56 Sparta Avenue • Newton, New Jersey 07860
(973) 300-3000 Sales • (973) 300-3600 Fax
www.thorlabs.com

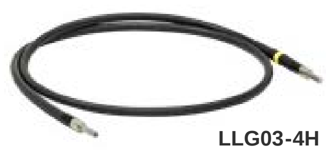
HPLS301 - October 24, 2019

Item # HPLS301 was discontinued on October 24, 2019. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

HIGH-POWER PLASMA LIGHT SOURCES

- **Broad UV to NIR Output Spectrum: 350 to 800 nm**
- **Versions Available with Free-Space or Liquid Light Guide Output**
- **Typical Lifetime of Bulb Module is 6000 hours**
- **Typical Optical Output Power Stability of 0.5%**

HPLS343
High-Power Plasma Light Source (Includes Liquid Light Guide)



LLG03-4H
Ø3 mm Liquid Light Guide (Available Separately)

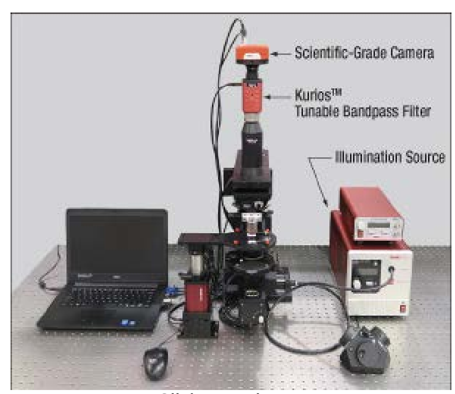
HPLS301
Free-Space, High-Power Plasma Light Source

Hide Overview

OVERVIEW

Features

- Output Spectrum: 350 nm to 800 nm
- Free-Space Output or Output Coupled to Liquid Light Guide
- Integrated Luxim® Light Emitting Plasma™ Bulb Module with Lifetime* 6000 hours (Typ.)
- Variable Attenuator Continuously Tunes Optical Output Intensity
- Independent Shutter Toggled via Automated and/or Manual Controls
- Three Operation Modes:
  - Open Loop is Default and Drives the Bulb Module with Constant Current Near Rated Maximum
  - Closed Loop Varies the Current to Stabilize Bulb's Optical Output Power at 80% of Open Loop Mode Power
  - ECO Mode Varies the Current to Stabilize Bulb's Optical Output Power at 50% of Open Loop Mode Power
- HPLS343 and HPLS345 Light Sources Include Liquid Light Guide (LLG)
  - Tip of LLG is Cooled Using Thermoelectric Coolers (TECs) to Extend LLG's Lifetime
  - Ø3 mm (Ø5 mm) Core LLG Included with HPLS343 (HPLS345)
- Downloadable Software Enables PC Control via USB and Access to Additional Control Features
- Connectors on Back Panel Enable External Control of Key Functions Using CMOS and Analog Voltage Signals



Click to Enlarge
A hyperspectral imaging system built using Thorlabs' Cerna® Microscopy Platform, KURIOS-VB1 Tunable Bandpass Filter, and HPLS343 High-Power Plasma Light Source. For details, please see the *Hyperspectral Imaging* tab.

Thorlabs' high-power light sources are convenient and configurable illumination systems built around the long-lived Luxim® Light Emitting Plasma (LEP)™ bulb module. These light sources are designed for long-term operation, and their optical output power is typically stable to 0.5%. Versions are available with a free-space output or with the light coupled into a liquid light guide (LLG), which homogenizes the transmitted bulb emission and produces a uniform output light field. The broadband wavelength spectrum extends down to 350 nm and overlaps with the common DAPI, FITC, and TRITC filter sets used in biological imaging, which makes these sources well suited for fluorescence microscopy. In addition, the wide spectrum of these sources is important for hyperspectral imaging, as explained in the *Hyperspectral Imaging* tab, endoscopy, and other lighting and inspection applications.

Optical Output Intensity

The transmitted intensity can be continuously controlled by turning a knob on the front panel, through software control, or by sending 0 V to 5 V signals to the connectors on the back panel when External control is engaged. Please see the *Operation* tab for more information. Adjusting the transmitted optical output intensity rotates an attenuation disk positioned between the bulb and the output. Being able to change the output intensity without changing the current driving the bulb module enables consistently stable optical output from the source. The intensity may be adjusted independently of the shutter control.

Front Panel Display

The front panel LCD shows bright text on a dark background, which is ideal for use in dim environments and is visible from across the room and at oblique angles. The displayed information includes the percentage of the available optical power coupled into the output port, the shutter state, and an estimate of the remaining bulb module lifetime in hours.

***Long Life Bulb Module: 6000 hours**

Due to the unique electrode-less design of the LEP bulb module (see the *LEP™ Bulb Module* tab), the lifetime of this bulb module is approximately 6 times that of a xenon bulb. The LEP bulb module ages gradually during operation when the source is operated in Open Loop mode, but when it operated in Closed Loop or Eco modes the effects of aging (decreasing optical power produced for a given driving current) are not observed until closer to the end of the bulb module's life (see the *Operation* tab). When the optical output power drops to 50% of the original power, which typically occurs after 6000 hours, the bulb module is considered to be at its end of life. However, it is not necessary to replace the bulb module until its output power can no longer fulfill the needs of your application.

Please note that replacement bulb modules are not available at this time.

Liquid Light Guides

The HPLS343 and HPLS345 are designed to couple light from the bulb into a LLG with a Ø3 mm or Ø5 mm core, respectively. The advantages of LLGs include a transmitted beam free of dead spots, flexibility that allows them to be coiled, a large core size, and a high numerical aperture. Please see the *LLGs* tab for additional information. The Ø3 mm light guide provides a beam with higher brightness, while higher total power is coupled into the Ø5 mm LLG. It is possible to focus the beam from the Ø3 mm guide into a smaller spot, and under certain conditions this smaller core diameter may result in more power being coupled into a microscope. Coupling light from the endface of the LLG to a variety of microscopes can be enabled by using the collimation adapters available below. Thorlabs also offers LLG-to-SM1 adapters for both Ø3 mm and Ø5 mm core LLGs (Item #s AD3LLG and AD5LLG).

These light sources use thermoelectric coolers to control the temperature of the LLG tip closest to the bulb, which extends the lifetime of the LLG. Closing the shutter during periods when the output emission of the light source is not needed will also extend the lifetime of the LLG, because this reduces its exposure to the UV radiation from the bulb. Accumulated exposure to the UV portion of the bulb's spectrum increases the attenuation of the LLG, and the LLG should be replaced when transmission levels drop below those required by the application. We recommend the LLGs offered below, which differ from our standard LLG offerings only in that these have a yellow band that acts as a visual guide that indicates when the LLG is correctly installed in the LLG Port of the light source.

Hide Specs

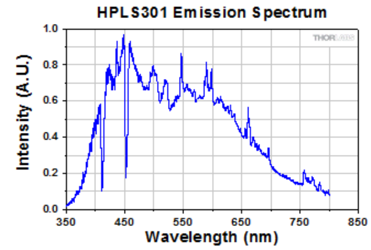
SPECS

Item #	HPLS301	HPLS301/M	HPLS343	HPLS345
Performance				
Wavelength Range	350 nm to 800 nm			
Output	Free Space, Ø50 mm		Liquid Light Guide	
Optical Output Power	9.5 W[a] (Typ.) 8.5 W[a] (Min)		4.0 W[b] (Typ.) 3.5 W[b] (Min)	7.0 W[b] (Typ.) 6.0 W[b] (Min)
Ouput Power Drift (Typ.)	0.2%/°C 0.03%/h		0.2%/°C[c] 0.05%/h[c]	
Output Power Stability[d]	0.5% (Typ.) 0.6% (Max)			

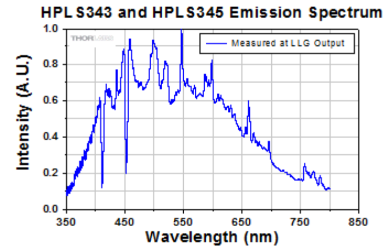
Transmitted Intensity, Range Tunable by Attenuator	1.5% to 100%	0.1% to 100%	
Output Intensity Non-Linearity	<2%		
Intensity Switch Time	<3 s (10% to 90% Intensity)		
Shutter States	Open, Closed (Independent of Intensity Setting)		
Shutter Switch Time	5 ms		
Shutter Repetition Rate (Max)	1 Hz (Extended Duration) 10 Hz (Burst)		
Bulb Module Life Time[e]	6000 h (Typ.)		
Correlated Color Temperature (CCT)	6000 K	6000 K[f]	
Color Rendering Index (CRI)	94	94[f]	
Beam Divergence (FWHM)	6°	-	
Liquid Light Guide			
Core Diameter	-	3 mm	5 mm
Numerical Aperture (NA)	-	0.59	
Length	-	4' (1.2 m)	
Operating Wavelength Range	-	340 nm to 800 nm	
Communications			
Baud Rate	115.2 kbps		
Data Length (1 Stop Bit, No Parity, No Flow Control)	8 Bit		
Command (=) and Query (?) Formats	Keyword=Argument (Carriage Return) Keyword? (Carriage Return)		
Trigger IN, Trigger OUT, and External Shutter Control	5 V CMOS		
Analog IN and Analog OUT (Output Intensity)	0 V to 5 V Analog (20 kΩ Impedance)		
Connectors on Back Panel	BNC Female, SMA Female, USB Type B[g]		
Electrical			
Power Supply	90 VAC to 264 VAC, 325 VA (47 Hz to 63 Hz)		
Fuse	5A, 250 VAC, Type T, Slow Blow		
Physical			
Dimensions (Length x Width x Height)	13.68" x 7.40" x 7.87"[h] (347.5 mm x 188.0 mm x 200.0 mm[h])	14.23" x 7.40" x 7.87"[i] (361.5 mm x 188.0 mm x 200.0 mm[i])	
Mechanical Drawings			
Output Beam Height	148 mm Including Feet 138 mm Excluding Feet	-	
Operating Temperature Range[j,k]	10 °C to 30 °C (Open and Closed Loop Mode) 10 °C to 35 °C (Eco Mode)		
Storage Temperature Range[k]	-15 °C to 70 °C		

- Power is measured after the free-space output, when the bulb is at start-of-life.
- Power is measured at the output of the liquid light guide, when bulb and LLG are at start-of-life.
- This value includes the photo-induced darkening of the liquid in the LLG that occurs naturally during operation as a result of exposure to UV radiation.
- Typical standard deviation for measurements taken over an hour at the output of the unit.
- Typical value, defined as the total operation time before the maximum optical output power of the bulb reaches 50% of its original output.
- Prior to LLG
- USB Functions as a Virtual COM Port; 2 Meter Cable Included.
- The height dimension includes the feet.
- The height dimension includes the feet, when they are folded closed.
- Assumes Long-Term Operation

- Non-Condensing Conditions



Click to Enlarge
Click Here for Raw Data



Click to Enlarge
Click Here for Raw Data
The Optical Spectrum Measured at the Output of the LLG

Hide Front & Back Panels

FRONT & BACK PANELS

HPLS301(/M) Front and Back Panels

Front Panel

Click to Enlarge
HPLS Series Free-Space, Plasma Light Source Front Panel

Callout	Description
F1	External Control Button with Integrated LED State Indicator
F2	Liquid Crystal Display Screen (Bright Text on Dark Field)
F3	Shutter Control Button
F4	Light Intensity Adjustment Knob
F5	Light Output Port
F6	4-40 Tapped Hole for 60 mm Cage System (4 Places)
F7	Shutter State LED Indicator
F8	Light Source State LED Indicator
F9	Power Switch

Back Panel

Click to Enlarge
HPLS Series Free-Space, Plasma Light Source Back Panel

Callout	Description
B1	External Shutter Control, BNC Female Port, 5 V CMOS

B2	Trigger OUT, SMA Female Port, 5 V CMOS
B3	Analog IN, BNC Female Port, 0 to 5 V
B4	Trigger IN, BNC Female Port, 5 V CMOS
B5	Analog OUT, SMA Female Port, 0 to 5 V
B6	USB Type B Port
B7	AC Power Plug Port
B8	Fuse Drawer

- See the *Pin Diagrams* tab for pin assignments.

HPLS343 and HPLS345 Front and Back Panels

Front Panel

Click to Enlarge
HPLS Series High-Power Plasma Light Source with LLG Front Panel

Back Panel

Click to Enlarge
HPLS Series High-Power Plasma Light Source with LLG Back Panel

Callout	Description
F1	External Control Button with Integrated LED State Indicator
F2	Liquid Crystal Display Screen (Bright Text on Dark Field)
F3	Shutter Control Button
F4	Light Intensity Adjustment Knob
F5	Liquid Light Guide Port
F6	Liquid Light Guide Release Switch
F7	Shutter State LED Indicator
F8	Light Source State LED Indicator
F9	Power Switch

Callout	Description
B1	External Shutter Control, BNC Female Port, 5 V CMOS
B2	Trigger OUT, SMA Female Port, 5 V CMOS
B3	Analog IN, BNC Female Port, 0 to 5 V
B4	Trigger IN, BNC Female Port, 5 V CMOS
B5	Analog OUT, SMA Female Port, 0 to 5 V
B6	USB Type B Port
B7	AC Power Plug Port
B8	Fuse Drawer

- See the *Pin Diagrams* tab for pin assignments.

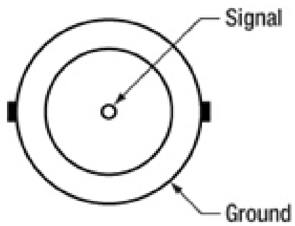
HPLS301(/M), HPLS343, and HPLS345 Pin Diagrams

Analog IN

Trigger IN

(Specify Intensity Output Level)

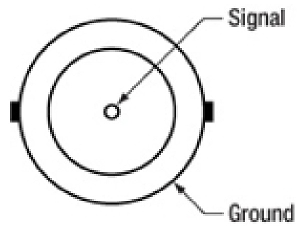
BNC Female



0 V to 5 V
1.5% to 100% Output Light Intensity
(HPLS301, HPLS301/M)
0.1% to 100% Output Light Intensity
(HPLS343, HPLS345)

(Enables Intensity Output Change)

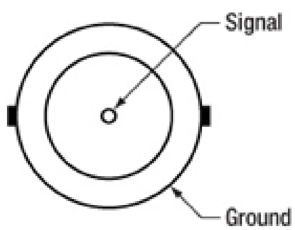
BNC Female



5 V CMOS
High Logic State: 3.5 V to 5 V
Low Logic State: 0 V to 1.5 V
(Falling Edge of Pulse Enables Intensity Level Change to Analog IN Value)

External Shutter Control

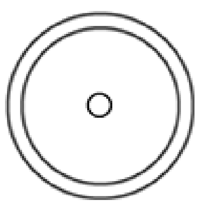
BNC Female



5 V CMOS
Close Shutter: High Logic State (3.5 V to 5 V)
Open Shutter: Low Logic State (0 V to 1.5 V)

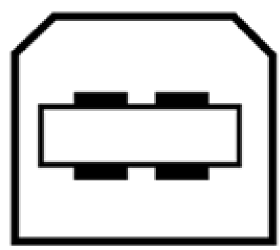
Trigger OUT

SMA Female



5 V CMOS
Default: High Logic State (3.8 V to 5 V)
During Intensity Tuning: Low Logic State (0 V to 0.55 V)

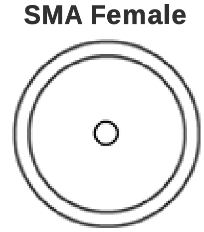
USB Type B Connector



A host PC connects to the HPLS series light source via the USB interface. This enables command-line control.

Analog OUT

SMA Female



0 V to 5 V

(Output Voltage Proportional to Output Light Intensty Percentage of Maximum)

For more information about the functions of the Analog IN, Trigger IN, Analog OUT, and Trigger OUT and the external control of the HPLS series high-power plasma light sources, please see the *Operation* tab. Information about the command-line language and using a host PC to control the HPLS sources can be found in Chapter 8 of the manuals and in the *Software* tab.

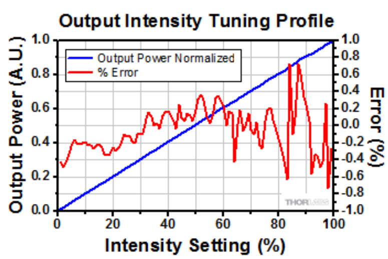
Hide Operation

OPERATION

Click on the following links to move to the different sections in this discussion.

Output Intensity and Shutter Control

Output Intensity Control: Rotate the Light Intensity Control Knob on the Front Panel to continuously vary the intensity of light transmitted through the output. Output intensity control operates independently of the shutter, and control of the intensity setting using the tuning knob and software may be performed regardless of whether the shutter is open or closed.



Click to Enlarge

Figure 1: The HPLS series light sources are calibrated to give a linear ratio between the intensity setting and the transmitted optical power. The red curve is an example of the typical error that exists between the calculated and measured output powers. For additional details, please see the text.

When a host PC is interfaced with the HPLS series light sources, the operator can also use the software to specify an intensity value as a percentage of the maximum possible optical output power. While operating the light source under External control, the intensity can be changed by sending the appropriate voltage signals to BNC ports on the instrument's back panel. When External control is enabled, the intensity tuning knob on the front panel is disabled. More information about External control and software control is included in Sections 5.5 and Chapter 7, respectively, of the manual.

Adjusting the output intensity does not affect the amount of optical power emitted by the bulb; the current driving the bulb is not affected by the intensity adjustment. Instead, the intensity adjustment controls the rotation angle of an attenuation disk placed between the bulb and the output. The disk has an aperture that varies with rotation angle, and adjustments to intensity cause the disk to rotate so that the desired amount of optical power is transmitted through the disk.

Using an attenuation disk to adjust the transmitted intensity, rather than performing this function by changing the current levels driving the bulb module, maintains the bulb in a stable operating state while also enabling the intensity to be quickly tuned; less than 3 seconds are required to adjust the output intensity between 90% and 10%.

The output powers of these high-power plasma light sources are calibrated so that the output power is a linear function of the intensity setting, as is illustrated by the blue curve in Figure 1. The intensity setting is reported as a percentage in the upper left corner of the display screen on the front panel, and its value is independent of the power emitted by the bulb. The red curve in Figure 1 is an example of the typical error between the measured power after the output and the predicted value of the output power calculated from the intensity setting and the calibration data. Each point on the error curve represents an average of 100 measurements. For optimum stability, allow these light sources to warm up for between 45 minutes and an hour before use.

Shutter Control: The shutter state can be toggled between open and closed by pressing the rectangular button beside the Light Intensity Control Knob, by sending the appropriate command to the light source when it is being controlled by a host PC, or by sending a 5 V CMOS signal to the Shutter Control female BNC port on the back panel when external control is enabled. The shutter is closed by default, and the state of the shutter (Open/Closed) is displayed in the lower left corner of the front panel's display screen. When the shutter is open, the LED indicator to the right of the shutter control button is illuminated. The shutter button is always operational, but pressing it while the light source is operating under external control will disable external control of the light source.

The shutter may be repetitively toggled between states with a repetition rate of up to 1 Hz for an indefinite duration, and its state may be toggled at rates up to

10 Hz during bursts of a few minutes at most. If the shutter state is toggled at rates in excess of 1 Hz for longer than a few minutes, the heat generated by this activity can cause the shutter to fail.

For HPLS343 and HPLS345 only: closing the shutter during periods when the output emission of the light source is not needed will extend the lifetime of the LLG. Exposure to the UV portion of the spectrum produced by these high-power light sources causes the transmissive properties of LLGs to gradually degrade, and closing the shutter blocks the coupling of the Luxim® LEP™ bulb's light into the LLG.

Software Control via a Host PC

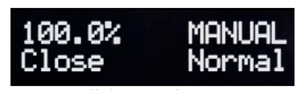
For greater control of the light source and more configuration options than are offered by the front panel interface, the HPLS series can be controlled by a host PC. A software package is available for download that includes drivers and installs a GUI. Control of the light source may be performed using the GUI or by running custom user-written programs. Please see the *Software* tab for more information. Prior to running a custom program via the command-line interface, install the drivers included in the software download, power on the light source, and connect a USB cable between the PC and the light source. The GUI and command line language, listed and described in Chapter 7 of the manuals, allow the user to:

- Obtain Various Status and Instrument Identification Information
- Turn the Bulb On and Off
- Set the Output Intensity Optical Power
- Set the Shutter State
- Set the Operation Mode: Open Loop, Closed Loop, and Closed Loop Eco Modes
- Toggle Between External (Voltage Signals Sent to Back Panel Connectors) and Local (Front Panel and PC) Operation

---

Information Shown on LCD Screen During Operation

The Liquid Crystal Display (LCD) screen features bright text on a dark background, and the text remains visible from across the room and at oblique angles. The dark background emits less light into the room than do displays featuring dark text on a bright background, which makes it less disruptive under dim lighting conditions. The display, an example of which is shown in Figure 2, has five different fields:



Click to Enlarge
Figure 2: Open Loop Mode: Example of LCD Screen

- **Upper Left Corner**: The transmitted light intensity, which is controlled by tuning the attenuator positioned between the bulb and the output, is shown.
- **Upper Right Corner**: MANUAL indicates front panel and PC control, and EXTERNAL indicates control via back panel connectors is enabled.
- **Lower Right Corner**: The current state of the device is shown.
- **Lower Left Corner**: The shutter state, which is either Open or Close, is displayed.
- **Center**: When operating in Open Loop Mode, nothing is displayed in the center (see the image at the right). The letter "C" is displayed when operating in Closed Loop Mode, and the letter "E" is displayed when operating in Eco Mode. Information about the different operating modes and examples of the Closed Loop and Eco display screens are shown in Figures 4 and 5, respectively.

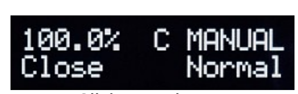
Operation Modes: Open Loop, Closed Loop, and Closed Loop Eco

The HPLS series light sources feature three different operation modes: Open Loop, Closed Loop, and Closed Loop Eco. When the operating mode is changed, the driving current sent to the bulb is affected. This is in contrast to using the front panel knob, software, or back panel connection controls to adjust the intensity, which changes the coupling ratio between the bulb and the liquid light guide but does not affect the current driving the bulb.

The default operation mode, which is set at the factory, is Open Loop mode. When a PC is interfaced with the light source, the operation mode can be changed using the GUI or command-line interface. It is not possible to change the operation mode via interaction with the front panel or when external control is enabled. Changing the operation mode updates the operation mode setting stored in non-volatile memory. When the light source is powered on, the active operation mode is the one that was active when the source was last powered down.

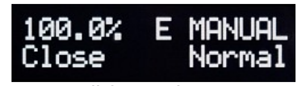
Open Loop Mode: This is the default operation mode, which is set at the factory and produces the highest optical output power from the bulb. In this mode, the current driving the lamp is held constant near the current limit. As the optical output intensity of the bulb is not stabilized, this intensity can be expected to slowly vary during short-term operation. Over longer durations, the output intensity of the bulb will gradually decrease as the bulb ages. Figure 2 shows an example of the display screen corresponding to operation in Open Loop Mode.

Closed Loop Mode: In Closed Loop mode, the optical output power of the bulb is stabilized at a target level using a feedback mechanism. An initialization process that occurs at start-up determines the target intensity. During initialization, the bulb is driven at a constant current level of approximately 90% of the current limit. A photodiode located near the bulb measures the optical output intensity, and then the target optical output power level for this mode is set to be 80% of this measured value. During operation, this optical output power is maintained by using a feedback mechanism to adjust the bulb's driving current as appropriate. Closed Loop mode operation provides a more stable output intensity than Open Loop mode, and it also compensates for the gradual decrease in the lamp's optical output power that occurs as the bulb ages. The letter "C" in the top-center of the LCD display shown



Click to Enlarge
Figure 3: Closed Loop Mode: Example LCD Screen

in Figure 3 indicates the light source is operating in Closed Loop mode.



Click to Enlarge
Figure 4: Eco Mode: Example LCD Screen

Eco Mode: This mode operates similarly to Closed Loop mode, with the difference being that Eco mode stabilizes the optical output power at a lower intensity. Rather than stabilize the optical output power of the bulb at 80% of the Open Loop mode power, as is done in Closed Loop mode, Eco mode stabilizes the optical output power of the bulb at 50% of the Open Loop mode power. A benefit of operating at this lower power level is that the bulb suffers less heat stress than it does when operating in the standard Closed Loop mode, and this is expected to extend the lifetime of the bulb. As is true when operating in the standard Closed Loop mode, Eco mode compensates for both transient variations in the optical output power of the bulb and the gradual decrease in the lamp's optical output power. The letter "E" in the top-center of the LCD display shown in Figure 4 indicates the light source is operating in Eco mode.

Click on the More [+] link below to view plots illustrating the effects of the operating mode and liquid light guide (HPLS343 and HPLS345 only) on the intensity of the transmitted light. Data were acquired over a continuous 48 hour period, and measurements were recorded both just before the input and at the output of the LLG (HPLS343 and HPLS345), or after the free-space output (HPLS301). Results are plotted for Open Loop and Closed Loop modes, with the Closed Loop mode data also applying to Eco mode.

The measurements taken at the input of the LLG and for the free-space version describe time-dependent bulb intensity independent of other effects. The measurements taken at the output of the LLG include the optical transmission characteristics of the LLG. As is discussed in the *LLGs* tab, LLGs act to homogenize the light transmitted through them, which smooths the time-dependent intensity data curves. In addition, the light transmission levels through LLGs decrease with time in response to exposure to UV radiation. While operation in Closed Loop or Eco modes maintains the optical output power of the bulb at the target level, these modes do not compensate for the attenuation of the transmitted light through the LLG that increases with time as a result of the aging of the liquid in the guide.

Graphs of Optical Intensity, Open and Closed Loop Operation, 48 Hour Duration

More [+]

External Control via Back Panel BNC and SMA Connections

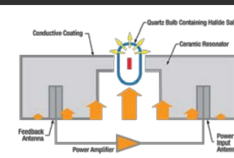
External control of the light source is enabled by pressing the button labeled "External," which is located above the LCD display on the front panel of the instrument. After the button is pressed, it illuminates and stays illuminated while External mode is active. Enabling External control disables both software (PC) and front panel control, with the exception of the shutter. Both the shutter button on the front panel and software control of the shutter remain active for safety reasons; however, using one of these methods to toggle the shutter will automatically disable External control and return the instrument to Local control, in which the front panel and PC control are active.

External control of the light sources is performed by sending signals to a trio of female BNC connectors of the back panel of the instrument (Shutter Control, Analog IN and Trigger IN). The back panel also includes a pair of female SMA output connectors that provide access to status information (Analog OUT and Trigger OUT). Please see the *Front & Back Panels* tab for information about the Back Panel connectors.

Hide LEP Bulb Module

LEP BULB MODULE

The Luxim® Light Emitting Plasma (LEP)™ bulb module at the core of the high-power light sources is an intense source of full-spectrum white light and has a typical lifetime of 6000 hours. A major contributing factor to its long life, which is six times that of a xenon bulb, is a design that includes no electrodes and is strikingly different than the design of metal-halide discharge lamps and other conventional light sources.



Click to Enlarge
Diagram of the LEP Bulb Module Architecture

The sketch in Figure 1 depicts the architecture of the LEP bulb module. Contained within the ceramic resonator are two antennas, and the sealed quartz bulb is positioned at the center. The bulb contains a small amount of a halide salt mixture as well as inert and other gasses. The radio frequency (RF) driver is connected to the power input and feedback antennas using low-loss coaxial cables. When operating, the electric circuit generates an RF field, which is amplified and concentrated by the structure of the ceramic resonator. The bulb position coincides with the most intense region of the RF field, and the energy of the field ionizes the gasses and vaporizes the halides contained in the quartz bulb. The ionized gases transfer energy to the metal halide salts, which form an intense plasma column at the center of the bulb. This is the highly-efficient source of the intense full-spectrum white light. A reflective material located at the back of the lamp is used to direct all generated light into the forward direction.

In conventional metal-halide discharge lamp designs, a plasma is formed inside the bulb by transmitting a high-energy pulse across the two electrodes. Each pulse not only creates a plasma in the bulb but also vaporizes some of the electrode material, which both erodes the electrodes and deposits a metal on the bulb. This degrades the performance of the lamp and leads to its failure. In addition, the electrodes act as heat sinks that draw power away from the bulb. The driving energy applied to the bulb must be high enough to overcome these losses.

The LEP bulb module, by energizing a plasma arc without using filaments or electrodes, eliminates all failure modes and inefficiencies of traditional broadband light sources, which results in an incredibly bright and stable source with long life span comparable only to light emitting diodes (LEDs).

Replacing the Luxim LEP Bulb Module

Please note that replacement bulb modules are not available at this time.

The LEP bulb module is considered to be at the end of its life when, for a given driving current, the optical output intensity of the bulb has dropped to 50% of the intensity it produced when it was new. This occurs after the bulb module has operated for 6000 hours (typical). When the optical output power drops to 50% of the original power, which typically occurs after 6000 hours, the bulb module is considered to be at its end of life. However, it is not necessary to replace the bulb module until its output power can no longer fulfill the needs of your application.

Replacing the bulb module package is a straight-forward procedure that can be performed by the user. Click the *More [+]* link below to see an illustrated summary of the steps, which are describe in more detail in the manual. Each bulb module has its own serial number that is read by the light source, and lifetime information for up to two bulb modules is stored in memory. This allows users to swap between two operational bulb units while preserving information about how long each has operated (the lifetime countdown).

Pictures of the Bulb Module Removal Procedure More [+]

Hide LLGs

L L G S & N B S P ;

Liquid Light Guides for HPLS343 and HPLS345

The liquid cores of LLGs gradually become less transmissive with increasing exposure to UV light. As the Luxim® LEP™ bulb spectrum extends into the UV, the LLGs used to transmit light from these high-power sources will gradually become more absorptive with use. When the transmission properties of an LLG drops below usable levels, the LLG should be replaced. This will occur before the LEP bulb module reaches its end-of-life. Closing the shutter during periods when the output emission of the light source is not needed will extend the lifetime of the LLG by blocking the coupling of the LEP bulb's light into the LLG.

The dust cap on the output end of the LLG may burn if exposed to the intense light emitted by the LLG. To protect the LLG, and for safety, remove the dust cap before powering on the light source.

Installing and Removing a Liquid Light Guide

While all of Thorlabs' standard Ø3 mm (Ø5 mm) liquid light guides are compatible with the HPLS343 (HPLS345), the LLG03-4H and LLG3-xH (LLG05-4H and LLG5-xH) are recommended for these light sources. These LLGs each feature a yellow band near one end that acts as a visual indicator to help the user determine when the LLG is properly seated in the light source. When an LLG without the yellow band is used with these sources, it can be difficult to know when the LLG is correctly installed in the light source.

To insert the LLG, slide it into the LLG port as shown in Figure 1. The LLG is fully inserted when the edge of the yellow marker ring is flush with the front panel, as shown in Figure 2. To remove the LLG, press up on the LLG Release switch and pull out the LLG, as shown in Figure 3. The light sources detect when an LLG is installed in the LLG Port. If there is no LLG present, the light source closes the shutter, and the shutter cannot be opened until an LLG is in place. This protects the user from exposure to the intense light emitted by the source.

To protect the tips of the LLGs from damage and to keep them as clean as possible, cover exposed LLG tips with their dust covers. Ensure that the tip of the LLG is free of grease, dust, and other contaminants before inserting it into the light source. For information on how to clean the tip, see the section following Figures 1 through 3.

Click to Enlarge
Figure 2: As shown above, the LLG is correctly installed when the edge of the yellow band is flush with the front panel of the light source.

Click to Enlarge
Figure 3: To remove the LLG, press up on the Release LLG switch and pull out the LLG.

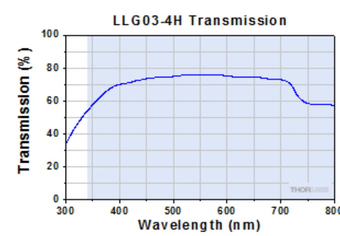
Click to Enlarge
Figure 1: After ensuring the tip closest to the yellow band is clean, slide that tip into the LLG Port. Continue to push the end of the LLG into the port until the edge of the yellow band is flush with the front panel (Figure 2).

Liquid Light Guide Overview

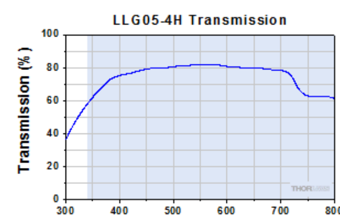
A variety of applications benefit from the heat and vibration isolation achieved by routing the optical power output by a light source from a distant location to where it is needed. The HPLS343 and HPLS345 have been designed to accept liquid light guides (LLGs) with Ø3 mm and Ø5 mm cores, respectively. LLGs are flexible light pipes fabricated from a polymer tube filled with a transparent, non-toxic, and non-flammable liquid. The tips of the tube are sealed with fused silica caps, which also act as optical end faces. Transmission through the LLG homogenizes the light field across the diameter of the core, which produces an output beam with uniform intensity. The many advantages of pairing an LLG with a high-power and broadband light source include:

- A Homogenous Transmitted Beam Free of the Dead Spots that Characterize the Light Field from a Silica Fiber Bundle
- The Ability to Coil and Arrange the LLGs, in Contrast to Silica Rods of Comparable Diameters that Break if Bent
- The Large Core Size and High Numerical Aperture of the LLG
- Excellent Transmission over the Entire Visible Spectral Range (Figures 4 and 5)

When used with the HPLS343 and HPLS345 light sources, the gasket of the LLG should not exceed 45 °C for long durations and 60 °C for durations of less than an hour. The gasket is indicated by the change in the fitting from chrome metal to a black color, as shown in the figure to the lower right. These LLGs are designed to operate at temperatures between -5 °C to 35 °C. The HPLS343 and HPLS345 light sources protect the LLG against excessive temperatures by monitoring the temperature of the tip of the LLG closest to the bulb, cooling the tip as required using a combination of thermoelectric coolers and fans, and powering down the light source if necessary. At higher temperatures, bubbles form in the liquid, which degrades the transmission properties of the LLG. If the temperature of gasket is between 45 °C to 60 °C for less than an hour, the bubbles can be reabsorbed by the liquid if the LLG is allowed to cool. We recommended a cool-down time of no less than 30 minutes. If the temperature of the gasket exceeds 60 °C, the LLG can be permanently damaged; the bubbles in the liquid will have a severe negative impact on the transmission properties of the LLG, and these high temperatures can also cause structural damage by degrading the seals between the various structural components of the guide.



Click to Enlarge
Figure 4: Plotted are typical transmission data for a Ø3 mm core, 4' long LLG, with the recommended operation wavelength range shaded blue. As a function of length, only minimal variations (<2.3%) are expected between our 4' (1.2 m), 6' (1.8 m), and 8' (2.4 m) long liquid light guides.



Click to Enlarge
Figure 5: Plotted are typical transmission data for a Ø5 mm core, 4' long LLG, with the recommended operation wavelength range shaded blue. As a function of length, only minimal variations (<2.3%) are expected between 4' (1.2 m), 6' (1.8 m), and 8' (2.4 m) long liquid light guides.

LLGs, while flexible, also posses minimum bend radii. See the table below for the minimum bend radii of these LLGs. The tubes will develop permanent kinks if forced into a bend tighter than the minimum specification.

Reduction in Transmission with Exposure to Ultraviolet Light: The liquid in LLGs gradually becomes less transmissive with increasing exposure to UV light. As the LEP bulb spectrum extends into the UV, the LLGs used with the HPLS sources will gradually become more absorptive with use. When the transmission properties drop below usable levels, the LLG should be replaced.

Cleaning the Optical End Faces of Liquid Light Guides: The fused silica, PTFE, and metal (either aluminum, chrome plated brass, or stainless steel) materials composing LLGs are resistant to common cleaning solvents; however, the tips of the LLGs should not be submerged in solvent, and neither should a heavily soaked cleaning pad be applied to the tip. Saturating the tip with solvent can result in the solvent penetrating the seal between the silica end face and the polymer tube and damaging the guide. If debris cannot be removed from the end face by wiping it with solvent, a razor blade, handled gently, can be used to clean the tip. If a razor blade is used, ensure that it does not chip the edge of the fused silica glass end face.

Liquid Light Guide Dimensions and Minimum Bend Radius:

Active Core Diameter	Standard End Fittings				Protective Sleeve	Min Bend Radius
d_0	d_1	l_1	d_2	l_2	d_3	-
Ø3 mm	Ø5 +0/-0.1 mm	20 ± 0.1 mm	Ø9 ± 0.1 mm	24 ± 0.1 mm	Ø7 ± 0.1 mm	40 mm
Ø5 mm	Ø7 +0/-0.1 mm	20 ± 0.1 mm	Ø10 ± 0.1 mm	24 ± 0.1 mm	Ø9.5 ± 0.1 mm	60 mm

The drawing and photograph below illustrate the dimensions given in the table above. 180 ± 1° indicates the flatness tolerence between the metal and black material in the segment labled l_2.

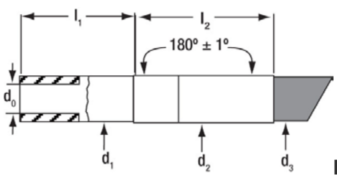


Figure 6: Diagram of an LLG Tip, with End Face at Left

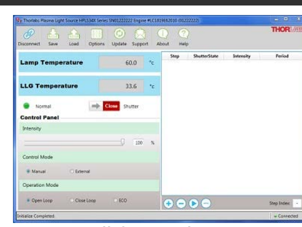
Figure 7: End portion of an LLG with Key Dimensions Labeled.

Hide Software

SOFTWARE

Software for the HPLS Series High-Power Plasma Light Sources

An external host PC can control the operation of the HPLS series high-power plasma light sources. Users can choose to operate the source through a GUI or by writing and running custom programs. The drivers and software that enable both methods of control can be downloaded by clicking on the following link. An image of the GUI is shown in the image to the right and described in Chapter 7 of the manual, while the command-line language used to write custom programs is described in Chapter 8. Prior to running a custom program via the command-line interface, the downloadable drivers should be installed, the instrument should be powered on, and a USB cable should be connected between the host PC and the USB type B port on the back panel of the light source.



Click to Enlarge
The GUI for the HPLS High-Power Plasma Light Sources

The basic command structure is a keyword, followed by an equals sign (=), followed by a character string, and terminated by a carriage return (CR). An example of a command is LAD=3 (CR), which sets the operation mode of the light source to Eco mode. The query command structure is a keyword, followed by a question mark (?), and terminated by a carriage return. An example of a query is LLG? (CR), which will return the temperature of the tip of the liquid light guide.

Software

Version 1.4.1

Firmware

HPLS301: Version 1.2

HPLS343 & HPLS345: Version 1.4

Software

Hide Shipping List

SHIPPING LIST

Items Included with Each HPLS301(/M) Plasma Light Source:

- One Light Source Unit
- One Region-Specific Power Cord
- One USB2.0 A-B Cable, 2 Meters Long
- One 2 mm Hex Key
- One 3 mm Hex Key
- One Flash Drive with Software and Operation Manual

Items Included with Each HPLS343 and HPLS345 Plasma Light Source:

- One Light Source Unit
- One Liquid Light Guide (LLG03-4H for the HPLS343, LLG05-4H for the HPLS345)
- One Region-Specific Power Cord
- One USB2.0 A-B Cable, 2 Meters Long
- One 2 mm Hex Key
- One 3 mm Hex Key
- One Flash Drive with Software and Operation Manual

Click to Enlarge
HPLS343 and HPLS345 System Components

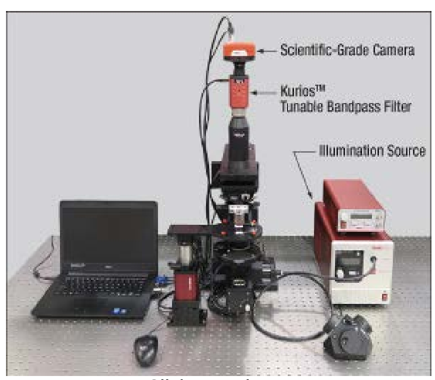
Hide Hyperspectral Imaging

HYPERSPECTRAL IMAGING

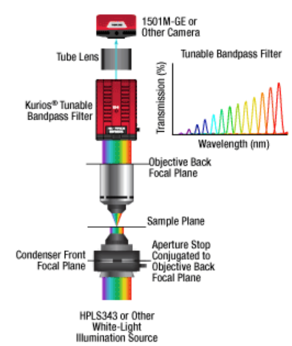
Application Idea: Hyperspectral Imaging

In hyperspectral imaging, a stack of spectrally separated, two-dimensional images is acquired. This technique is frequently used in microscopy, biomedical imaging, and machine vision, as it allows quick sample identification and analysis.

Hyperspectral imaging obtains images with significantly better spectral resolution than that provided by standalone color cameras. Color cameras represent the entire spectral range of an image by using three relatively wide spectral channels—red, green, and blue. In contrast, hyperspectral imaging systems incorporate optical elements such as liquid crystal tunable bandpass filters or diffraction gratings, which create spectral channels with significantly narrower bandwidths.



Click to Enlarge
A hyperspectral imaging system built using Thorlabs' Cerna® Microscopy Platform, KURIOS-VB1 Tunable Bandpass Filter, 1501M-GE Monochrome Scientific Camera, and the HPLS343 High-Power Plasma Light Source. Please contact technical support for infomation on building this system.



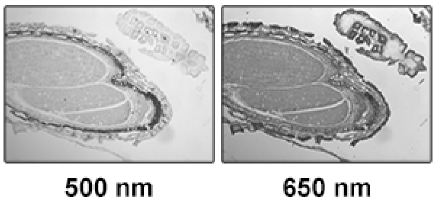
Click to Enlarge
Schematic of Hyperspectral Imaging

Thorlabs' Cerna® microscopy platform, Kurios® tunable filters, and scientific-grade cameras are easily adapted to hyperspectral imaging. The Cerna platform is a modular microscopy system that integrates with Thorlabs' SM lens tube construction systems and supports transmitted light illumination. Kurios tunable filters have SM-threaded interfaces for connections to the Cerna platform and our cameras. In addition, Kurios filters include software and a benchtop controller with external triggers, which enable fast, automated, synchronized wavelength switching and image capture.

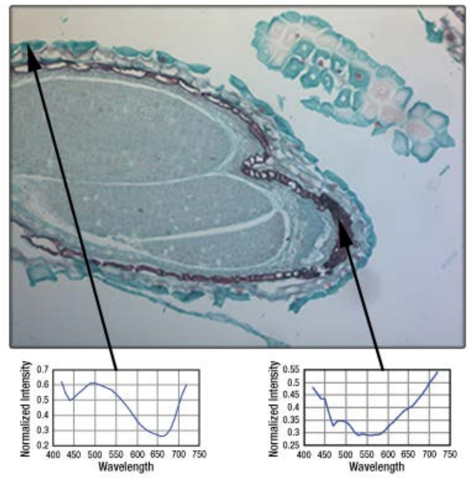
Example Image Stack

The data in the images and video below demonstrate the hyperspectral imaging technique. Figure 1 depicts two images of a mature *capsella bursa-pastoris* embryo (also known as shepherd's-purse) taken with a Kurios filter set to center wavelengths of 500 nm and 650 nm. These two images show that an entire field of view is acquired at each spectral channel. Figure 2 is a video containing 31 images of the same sample, taken at center wavelengths from 420 nm to 730 nm in 10 nm steps. (10 nm is not the spectral resolution; the spectral resolution is set by the FWHM bandwidth at each wavelength.) In Figure 3, images from each spectral channel are used to determine the color of each pixel and assemble a color image. Figure 3 also demonstrates that a broadband spectrum is acquired at each pixel, permitting spectroscopic identification of different sample features within the field of view.

Kurios tunable filters offer a number of advantages for hyperspectral imaging. Unlike approaches that rely upon angle-tunable filters or manual filter swapping, Kurios filters use no moving parts, enabling vibrationless wavelength switching on millisecond timescales. Because the filter is not moved or exchanged during the measurement, the data is not subject to "pixel shift" image registration issues. Our filters also include software and a benchtop controller with external triggers, making them easy to integrate with data acquisition and analysis programs.



Click to Enlarge
Figure 1: Two images of a mature *capsella bursa-pastoris* embryo taken at different center wavelengths. The entire field of view is acquired for each spectral channel.

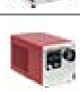


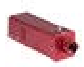
Click to Enlarge
Figure 3: A color image of the mature *capsella bursa-pastoris* embryo, assembled using the entire field of view acquired in each spectral channel, as shown in Figure 1. By acquiring across multiple channels, a spectrum for each pixel in the image is obtained.

Hide Lamp Selection Guide

LAMP SELECTION GUIDE

Below is a selection guide for all of our white-light, broadband light sources (or lamps). In addition to these sources, Thorlabs also offers unmounted white-light LEDs, white-light mounted LEDs, white-light fiber-coupled LEDs, and high-powered, white-light Solis™ LEDs.

Broadband Light Source Selection Guide									
Item #	**(Click to Enlarge; Not to Scale)**	**Emitter Type**	**Wavelength Range (Click for Plot)**	**Output Coupling**	**Output Power**	**Bulb Electrical Power**	**Color Temperature**	**Bulb Lifetime**	**Replacement Bulb**
SLS204		Deuterium	200 - 700 nm	Free Space or Fiber Coupled (SMA)	2 mW[a] 0.1 mW[b] (Typ.)	30 W	N/A	2000 h[c]	SLS254B
SLS401		Xenon Arc	240 - 2400 nm	Free Space[d]	>1.3 W[a]	150 W	5800 K	2000 h[c]	SLS401B
SLS402		Mercury-Xenon Arc	240 - 2400 nm	Free Space[d]	>1.3 W[a]	150 W	6000 K	2000 h[c]	SLS402B
HPLS301(/M)		RF-Driven Plasma	350 - 800 nm	Free Space	9.5 W[a] (Typ.)	-	6000 K	6000 h[c]	HPLSB[e]
HPLS343			350 - 800 nm	Ø3 mm Liquid Light Guide	4 W[f] (Typ.)	-	6000 K[g]	6000 h[c]	HPLSB[e]
HPLS345			350 - 800 nm	Ø5 mm Liquid Light Guide	7 W[f] (Typ.)	-	6000 K[g]	6000 h[c]	HPLSB[e]
				[d]					

SLS201L(/M)		Quartz Tungsten-Halogen	360 - 2600 nm	Free Space or Fiber Coupled (SMA)	500 mW[a] 10 mW[h]	9 W	2796 K	10 000 h	SLS251
SLS301			360 - 3800 nm	Free Space[d]	>1.6 W[a]	150 W	3400 K	1000 h[i]	SLS301B
OSL2			Typical Spectrum	Fiber Bundle	1.4 W[j]	150 W	3200 K	1000 to 10 000 h[c]	OSL2B, OSL2B2, or OSL2BIR
QTH10(/M)			400 - 2200 nm	Free Space	50 mW (Typ.)	10 W	2800 K[k] (Typ.)	2000 h	QTH10B
SLS202L(/M)		Tungsten	450 nm - 5.5 µm	Free Space[d] or Fiber Coupled (SMA)	400 mW[a] 2 mW[l]	7.2 W	1900 K	10 000 h	SLS252
SLS203L(/M)		Silicon Carbide Globar	500 nm - 9 µm	Free Space	>1.5 W[a]	24 W	1500 K	10 000 h	SLS253
SLS303		Silicon Nitride Globar	550 nm - 15 µm	Free Space	4.5 W[a]	70 W	1200 K	5000 h[i]	SLS303B

- Free-space optical power measured without adapters at the beginning of bulb lifetime.
- Measured with Thorlabs' M114L01 solarization-resistant patch cable at beginning of bulb lifetime.
- Operation time before the maximum optical output power of the bulb reaches 50% of its original output.
- Adapters are available separately to couple the free-space output into liquid light guides (LLGs).
- Please note that replacement bulb modules are not available at this time.
- Measured at the output of the liquid light guide, when both the bulb and the LLG are at start-of-life.
- Prior to LLG
- Fiber-coupled optical power, measured with included M28L01 fiber patch cable at beginning of bulb lifetime.
- Operation time before the controller cannot stabilize the output power of the bulb.
- Power at Fiber Tip at Maximum Bulb Intensity
- Color temperature will vary from unit to unit.
- Measured with Thorlabs' MZ41L1 ZrF_4 mid-IR patch cable at the beginning of bulb lifetime.

Hide High-Power Plasma Light Source, Free Space

High-Power Plasma Light Source, Free Space

- Integrated Luxim® LEP™ Bulb Module with 6000 Hour Lifetime (Typ.)
- Typical Output Power of 9.5 W with Stability of 0.5%
- Ø2" Free-Space Output with Internal SM2 (2.035"-40) Threading
- 4-40 Taps Centered on Output for Compatibility with 60 mm Cage Systems
- Variable Attenuator Continuously Tunes Optical Output Intensity from 1.5% to 100%
- Software Control by a PC via USB
- Open Loop, Closed Loop, and Eco Operating Mode Options

Click to Enlarge
[APPLIST]
[APPLIST]
The mounting feet can be removed from the bottom of the HPLS301(/M) in order to attach Ø1" pedestal posts via the 8-32 (M4) tapped holes on the bottom of the housing. The assembly can then be secured to an optical table with the use of stainless steel clamping forks.

This light source has a free-space output and can be controlled via front panel controls, a host PC, or by sending voltage signals to connectors on the back panel. Controls include the ability to continuously adjust the intensity of the emitted light via the attenuation knob on the front panel. When a PC is used to control these light sources, the operator has access to commands and controls not accessible otherwise, including the ability to change the operation mode.

Each of the three operation modes is optimized for different application requirements. Open Loop mode, which is the default, drives the bulb module with current that is near the maximum specified current limit. This gives the user access to the maximum available optical output power, but does not attempt to stabilize the optical output power. Closed Loop mode uses a feedback loop to stabilize the optical output power at 80% of the maximum power achievable in Open Loop mode. Stabilization is performed by adjusting the current level driving the bulb module. Eco mode uses the Closed Loop feedback technique, but it stabilizes the optical output power at 50% of the power achievable in Open Loop mode. As Eco mode drives the bulb module at lower currents, the bulb is subjected to less heat stress; operation in this mode is expected to lengthen the lifetime of the bulb module beyond the 6000 hours lifetime (typical). Please note that replacement bulb modules are not available at this time.

The unit comes with four rubber mounting feet. These can be removed in order to access the 8-32 (M4) mounting taps on the bottom of the housing. This allows the unit to be mounted on four Ø1" pedestal posts or Ø1" pillar posts.

The output port features internal SM2 (2.035"-40) threading and can be integrated with our SM2 lens tube systems. Four 4-40 tapped holes are located around the output for compatibility with our 60 mm cage systems. The center of the output beam is 148 mm above the table surface when the rubber feet are attached, or 138 mm from the bottom of the housing.

Part Number	Description	Price	Availability
HPLS301/M	High-Power Plasma Light Source, Free-Space Output, M4 Mounting Taps	$4,986.23	Lead Time
HPLS301	High-Power Plasma Light Source, Free-Space Output, 8-32 Mounting Taps	$4,986.23	Lead Time

Hide High-Power Plasma Light Source with Liquid Light Guide

High-Power Plasma Light Source with Liquid Light Guide

- Integrated Luxim® LEP™ Bulb Module with 6000 Hour Lifetime (Typ.)
- Typical Output Power of 4.0 W (HPLS343) or 7.0 W (HPLS345), with Stability of 0.5%
- Ø3 mm (Ø5 mm) LLG with Yellow Band Insertion Depth Indicator Included with the HPLS343 (HPLS345)
- Variable Attenuator Continuously Tunes Optical Output Intensity from 0.1% to 100%
- Software Control by a PC via USB
- Open Loop, Closed Loop, and Eco Operating Mode Options

These sources are designed to be used with liquid light guides and can be controlled via front panel controls, a host PC, or by sending voltage signals to connectors on the back panel. Controls include the ability to continuously adjust the amount of light coupled from the bulb into the LLG and to independently toggle the shutter state. When a PC is used to control these light sources, the operator has access to commands and controls not accessible otherwise, including the ability to change the operation mode.

Each of the three operation modes is optimized for different application requirements. Open Loop mode, which is the default, drives the bulb module with current that is near the maximum specified current limit. This gives the user access to the maximum available optical output power, but does not attempt to stabilize the optical output power. Closed Loop mode uses a feedback loop to stabilize the optical output power at 80% of the maximum power achievable in Open Loop mode. Stabilization is performed by adjusting the current level driving the bulb module. Eco mode uses the Closed Loop feedback technique, but it stabilizes the optical output power at 50% of the power achievable in Open Loop mode. As Eco mode drives the bulb module at lower currents, the bulb is subjected to less heat stress; operation in this mode is expected to lengthen the lifetime of the bulb module beyond the 6000 hours lifetime (typical). Please note that replacement bulb modules are not available at this time.

The dust cap on the output end of the LLG may burn if exposed to the intense light emitted by the LLG. To protect the LLG, and for safety, remove the dust cap before powering on the light source.

Part Number	Description	Price	Availability
HPLS343	High-Power Plasma Light Source and Ø3 mm Liquid Light Guide	$5,486.34	Lead Time
HPLS345	High-Power Plasma Light Source and Ø5 mm Liquid Light Guide	$5,518.80	5-8 Days

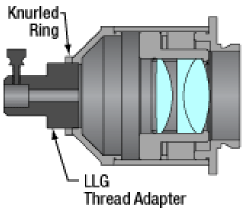
Hide Multi-Optic Collimating Microscope Adapters for Thorlabs' Cerna® Microscopes

Multi-Optic Collimating Microscope Adapters for Thorlabs' Cerna® Microscopes

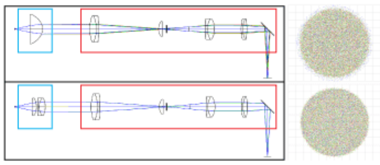
Thorlabs offers collimation adapters to couple Ø3 mm or Ø5 mm liquid light guides (LLGs) to our CSE2100 and CSE2200 Cerna Epi-Illuminator Modules; see the table at the bottom right for compatibility information. For even illumination at the back focal plane of the objective, these adapters feature an optic pair of an achromatic doublet and a double convex lens.

These adapters utilize a male D3T dovetail adapter to connect to the end of the epi-illuminator module; for additional information about microscope dovetails, see the full web presentation. The LLG is secured via a thumbscrew at the back of the adapter.

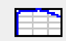
These adapters are calibrated such that the image plane from the LLG output is located at the back aperture of the objective when used with the compatible epi-illuminator module; to optimize illumination for your microscope or realign the image plane, the collimation can be fine-adjusted via the knurled ring on the thread adapter (see image to the bottom left).



Click to Enlarge
Cutaway View of LLG Collimation Adapter Depicting Multi-Element Design



Click for Details
These simulations illustrate chromatic focal shift in a system with a collimated light source and a CSE2100 epi-illuminator module. A collimation adapter using a single optic (top) produces a larger focal shift for different wavelengths at the objective back aperture compared to a collimation adapter with a multi-element design (bottom).

Specifications				
Item #	LLG3A6	LLG5A6	LLG3A7	LLG5A7
Effective Focal Length	40 mm		70 mm	
Compatible Epi-Illuminator Module	CSE2100		CSE2200	
LLG Diameter	3 mm	5 mm	3 mm	5 mm
Collimating Optics	Achromatic Doublet & Double Convex Lens			
AR Coating	350 nm - 650 nm R_{avg} < 0.5% at Each Surface			
Transmission Graph (Click Here for Raw Data)				
Numerical Aperture	0.3			
Magnification	Infinite			

Part Number	Description	Price	Availability
LLG3A6	Ø3 mm LLG Collimating Adapter for Cerna CSE2100, ARC: 350-650 nm	$477.41	Today
LLG5A6	Ø5 mm LLG Collimating Adapter for Cerna CSE2100, ARC: 350-650 nm	$477.41	Today
LLG3A7	Ø3 mm LLG Collimating Adapter for Cerna CSE2200, ARC: 350-650 nm	$477.41	Today
LLG5A7	Ø5 mm LLG Collimating Adapter for Cerna CSE2200, ARC: 350-650 nm	$477.41	Today

Hide Single-Element Collimating Microscope Adapters

Single-Element Collimating Microscope Adapters

Thorlabs offers collimation adapters with AR-coated aspheric condenser lenses (EFL = 40 mm) for collimating the output from our High-Power Light Sources. Four different collimator housings are available; each is designed to mate to the illumination port on an Olympus IX/BX, Leica DMI, Zeiss Axioskop, or Nikon Eclipse Ti microscope.

Click to Enlarge
Collimation Adapter Fitted to the Tip of an LLG

Click to Enlarge
Output Without Collimation Adapter

Click to Enlarge
Output With Collimation Adapter

These adapters quickly mount onto the end of either the Ø3 mm or Ø5 mm Liquid Light Guide (LLG). The LLG is secured into the back of the collimator via a 4-40 setscrew with a 0.050" hex. The addition of these adapters allows the user to incorporate our HPLS343 and HPLS345 lamps into a microscope illumination port.

Compatible Microscopes	Olympus BX & IX Microscopes		Leica DMI Microscopes		Zeiss Axioskop Microscopes		Nikon Eclipse Ti Microscopes	
Item Photo (Click to Enlarge)								
Item #	LLG3A1-A	LLG5A1-A	LLG3A2-A	LLG5A2-A	LLG3A4-A	LLG5A4-A	LLG3A5-A	LLG5A5-A
LLG Diameter	3 mm	5 mm	3 mm	5 mm	3 mm	5 mm	3 mm	5 mm

Optic Specifications	
Item #	ACL5040-A Aspheric Condenser Lens

AR Coating	350 nm - 700 nm, R_{avg} <0.5% at Each Surface
Focal Length	40.00 mm ± 5%
NA	0.554
Magnification	Infinite
Surface Quality	60-40 Scratch-Dig
Centration	<30 arcmin

Part Number	Description	Price	Availability
LLG3A1-A	Ø3 mm LLG Collimating Adapter, Olympus BX / IX, ARC: 350-700 nm	$341.95	Today
LLG5A1-A	Ø5 mm LLG Collimating Adapter, Olympus BX / IX, ARC: 350-700 nm	$341.95	Today
LLG3A2-A	Ø3 mm LLG Collimating Adapter, Leica DMI, ARC: 350-700 nm	$341.95	Today
LLG5A2-A	Ø5 mm LLG Collimating Adapter, Leica DMI, ARC: 350-700 nm	$341.95	Today
LLG3A4-A	Ø3 mm LLG Collimating Adapter, Zeiss Axioskop, ARC: 350-700 nm	$341.95	Today
LLG5A4-A	Ø5 mm LLG Collimating Adapter, Zeiss Axioskop, ARC: 350-700 nm	$341.95	Today
LLG3A5-A	Ø3 mm LLG Collimating Adapter, Nikon Eclipse Ti, ARC: 350-700 nm	$450.16	Today
LLG5A5-A	Ø5 mm LLG Collimating Adapter, Nikon Eclipse Ti, ARC: 350-700 nm	$450.16	Today

Hide Liquid Light Guides

Liquid Light Guides

- Yellow Band Visually Indicates when LLG is Fully Inserted Into the HPLS343 or HPLS345
- High Transmission from 340 - 800 nm
- Homogenous Transmitted Beam and a Light Field Free of Dead Spots
- Flexible with Minimum Bend Radius of 40 mm (Ø3 mm Core) or 60 mm (Ø5 mm Core)
- Microscope Collimation Adapters Available Below

Click to Enlarge
As shown above, the LLG is correctly installed when the edge of the yellow band is flush with the front panel of the light source.

Thorlabs' Liquid Light Guides (LLGs) offer high transmission from 340 nm - 800 nm for white light illumination applications. These LLGs are offered from stock with a core diameter of either 3 or 5 mm, and in lengths of 4' (1.2 m), 6' (1.8 m), or 8' (2.4 m). For large core diameters, liquid light guides are a more efficient transmission solution than fiber bundles as they eliminate the packing fraction loss (dead space) in the light fields transmitted by optical fiber bundles. For more information about LLGs, please see the *LLGs* tab.

These Ø3 mm and Ø5 mm core LLGs are designed to be used with the HPLS343 and HPLS345 high-power plasma light sources, respectively. Each light guide features a yellow band near one end, which indicates when the LLG is inserted to the correct depth in the LLG port of these light sources.

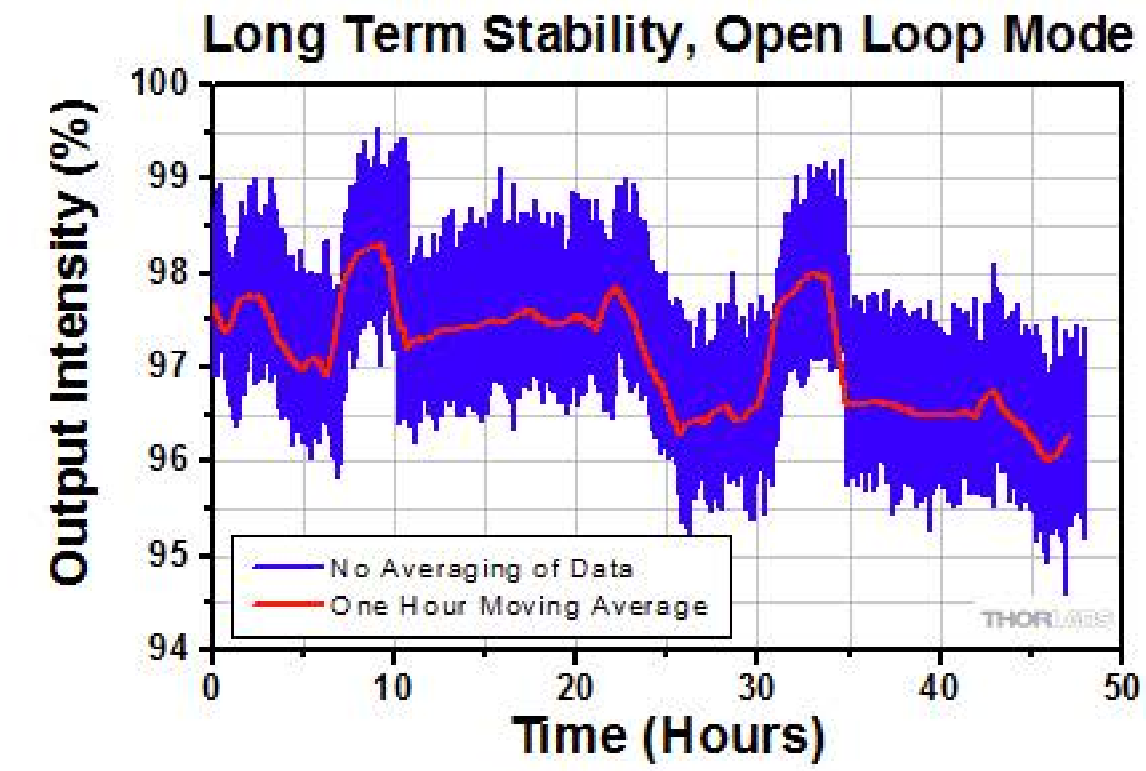
Thorlabs also offers collimation adapters for our Ø3 mm and Ø5 mm liquid light guides, which are sold separately below. We also offer an LLG to SM1 adapter for both Ø3 mm and Ø5 mm core LLGs.

Part Number	Description	Price	Availability
LLG03-4H	Liquid Light Guide, Ø3 mm Core, 340 - 800 nm, 4' (1.2 m) Length	$380.90	Today
LLG3-6H	Liquid Light Guide, Ø3 mm Core, 340 - 800 nm, 6' (1.8 m) Length	$448.00	Today
LLG3-8H	Liquid Light Guide, Ø3 mm Core, 340 - 800 nm, 8' (2.4 m) Length	$514.01	Today
LLG05-4H	Liquid Light Guide, Ø5 mm Core, 340 - 800 nm, 4' (1.2 m) Length	$491.28	Today
LLG5-6H	Liquid Light Guide, Ø5 mm Core, 340 - 800 nm, 6' (1.8 m) Length	$580.01	Today
LLG5-8H	Liquid Light Guide, Ø5 mm Core, 340 - 800 nm, 8' (2.4 m) Length	$656.84	Today

Graphs of Optical Intensity, Open and Closed Loop Operation, 48 Hour Duration

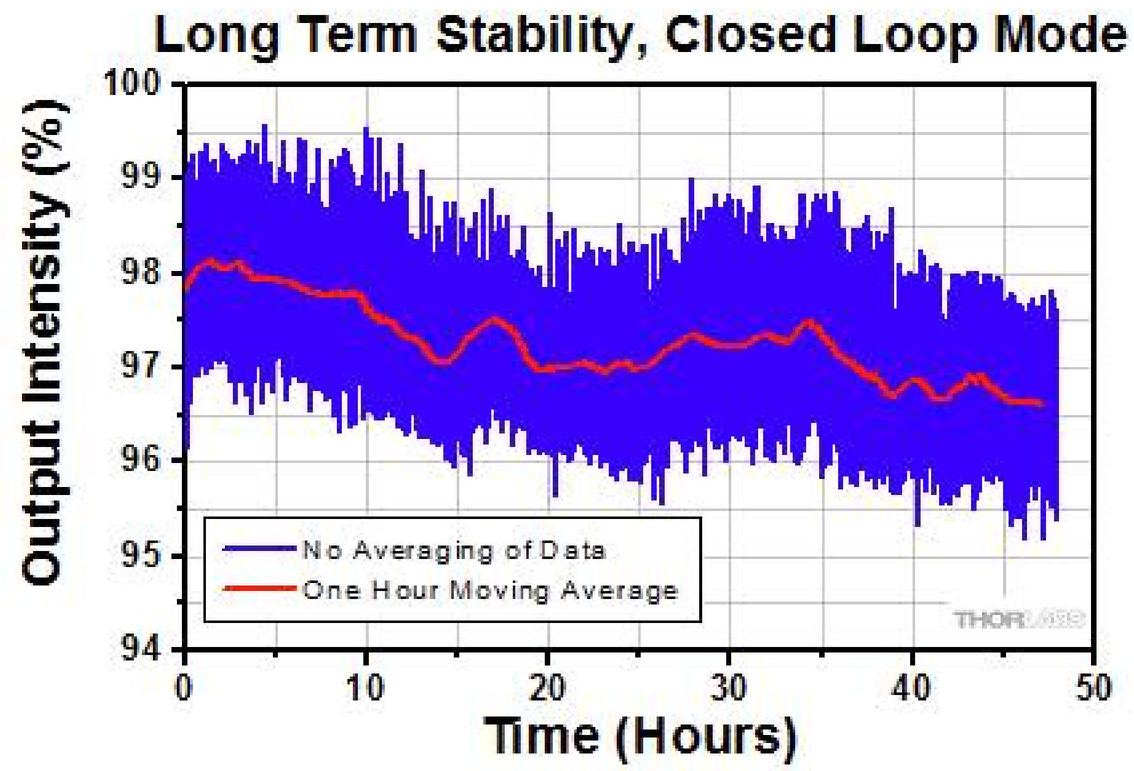
Less [-]

HPLS301



Click to Enlarge

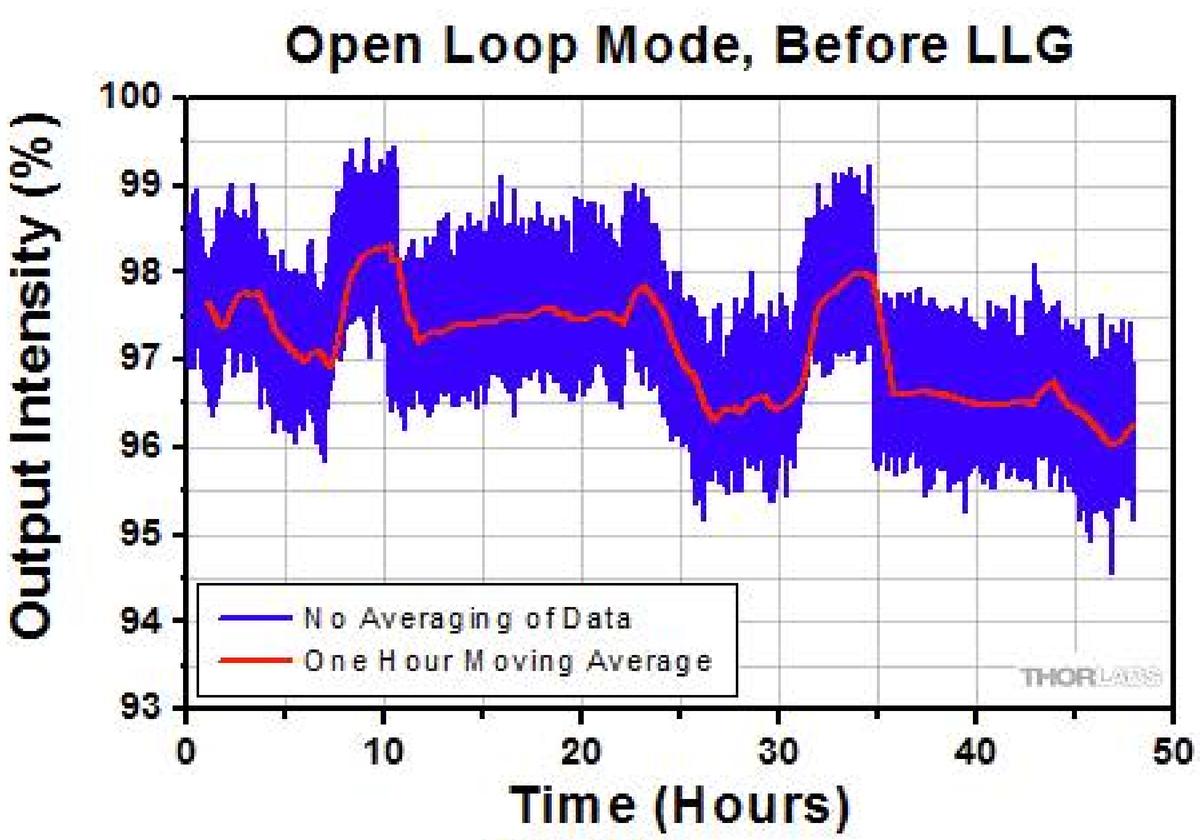
Output power intensity monitored after the free-space output. Open Loop mode drives the bulb at constant current and does not maintain constant output power, which results in variations of the output power and a gradual decrease in optical intensity as the bulb ages.



Click to Enlarge

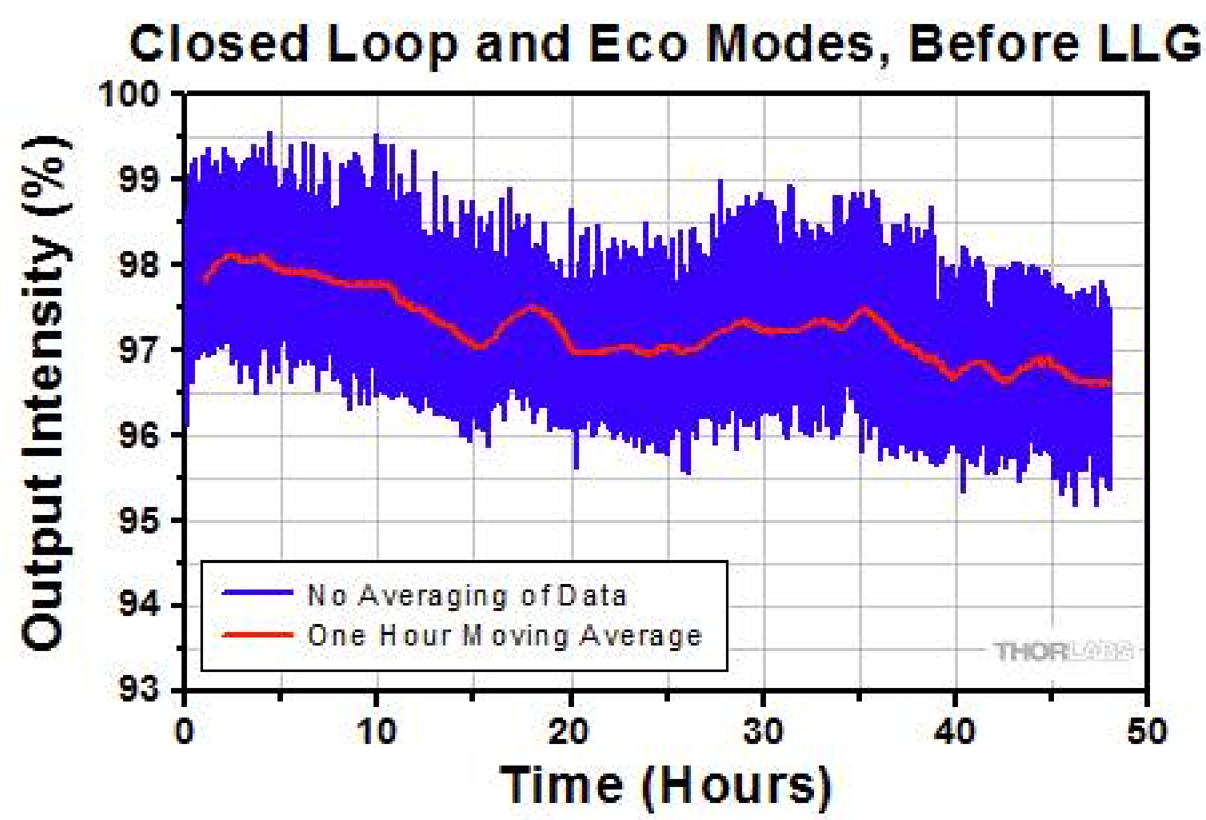
Output power intensity monitored after the free-space output. Closed Loop mode uses a feedback loop to stabilize the output power of the bulb. This mitigates variations in optical output power and compensates for the gradual decrease in output intensity as the bulb ages.

HPLS343, HPS345



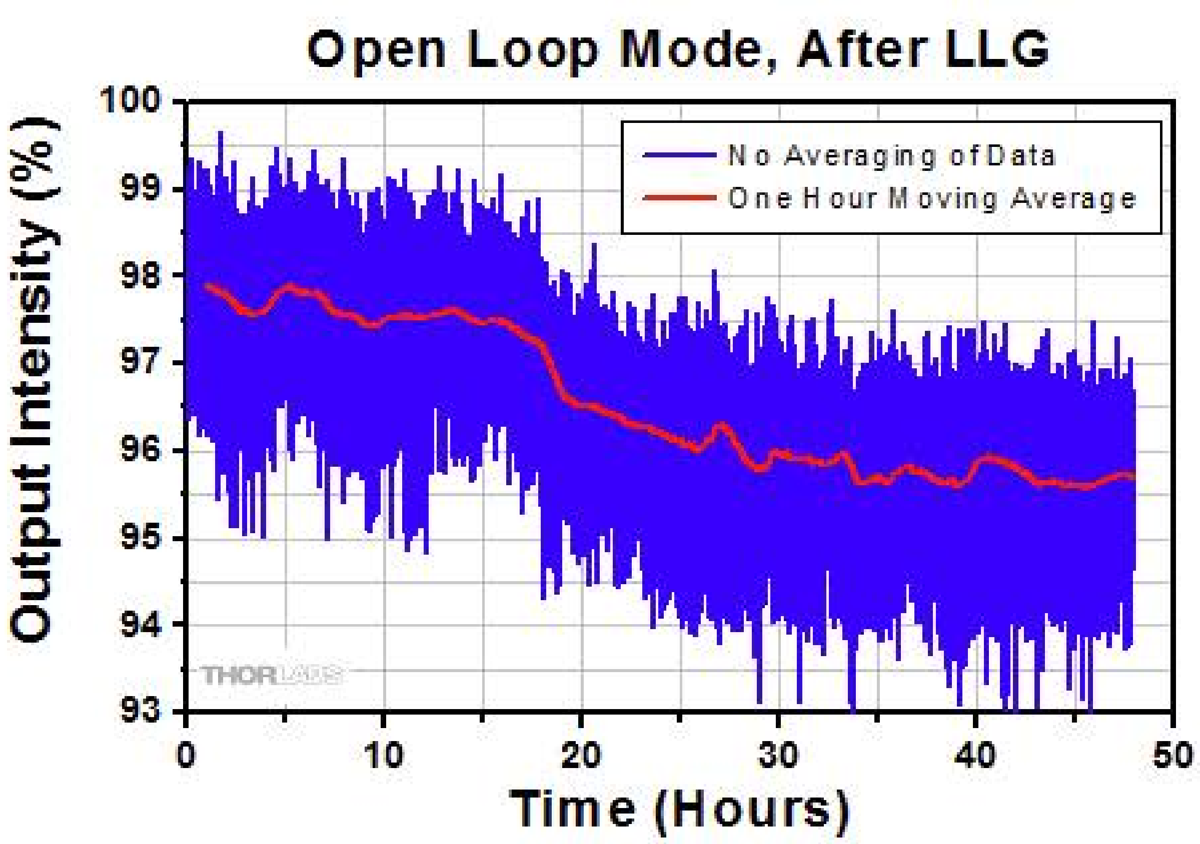
Click to Enlarge

Output power intensity monitored immediately before the input to the LLG is plotted with respect to time. Open Loop mode drives the bulb at constant current and does not maintain constant output power, which results in variations of the output power and a gradual decrease in optical intensity as the bulb ages.



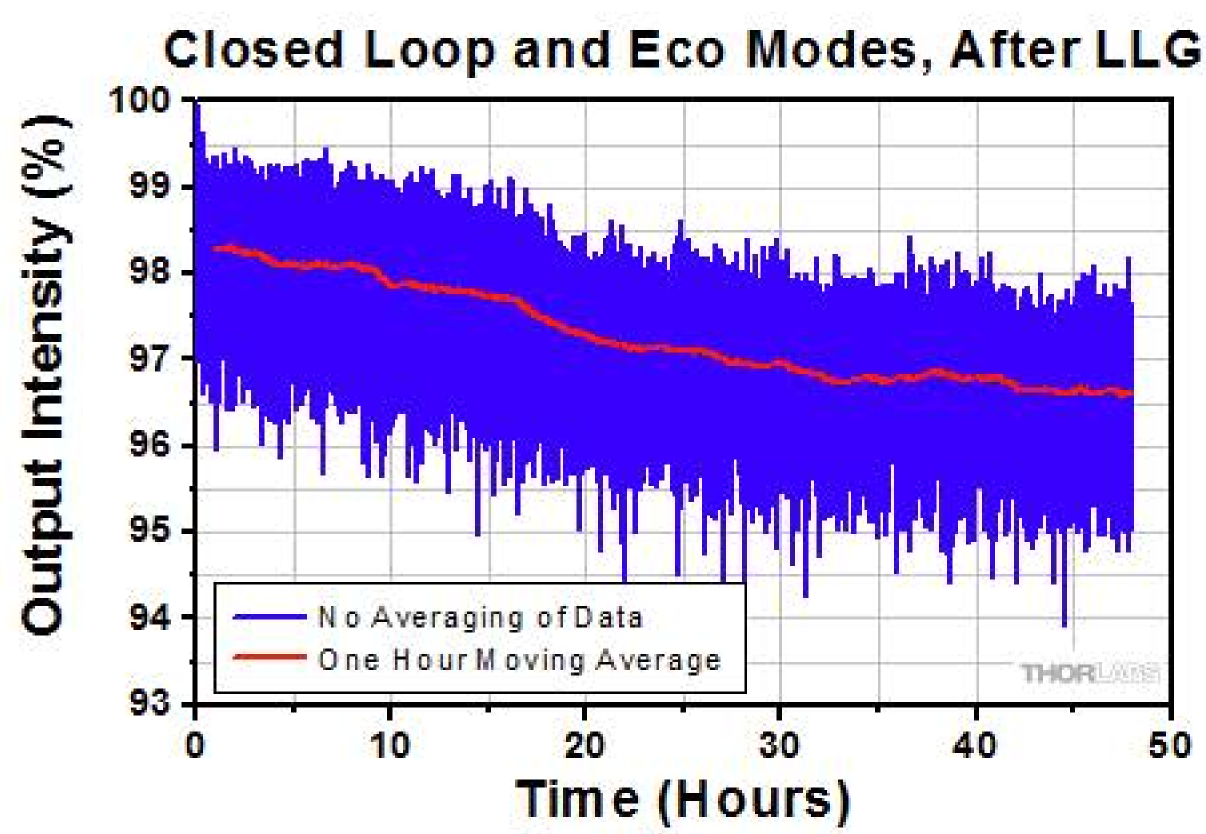
Click to Enlarge

Output power intensity monitored immediately before the input to the LLG is plotted with respect to time. Closed Loop mode uses a feedback loop to stabilize the output power of the bulb. This mitigates variations in optical output power and compensates for the gradual decrease in output intensity as the bulb ages.



Click to Enlarge

Output power intensity monitored at the output of the LLG is plotted with respect to time. The intensity measured at the output of the LLG includes the transmission characteristics of the LLG. The LLG homogenizes the transmitted light, and its attenuation levels gradually increase as the liquid is exposed to ultraviolet light. The transmitted intensity measured at the output of the LLG decreases gradually with time due to the progressive darkening of the LLG as well as the gradual decrease in bulb intensity with time, which is due to the aging of the bulb and is not compensated for in Open Loop mode.



Click to Enlarge

Output power intensity monitored at the output of the LLG is plotted with respect to time. The intensity measured at the output of the LLG includes the transmission characteristics of the LLG. The LLG homogenizes the transmitted light, and its attenuation levels gradually increase as the liquid is exposed to ultraviolet light. The transmitted intensity measured at the output of the LLG decreases gradually with time due to the progressive darkening of the LLG, but Closed Loop mode compensates for the gradual decrease in bulb intensity with time due to the aging of the bulb.

Pictures of the Bulb Module Removal Procedure

Less [-]

The 2 mm and 3 mm hex keys required to complete the replacement of the bulb module are included with the high-power light sources. The procedure for removing the bulb is summarized below, and the replacement bulb module can be installed by reversing this process. The HPLS343 is shown here; follow the same steps to replace the bulb on the other HPLS series models.

Click to Enlarge

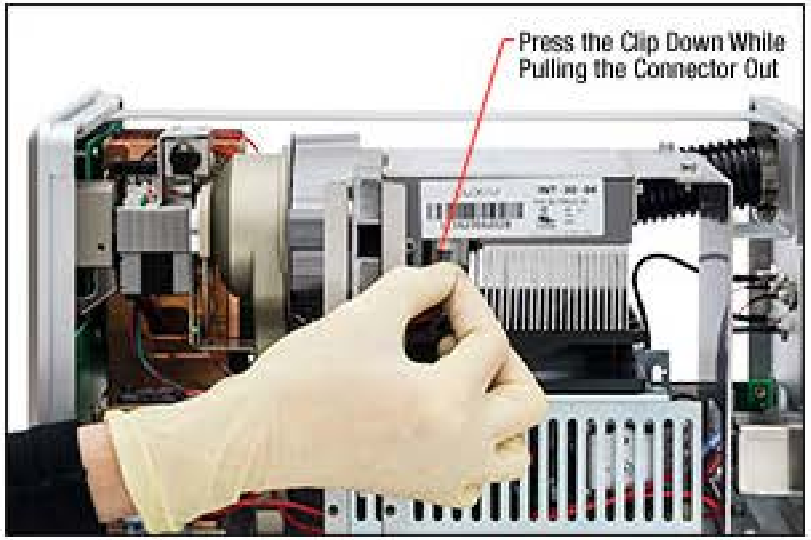
Step 1: Remove the 6 cap screws on the back panel, and then slide the cover off.

Click to Enlarge

Step 2: Locate the installed bulb module in the position shown.

Click to Enlarge

Step 3: Remove the two cap screws securing the bulb module.

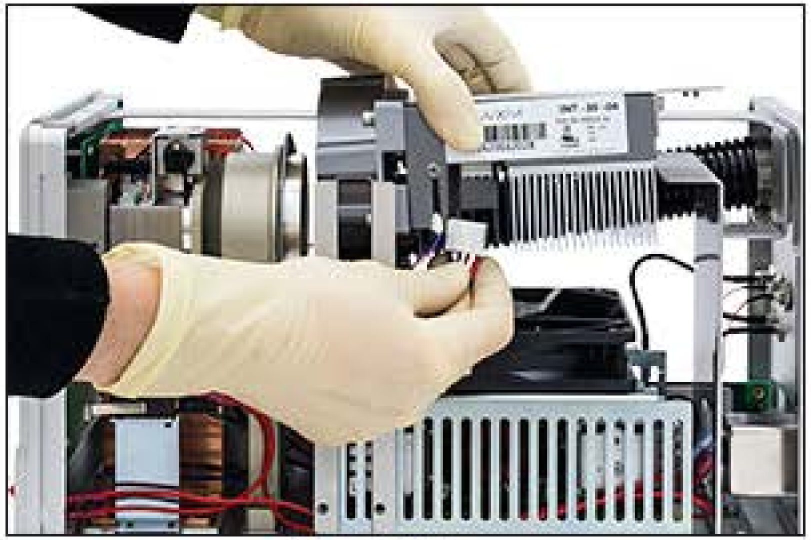


Click to Enlarge

Step 4: There are two electrical connectors joining the bulb module to the rest of the HPLS series light source. Disconnect the smaller connector.

Click to Enlarge

Step 5: Slide the light engine backwards to disconnect it from the lens holder.



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Step 6: Disconnect the larger connector.