



KURIOS[®] Liquid Crystal Tunable Filters

User Guide



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Chapter 1 Warning Symbol Definitions

Below is a list of warning symbols you may encounter in this manual or on your device.

Symbol	Description
	Direct Current
	Alternating Current
	Both Direct and Alternating Current
	Earth Ground Terminal
	Protective Conductor Terminal
	Frame or Chassis Terminal
	Equipotentiality
	On (Supply)
	Off (Supply)
	In Position of a Bi-Stable Push Control
	Out Position of a Bi-Stable Push Control
	Caution: Risk of Electric Shock
	Caution: Hot Surface
	Caution: Risk of Danger
	Warning: Laser Radiation
	Caution: Spinning Blades May Cause Harm

Chapter 2 Safety

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly.



DO NOT OPEN HOUSING



Except for the main fuse, which is accessible from the outside of the housing, KURIOS has no user-serviceable parts. Service should only be performed by trained service personnel.



SHOCK WARNING



High voltage inside. To avoid electrical shock, before powering up, make sure that the ground pin of the power cord is correctly connected to the ground connector in the power socket. Improper grounding can cause electric shock resulting in severe injury or even death. Do not operate without the cover installed.



CAUTION



Except for the main fuse, which is accessible from the outside of the housing, KURIOS has no user-serviceable parts. Service should only be performed by trained service personnel.



WARNING



This unit must not be operated in explosive environments. Additionally, this unit should not be used in wet/damp conditions. Do not obstruct the air ventilation slots in the housing!

Kurios is supplied with a 115 V power cord for use in North America only. For all other applications, use an IEC 320 compatible power cord fitted with a plug appropriate for your particular power socket. Make sure that the line voltage rating marked on the rear panel agrees with your local power supply and that the appropriate fuses are installed. Changing of the main fuse can be done by the user. With the exception of this fuse, there are no user-serviceable parts in this product.



CAUTION



Always connect the optical head to the main controller unit before powering on.

Mobile telephones, cellular phones or other radio transmitters should not be used with a range of 3 m of this unit since the electromagnetic field intensity may exceed the maximum allowable disturbance values, according to EN50082-1.

The maximum current output from the optical head connector is 1 A, and the optical head does not support hot plugging. Plugging or unplugging the connector while the unit is powered on can cause damage to the optical head and/or controller.

Chapter 3 Description

3.1. Overview

A liquid crystal tunable filter consists of a series of liquid crystal cells and polarizers. The KURIOS Tunable Filters are directly controlled by the bundled KURIOS controller. The drive voltages of the liquid crystal cells are calibrated to provide a specific retardance for each cell. This combination of retardances, along with the polarizers used, result in a bandpass filter in which the passband wavelength can be adjusted by varying the drive voltages. Special signals are applied to optimize the response when switching between wavelengths (voltages for each cell). The filter is internally temperature controlled for consistent performance and fast switching. Two passband wavelength ranges are available. The KURIOS-WB1(/M), KURIOS-VB1(/M), KURIOS-WL1(/M), and KURIOS-XL1(/M) Tunable Filters are designed for visible wavelength (VIS) operation. The KURIOS-XE2(/M) is designed for Near-Infrared (NIR) operation. For VIS filters, a premium shortpass filter, cut-off wavelength at 750 nm, is included and is recommended to be used at the incident side of the filter.

The KURIOS-WB1(/M), KURIOS-VB1(/M) and KURIOS-XE2(/M) optical heads have a clear aperture of Ø20 mm and are internally SM1 (1.035"-40) threaded. SM1-threaded adapters can be used to mount lens tubes, filters, and other optics on the head. In addition, these optical heads are compatible with Thorlabs' 30 mm cage system. It can also be post mounted using the 8-32 (M4) tapped holes located on the sides of the filter housing.

The KURIOS-WL1(/M) and KURIOS-XL1(/M) optical heads have a clear aperture of Ø35 mm and are internally SM2 (2.035"-40) threaded. SM2-threaded adapters can be used to mount lens tubes, filters, and other optics on the head through the screw threads. In addition, the optical head is compatible with Thorlabs' 60 mm cage system. It can also be mounted by standard posts using the 8-32 (M4) tapped holes located on the sides of the filter housing.

The full featured KURIOS controller is custom designed for the KURIOS optical heads. There are different modes of operation and bandwidth. The passband wavelength can be controlled in normal manual mode, as well as externally adjusted via an analog control signal or software. A complete software package is provided that accesses all the functions of the KURIOS controller. In addition, a full command-line interface can be used for custom software development. The KURIOS is also fully compatible with the command set of CRi VariSpec tunable filters.

3.1.1. Parts List – Accessories

Thorlabs KURIOS® tunable filters are well tested and packed before shipping. The section below lists the components and accessories of each filter.



Figure 1 Controller



Figure 2 Filter Head



Figure 3 Aluminum Case for Filter Head



SM1CP2
KURIOS-WB1(/M)
KURIOS-VB1(/M)
KURIOS-XE2(/M)

SM2EC2
KURIOS-WL1(/M)
KURIOS-XL1(/M)

Figure 4 Cover for Clear Apertures



Figure 5 USB, Connection, and Power Cables



Figure 6 Test Report



Figure 7 USB Drive with Software and Manual



1" FESH0750
KURIOS-WB1(/M)
KURIOS-VB1(/M)



2" FESH0750
KURIOS-WL1(/M)
KURIOS-XL1(/M)

Figure 8 Premium Shortpass Filter, Cut-Off Wavelength: 750 nm

3.2. Controls and Connections

3.2.1. KURIOS Controller: Front Panel



Figure 9 KURIOS Front Panel

Controls

WAVELENGTH:

Adjust the passband wavelength in MANUAL mode.

BANDWIDTH:

KURIOS-WB1(/M): Toggle between WIDE and BLACK (beam blocking) modes.

KURIOS-WL1(/M): Toggle between WIDE and BLACK (beam blocking) modes.

KURIOS-XL1(/M): Toggle between NARROW and BLACK (beam blocking) modes.

KURIOS-XE2(/M): Toggle between NARROW and BLACK (beam blocking) modes.

KURIOS-VB1(/M): Toggle between WIDE, MEDIUM, NARROW and BLACK (beam blocking) modes.

Connectors

TRIGGER IN:

Connect a 5 V TTL signal. It is used in the “SEQUENCE (with external trigger)” and “ANALOG (with external trigger)” modes. In these modes, the TRIGGER IN is used to trigger the controller to switch wavelength.

ANALOG IN:

Connect a 0 - 5 V analog signal. It is used in the ANALOG mode. In this mode, the filter adjusts its wavelength, in accordance to the voltage of the analog signal. The ANALOG IN signal tunes the filter's passband wavelength from the shortest wavelength (0 V, W_s) to the longest wavelength (5 V, W_l), meaning that the voltage step size for analog tuning is $\left(\frac{5}{W_l - W_s}\right)$ V/nm.

Status Display**BANDWIDTH:**

- WIDE: filter works at wide bandwidth mode. (Default filter operation after power on for WB1/VB1/WL1 filters)
- MEDIUM: filter works at medium bandwidth mode.
- NARROW: filter works at narrow bandwidth mode. (Default filter operation mode for XE2/XL1 filters)
- BLACK: Beam blocking mode, minimum transmission.

WAVELENGTH:

Current passband wavelength. In BLACK mode, it shows the most recent passband wavelength.

MODE:

- MANUAL: Manual mode
- SEQ.INT: Sequenced, with internal trigger.
- SEQ.EXT: Sequenced, externally triggered.
- ANA.INT: Analog signal controlled, with internal trigger.
- ANA.EXT: Analog signal controlled, externally triggered.

STATUS:

INIT...: Filter is in transition from idle to operation state. This initialization procedure takes 90 seconds from power on. The controller screen shows the message:

“INITIALIZING”

“Please Wait: --s”

where the dashes are replaced by the number of seconds remaining.

WARM UP: Filter is being warmed up to 40 °C. During this time, the filter is operational. However, the passband wavelength might be shifted from the displayed value, and wavelength switching speed is not fully optimized.

READY: Filter has reached 40°C and is now fully functional.

3.2.2. KURIOS Controller Back Panel



Figure 10 KURIOS Back Panel

OPTICAL HEAD:

Connects to the optical head of the filter. This should be connected before the controller is turned on. If the cable is not connected while the power is on, then the controller must be restarted. The controller screen will remind the user to power down and connect the optical head:

“Power Down To”

“Connect LC Head”

CAUTION

Always connect the optical head to the main controller unit before powering on.

The maximum current output from the optical head connector is 1 A, and the optical head does not support hot plugging. Plugging or unplugging the connector while the unit is powered on can cause damage to the optical head and/or controller.

USB:

Connects to the computer for software or command-line control.

TRIGGER OUT:

A BNC connector output trigger issued by the controller during every tuning cycle. For normal trigger mode, the TRIGGER OUT raises to 5 V at the beginning of a wavelength tuning cycle. It remains high during the tuning time, and drops to 0 V once the filter settles into its new wavelength. The user also can use the command-line or software to flip the trigger out waveform. Please refer to the schematic below of the trigger out signal while choosing Normal or Flipped mode.

NOTE: Since the tuning time varies with wavelength (and depends on the to and from wavelength), the duration of the TRIGGER OUT also varies accordingly.

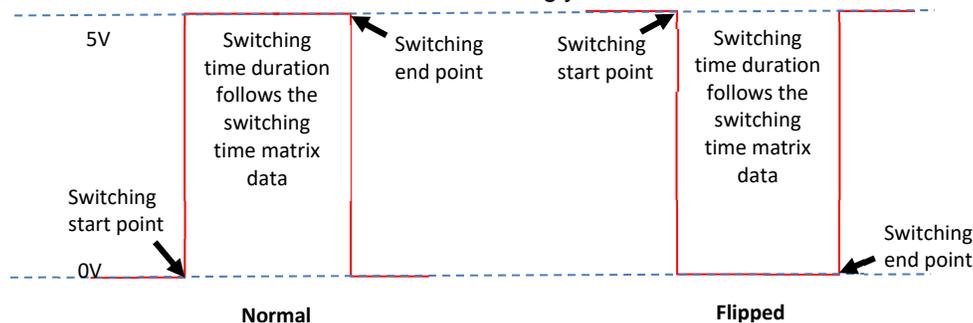


Figure 11 Schematic of KURIOS Trigger Out

3.2.3. KURIOS Optical Head



Figure 12 KURIOS Optical Head

All KURIOS optical heads have a similar appearance, but different KURIOS models have different path thicknesses, clear aperture, and threads.

Connector:

Connects to the optical head connector on the KURIOS controller.

Status LED:

Red: Filter warming up to 40°C.

Green: Filter is at 40°C and is fully functional.

T-AXIS: Transmission axis of the filter on each side. The filter may be used in both directions. However, the input/output polarizations should be aligned to the corresponding T-axis for maximum transmission.

Chapter 4 Installation

NOTE: Kurios is supplied with a 115 V power cord for use in North America only. For all other applications, use an IEC 320 compatible power cord fitted with a plug appropriate for your particular power socket. Make sure that the line voltage rating marked on the rear panel agrees with your local power supply and that the appropriate fuses are installed. Changing of the main fuse can be done by the user.

4.1. Connections

Controller Connection:

Connect the special cable provided between the KURIOS controller and the optical head before powering on the KURIOS controller.

PC Connection:

If using the software interface or command line for controlling the filter, connect the provided USB cable from the back of the KURIOS controller to the PC.

TRIGGER IN:

If using the externally triggered SEQUENCE or ANALOG modes, connect a 5 V TTL signal to the TRIGGER IN BNC connector on the KURIOS controller front panel.

TRIGGER OUT:

The back panel TRIGGER OUT BNC connector will output a 0 V or 5 V voltage when wavelength switching. By default, the trigger switches low to high while tuning is occurring. The TRIGGER OUT waveform can be set by the command line or in software.

ANALOG IN:

If using the ANALOG modes (which require internal or external triggering), connect a 0 – 5 V signal to the ANALOG IN BNC connector on the KURIOS controller front panel.

4.2. Optical Head

The KURIOS optical head may be used in both directions, i.e. the input beam can enter from either the front or back face of the head. Since the filter is polarization sensitive, the polarization of the input beam needs to be aligned with the engraving on the optical head for maximum transmission. The transmission axis is denoted by the T-AXIS marking on the head. Note that the polarization is rotated by 90° through the device. Both the front and back faces of the KURIOS-WB1(/M), KURIOS-VB1(/M), and KURIOS-XE2(/M) optical heads have four 4-40 internal threads and SM1(1.035"-40) internal threads, which are used for mounting Thorlabs' 30 mm cage systems and lens tubes, respectively. The optical head and faces of KURIOS-WL1(/M) and KURIOS-XL1(/M) have four 4-40 internal threads, which are compatible with Thorlabs' 60 mm cage systems, as well as SM2(2.035"-40) internal threads for lens tube mounting.

For tunable filters working in the VIS range, a premium shortpass filter with a cut-off wavelength of 750 nm is included in the package and pre-installed in a lens tube. There is a Ø1" premium shortpass filter included with the KURIOS-WB1(/M) and KURIOS-VB1(/M), pre-installed in an SM1L03 lens tube. There is a Ø2" premium shortpass filter included with the KURIOS-WL1(/M) and KURIOS-XL1(/M), pre-installed in an SM2L03 lens tube. The lens tube with the mounted filter can easily be screwed on the tunable filter input port to block unwanted light above 750 nm, protecting the KURIOS filter from excessive NIR light illumination. Please refer to Thorlabs Item # FESH0750 for a detailed transmission spectrum.



Figure 13 KURIOS Optical Head With A Premium Shortpass Filter

All KURIOS tunable filter heads have three 8-32 (M4) tapped holes for post mounting.

The field of view of the optical head is $\pm 6^\circ$ and therefore it is best to pass a well collimated beam into the filter for optimal performance.



CAUTION



Except for the main fuse, which is accessible from the outside of the housing, KURIOS has no user-serviceable parts. Service should only be performed by trained service personnel.

Chapter 5 Operation

The KURIOS may be operated in one of three ways:

1. From the front panel
2. Using the included software
3. Using the command set

5.1. Operation Modes

5.1.1. Bandwidth

KURIOS has four bandwidth modes: WIDE, MEDIUM, NARROW, and BLACK.

Pressing the bandwidth button on the controller cycles through the modes in the following order:

KURIOS-WB1(/M) : WIDE, BLACK.

KURIOS-WL1(/M) : WIDE, BLACK.

KURIOS-XE2(/M) : NARROW, BLACK.

KURIOS-XL1(/M) : NARROW, BLACK.

KURIOS-VB1(/M) : WIDE, MEDIUM, NARROW, BLACK.

In the software interface, WIDE, MEDIUM, NARROW and BLACK modes are in the Bandwidth Mode section.

The command line can switch between modes using the following commands: BW=1 (BLACK), BW=2 (WIDE), BW=4 (MEDIUM), BW=8 (NARROW).

5.1.2. Manual

In MANUAL mode, the passband wavelength is directly controlled and changes take effect immediately. There are various ways to control the passband wavelength:

Turning the WAVELENGTH knob on the KURIOS front panel.

Using the wavelength slider, or directly inputting the desired wavelength in the software interface.

Issuing the command WL=n, where n is the desired wavelength.

When the KURIOS controller is first powered on, it defaults to MANUAL mode after initialization. In other cases, do one of the following to activate MANUAL mode:

Press the MODE button on the controller repeatedly until MANUAL is shown on the controller.

In the software interface, press Manual in the Control Mode section.

Issue the WL=n command, where n is the desired wavelength.

Issue the OM=1 command.



SHOCK WARNING



High voltage inside. To avoid electrical shock, before powering up, make sure that the ground pin of the power cord is correctly connected to the ground connector in the power socket. Improper grounding can cause electric shock resulting in severe injury or even death. Do not operate without the cover installed.



WARNING



This unit must not be operated in explosive environments. Additionally, this unit should not be used in wet/damp conditions. Do not obstruct the air ventilation slots in the housing!

5.1.3. Sequenced

In SEQUENCED mode, the KURIOS stores a set of passband wavelengths and it issues the wavelengths to the optical head whenever a trigger is received. The number of wavelengths that can be stored ranges from 1 to 1024. When it reaches the end of the sequence, it loops back to the beginning and starts over again. The switching of wavelengths in the SEQUENCED mode can be internally or externally triggered.

To activate SEQUENCED mode, do one of the following:

1. Press the MODE button on the controller repeatedly until either SEQ.INT or SEQ.EXT is shown on the controller.
2. In the software interface, press Sequence in the Control Mode section.
3. Issue the OM=2 or OM=3 command

In the SEQUENCED mode, the list of wavelengths and their corresponding interval times (for internal trigger mode) are preloaded into the controller via the software interface or command line.

5.1.4. Analog Input

In ANALOG mode, the passband wavelength is directly controlled by a 0 – 5 V signal connected to the ANALOG IN connector on the KURIOS front panel. The 0 V corresponds to the shortest wavelength (420 nm or 430 nm for VIS filter, 650 nm for NIR filter) and 5 V corresponds to the longest wavelength (730 nm for VIS filter, 1100 nm for NIR filter). Similar to the SEQUENCE mode, the update of the wavelength (according to the ANALOG IN voltage) is triggered by an internal trigger or external trigger.

To activate ANALOG mode, do one of the following:

1. Press the MODE button on the controller repeatedly until either ANA.INT or ANA.EXT is shown on the controller.
2. In the software interface, press Analog in the Control Mode section.
3. Issue the OM=4 or OM=5 command.

5.1.5. Internal Trigger vs. External Trigger

In both SEQUENCED and ANALOG modes, a trigger is needed to update the passband wavelength, which is either stored in the preloaded sequence or set by the analog signal input. In particular, during ANALOG mode, the controller does not sample the analog input signal until a trigger is received. The voltage of the analog control signal during other times is ignored. There are two triggering modes: internal trigger and external trigger.

In internal trigger mode, the trigger is provided by a clock within the controller and the user can specify the triggering interval time by issuing the command “TI=n”, where n is the setting time that ranges from 1 ms to 60 s and the default triggering interval time is 50 ms. Moreover, in SEQUENCED mode, each wavelength in the sequence list can have its own interval time. The user can also reset all wavelengths to a default interval time. For ANALOG mode, the controller updates the wavelength according to the analog input signal at the interval times set by the user.

In external trigger mode, the trigger is provided by the TRIGGER IN BNC connector from the front panel. In both SEQUENCED and ANALOG modes, the wavelength updates when a trigger is received. During other times, the wavelength remains unchanged.

5.1.6. Black

The BLACK mode is a special beam blocking mode. In this mode, the filter transmission is set to a minimum regardless of the value of passband wavelength being set.

To activate BLACK mode, do one of the following:

1. Press the BANDWIDTH button on the controller repeatedly until BLACK is shown on the controller.
2. In the software interface, press Black in the Bandwidth Mode section.
3. Issue the BW=1 command.

5.2. Software GUI

The bundled software accesses all features supported by the KURIOS controller. Figure 14 shows the main window of the software GUI. In addition to the operation modes and wavelength selection, it allows the user to enter the wavelengths, time intervals, and bandwidth mode (for KURIOS-VB1 only) for the SEQUENCE mode, which is not available directly on the controller itself.

The complete set of configurations, including the wavelength sequence list, can be saved and loaded using the "Save Profile" and "Load Profile" buttons. The sequence list can also be imported or exported in comma separated value (CSV) format by right-clicking on any text field on the sequence list. The CSV file can be edited by Microsoft Excel or any text editing software. Refer to the documentation within the software GUI for details and operation. Kurios' software package allows the user to select between the Manual, Sequence, and Analog Modes for determining the center wavelength of the optical head. In manual mode, the wavelength slider is enabled, which lets the user choose any center wavelength within the 420 - 730 nm range for VIS filters (KURIOS-XL1 within 430 – 730 nm), 650-1100nm for NIR filter. For sequence and analog modes, either internal or external triggering can be chosen; triggers are needed to update the center wavelength. In sequence and analog modes, the user may define sequences of up to 1024 wavelengths to be cycled through by the controller. Each step in the sequence has its own wavelength and duration (1 ms to 60 s), and for KURIOS-VB1, the bandpass width mode can also be changed from step to step. Sequences can be saved and loaded in CSV format using the "Save Profile" and "Load Profile" buttons. We also provide C/C++ and LabVIEW® software development kits for controlling Kurios with other instruments through the USB port on the controller. Sample C++ code and LabVIEW programs help to illustrate how the C commands and LabVIEW VIs can be utilized. Full documentation on the available commands is provided in the SDK manual.

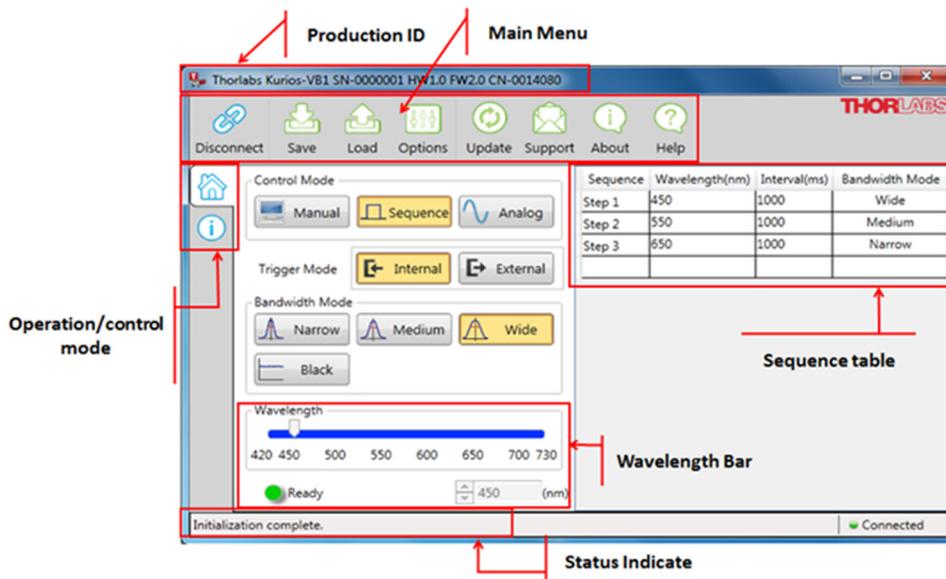


Figure 14 Software GUI Main Window

5.2.1. Product ID

Indicating the product ID while a KURIOS product is connected:

Thorlabs Kurios-xxx SN-xxxxxxx HWxx FWxx CN-xxxxxxx

5.2.2. Main Menu

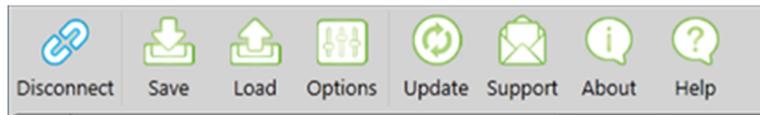


Figure 15 Software GUI Main Menu

Connect/Disconnect

Enable or disable the connection between the KURIOS and the PC. When clicking **Connect**, all available KURIOS productions are listed in the pop-up connection table.

Save Profile

Save the user defined settings in XML format.

Load Profile

Load the user defined settings in XML format.

Options

The Trigger out waveform and language settings can be set in the options tab.

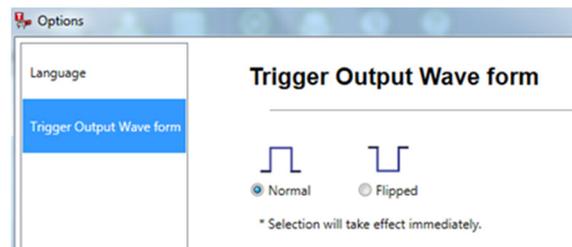


Figure 16 Software Option Window

Update

Update the KURIOS software to the most up-to-date version, if available.

Support

For technical support, Microsoft Outlook launches (if installed) and directly addresses to **techsupport@thorlabs.com**.

About

Displays the detailed information about the KURIOS software. Please have these details available when contacting Thorlabs Technical Support.

Help

Opens the KURIOS software help documentation.

5.2.3. Operation / Control Mode

Control Mode



Figure 17 Software Control Mode

Manual: Set filter to manual mode. Tuning the knob at controller front panel and drag wavelength bar and wavelength setting frame are available.

Sequence: Set filter to sequence mode. There are two trigger modes available: Internal (default), External.

Internal: The sequence table is available and filter output wavelength switches according to the sequence interval time in the sequence table.

External: The sequence table is available and filter output wavelength switches according to the External trigger time.

Analog: Set filter to analog mode. There are two trigger modes available: Internal (default), External.

Internal: User inputs a 0-5V voltage from Analog in port. The switching time is according to the internal time.

External: User inputs a 0-5V voltage from Analog in port, filter output wavelength switches according to the External trigger in time.

Bandwidth Mode

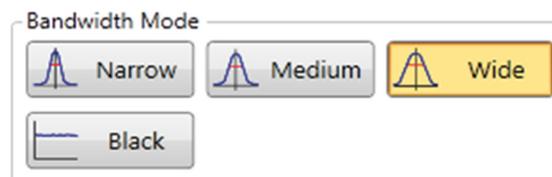


Figure 18 Software Bandwidth Mode

Different version of KURIOS tunable filter has different bandwidth mode available.

KURIOS-WB1(/M), KURIOS-WL1(/M) : WIDE, BLACK

KURIOS-VB1(/M): WIDE, MEDIUM, NARROW, BLACK

KURIOS-XE2(/M), KURIOS-XL1(/M): NARROW, BLACK

Wavelength



Figure 19 Software Wavelength

The wavelength bar indicates the current wavelength setting. Dragging the bar or inputting the wavelength in the frame sets the working wavelength.

By right clicking on the table, basic operations are shown.

5.3. Command Line

The KURIOS can be controlled by a command line through the USB port, as a virtual COM or RS-232 device. This is offered to enable operation through a terminal interface or for those who wish to write their own program to control the unit. The command-line language is described below. Prior to running the command-line interface, the included drivers should be installed, the unit should be powered on, and a USB cable should be connected between the KURIOS controller and the host PC.

The terminal emulator should be configured as follows:

- Baud Rate: 115.2 kbps
- Data Bits: 8
- Parity: None
- Stop Bits: 1
- Flow Control: None

If the connection is correct, you will see the following after pressing the Enter key (without any leading commands):

```
CMD_NOT_DEFINED  
>
```

The above error indicates that an empty command (which is equivalent to an incorrect command) is sent.

The basic structure of the interface is a keyword followed by either an equal sign (=) or a question mark (?). The = or ? character determines if the string is a command or a query. All strings, commands and queries, must be terminated by a carriage return (CR).

The command structure is as follows:

```
Keyword=argument (CR)
```

Where “keyword” defines the function and “argument” is a numerical value followed by a carriage return (CR). Notice that some commands might have more than one arguments, separated by a space character.

The query structure is as follows:

```
Keyword? (CR)
```

Where “keyword” defines the function and the question mark (?) indicates a query. The string is terminated with a carriage return (CR).

There are a few exceptions to this which are noted below, also noted are unique shortcut keys. The following table lists the commands and queries available with this device. The prompt symbol (>) appears on power up and after a command is accepted by the controller indicating it is ready to receive the next command.

If the command is incorrect, the controller returns `CMD_NOT_DEFINED`; if the setting value is out of range, it returns `CMD_ARG_RANGE_ERR`.

Command	Syntax	Description
Get ID	*idn? or *IDN?	Returns the model number, hardware and firmware versions
Get Specification	SP?	Returns connected filter's wavelength range
Get Optical Head Type	OH?	Returns two bytes integer (int 16), Top 8 bits represents filter spectrum; 0000 0001 = Visible 0000 0010 = NIR Bottom 8 bits represents available bandwidth mode: 0000 0001 = BLACK 0000 0010 = WIDE 0000 0100 = MEDIUM 0000 1000 = NARROW
Set Output Mode	OM=1	Sets output mode to manual (PC or front panel control)
	OM=2	Sets output mode to sequenced, internal clock triggered
	OM=3	Sets output mode to sequenced, external triggered
	OM=4	Sets output mode to analog signal controlled, internal clock triggered
	OM=5	Sets output mode to analog signal controlled, external triggered
Get Output Mode	OM?	Returns the current output mode
Set Bandwidth Mode	BW=1	Set bandwidth mode to BLACK mode
	BW=2	Set bandwidth mode to WIDE mode
	BW=4	Set bandwidth mode to MEDIUM mode
	BW=8	Set bandwidth mode to NARROW mode
Get Bandwidth Mode	BW?	Returns the current bandwidth mode
Set Wavelength	WL=n	Where n equals a wavelength within the available wavelength range
Get Wavelength	WL?	Returns the current wavelength
Set Sequence 1~1024 Wavelength and Time Interval	SS=1~1024 n1 n2 n3*	Where n1 equals a wavelength within filter's range, and n2 equals time interval, n3 equal bandwidth
Get Sequence 1~1024 Wavelength	SS1~1024?	Returns one entry out of the sequence wavelength and time interval
Get Entire Sequence	SS?	Returns the entire sequence of wavelength and time interval
Insert into Sequence	IS=1~1024 n1 n2, n3*	Inserts an entry into the current sequence. n1 equals wavelength, n2 equals time interval
Delete item in Sequence	DS=0~1024	Deletes an entry from the current sequence. DS=0, delete all sequence.
Set Default Wavelength for all Elements in Sequence	WD=n	Where n equals a wavelength within the available wavelength range.
Get Default Wavelength for all Elements in Sequence	WD?	Returns the current default wavelength for all elements in sequence.
Set Default Bandwidth Mode for all Elements in Sequence	BD=2	Set bandwidth mode to WIDE mode for all elements in sequence.
	BD=4**	Set bandwidth mode to MEDIUM mode for all elements in sequence.
	BD=8**	Set bandwidth mode to NARROW mode for all elements in sequence.
Get Default Bandwidth for all Elements in Sequence	BD?	Returns the current default Bandwidth Mode for all elements in sequence.
Set Default Time Interval for all Elements in Sequence	TI=n	Where n equals internal trigger default time between 1ms and 60000ms, applies to all all elements in sequence.
Get Internal Trigger Default Time for all Elements in Sequence	TI?	Returns the current internal trigger default time.
Get Sequence Length	SL?	Returns the sequence length
Get Status	ST?	Returns current filter status: 0 - initialization; 1 - warm up; 2 - ready
Get Temperature	TP?	Returns the current filter temperature
Set Trigger Output Waveform	TO=n	Where n equals 0 or 1: 0 - normal; 1 - flipped
Get Trigger Output Waveform	TO?	Returns trigger output waveform setting
Force Trigger	ET=1	Enforce on step ahead in external triggered sequence mod (Firmware Version 3.1 or above)

NOTE: *Only KURIOS-VB1(/M) has n3 in sequence representing the bandwidth mode.*

NOTE: **KURIOS-VB1(/M) has BD=4 or BD=8 to set bandwidth mode for all elements in sequence. KURIOS-XE2(/M) has default BD=8 to set bandwidth mode.**

5.4. Description of Commands

5.4.1. *idn? or *IDN?– Hardware Information

Queries the optical head model, controller hardware and firmware versions.

Return:

```
THORLABS KURIOS-VB1 SN-xxxxxxxx HWx.x FWx.x CN-xxxxxxxx
```

where SN is optical head serial numbers; HW is controller hardware version; FW is firmware version; CN is the controller serial number.

5.4.2. SP? – Filter Wavelength Range

Queries the range of wavelength that the filter optical head supports.

For VIS tunable filter return:

```
WLmax=730.000
```

```
WLmin=420.000
```

For NIR tunable filter return:

```
WLmax=1100.000
```

```
WLmin=650.000
```

where WLmax and WLmin are the maximum and minimum wavelengths that can be set.

5.4.3. OH? – Filter Features

Queries the features supported by the connected filter. The OH? command returns a 16-bit number which reports the features and bandwidth modes supported.

Return:

```
OH=n
```

where n is a 16-bit integer. When converted into binary form, n has the following Boolean structure:

```
n = 0000 0000 0000 0000
```

The higher 8-bit represents the spectral range, with

```
0000 0001 = Visible
```

```
0000 0010 = Near Infrared
```

Other values are reserved for other future filter models.

The lower 8-bit represents the bandwidth mode supported, with

```
0000 0001 = Black (beam blocking)
```

```
0000 0010 = Wide bandwidth
```

```
0000 0100 = Medium bandwidth
```

```
0000 1000 = Narrow bandwidth
```

Other values are reserved for other future filter models. More than one mode may be supported, depending on filter models.

NOTE: For KURIOS-VB1 optical head, which is a selectable bandwidth visible filter supporting BLACK, WIDE, MEDIUM, NARROW mode, then OH? returns 271 (= 0000 0001 0000 1111).

5.4.4. OM=n; OM? – Operation Mode

The OM command is used to set or query the current operation mode. There are five available modes: MANUAL, SEQUENCE (internal clock), SEQUENCE (external triggered), ANALOG (internal clock), and ANALOG (external triggered).

OM=n

Sets the operation mode. The value of n can be one of the following:

- n=1: MANUAL
- n=2: SEQUENCE (internal clock)
- n=3: SEQUENCE (external triggered)
- n=4: ANALOG (internal clock)
- n=5: ANALOG (external triggered)

OM?

Queries the current operation mode.

Return:

OM=n

where n is the current operation mode, see above for values of n.

5.4.5. BW=n; BW? – Bandwidth Mode

The BW command is used to set or query the bandwidth mode of the filter. KURIOS-WB1(M) and KURIOS-WL1(M) optical heads have two bandwidth modes available: WIDE and BLACK. KURIOS-VB1(M) optical head has four bandwidth modes available: WIDE, MEDIUM, NARROW and BLACK. KURIOS-XL1(/M) and KURIOS-XE2(/M) optical head has two bandwidth modes available: NARROW and BLACK.

BW=n

Sets the bandwidth mode. The value of n follows the format of the lower 8-bit reported by the OH? command. However, only one mode is supported at a time, with:

- n=1: BLACK mode
- n=2: WIDE mode
- n=4: MEDIUM mode
- n=8: NARROW mode

For KURIOS-WB1(/M) and KURIOS-WL1(/M), valid values for n are 1 (BLACK) and 2 (WIDE).

For KURIOS-VB1(/M), valid values for n are 1 (BLACK) and 2 (WIDE), 4(MEDIUM), 8(NARROW).

For KURIOS-XE2(/M) and KURIOS-XL1(/M), valid values for n are 1 (BLACK) and 8 (NARROW).

BW?

Queries the current bandwidth mode.

Return:

BW=n

where n is the current bandwidth mode, see above for values of n.

5.4.6. WL=n; WL? – Passband Wavelength

The WL command can be used to set or query the passband wavelength.

WL=n

Sets the passband wavelength. The value of n must be within WL_{max} and WL_{min} as specified by the SP? command. For the KURIOS VIS tunable filter wavelength range, the applicable range is from 420 nm to 730 nm. For the KURIOS NIR tunable filter wavelength range, the applicable range is from 650 nm to 1100 nm.

NOTE: Sending a WL=n command automatically changes the operation mode to MANUAL.

WL?

Queries the current passband wavelength.

Return:

WL=n

where n is the current passband wavelength.

5.4.7. SS=n1 n2 n3 n4; SS=n1 n2; SSn?; SS? – Setup Sequence

The SS command is used manipulate the list used in SEQUENCE mode. It is used to adjust the wavelengths and time intervals (for internal clock mode) and bandwidth mode. If only the wavelength value is given, then the time interval is automatically set to the default value (50 ms, or defined by the TI command) and the default bandwidth mode is WIDE.

SS=n1 n2 n3 n4

Sets the wavelength and time interval, where:

n1 is the index of the sequence entry, valid value ranges from 1 to 1024.

n2 is the set wavelength, in the range between WL_{min} and WL_{max} (for KURIOS VIS tunable filter wavelength, WL_{min}=420, WL_{max}=730, for KURIOS NIR tunable filter wavelength, WL_{min}=650, WL_{max}=1100).

n3 is the time interval in ms for the sequence entry, before it switches to the next or loops back to the beginning of the sequence if the end of sequence is reached. Valid values of n3 ranges from 1 to 60000. If n3 is not given, then it is set to the default value of 50ms or as defined by the TI command).

n4 is the set bandwidth mode.

KURIOS-WB1(/M): valid values SS=n1 n2 n3. n4 is not given, then it is set to the default value n4=2 (WIDE).

KURIOS-WL1(/M): valid values SS=n1 n2 n3. n4 is not given, then it is set to the default value n4=2 (WIDE).

KURIOS-XE2(/M): valid values SS=n1 n2 n3. n4 is not given, then it is set to the default value n4=2 (NARROW).

KURIOS-XL1(/M): valid values SS=n1 n2 n3. n4 is not given, then it is set to the default value n4=2 (NARROW).

KURIOS-VB1(/M): valid values SS=n1 n2 n3 n4 for n4 are 1 (BLACK) and 2 (WIDE), 4(MEDIUM), 8(NARROW). If n4 is not given, then it is set to the default value n4=2 (WIDE).

SSn?

Queries the wavelength and time interval of a particular sequence entry where n is the sequence index.

Return:

SSn=n2 n3 n4

where n2 is the wavelength and n3 is the time interval for the enquired sequence index, n4 is the set bandwidth mode (only KURIOS-VB1(/M) has this value). If the index of the sequence entry is out of the current list range, the controller returns CMD_ARG_RANGE_ERR.

SS?

Queries the wavelength and time interval of the entire sequence list.

```
SS1=n12 n13 n14
SS2=n22 n23 n24
SS3=n32 n33 n34
:
:
```

If the sequence has not been initialized for the first time, or has been deleted, then SS? returns the following:

```
SS=0
```

NOTE: When setting sequence items using the SS command which is greater than the existing sequence list length, the controller automatically fills in the intermediate values with a default wavelength of 550 nm for VIS tunable filter (or 850nm for NIR tunable filter) and time intervals of 50ms (or values defined by the TI command). For example, if KURIOS-VB1(/M) a sequence has not been initialized but an `SS=3 650 100 8` is sent, then the sequence becomes:

```
SS1=550.000 50 2
SS2=550.000 50 2
SS3=650.000 100 8
```

Moreover, if SS1 and SS2 has been defined but deleted (using the DS command) previously, setting values for SS3 restores the previously deleted wavelengths and time intervals for SS1 and SS2.

5.4.8. IS=n1 n2 n3 n4; IS=n1 n2 – Insert into Sequence

The IS command is used to insert sequence entries into the existing sequence list, where:

n1 is the sequence index

n2 is the set wavelength

n3 is the time interval (in ms, from 1 to 60000)

n4 is the bandwidth mode 1 (BLACK) and 2 (WIDE), 4(MEDIUM), 8(NARROW), (KURIOS-VB1(/M) only).

The index to be inserted must be within the list that is already set up. That is, it cannot be used to specify an index which is out of the range of the current list, in contrast to the SS command. Again, the time interval n3 is optional and if it is not given, default value of 50ms or as defined by TI command is applied. n4 is optional and if it is not given, default value is 2 (WIDE).

NOTE: When inserting sequence entries, the length of the sequence automatically increments by 1 and the entries from current index to the end of list is shifted downward. For example, if the current list has 5 entries, inserting in to the 3rd entry (n1=3) will update the wavelength and time interval values in index 3. The original values from index 3 to 5 will move to index 4 to 6.

If n1 is out of the current list range, the controller returns `CMD_ARG_RANGE_ERR`.

5.4.9. DS=n – Delete Sequence Entry

The DS command is used to delete an entry in the existing sequence list. The value of n must be within the length of the current list, otherwise the controller returns `CMD_ARG_RANGE_ERR`. After an entry is deleted, the remaining entries after the current index is automatically shifted upward. If value n=0, the command delete all sequence.

5.4.10. WD=n; WD? – Default Wavelength for all Elements in Sequences

The WD command is used to set or query the default Wavelength for all elements in sequence.

WD=n

Sets the default Wavelength value *n*, in nm. Valid values of *n* ranges from 420 to 730 for VIS tunable filter and 650 to 1100 for NIR tunable filter, in nm. When a sequence list already exists, it resets the Wavelength of all elements in the current list to the value specified by *n*. If *n* is out of the allowable range, the controller returns CMD_ARG_RANGE_ERR.

WD?

Queries the current default Wavelength value in sequence, in nm.

Return:

WD=*n*

where *n* is the default Wavelength. If it is never specified from power on, then *n* is defined as 550 nm for VIS tunable filter and 850 nm for NIR tunable filter.

5.4.11. BD=n; BD? – Default Bandwidth Mode for all Elements in Sequences

The BD command is used to set or query the default Bandwidth Mode for all elements in sequence. This command is only available for KURIOS-VB1(/M). The default Bandwidth Mode for KURIOS-WL1(/M) and KURIOS-WB1(/M) is WIDE. The default Bandwidth Mode for KURIOS-XE2(/M) and KURIOS-XL1(/M) is NARROW.

BD=n

Sets the default Bandwidth Mode. Valid values of *n* are:

n=2 : WIDE mode

n=4 : MEDIUM mode

n=8 : NARROW mode

When a sequence list already exists, it resets the Bandwidth Mode of all elements in the current list to the value specified by *n*. If *n* is out of the allowable range, the controller returns CMD_ARG_RANGE_ERR.

5.4.12. TI=n; TI? – Default Time Interval

The TI command is used to set or query the default time interval for sequence list entries, if they are not specified when using the SS and IS commands.

TI=n

Sets the default time interval value *n*, in ms. Valid values of *n* ranges from 1 to 60000. When a sequence list already exists, it also resets the time interval of all elements in the current list to the value specified by *n*. If *n* is out of the allowable range, the controller returns CMD_ARG_RANGE_ERR.

TI?

Queries the current default time interval value, in ms.

Return:

TI=*n*

where *n* is the default time interval. If it is never specified from power on, then *n* is defined as 50 (or 50 ms).

5.4.13. SL? – Sequence Length

The SL? command queries the current length of the sequence list.

Return:

SL=*n*

where *n* is the number of entries in the current list.

5.4.14. ST? – Filter Status

Queries the current status of the optical head.

Return:

ST=n

where n can be one of the following:

n=0: Initialization. The filter is in an initialization stage to transit from idle to operation state. This initialization period takes 90sec from power up.

n=1: Warm up. The internal heater is providing heat to the optical elements in order to reach a target of 40°C, which is the optimal operating temperature of the filter. While warming up, the filter is fully operational, except that the passband wavelength might be shifted and the switching speed is slower.

n=2: Ready. The temperature of the optical elements has reached 40°C and the filter is fully operational and performs as specified.

5.4.15. TP? – Filter Temperature

The TP? command queries the internal temperature of the KURIOS-VB1 optical head. The filter is designed to operate at 40°C and there is a heating element within the optical head. This temperature can be monitored in real time.

Return:

TP=n

where n is the current temperature in °C.

5.4.16. TO=n; TO? – Trigger Output Setting

The TO command sets or queries the trigger output operation mode. When n=0, the trigger output is in normal operation mode (low during idle, high during wavelength switch). When n=1, the trigger output is flipped (high during idle, low during wavelength switch).

TO=n

Sets the trigger output operation mode. Valid values of n is 0 (normal) or 1 (flipped).

TO?

Query the current trigger output operation mode.

Return:

TO=n

where n=0 (normal) or n=1 (flipped).

5.4.17. ET=1; Enforce Trigger Out

Supported in firmware version 3.1 or above, while filter is in external trigger sequence mode, issuing ET=1 causes the filter to advance one step ahead, regardless of the current trigger in signal. This can be regarded as a software trigger when hardware trigger is not available.

Chapter 6 Technical Terminology

6.1. Bandwidth

Thorlabs' KURIOS® tunable filter defines the passband bandwidth as the Full Width at Half Maximum (FWHM). This is the spectral width between the two points where the filter's transmission reaches half of the peak value. The KURIOS filter's bandwidths are dependent on wavelength and optical design, and therefore different models and bandwidth modes (for KURIOS-VB1) have different bandwidth values.

6.2. Center Wavelength

The center wavelength of the KURIOS tunable filter is the center point wavelength between half maximum points. Note that the center wavelength is not necessarily the same as the peak wavelength (the wavelength with highest transmission), and there may be a slight offset between them.

6.3. Transmission

The transmission refers to the peak transmission of the passband profile with a given center wavelength. The transmission value is measured with an incident light beam linearly polarized parallel to the transmission axis of the filter. The KURIOS tunable filter transmission is wavelength-dependent.

6.4. Passband

The passband is defined as the range between the first local minimum values on either side of the center wavelength. The passband spectral range is approximately from [Center Wavelength - 1.2 * FWHM] to [Center Wavelength + 1.2 * FWHM].

6.5. Out-of-Band Blocking

Out-of-Band Blocking is the maximum transmittance measured from the entire operating wavelength range, but outside of the passband range. The KURIOS filter defines blocking range transmittance with optical density $OD > 2$, which corresponds to transmittance of less than 1%.

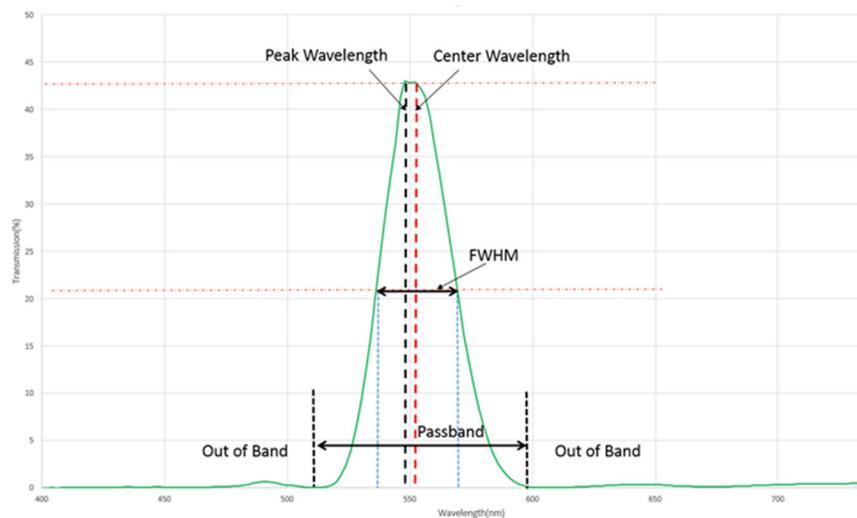


Figure 22 Illustration of Technical Terminology

6.6. Switching Speed

KURIOS tunable filters take a certain time to switch between two wavelengths. The switching time depends on the initial and final wavelength. The switching time data is calibrated for each filter and is saved in its EEPROM memory. This switching time matrix map gives the switching time as a function of the initial wavelength and the final wavelength. Note that when switching from longer wavelengths to shorter wavelengths, the switching time is shorter than switching in the opposite direction. This is due to properties of liquid crystal optics.

6.7. Tuning Accuracy

The difference between the wavelength setting and the actual filter output center wavelength is defined as tuning accuracy, and is measured in terms of FWHM at the current set wavelength. KURIOS tunable filter output center wavelength accuracy is corrected to within $\pm\text{FWHM}/10$. Tuning Accuracy or wavelength error can be wavelength dependent.

6.8. Wavelength Uniformity

Uniformity is defined as the maximum center wavelength shift within the clear aperture in terms of the FWHM bandwidth at the specified wavelength setting. This is measured with a small broadband incident beam through the filter to obtain the filter output center wavelength. The incident beam is then scanned across the entire clear aperture of the filter while the output wavelength at each point is recorded. The wavelength shift at each point is then calculated.

6.9. Angle of Incidence (Field of View)

Field-of-view (FOV) is defined as the maximum angle of off-axis rays propagating through the filter while the center wavelength shift is within $\pm\text{FWHM}/2$ from the set wavelength. For KURIOS visible wavelength filters (-WB1, -VB1, XL1 and -WL1), the AOI at 550 nm is measured as reference. For the KURIOS near-IR filter (-XE2), the AOI at 850 nm is measured as reference.

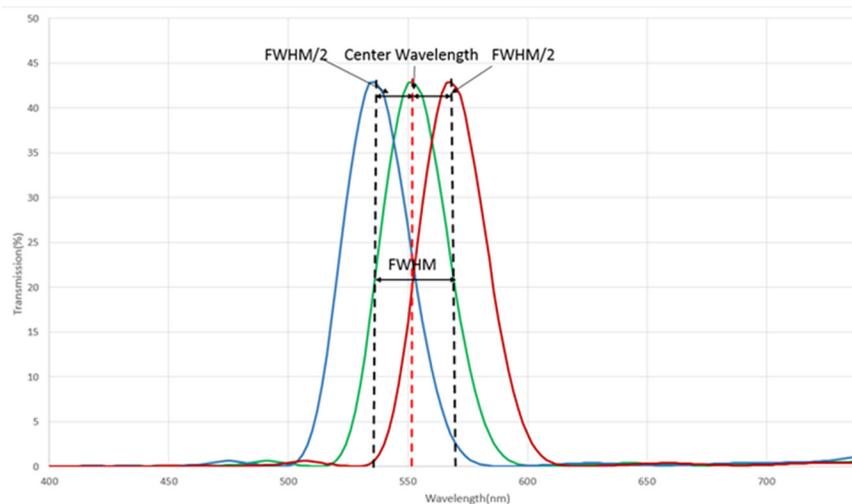


Figure 23 Illustration of Center Wavelength Shift with Off-Axis Rays Propagating through the Filter

Each KURIOS tunable filter comes with a test report including plots of the spectrum, FWHM, transmission, tuning accuracy, and switching time.

Chapter 7 Specifications

7.1. Fixed Bandwidth Tunable Filters

Specification		Value			
Item #		KURIOS-WB1(/M)	KURIOS-WL1(/M)	KURIOS-XL1(/M)	KURIOS-XE2(/M)
Center Wavelength		420 - 730 nm		430 - 730 nm	650 - 1100 nm
Bandwidth (FWHM)		35 nm at 550 nm		10 nm at 550 nm	17 nm at 850 nm
Polarized Transmission		45% at 550 nm		17% at 550 nm	44% at 850 nm
Out-of-Band Blocking		OD > 2			
Minimum Incremental Step Size		1 nm			
Tuning Accuracy		±FWHM/10			
Clear Aperture		Ø20 mm	Ø35 mm		Ø20 mm
Field of View		±6°			
Switching Speed		<40 ms	<50 ms	<70 ms	<250 ms
Uniformity		FWHM/8	FWHM/4		
Damage Threshold	Pulsed (ns)	0.1 J/cm ²			0.1 J/cm ² (810 nm, 7.2 ns, 10 Hz, Ø0.216 mm)
	Pulsed (fs)	0.02 J/cm ² (532 nm, 76 Hz, 100 fs, Ø162 µm)			0.006 J/cm ² (800 nm, 100 Hz, 36.4 fs, Ø189 µm)
	CW	CW: 0.8 W/cm (532 nm, Ø0.471 mm)			-
Operating Temperature		0 to 40 °C			
Storage Temperature		-15 to 65 °C			

7.2. Selectable Bandwidth Tunable Filters

Specification		Value		
Item #		KURIOS-VB1(/M)		
Center Wavelength		420 - 730 nm		
Bandwidth (FWHM at 550 nm)		32 nm (Wide)	18 nm (Medium)	10 nm (Narrow)
Polarized Transmission (at 550 nm)		20%	17%	13%
Out-of-Band Blocking		OD > 2		
Minimum Incremental Step Size		1 nm		
Tuning Accuracy		±FWHM/10		
Clear Aperture		Ø20 mm		
Field of View		±6°		
Switching Speed		<100 ms (Wide)	<150 ms (Medium)	<230 ms (Narrow)
Uniformity		FWHM/4		
Damage Threshold	Pulsed(ns)	0.1 J/cm ²		
	Pulsed(fs)	0.02 J/cm ² (532 nm, 76 Hz, 100 fs, Ø162 µm)		
	CW	CW: 0.8 W/cm (532 nm, Ø0.471 mm)		
Operating Temperature		0 to 40 °C		
Storage Temperature		-15 to 65 °C		

7.3. Mechanical Drawings

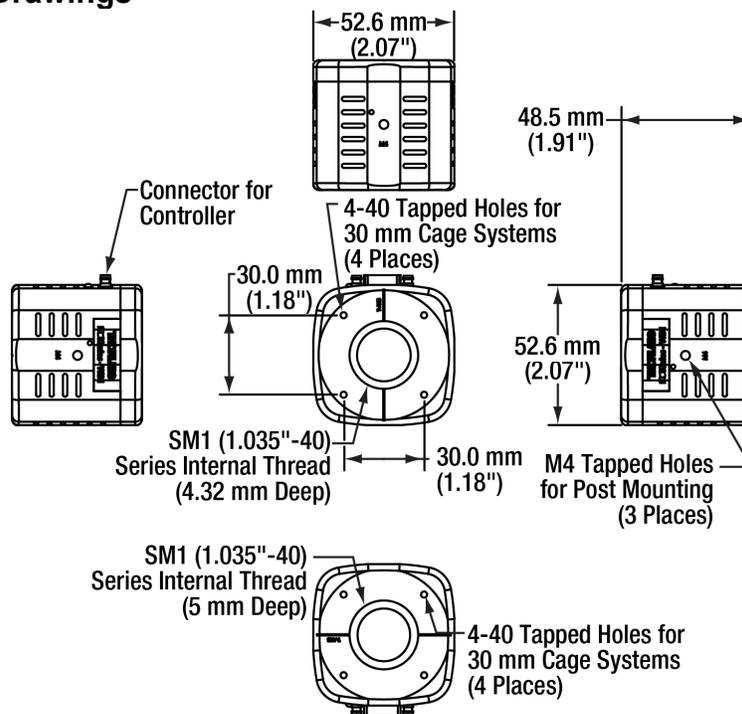


Figure 24 KURIOS-WB1/M Optical Head

Note: KURIOS-WB1 contains 8-32 tapped holes (in 3 places) instead of M4 tapped holes.

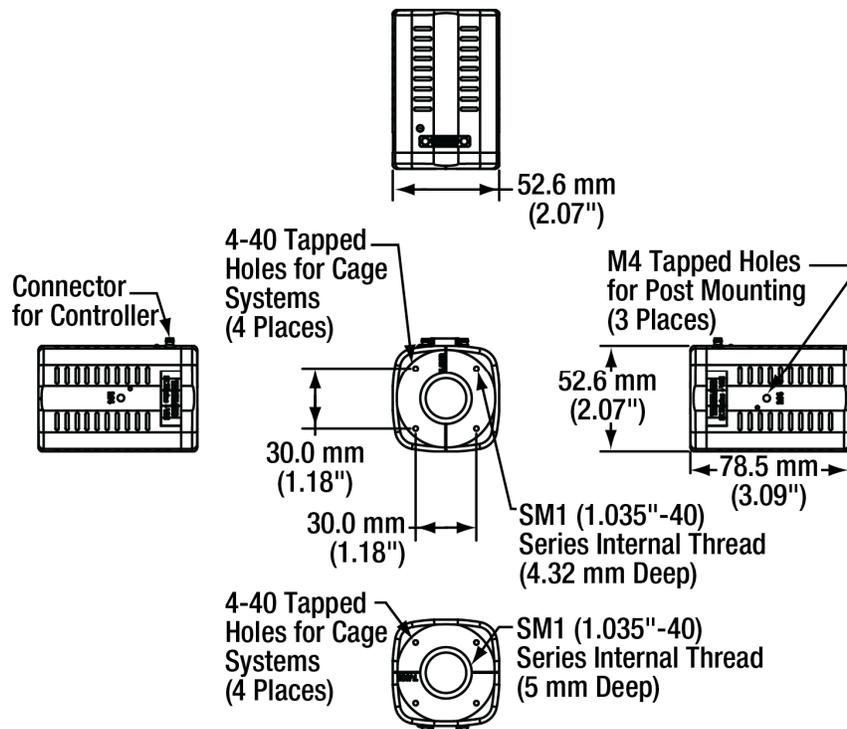


Figure 25 KURIOS-VB1/M Optical Head

Note: KURIOS-VB1 contains 8-32 tapped holes (in 3 places) instead of M4 tapped holes.

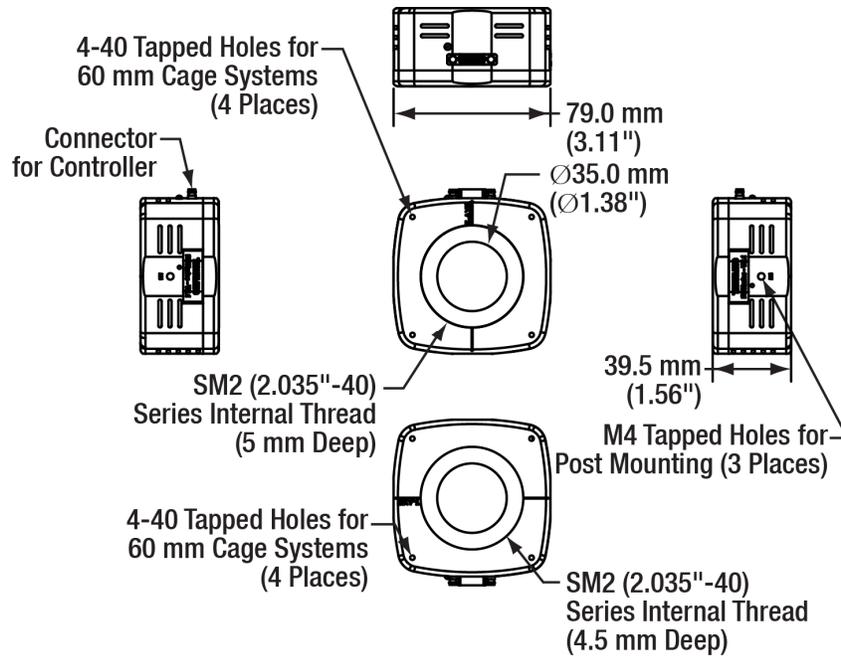


Figure 26 KURIOS-WL1/M Optical Head

Note: KURIOS-WL1 contains 8-32 tapped holes (in 3 places) instead of M4 tapped holes.

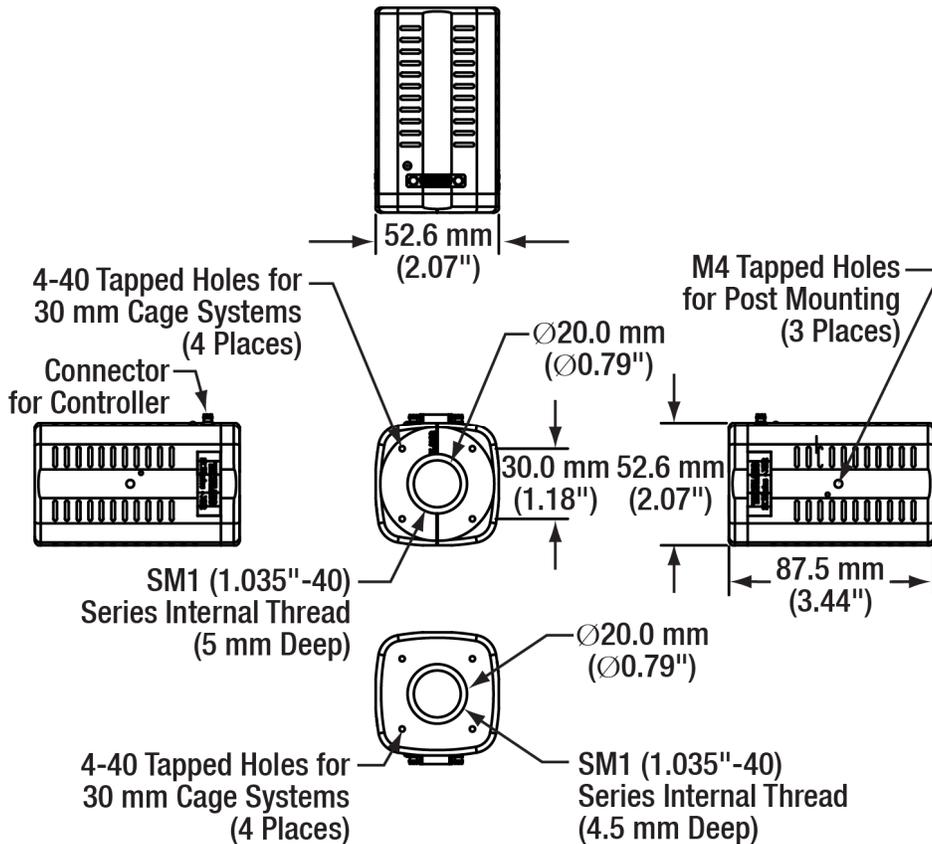


Figure 27 KURIOS-XE2/M Optical Head

Note: KURIOS-XE2 contains 8-32 tapped holes (in 3 places) instead of M4 tapped holes.

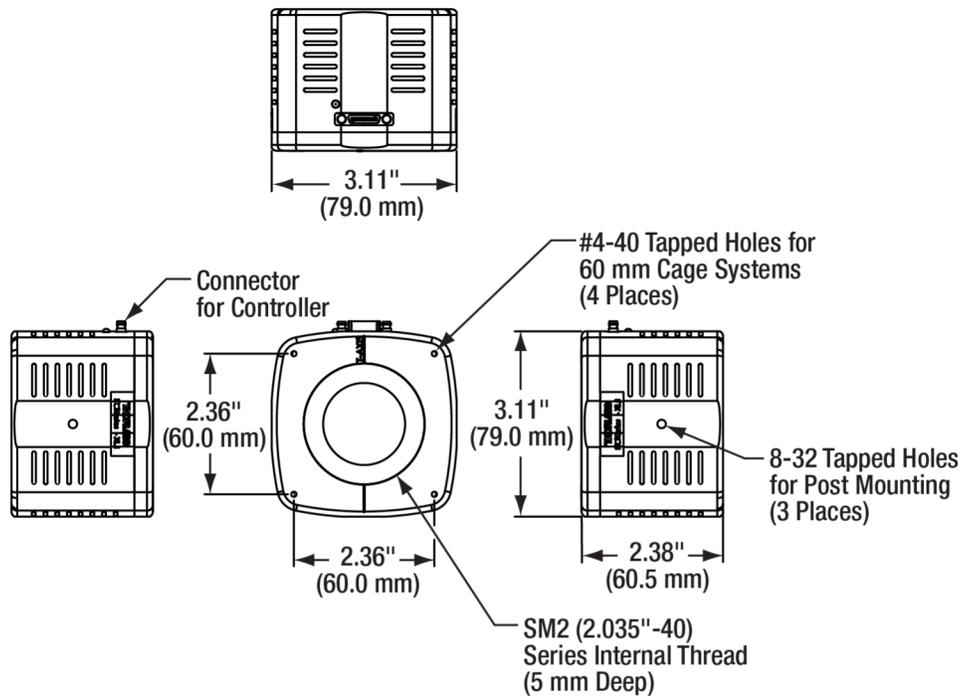


Figure 28 KURIOS-XL1 Optical Head

Note: KURIOS-XL1/M contains M4 tapped holes (in 3 places) instead of 8-32 tapped holes.

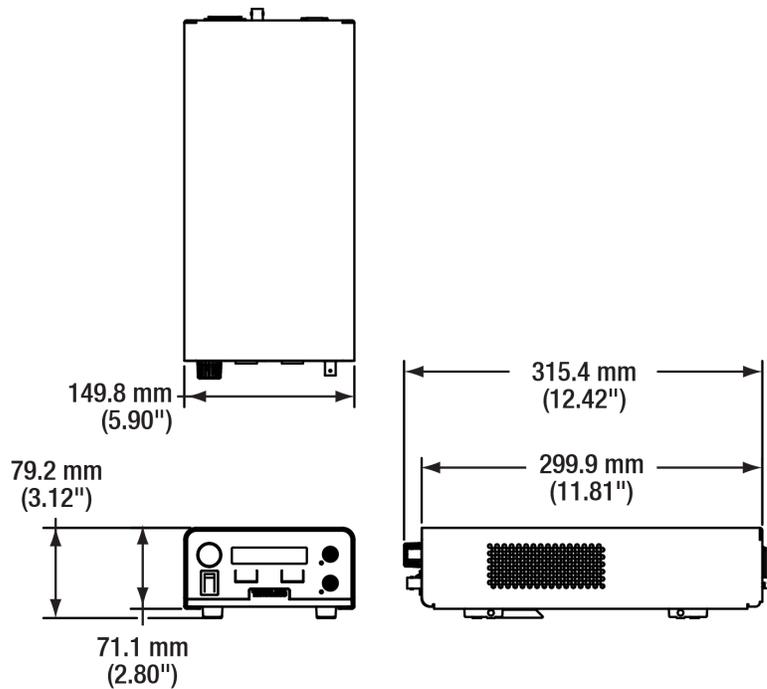


Figure 29 Controller for All KURIOS Liquid Crystal Tunable Filters

Chapter 8 Certification and Compliances



Declaration of Conformity

We: Thorlabs Optical Electronic Technology (Shanghai) Co., Ltd
of: Room A101, No.100, Lane 2891, South Qilianshan Rd, Shanghai

In accordance with the following Directive(s):

2006/95/EC	Low Voltage Directive
2004/108/EC	Electromagnetic Compatibility Directive
2011/65/EC	Restriction of Use of Certain Hazardous Substances (RoHS)

hereby declare that:

Model: KURIOS-WB1(/M), KURIOS-VB1(/M), KURIOS-WL1(/M), KURIOS-XE2(/M), KURIOS-XL1(/M)
Equipment: Liquid Crystal Tunable Filter

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

EN 61010-1:2010
EN 61326-1:2013

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 section of the above referenced specifications, and complies with all applicable Essential Requirements of the Directives.

Signed:

on: 14. August 2019

Name: Shanshan Song
Position: General Manager

Declaration of Conformity

**Thorlabs Optical Electronic Technology(Shanghai) Co.,Ltd
Room A101, No.100, Lane 2891, South Qilianshan Rd., Shanghai**

declares under it's own responsibility, that the product:

Liquid Crystal Tunable Filter

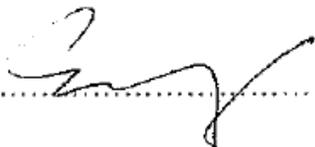
Model No.: **KURIOS-WB1(/M), KURIOS-VB1(/M), KURIOS-WL1(/M), KURIOS-XE2(/M), KURIOS-XL1(/M)**

fulfills the requirements of the standard

47 CFR, Part 2, Part 15, CISPR PUB. 22

and therefore corresponds to the regulations of the directive.

Shanghai, 14. August 2019



.....

Place and date of issue

Name and signature of authorized person

Chapter 9 Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

- This offer is valid for Thorlabs electrical and electronic equipment:
- Sold after August 13, 2005
- Marked correspondingly with the crossed out “wheelie bin” logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated



As the WEEE directive applies to self-contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB's, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

Waste Treatment is Your Own Responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

Ecological Background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

Chapter 10 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

Europe

Thorlabs GmbH
europe@thorlabs.com

France

Thorlabs SAS
sales.fr@thorlabs.com

Japan

Thorlabs Japan, Inc.
sales@thorlabs.jp

UK and Ireland

Thorlabs Ltd.
sales.uk@thorlabs.com
techsupport.uk@thorlabs.com

Scandinavia

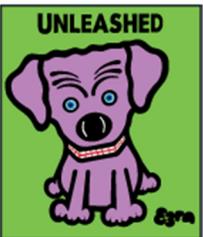
Thorlabs Sweden AB
scandinavia@thorlabs.com

Brazil

Thorlabs Vendas de Fotônicos Ltda.
brasil@thorlabs.com

China

Thorlabs China
chinasales@thorlabs.com



THORLABS
www.thorlabs.com
