trigger Out Connectors

The rear panel provides two 5V TTL type SMA connectors for use in triggering applications. TRIG 1 is preconfigured as an input and TRIG 2 is an output, pulled up to 5V.

Appendix B 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.

B.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).

B.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 C Specifications and Associated Parts

C.1 Specifications

Parameter	Value
Maximum Exposure Rate	20 Hz
Minimum Exposure Time	15 ms
Typical Transfer Time	1.5 ms
Accuracy	0.3 ms (at 15 ms exposure)
On/Off Times	10 ms to 1000 s
Maximum steady state power	3.5 W
Hold voltage range	6.5 to 7.5 Average Volts PWM
Voltage Output	15 V Max (7 V Average PWM Hold)
Trigger Input/Output	TTL
Output Enable	Key Switch and Interlock Jack Plug
Operating Modes	
Manual	User Controlled On/Off
Single	DSP Controlled Single On/Off Cycle
Auto	DSP Controlled Multiple On/Off Cycles
Triggered	Externally Triggered On/Off
TRIG 1	Trigger Input, SMA, TTL Type 5V
TRIG 2	Trigger Output, SMA, TTL Type 5V
Output (6 Way Hirose)	
Solenoid Drive	15V Pulse (10V Hold)
Position Sensor Feedback	Photodiode
Input Power Requirements	
Voltage	15 V Regulated DC
Current	1A Peak, 300mA Steady State
General	
Housing Dimensions (W x D x H)	60 x 60 x 47 mm (2.4" x 2.4" x 1.8")
USB Connector Type	USB 3.0
USB Connection Speed	USB 1.1 Full Speed (12 Mbps)
Instrument Weight	160 g (5.5 oz)

C.2 Associated Products

Product Name	Part Number
K-Cube Controller 6-Channel USB Hub	KCH601
K-Cube Controller 3-Channel USB Hub	KCH301
Single Way Power Supply	KPS201[a]
1/2” Shutter	SH05
1” Shutter	SH1

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

Appendix D Motor Control Method Summary

In addition to providing the functionality required for a client application to control one or more of the APT series of motor controller units, the 'Motor' ActiveX Control also provides the functionality for the KSC101 K-Cube Solenoid Controller.

To specify the particular controller being addressed, every unit is factory programmed with a unique 8-digit serial number. This serial number is key to the operation of the APT Server software and is used by the Server to enumerate and communicate independently with multiple hardware units connected on the same USB bus. The serial number must be specified using the HWSerialNum property before an ActiveX control instance can communicate with the hardware unit. This can be done at design time or at run time. Note that the appearance of the ActiveX Control GUI (graphical user interface) will change to the required format when the serial number has been entered.

A brief summary of the methods and properties applicable to the KSC101 is given below,. For more detailed information and individual parameter descriptions, please see the on-line help file supplied with the APT server.

Methods

DeleteParamSet	Deletes stored settings for specific controller.
GetCtrlStarted	Gets the ActiveX Control started flag.
SC_Disable	Disables (turns off) the solenoid.
SC_Enable	Enables (turns on) the solenoid.
SC_GetCycleParams	Gets solenoid parameters for automated on/off operation.
SC_GetOperatingMode	Gets the solenoid operating mode.
SC_GetOPState	Gets the activity state of the solenoid.
SC_SetCycleParams	Sets solenoid parameters for automated on/off operation.
SC_SetOperatingMode	Sets the solenoid operating mode.
ShowSettingsDlg	Display the GUI Settings panel.
StartCtrl	Starts the ActiveX Control (starts communication with controller)
StopCtrl	Stops the ActiveX Control (stops communication with controller)

Properties

APTHelp	Specifies the help file that will be accessed when the user presses the F1 key. If APTHelp is set to 'True', the main server helpfile MG17Base will be launched.
HWSerialNum	specifies the serial number of the hardware unit to be associated with an ActiveX control instance.

Appendix E Regulatory

E.1 Declarations Of Conformity

E.1.1 For Customers in Europe

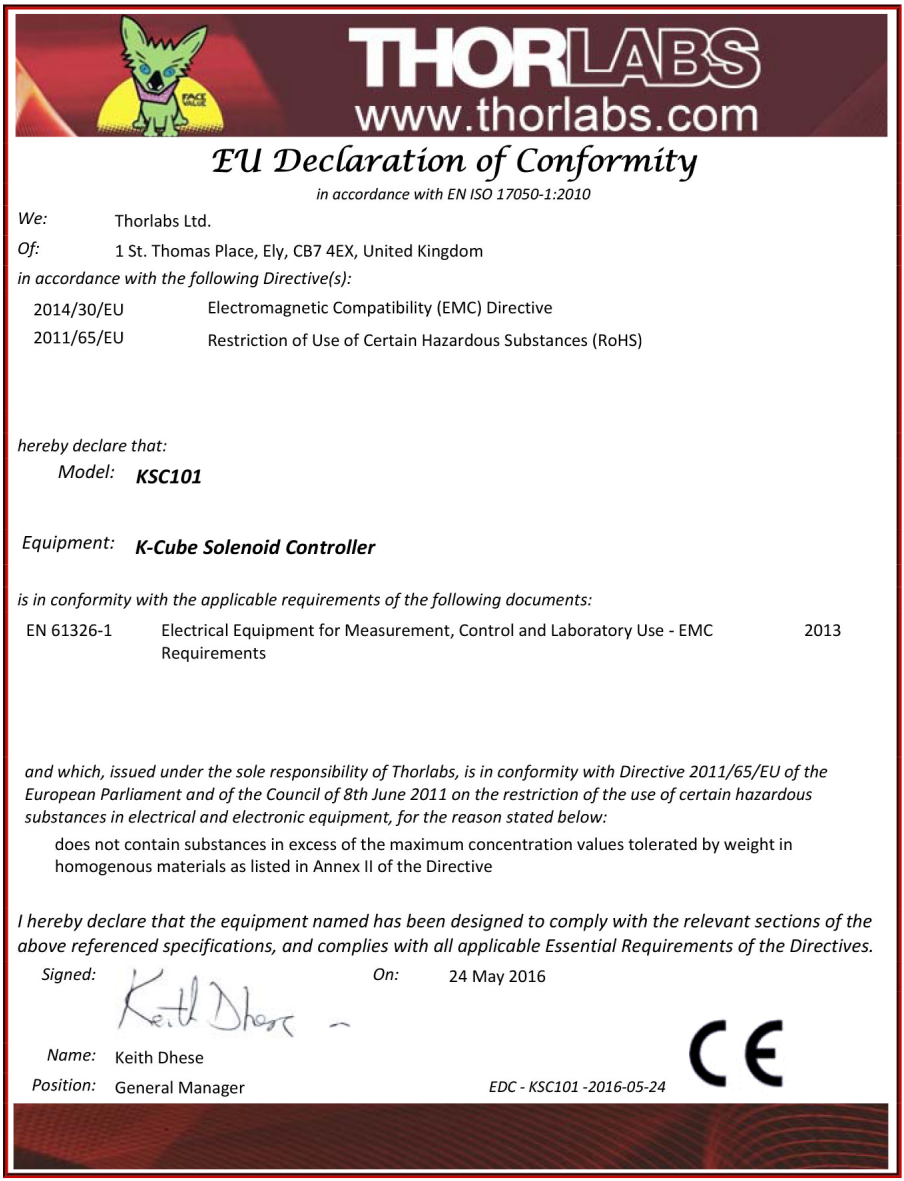
See Section E.2.

E.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.

E.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):

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

hereby declare that:

Model: ***KSC101***

Equipment: ***K-Cube Solenoid Controller***

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

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: *On:* 24 May 2016

Name: Keith Dhese

Position: General Manager

EDC - KSC101 -2016-05-24

CE

Appendix F 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.