THORLABS

KLS635
KLS1550
K-Cube Laser Source

APT User Guide

Original Instructions

Contents

Appendices

Chapter 1   Overview

1.1   Introduction

The KLSxxx K-Cube is a Fiber Coupled Laser source for stand alone operation or use with the K-Cube Controller Hub. It uses an internally-pigtailed Fabry-Perot laser diode that is connected to the rear panel FC feed through via a single mode fiber. By connecting a fiber to fiber connection at the output, these devices deliver more useful optical power than systems that use a receptacle with embedded optics.

This laser source is a fully functional yet highly compact controller, incorporating driver electronics and FC/PC connected pigtailed laser diode in both 635nm and 1550nm variants. It is provided with a USB interface for easy PC control and also a manual interface panel containing an LCD display, adjustment potentiometer, Enable button and safety keyswitch.

The laser source operates in 'constant optical power' mode. The output power of the laser diode is monitored continuously. A feedback circuit adjusts the laser power to achieve a constant output power.

For convenience the footprint of this unit has been kept to a minimum, measuring only 121mm x 60mm x 47mm (4.8" 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. The Menu and Enable buttons allow the various operating modes to be selected easily. There is also a key switch and interlock plug fitted to this compact unit for use in laser applications requiring such functionality.

Fig. 1.1   K-Cube Laser Source (KLS635)

USB connectivity provides easy 'Plug and Play' PC controlled operation - multiple K-Cube units can be connected to a single PC via standard USB hub technology, or by using the K-Cube Controller Hub (see below). Coupling this with the user friendly APT software (supplied) allows the user to get up and running in a short space of time. Advanced custom applications and sequences are also possible using the extensive programming environment also supplied. This programming library is compatible with many development tools such as LabView, Visual Basic, Visual C++, C++ Builder, LabWindows/CVI, and Delphi.

See Section 1.3. for a full description of the software.

In the remainder of this handbook, the Tutorial section (Chapter 5) provides a good initial understanding on using the unit, and the reference section (Chapter 6) covers all operating modes and parameters in detail.

1.2 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 these controllers, Thorlabs also offers a 3-channel (KCH301) and 6-channel (KCH601) K-Cube Controller Hub. 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.

Internally the Controller Hub contains a fully compliant USB 2.0 hub circuit to provide communications for all six 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 up to six K-Cubes, requiring only a single power connection.

See the product page at www.thorlabs.com for more details.

1.3 APT Software Overview

As a member of the APT range of controllers, the KLSxxx Laser Source 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 1.3.1.) and APTConfig (see Section 1.3.2.) 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 1.3.3.

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 1.3.3. for further details.

1.3.1   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.
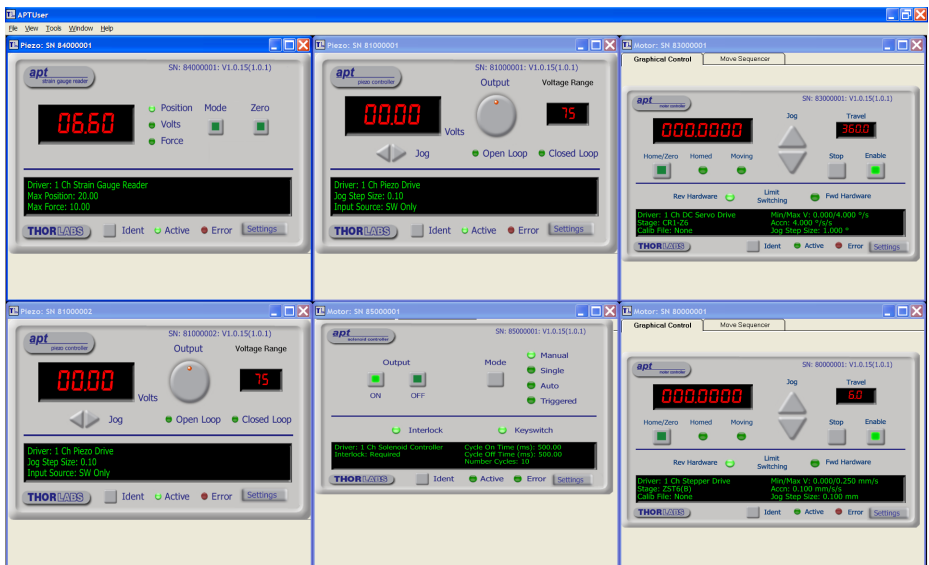
All basic operating parameters can be altered and, similarly, all operations (such as setting the scan circle size) can be initiated. Settings and parameter changes can be saved and loaded to allow multiple operating configurations to be created and easily applied.

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 customize and automate usage of the controller (e.g. to implement a positioning algorithm), 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.

1.3.2 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 only be made 'off-line' before running the APT software. These settings have global effect; such as switching between simulator and real operating mode and incorporation of calibration data.
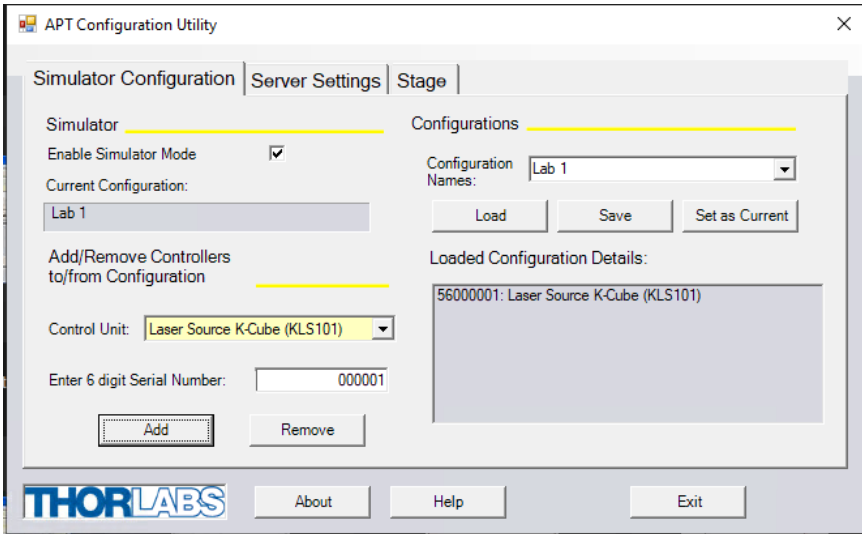

The APTConfig utility is provided as a convenient means for making these system wide settings and adjustments. Full details on using APTConfig are provided in the online help supplied with the utility.

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.

1.3.3   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 KSG101 Strain Gauge controller. 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 with the KLSxxx Laser Source K-Cube.
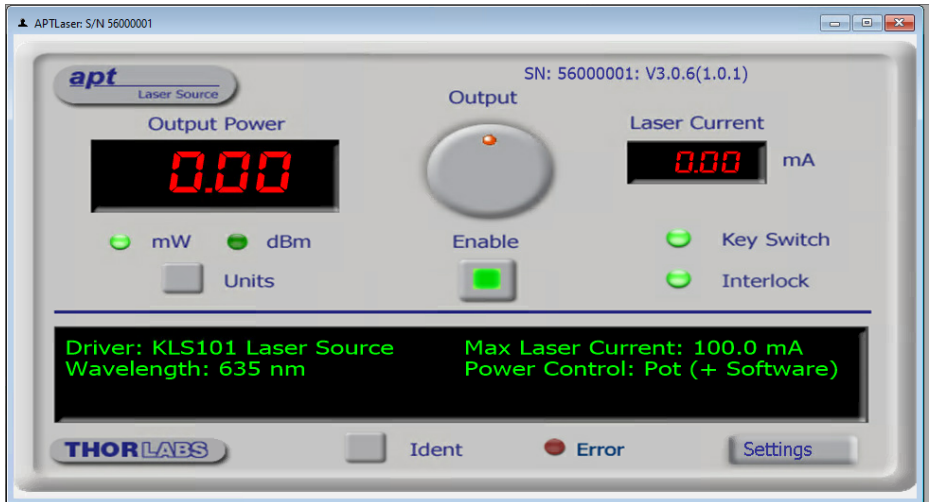
This Control provides a complete user graphical instrument panel to allow the Laser Driver unit to be manually operated, as well as a complete set of software functions (often called methods) to allow all parameters to be set and control operations to be automated by a client application. The instrument panel reflects the current operating state of the controller unit to which it is associated (e.g. such as Laser Intensity). 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 Laser Driver Control to track the increase the laser intensity, progress is monitored automatically on the graphical interface, without the need for further programming intervention.

For many users, the GUI application provides all of the functionality necessary to operate the hardware without the need to develop any further custom software. For those who do need to further customize and automate usage of the controller, this application illustrates how the rich functionality provided by the APT server is exposed by a client application.

The APT Controls collection provides a rich set of graphical user panels and programmable interfaces allowing users and client application developers to interact seamlessly with the hardware. Each of the controllers has an associated ActiveX Control and these are described fully in the handbooks associated with the controllers.
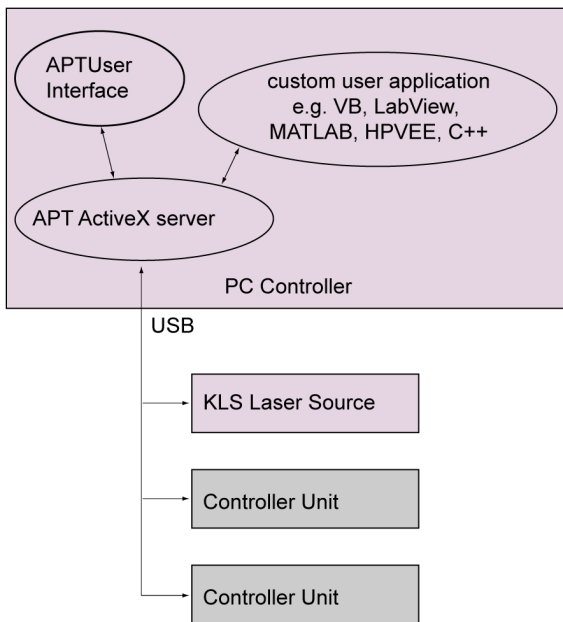
Fig. 1.2   System Architecture Diagram

Refer to the main APT Software online help file, for a complete programmers guide and reference material on using the 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.

1.3.4   Software Upgrades

Thorlabs operate a policy of continuous product development and may issue software upgrades as necessary. The latest software can be downloaded from the 'services' section of www.thorlabs.com.

Chapter 2   Safety

2.1   Safety Information

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

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

> **Warning: Risk of Electrical Shock**
>
> Given when there is a risk of injury from electrical shock.

> **Warning: Laser Radiation**
>
> Given when there is a risk of injury from laser radiation.

> **Warning**
>
> Given when there is a risk of injury to users.

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

> **Note**
>
> Clarification of an instruction or additional information.

2.2   General Warnings

> **Warning**
>
> If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. In particular, excessive moisture may impair operation.
>
> Spillage of fluid, such as sample solutions, should be avoided. If spillage does occur, clean up immediately using absorbant tissue. Do not allow spilled fluid to enter the internal mechanism.

2.3 Warnings Relating To Laser Safety

Warning: Laser Radiation

Inappropriate use of any Laser product could result in permanent eye damage.

To prevent injury, all personnel in the vicinity of the laser source should wear appropriate eye protection.

2.4 Laser Markings

The KLS1550 is a Class 1 laser product. The KLS635 is a Class 3B laser product. The units are marked as follows::

KLS1550   **KLS635**

FC/PC OUTPUT   **FC/PC OUTPUT**

CLASS 1 LASER PRODUCT

LASER RADIATION
AVOID DIRECT EYE EXPOSURE
1500 - 1800nm <10mW

CLASS 3B LASER PRODUCT

LASER RADIATION
AVOID DIRECT EYE EXPOSURE
600 - 700nm <10mW

COMPLIES WITH IEC 60825-1 ED 1.2 2001-01 AND 21 CFR 1040.10 AND 1040.11 EXCEPT FOR DEVIATIONS PERSUANT TO LASER NOTICE NO. 50 DATED 5/27/2001

COMPLIES WITH IEC 60825-1 ED 1.2 2001-01 AND 21 CFR 1040.10 AND 1040.11 EXCEPT FOR DEVIATIONS PERSUANT TO LASER NOTICE NO. 50 DATED 5/27/2001
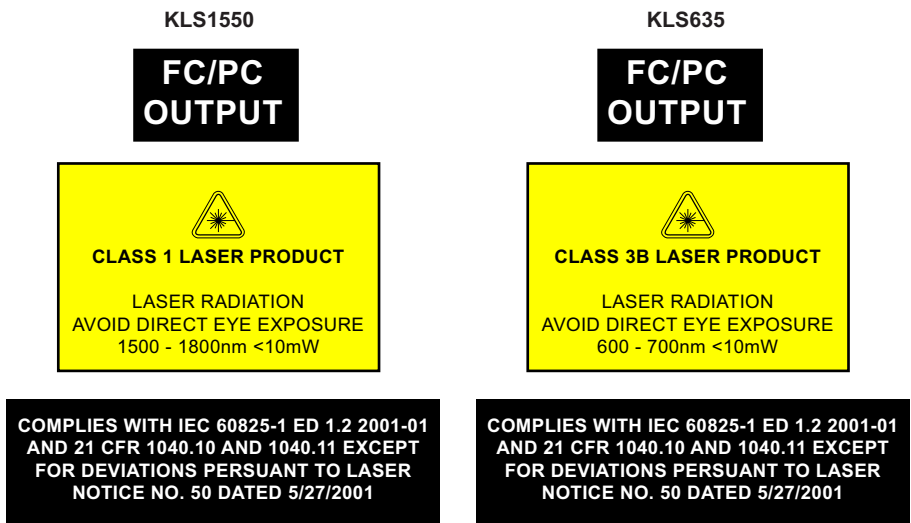
Fig. 2.1 Laser Markings

Note

The output power of the KLS1550 is limited to 7.0 mW and the KLS635 is limited to 8 mW, even though the standard warning labels above quote 10 mW.

Chapter 3   Getting Started

3.1   Install The Software

> **Note**
>
> When operating via a PC, direct user interaction with the unit is accomplished through intuitive graphical user interface panels (GUIs), which expose all key operating parameters and modes. The user can select multiple panel views displaying different information about a particular hardware unit. The multitasking 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 Laser Source is shipped with a baseplate fitted, ready to be bolted 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 1.2. 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 buttons.

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 four clips.

Fig. 3.1   Using The Baseplate

3.3   Electrical Installation
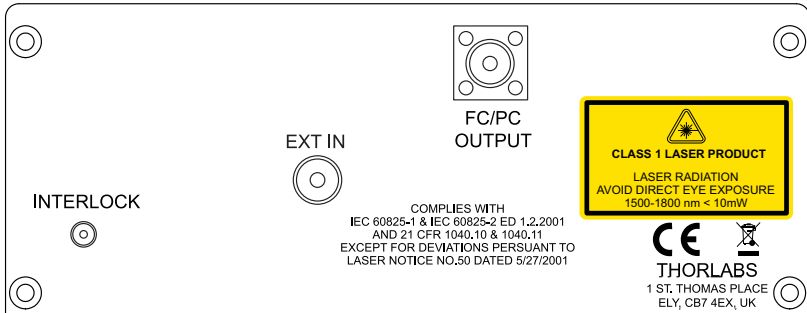
3.3.1   Rear Panel

Fig. 3.2 Rear Panel Connections

INTERLOCK – The interlock must be fitted before the laser output can be enabled. The INTERLOCK LED on the GUI panel is lit green when the 'Interlock' pin is fitted, red when open circuit - see Section 6.1.

> ⚠️ **Caution**
>
> Do not apply a voltage to this connector

FC/PC OUTPUT – Provides connection of the output fiber.

EXT IN (SMA connector) – Used to control the intensity of the laser output from an external source. This input can be driven from a 0 to 10V voltage source. The input impedence is 16kΩ.

> **Note**
>
> Thorlabs supply a variety of SMA to BNC and SMC to BNC adaptor and extension cables. Please see our catalog, or visit www.Thorlabs.com for further details.

3.3.2   Using the Safety Interlock and Key Switch

The K-Cube Laser Source is a class 1 (1550 nm) / class 3B (635 nm) laser device and therefore is not required to have a safety interlock and/or key switch. However, a functional interlock (see Fig. 3.2) and key switch (see Fig. 4.1) is provided on these products. The key switch must be turned on, and a short circuit must be applied across the terminals of the interlock before the unit can be enabled.

An INTERLOCK pin (2.5mm) is supplied with the unit to close this connection. Alternatively, the contact can be controlled externally; the user can use a custom 2.5mm jackplug connected to a remote actuated (normally open) switch (e.g. an open door indicator), which must be closed before the unit can operate.

> **Note**
>
> When open circuit, the INTERLOCK jack centre pin is at about +3.7V. When shorted, the current is typically 1mA.

3.3.3 Front Panel

Fig. 3.3 Front Panel Connections

POWER - A Standard 3.5 mm front panel jack connector for connecting the unit to a regulated DC power supply of 15 V, 0.4 - 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. 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.

IO 1 and IO 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 6.2.2.

3.3.4   Supply Voltage and Current Requirements

The unit is fitted with a 3.5 mm DC connector. Thorlabs offers a compact, 15V single way power supply (KPS201) for use with a single laser source cube. Alternatively, an external regulated 15V power supply can be used.

> ⚠️ **Warning**
>
> Exceeding the power supply maximum voltage, or connecting a reverse polarity voltage can cause permanent damage to the unit and could result in personnel injury.

Supply	Minimum	Maximum	Operating Current
+15V	+14.9V	+15.1V	Typically 150 mA, Max 400 mA

> ⚠️ **Caution**
>
> Do not connect the laser driver to a 'live' external power supply. Doing so (i.e. "hot plugging") carries the risk of PERMANENT damage to the unit. Always ensure the power supply unit is isolated from the mains and the front panel switch turn OFF before connecting to the unit.
>
> Always power up the laser driver by connecting its power supply to the mains then switch ON using the front panel switch. Similarly, to power down the unit, turn the front panel switch OFF, then disconnect the power supply from the mains before disconnecting the laser driver.

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 in the order stated. Problems may occur if the process is not performed in the correct sequence.

3) Connect the laser source unit to your PC.

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

4) Connect the connectorized output fiber to the unit - see Section 3.3.1.
5) Connect the INTERLOCK jack pin - see Section 3.3.2..

> ⚠️ **Caution**
>
> During item (6) ensure the power switch on the front 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.

6) Connect the Controller unit to the power supply - see Section 3.3.
7) Connect the PSU to the main supply.
8) Switch 'ON' the unit using the switch on the front panel.
9) Windows® should detect the new hardware. Wait while Windows® installs the drivers for the new hardware.

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

```
THORLABS



Thorlabs KLS635

SwRev 010001
```

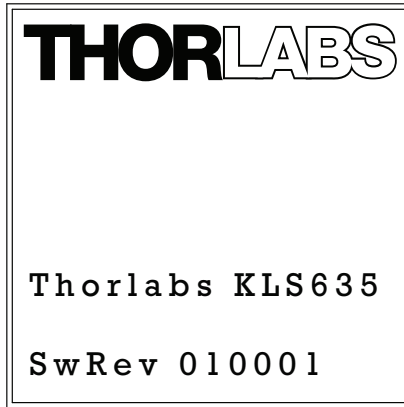**Fig. 3.4   KLS635 start up screen**

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.

For best accuracy, wait approximately 30 minutes for the unit to thermally stabilize to the environment.

Chapter 4   Standalone Operation

4.1   Control Panel Buttons and Indicators
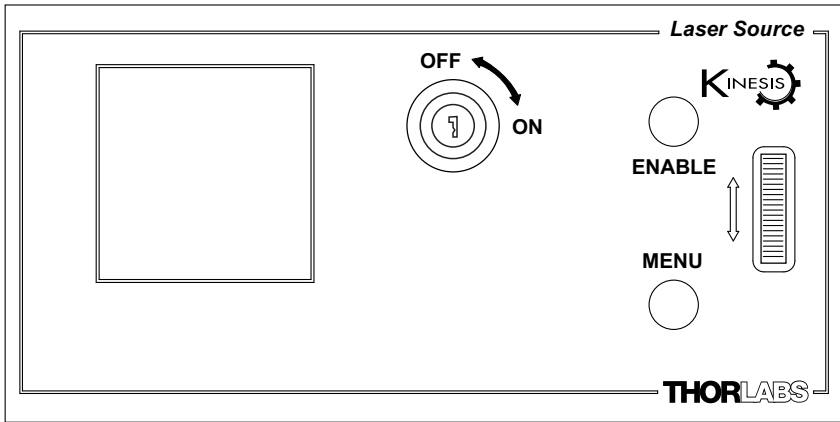
Fig. 4.1 Panel Controls and Indicators

Wheel - Used to set the laser power and to scroll through the setting menu options - see Section 4.2.

Digital Display - The display shows the menu options and settings, accessed via the menu button - see Section 4.3. 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 4.3.

ENABLE - Turns the laser output ON and OFF.

KEYSWITCH - Turns the laser output ON and OFF. The KEYSWITCH LED on the GUI panel is lit green when the key switch is turned ON and red when the switch is OFF - see Section 6.1.

Note

The main display will flash when the 'Ident' button is clicked on the Software GUI panel - see Section 6.1. for further details.

4.1.1   Digital Display - Operating Mode

During normal operation, the digital display shows the laser output power in mW and dBm (The dBm mode uses a 1mW reference, i.e. 0dBm = 1mW) and the laser output current in mA. It also shows a bar graph which represents the output power level in relation to full power.
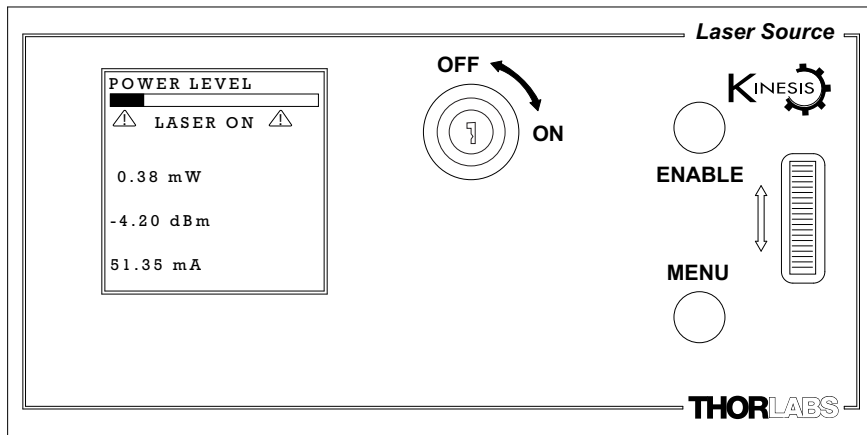

Fig. 4.2   Digital Display - Normal Operation

The interlock jack plug must be fitted and the key switch turned on (see Section 3.3.2.) before the laser output can be enabled. Once enabled, a LASER ON warning is displayed on the digital display.

4.2   Top Panel Wheel Operation

The top panel wheel is an infinite turn encoder, used to adjust the output of the laser. To increase the output, turn the wheel upwards - once the maximum output is attained, subsequent upwards turns have no effect, however the output decreases immediately the control is turned downwards. Similarly, once the output has been decreased to zero, subsequent downwards turns have no effect, but the output increases immediately the control is turned upwards.

> **Note**
>
> Operating the KLS unit at maximum power (>70%) for long periods can shorten the life of the product.

The wheel is also used to scroll through the settings menu options as described in Section 4.3.

4.3 Settings Menu

4.3.1 Overview

After the power up sequence is complete, the normal operating screen is displayed.

```
POWER LEVEL
⚠  LASER ON  ⚠

 0.38 mW

-4.20 dBm

51.35 mA
```
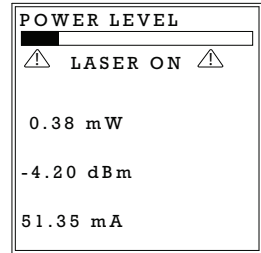
MENU

Press the MENU button to enter the settings mode.

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

```
OPTION MENU
Use the wheel ↕
to select the
submenu..
```
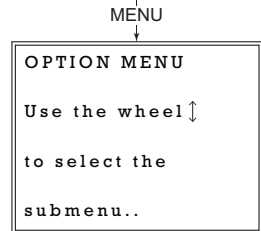
Set the Control Input Source - see Section 4.3.2.

```
1 CONTROL SOURCE
Press MENU and
use the wheel ↕
to change.
```
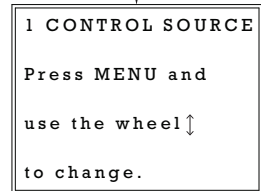
Set the display brightness - see Section 4.3.3.

```
2 BRIGHTNESS
Press MENU and
use the wheel ↕
to change.
```
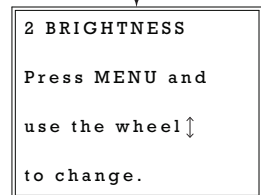
Display information - see Section 4.3.4.

```
3 INFORMATION
Wavelength: 1.5um
Max power: 7mW
Temp: 30°C (86°F)
SwRev: 010001
```

```
┌─────────────────────────┐
│ POWER LEVEL             │
│ ⚠  LASER ON  ⚠         │
└─────────────────────────┘
```
MENU
```
┌─────────────────────────┐
│ OPTION MENU            │
│ Use the wheel ↕        │
└─────────────────────────┘
```
MENU
```
┌─────────────────────────┐
│ 1 CONTROL SOURCE       │
│ Press MENU and         │
│ use the wheel ↕        │
│ to change.             │
└─────────────────────────┘
```

```
┌─────────────────────────┐
│ SELECT CONTROL         │
│ WHEEL+SOFTWARE         │
│ use the wheel ↕        │
│ to change.             │
└─────────────────────────┘
```

```
┌─────────────────────────┐
│ SELECT CONTROL         │
│ EXTERNAL ONLY          │
│ use the wheel ↕        │
│ to change.             │
└─────────────────────────┘
```

```
┌─────────────────────────┐
│ SELECT CONTROL         │
│ SOFTWARE ONLY          │
│ use the wheel ↕        │
│ to change.             │
└─────────────────────────┘
```
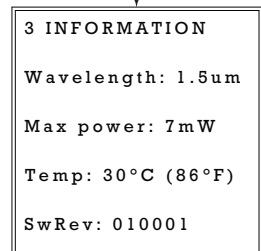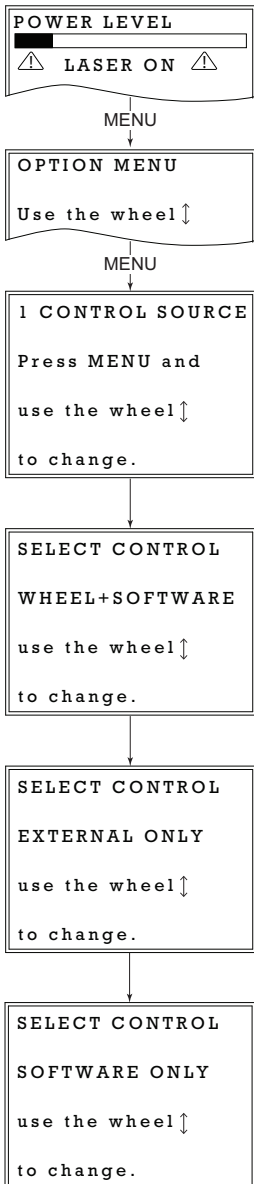
4.3.2   Menu Option - CONTROL SOURCE

This option is used to select the method of adjusting the laser power; top panel wheel and/or software, software only, or via a 0 to 10V source connect to the rear panel EXT IN connector.

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

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

If *WHEEL+SOFTWARE* is selected, the output is the sum of the value set in software and that set using the top panel wheel.

If *EXTERNAL ONLY* is selected, the unit responds only to the analog signal on the rear panel EXT IN SMC connector (0 to 10V).

If SOFTWARE ONLY is selected, the unit responds only to software commands and the output to the laser is that set using the appropriate software function, or the 'SET' control on the GUI panel.
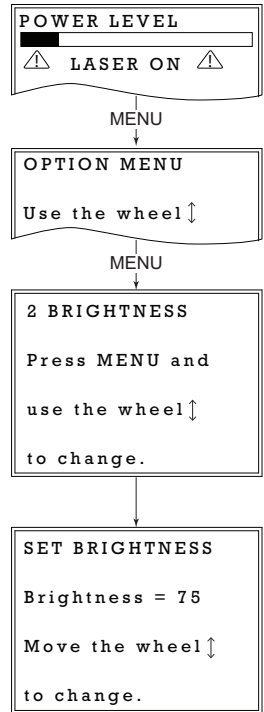
4.3.3 Menu Option - BRIGHTNESS

In certain applications, it may be necessary to adjust the brightness of the LCD display. The brightness is set as a value from 30 (dimmest) to 100 (brightest). The display cannot be turned off completely.

```
┌─────────────────────────┐
│ POWER LEVEL             │
│ ▇▇▇▇                    │
│ ⚠  LASER ON  ⚠          │
└─────────────────────────┘
          MENU
           ↓
```

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

```
┌─────────────────────────┐
│ OPTION MENU             │
│                         │
│ Use the wheel ↕         │
└─────────────────────────┘
          MENU
           ↓
```

Press the MENU button to enter the Brightness option.

```
┌─────────────────────────┐
│ 2 BRIGHTNESS            │
│                         │
│ Press MENU and          │
│                         │
│ use the wheel ↕         │
│                         │
│ to change.              │
└─────────────────────────┘
           ↓
```

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

```
┌─────────────────────────┐
│ SET BRIGHTNESS          │
│                         │
│ Brightness = 75         │
│                         │
│ Move the wheel ↕        │
│                         │
│ to change.              │
└─────────────────────────┘
```
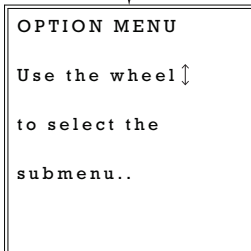
4.3.4   Menu Option - INFORMATION

This option is used to display the present settings for wavelength, Max Power, Temperature and Software version number.
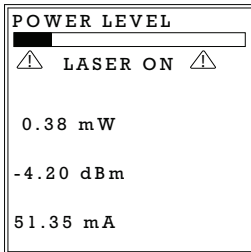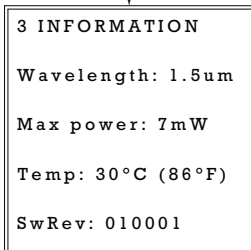
```
┌────────────────────────┐
│POWER LEVEL             │
│ ⚠  LASER ON  ⚠         │
│                        │
│ 0.38 mW                │
│                        │
│-4.20 dBm               │
│                        │
│51.35 mA                │
└────────────────────────┘
```

MENU

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

Press the MENU button to enter the INFORMATION option.

```
┌────────────────────────┐
│OPTION MENU             │
│Use the wheel ↕         │
│                        │
│to select the           │
│                        │
│submenu..               │
│                        │
│                        │
└────────────────────────┘
```

```
┌────────────────────────┐
│3 INFORMATION           │
│                        │
│Wavelength: 1.5um       │
│                        │
│Max power: 7mW          │
│                        │
│Temp: 30°C (86°F)       │
│                        │
│SwRev: 010001           │
└────────────────────────┘
```

The present settings for Wavelength, Max Power, Temperature and the Software version number are displayed.

Press the MENU button to return to the main operating display. The unit will automatically return to the operating display after 5 seconds.

4.4   Manual Operation Tutorial

1) Connect an optical device to the LASER OUT socket on the rear panel.
2) Make power supply connections as detailed in Section 3.3.3.
3) Turn ON the power supply unit.
4) Fit the INTERLOCK pin - see Section 3.3.2.
5) Turn on the unit using the switch on the front panel.
6) Turn the Key Switch ON.
7) Press the ENABLE button to turn ON the laser output.
8) Turn the wheel to adjust the laser intensity.

Note

The keyswitch must be turned 'ON' and the interlock fitted before the laser can be enabled. During normal operation, if the interlock is removed or the keyswitch turned 'OFF', the laser must be re-enabled before it can operate.

Chapter 5   PC Operation - Tutorial

5.1   Introduction

The following brief tutorial guides the user through a typical series of actions and parameter adjustments performed using the PC based software. It assumes that the unit is electrically connected as shown in Section 3.3. and that the Software is already installed - see Section 3.1.

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 laser intensity adjustment) can be initiated. Hardware configurations and parameter settings can be saved to a file, which simplifies system set up whenever APT User is run up.

This tutorial shows how the APTUser application provides all of the functionality necessary to operate the APT hardware.

1)   Connect the laser source as detailed in Section 3.3. then switch the unit ON.

Note

The 'APT Config' utility can be used 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 - see Section 5.3. for further details.

2)   For best accuracy, wait approximately 30 minutes for the unit to thermally stabilize to the environment.

3)   Fit the INTERLOCK jack plug - see Section 3.3.2.

4)   Turn the Key Switch ON.

5)   Run the APT User program - Start/All Programs/Thorlabs/APT User/APT User. The APT server registers automatically the units connected on the USB bus and displays the associated GUI panels as shown in Fig. 5.1.

6) Click the 'Enable' button on the GUI to turn ON the laser output. Notice how the LED in the button is lit to indicate that the laser output is ON..
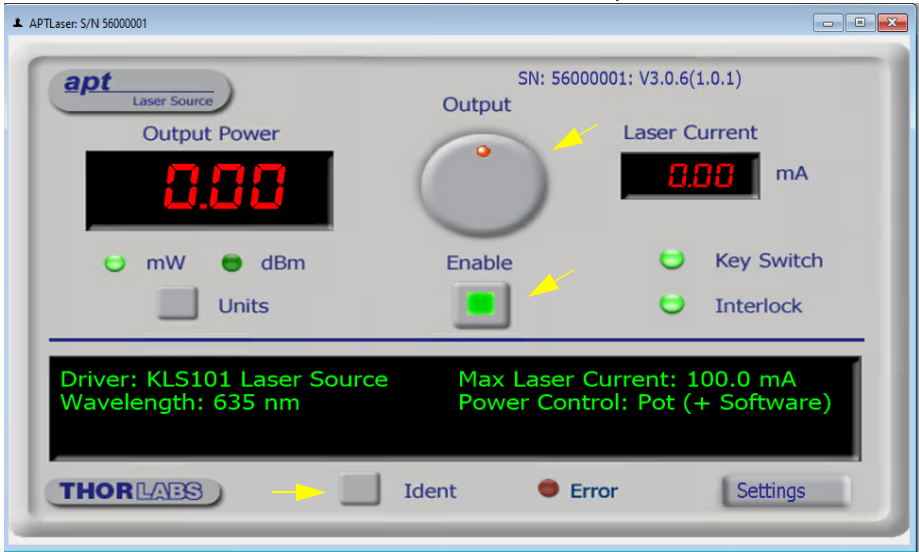

Fig. 5.1 Gui panel showing jog and ident buttons

7) Click the 'Ident' button. The Power LED and digital display on the front panel of the associated controller flashes. This is useful in multi-channel systems for identifying which channel is associated with which GUI.

8) Turn the OUTPUT control on the GUI panel to change the output power of the laser. The power display should increment and decrement accordingly.

9) Click and hold on the OUTPUT control then rotate to adjust the laser intensity.

10) Click the units button to toggle between mW and dBm display modes.

See Section 6.1. for more details on the parameters shown in the GUI panel.

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.
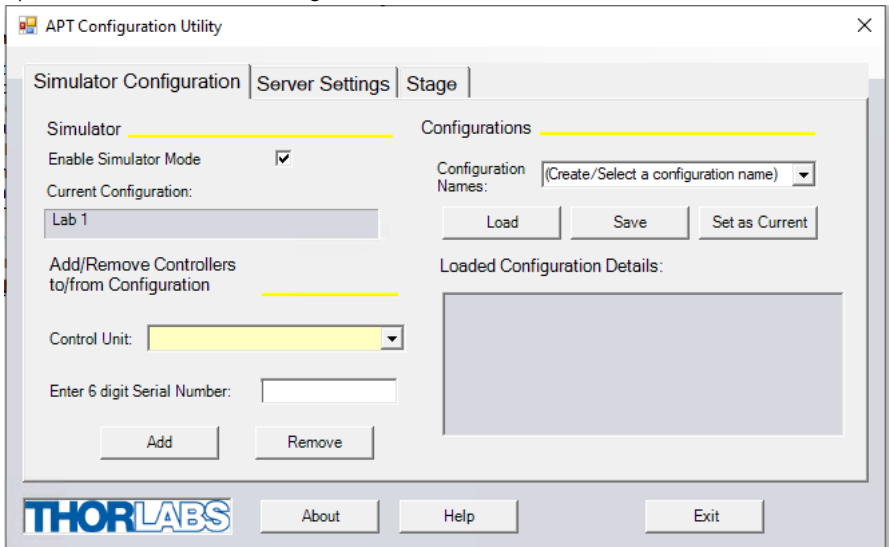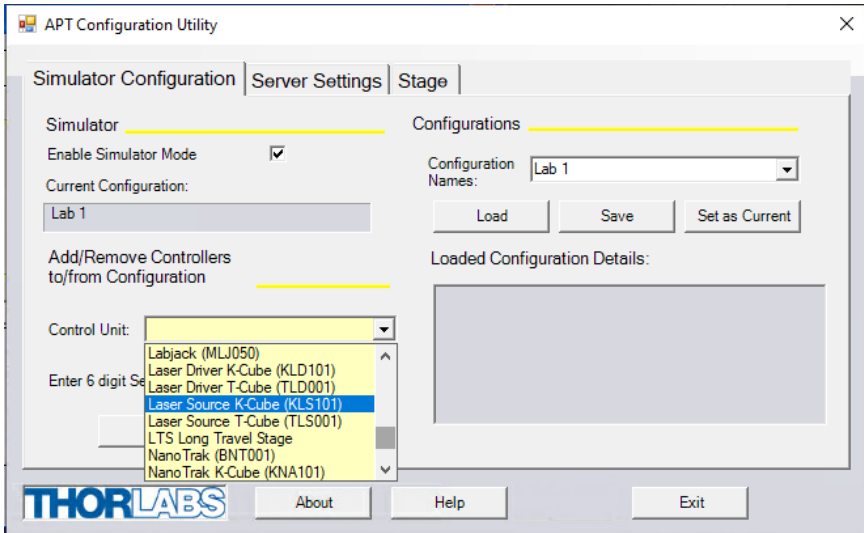
2) Click the 'Simulator Configuration' tab.

Fig. 5.2 APT Configuration Utility - Simulator Configuration Tab

3) Enter a configuration name, e.g. 'LAB1' 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 'Laser Source K-Cube (KLS101)'.
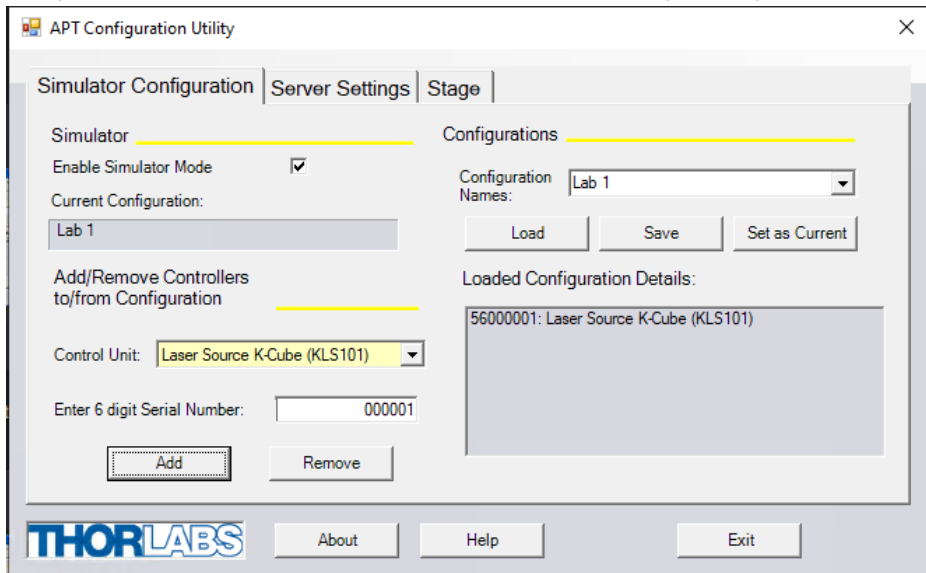
6) Enter a 6 digit serial number.

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 KLS series K-Cube Laser Sources are:

56xxxxxx - 1 Channel Laser Source T-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) Enter a name into the 'Configuration Names' field.
10) Click 'Save'.
11) Click 'Set As Current' to use the configuration.

Chapter 6   Software Reference

6.1   GUI Panel

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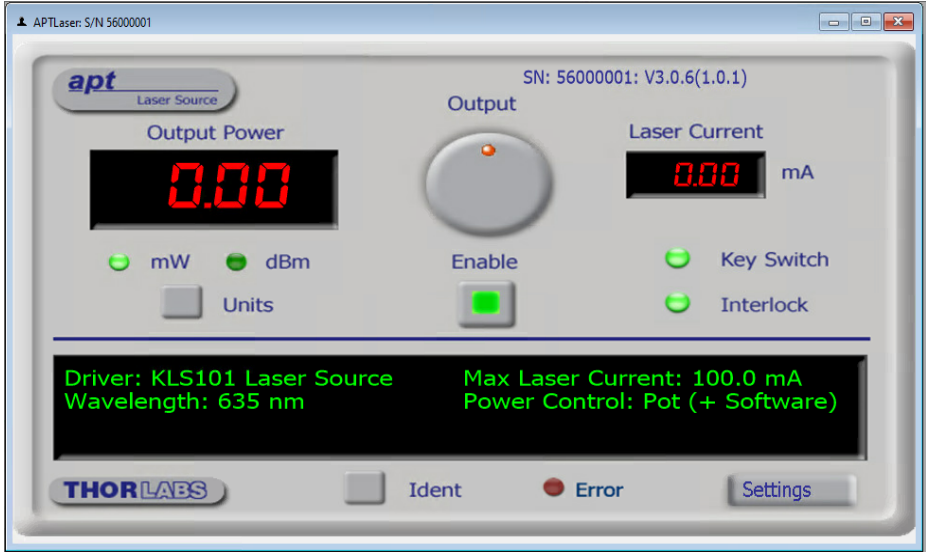

Fig. 6.1   Laser Source Software GUI

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

Output Control - used to adjust and set the output power of the laser, as displayed in the main digital display.

Output Power Display - shows the output power of the laser.

Laser Current Display - shows the actual output current of the laser.

mW and dBm LEDs - lit when the associated display units are selected - see Section 6.2.

Key Switch LED - lit green when the front panel key switch is turned ON, red when the switch is OFF - see Section 4.1.

Interlock LED - lit green when the 'Interlock' jack plug is fitted, red when open circuit - see Section 3.3.2.

Enable Button - turns the output of the laser ON and OFF.

> **Note**
>
> The laser output cannot be enabled unless the interlock jackplug is fitted and the key switch is turned on.

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

Wavelength - the wavelength of the laser output

Max Laser Current - the maximum current limit of the laser source. Due to individual variations between laser diodes, this value will differ from unit to unit.

Power Control: the source(s) which control the output from the laser unit :

Software Only - the unit responds only to software commands and the output to the laser is that set using the SetPowerSetpoint method, or the 'OUTPUT' control on the GUI panel.

Ext I/P (SMA) - the unit responds to the analog signal on the rear panel EXT IN SMA connector (0 to 10V).

Pot (+ Software) - the output is the sum of the value set in software and that set using the front panel potentiometer.

Settings button - Displays the 'Settings' panel, which allows the tuning parameters to be entered - see Section 6.2.

Ident - when this button is pressed, the front panel LED and digital display of the associated controller T-Cube will flash for a short period.

Active - lit when the unit is operating normally and no error condition exists.

Error - lit when an internal fault is detected.

6.2   Settings Panel

When the 'Settings' button on the GUI panel is clicked, the 'Settings' window is displayed. This panel allows data such as trigger functionality and input sources to be entered. Note that all of these parameters have programmable equivalents (refer to the *APT Server helpfile* for further details.

6.2.1   Control Tab
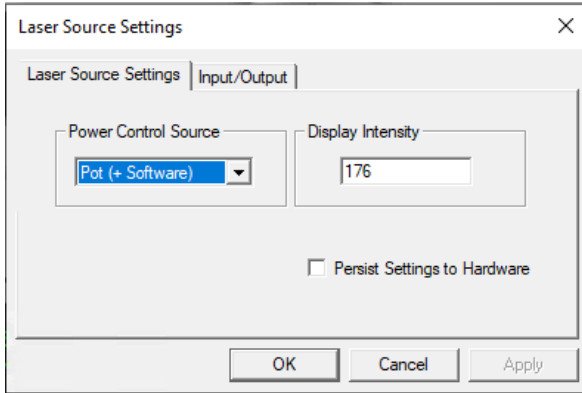

Fig. 6.1 Laser Source Settings Tab

Power Control Source - the source(s) which control the output from the laser unit:

If *Software Only* is selected, the unit responds only to software commands and the output to the laser is that set using the controls on the GUI panel (or software messages if applicable).

If *External Only* is selected, the unit responds to the analog signal on the rear panel EXT IN SMC connector (0 to 10V).

If *Pot + Software* is selected, the output is the sum of the value set via the GUI and that set using the top panel wheel.

Note

When the EXT IN is used for modulation the KLS works in hybrid constant current mode. The KLS searches for the laser threshold and then switches to current modulation.

Display Intensity - determines the brightness of the control panel display.

Enter a value from 0 to 255 (OFF to 100%).

Persist Settings to the Device - Many of the parameters that can be set for the KLS laser source 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 Step Size parameter described above is a good example of a setting 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 APT, the default APTServer settings will be loaded at boot up, even if the 'Persist Settings' option has been checked.
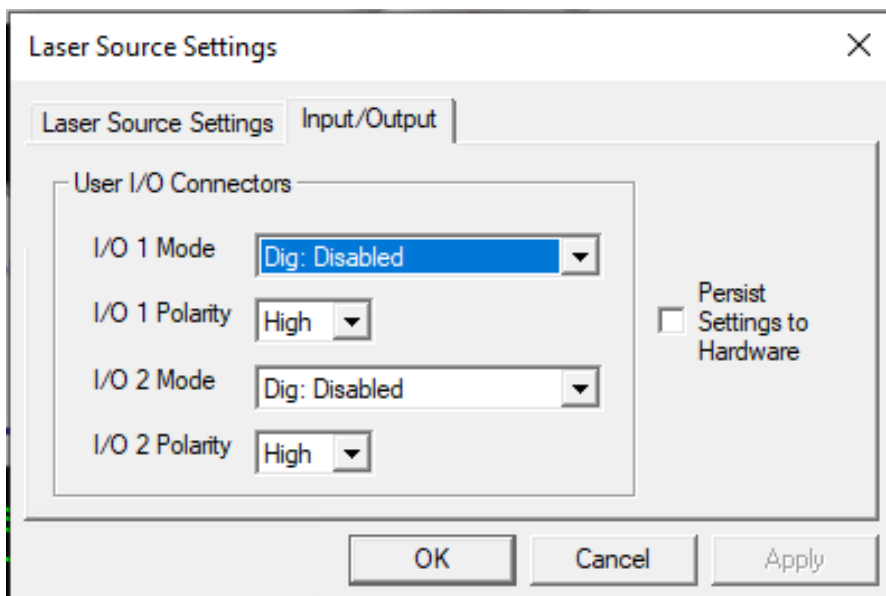

6.2.2   Input/Output Tab

Fig. 6.2 Laser Source Advanced Tab

User I/O Connectors

Note

When used for triggering, the IO port is edge sensitive, i.e. it has to see a transition from the inactive to the active logic state (Low to High or High to Low) for the trigger input to be recognized. For the same reason a sustained logic level will not result in repeated trigger signals. The trigger input has to return to its inactive state first in order to start the next trigger.

I/O 1 and I/O 2 Modes

When configured as an input, the IO ports can be used as a general purpose digital input, or for triggering a choice of actions as follows:

Disabled - The trigger IO is disabled.

Dig IN: Gen. Logic I/P - General purpose logic input (read through status bits using the software messages - see the helpfile for more details).

Output Trigger Modes

When configured as an output, the IO ports can be used as a general purpose digital output, or to indicate laser status or to produce a trigger pulse at specific events as follows:

Dig Out: Gen. Logic O/P - General purpose logic output (set using the software messages - (see the helpfile for more details).

Laser ON - Trigger output active when the laser output is ON. The output trigger goes high (5V) or low (0V) (as set in the *Polarity* parameter) when the laser is active.

Interlock - Trigger output active when the interlock state is Enabled.

Set Point Change - Trigger output active when the laser set point value is changed.

I/O 1 and I/O 2 Polarity - The active state of the Trigger, Active High (5V) or Active Low (0V)

Persist Settings to the Device - Many of the parameters that can be set for the Laser Source 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 *Input Source* parameter described previously is a good example of a setting 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.

Appendix A Preventive Maintenance

> **Warning**
>
> The equipment contains no user serviceable parts.
>
> Only personnel authorized by Thorlabs Ltd and trained in the maintenance of this equipment should remove its covers or attempt any repairs or adjustments.
>
> Maintenance is limited to safety testing and cleaning as described in the following sections.

A.1 Cleaning

> **Warnings**
>
> 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.

The fibre tip at the Laser Aperture may be cleaned using Thorlabs product FBC1 - One-Step Fiber Bulkhead and Connector Cleaner.

Appendix B Specifications and Associated Parts

B.1   Specifications

Parameter	Value
Wavelength	635 nm or 1550 nm
Maximum Full Output Power	1550 nm: 7.0 mW [a] 635 nm: 8.0 mW [a]
Stability	±0.1 dB
Display Accuracy	±10%
Set Point Resolution	0.01 mW
Operating Temperature	15°C to 35°C
Storage Temperature	0°C to 50°C
Modulation Input	0 to 10V = 0 to Full Power
Modulation Bandwidth	Sine Wave: 600 Hz at 3 dB 1kHz at 6 dB
EXT IN Input Impedence [b]	16kΩ
Power Input	15 V
Housing Dimensions (W x D x H)	121 x 60 x 47 mm (4.8" x 2.4" x 1.8")
USB Connector Type	USB 3.0
USB Connection Speed	USB 1.1 Full Speed (12 Mbps)
Weight	KLS635 350 g (12.35 oz) KLS1550 300g (10.58 oz)

[a] Measured at 20 °C

[b] When the EXT IN is used for modulation the KLS works in hybrid constant current mode. The KLS searches for the laser threshold and then switches to current modulation.

B.2   Associated Products

Product Name	Part Number
Power Supply Unit for Single Laser Source Cube	KPS201[a]
K-Cube 3-channel Controller Hub and power supply	KCH301
K-Cube 6-channel Controller Hub and power supply	KCH601
SMA to BNC Converter Cable 6"	CA2806
SMC to BNC Male Converter	T4289
SMC to BNC Female Converter	T4290

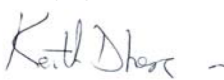a. The previous-generation KPS101 power supply is also compatible.

Appendix C Regulatory

C.1   Declarations Of Conformity

C.1.1   For Customers in Europe
See Section C.2.

C.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.

C.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):

2014/35/EU	Low Voltage Directive (LVD)
2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS)

hereby declare that:

Model: **KLS Series**

Equipment: **K-Cube Laser Source 635nm & 1550nm**

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

EN 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use.	2010
EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013

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

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

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

Signed: *On:*   07 March 2018

Name: Keith Dhese

Position: General Manager   EDC - KLS Series -2018-03-07

CE

Appendix D 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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Scandinavia
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Brazil
brasil@thorlabs.com

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.

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