THORLABS

HPLS343 & HPLS345
High-Power Plasma Light
Sources with
Liquid Light Guides

User Guide

Table of Contents

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

The lamp comes with a switching power supply compatible with voltages from 100 to 240 VAC. There is no need to change the fuse when selecting your regional voltage. If the user needs to change the fuse located below the AC plug on the back of the unit, see section 6.1.

SHOCK WARNING

High voltage inside. To avoid electrical shock, before powering unit, make sure that the protective conductor of the 3-conductor power cord is correctly connected to the protective earth contact of the socket outlet. Improper grounding can cause electric shock resulting in severe injury or even death. Do not operate without cover installed.

WARNING

This unit must not be operated in explosive environments.

CAUTION

Do not operate in wet/damp conditions.

WARNING

Do NOT look directly at the light source beam during operation. Do NOT place hand or body part in the light beam as this may result in burns. NEVER place objects inside the LLG mount except for the LLG tip, fully inserted.

CAUTION: HOT SURFACE

The housing of the lamp housing can get very hot during operation. Extended contact may result in burns.

CAUTION: HOT SURFACE

The temperature of the lamp module will exceed 75 ˚C during operation. Always wait for at least 10 minutes for the light source to cool down before performing a lamp module replacement. Always wear gloves when handling the lamp module.

CAUTION

When one tip of the liquid light guide is installed in the light source, do NOT put the dust cap on the other tip of the LLG while the shutter is open. The dust cap may burn if exposed the intense light emitted from the tip of the LLG.

WARNING

Always power off the unit before opening the housing.

Chapter 3   Description

3.1.   Overview

Thorlabs' HPLS300 series plasma light sources combine the best features of solid-state electronics and full spectrum plasma emitters. The Luxim® Light Emitting Plasma (LEP)™ bulb module uses a ceramic resonant cavity to efficiently couple power from a solid-state power amplifier into a high-intensity discharge vessel. This technique results in the long life of the bulb module (6000 hours typical operating time before the optical power output at given driving current drops to 50% of the initial intensity) and produces a complete color spectrum. These light emitters are ideal for applications such as endoscopy, microscopy, and other medical lighting and inspection applications.

3.2.   Light Emitting Plasma

Thorlabs' HPLS300 series light sources feature the Luxim® LEP™ bulb module which is an intense white light source. The Luxim® LEP™ lamp source generates a light emitting plasma using a bulb module, illustrated in Figure 1, that includes no electrodes. Instead, the electrical circuit generates an RF field that the ceramic resonator focuses at the location of the quartz bulb. The plasma excited in the bulb produces light with a complete color spectrum. As the bulb module does not include electrodes, it is efficient and has a long lifetime. The LEP™ bulb module consists of two fundamental parts:

Emitter: A quartz bulb embedded in a ceramic resonator

Radio Frequency (RF) Driver: A solid-state RF generator and micro-controller.

A radio-frequency signal is generated and amplified by the RF driver, which is guided into the ceramic resonator. The structure of the resonator concentrates the RF field, delivering energy to the fully-sealed quartz bulb without electrodes or filaments. The highly concentrated electric field ionizes the gasses and vaporizes the halides in the bulb - creating a plasma state at its center - resulting in an intense source of white light.
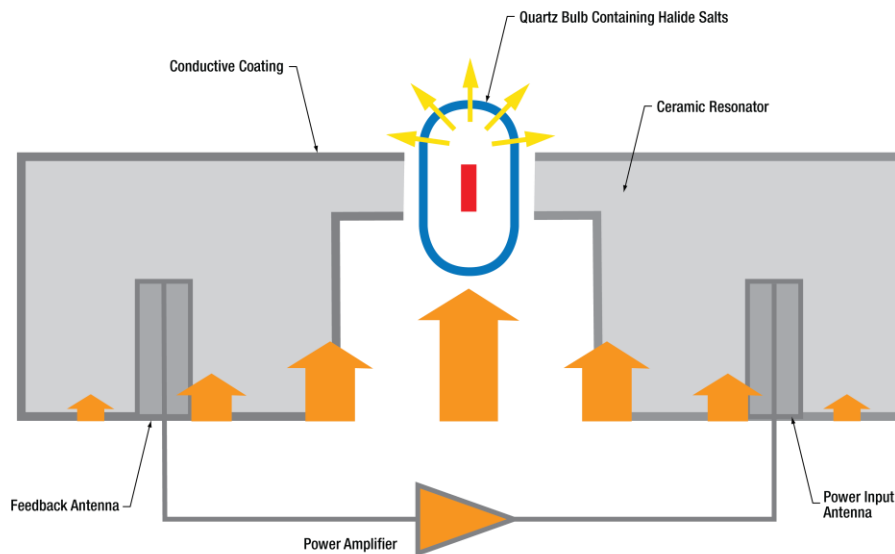
Figure 1   Architecture of a Plasma Light Source

Inside the back of the bulb, a diffuse yet highly reflective material is used to reflect all of this light to the forward direction in a Lambertian pattern. The color of the light is tailored by the fill chemistry inside the lamp to provide naturally white and high color rendering light.

By energizing a plasma arc without using filaments or electrodes, all failure modes and inefficiencies of traditional broadband light sources are eliminated in an LEP™ lamp source, leaving behind an incredibly bright and stable source with long life span comparable only to light emitting diodes (LEDs).

3.3.   Liquid Light Guide

In Thorlabs' HPLS343 and HPLS345 light sources, the high power white light output from the plasma emitter is coupled into and then delivered through a 3 mm core and 5 mm core liquid light guide, respectively.

The liquid light guide (LLG) can be thought of as an optical fiber with a very large core size. A key difference between LLGs and conventional optical fibers is that the core of the LLG consists of a non-toxic and non-flammable liquid. The liquid is sealed inside a polymer tube with silica tips on both ends. The LLG offers a large core size and high NA, and its transmission window includes the entire visible spectrum. Thus an LLG are is a powerful tool to deliver the intense light output from the HPLS343 and HPLS345 light sources.

When the LLG is inserted and the light sources are operating, the HPLS343 and HPLS345 actively monitor the temperature of the tip of the light guide and cool as necessary to prevent it from overheating. This assures the maximum life span of the liquid light guide is achieved.

3.4.   Spectrum

HPLS343 and HPLS345 Emission Spectrum
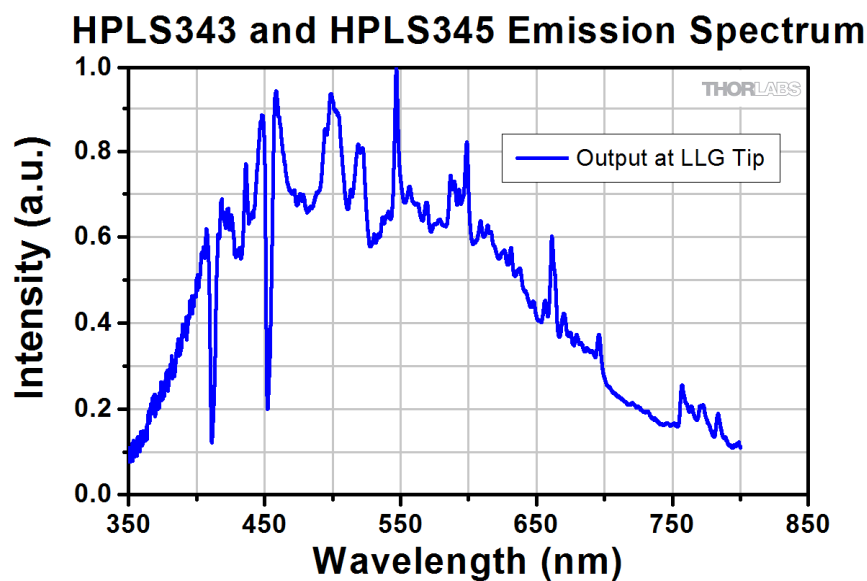
Figure 2   Typical Output Spectrum of the HPLS343/345

The HPLS343 and HPLS345 light sources provide a full color spectrum from 350 nm to 800 nm. Figure 2 shows a typical output spectrum of an HPLS343 and HPLS345 light source, measured at the output tip of the liquid light guide.

Chapter 4   Setup

4.1.   Part List

The package contains the following items:

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

4.2.   Operation Elements
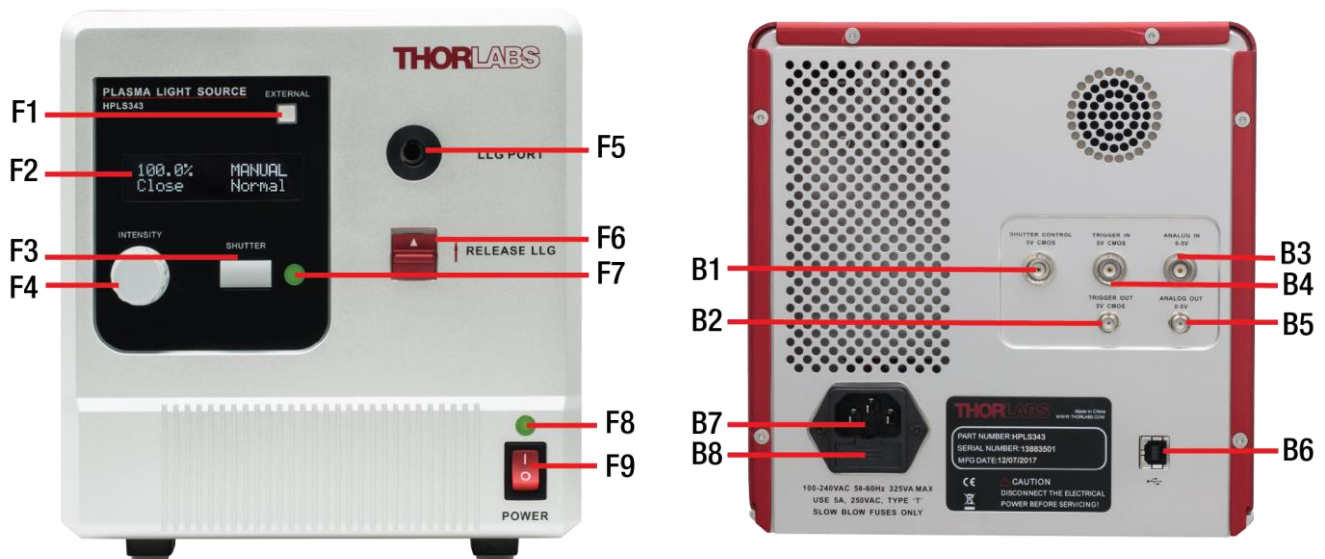
Figure 3   Front and Back Panel of the HPLS343/HPLS345 Light Sources

- F1. External Control Button with LED
- F2. LCD Screen
- F3. Shutter Control Button
- F4. Light Intensity Adjustment Knob
- F5. Liquid Light Guide Port
- F6. Liquid Light Guide Release Switch
- F7. Shutter State LED
- F8. Light Source State Indicator LED
- F9. Power Switch

- B1. BNC Port for External Shutter Control: 5 V CMOS
- B2. SMA Port for Trigger OUT: 5 V CMOS
- B3. BNC Port for Analog IN: 0 to 5 V
- B4. BNC Port for Trigger IN: 5 V CMOS
- B5. SMA Port for Analog OUT: 0 to 5 V
- B6. USB Port
- B7. AC Power Inlet
- B8. Fuse Drawer

4.3. Initial Setup

Take the light source out of its packaging and place it onto a table. The two feet closest to the front panel can be flipped open to change the viewing angle of the front panel.

The light source also has four slots, located at the four bottom corners. As shown in Figure 4, by using Thorlabs table clamp CL6 or CL8, together with one of Thorlabs' baseplates, one can securely mount the plasma light source onto the surface of an optical table or breadboard with 1/4"-20 or M6 threaded mounting holes.
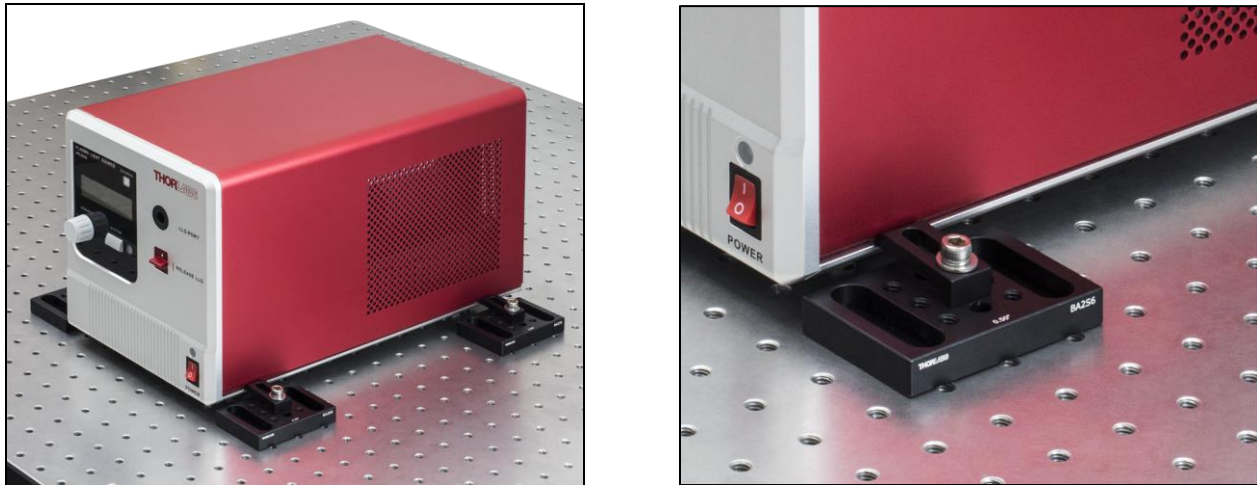
Figure 4   HPLS343/345 Mounted on a Breadboard Using CL6 Table Clamp and BA2S6 Baseplate

4.4. Connected Liquid Light Guide

The HPLS343 and HPLS345 light sources include with a 3 mm or 5 mm core liquid light guide (LLG), respectively. Both sizes are shown in Figure 5.

Figure 5   A 3 mm Core LLG (Left) and a 5 mm Core LLG (Right)

To install the LLG in the light source, first remove the red dust caps from the tips of the LLG. Take the end that has a yellow marking ring on it and insert it to the LLG port in the front panel of the light source. The marking ring visually indicates when the LLG is inserted to the correct depth. It is fully inserted when the edge of the yellow band is flush with the front panel, as shown in Figure 6.
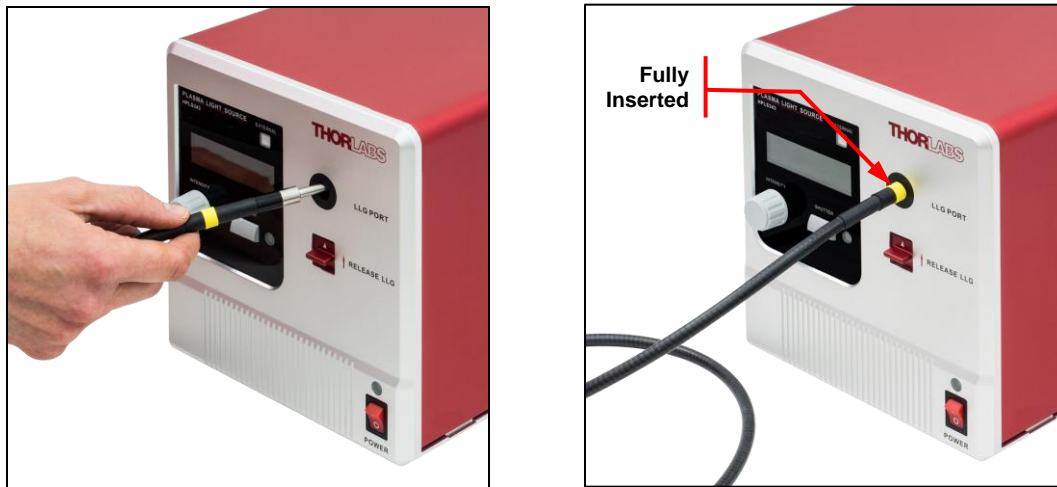
Figure 6   Insert the LLG into the Light Source

We highly recommend using the LLGs featuring the yellow marking ring with these light sources, though all of Thorlabs' standard liquid light guides are compatible, taking core diameter into consideration. When using an LLG that does not have the marking ring, there is the risk that the light guide may not be inserted to the proper depth during installation.

To remove the LLG, lightly press the LLG release switch upwards and pull out the light guide. This is shown in Figure 7.
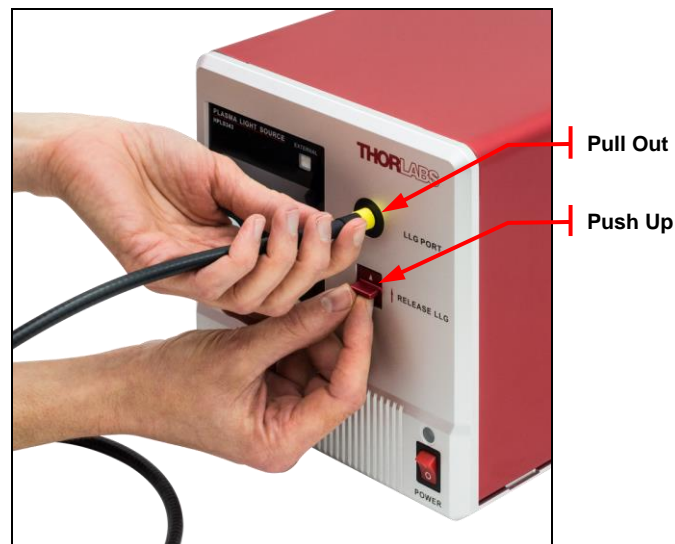
Figure 7   Remove the LLG

NOTE: Liquid light guides are sensitive items that require caution for proper handling. Any grease, dust or scratches on the light guide tip may cause damage to the light guide during operation. Please always keep the dust cap on whenever the light guide is not in use.

4.5.   Microscope Collimation Adapters

Thorlabs offers collimation adapters with AR-coated aspheric condenser lenses (EFL = 40 mm) for collimating the output from the HPLS343 and HPLS345 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. These collimation adapters are sold separately on the Thorlabs website.

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

These adapters can be quickly mounted onto the end of a liquid light guide. The LLG is secured into the back of the collimator using a setscrew. With these collimation adapters, users can easily couple the white light output from an HPLS343 or HPLS345 light source to either the epi-illumination or the trans-illumination port of the compatible microscopes above. The broadband spectrum, high brightness, and high color rendering index of these light sources makes them ideal for both fluorescence and bright field microscopy.

Chapter 5   Operation

⚡	**SHOCK WARNING**	⚡
	High voltage inside. To avoid electrical shock, before powering unit, make sure that the protective conductor of the 3-conductor power cord is correctly connected to the protective earth contact of the socket outlet. Improper grounding can cause electric shock resulting in severe injury or even death. Do not operate without cover installed.	

⚠	**CAUTION**	⚠
	Do not operate in wet/damp conditions.	

⚠	**WARNING**	⚠
	This unit must not be operated in explosive environments.	

5.1.   Starting the Light Source

Make sure both the power cable and the liquid light guide are securely connected, then press power switch to turn on the light source.

After the light source is turned on, an initialization screen will appear on the LCD and the light source will warm up. Meanwhile, the state indicator LED above the power switch will glow orange.
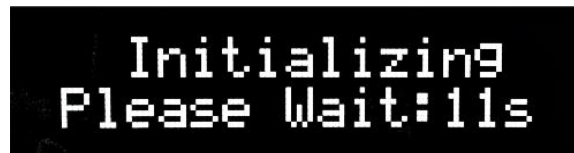
Figure 8   Initialization Screen

After initialization, the state indicator LED will turn blue and the operation screen shown in Figure 9 will appear.

The light source is now operational. However, please always allow a 45 to 60 minute warm up period after initialization to allow the light source to reach a stable state.

⚠	**CAUTION**	⚠
	The surface of the light source may get hot during operation. Avoid extensive contact with the housing.	

5.2.   LCD Screen

The normal operation screen is show in Figure 9.

Light Intensity → 100.0%   MANUAL ← Control Mode: EXTERNAL/MANUAL

Shutter State: → Close   Normal ← State of the Device and
Open/Close   Warning Messages

Figure 9   Operation Screen

- The percentage on the upper left corner of the screen represents the intensity setting that determines how much of the available power from the bulb is coupled into the LLG.

- On the upper right corner, the control mode is displayed. "Manual" means that the light source is operated via the front panel while "External" means that the light source is controlled via the I/O port on the back panel.

- On the bottom left corner, the shutter state is displayed.

- On the bottom right corner, the current state of the device is shown.

5.3.   Shutter Operation

The shutter of HPLS300 series is closed by default. After Initialization, press the shutter button (F3) to open/close the shutter. When shutter is open, the shutter state LED will be ON.

⚠ WARNING ⚠
Do NOT look directly at the tip of the liquid light guide during operation. The intense white light output may cause permanent damage to the eye. Do NOT place hand or body part on the tip of the light guide during operation as this may result in burns. NEVER place objects on the tip of the light guide during operation.

⚠ CAUTION ⚠
Do NOT put the dust cap on when the shutter is open. The dust cap cannot withstand the intense light coming out of the liquid light guide and may cause burning of the LLG tip.

5.4.   Intensity Tuning

After initialization, turn the knob under the LCD screen to adjust the output light intensity of the light source. Intensity tuning does not affect the electrical current driving the bulb. Instead, it determines the state of an attenuator placed between the bulb and the input tip of the LLG.

During tuning, the intensity percentage display on the LCD screen will change accordingly.

The HPLS343 and HPLS345 light sources feature an intensity tuning function with a range of 0.1% to 100%, with a setting resolution of 0.1%. The tuning knob is functional regardless the state of the shutter (closed or open).

5.5.   External Control

The HPLS300 series can also be controlled by sending a voltage signal to the ports on the back panel of the device. To enable this external control function, press the external control button on the front panel. The button has an LED which will be ON when the external control mode is enabled.

5.5.1. External Shutter Operation

The shutter can be controlled via the "SHUTTER CONTROL" port on the back panel. The female BNC port accepts a 5 V CMOS signal. A low logic state will open the shutter and a high logic state will close the shutter.

Port Name	Connector	Signal Type	Signal definition
SHUTTER CONTROL	BNC Female	5 V CMOS	Close: high logic state, 3.5 to 5 V
			Open: low logic state, 0 to 1.5 V

NOTE: The shutter button on the front panel is always operational, even when external control mode is enabled. Pressing the shutter button changes the shutter state and disables the external control mode. The shutter button on the front panel is always active for safety reasons.

5.5.2. ANALOG IN and TRIGGER IN

In external control mode, the light intensity tuning knob on the front panel is disabled. Users can control the light intensity by sending signals to the "ANALOG IN" and "TRIGGER IN" ports on the back panel.

The "ANALOG IN" female BNC port accepts 0 to 5 V analog signal input. Input voltage signals of 0 V and 5 V correspond to 0.1% and 100% transmitted intensity respectively.

The light source does not respond to the input on "ANALOG IN" on its own. In order for the voltage signal on "ANALOG IN" port to cause a change in the intensity, a trigger signal must be sent to the "TRIGGER IN" port. This female BNC accept 5 V CMOS. When the falling edge of the pulse sent to the "TRIGGER IN" port is detected, the light source will start to change the transmitted intensity to that specified by the voltage on the "ANALOG IN" port.

Port Name	Connector	Signal Type	Signal definition
ANALOG IN	BNC Female	0 to 5 V	Light source sets the output light
		20 kΩ Impedance	intensity percentage propotionally to the input voltage
TRIGGER IN	BNC Female	5 V CMOS	High: 3.5 to 5 V
			Low: 0 to 1.5 V
			Trigger at falling edge of a pulse
			Pulse width >0.1 ms

5.5.3. ANALOG OUT and TRIGGER OUT

The HPLS300 series light sources also have two female SMA ports on the back panel for monitoring the light source.

The "ANALOG OUT" female SMA port outputs a 0 to 5 V signal that is proportional to the intensity percentage of the light source.

The "TRIGGER OUT" female SMA port outputs a 5 V CMOS. The output is in high state by default. When the light source starts intensity tuning, "TRIGGER OUT" outputs low state until the intensity tuning is finished.

Port Name	Connector	Signal Type	Signal definition
ANALOG OUT	SMA Female	0 to 5 V	Output voltage is propotional to the
		20 kΩ Impedance	intensity percentage
TRIGGER OUT	SMA Female	5 V CMOS	High: 4.3 to 5 V
			Low: 0 to 0.55 V
			Outputs high by default;
			Outputs low during intensity tuning.

Both "ANALOG OUT" and "TRIGGER OUT" are functional all the time, even when external control is disabled.

5.5.4. Signal Train

Figure 10 gives an example of the signal train in the HPLS300 series light source, when set to external control mode.

When the "ANALOG IN" signal changes, the light source actually does nothing until a "TRIGGER IN" pulse arrives. Then at the falling edge of the trigger, the light source will start to tune its light intensity according to the "ANALOG IN" signal. Meanwhile the state of "TRIGGER OUT" will change from HIGH to LOW. When the tuning is finished, the "ANALOG OUT" will output a voltage according to the new intensity, and the "TRIGGER OUT" will switch from LOW to HIGH.

Figure 10   Signal Train in HPLS300 Series
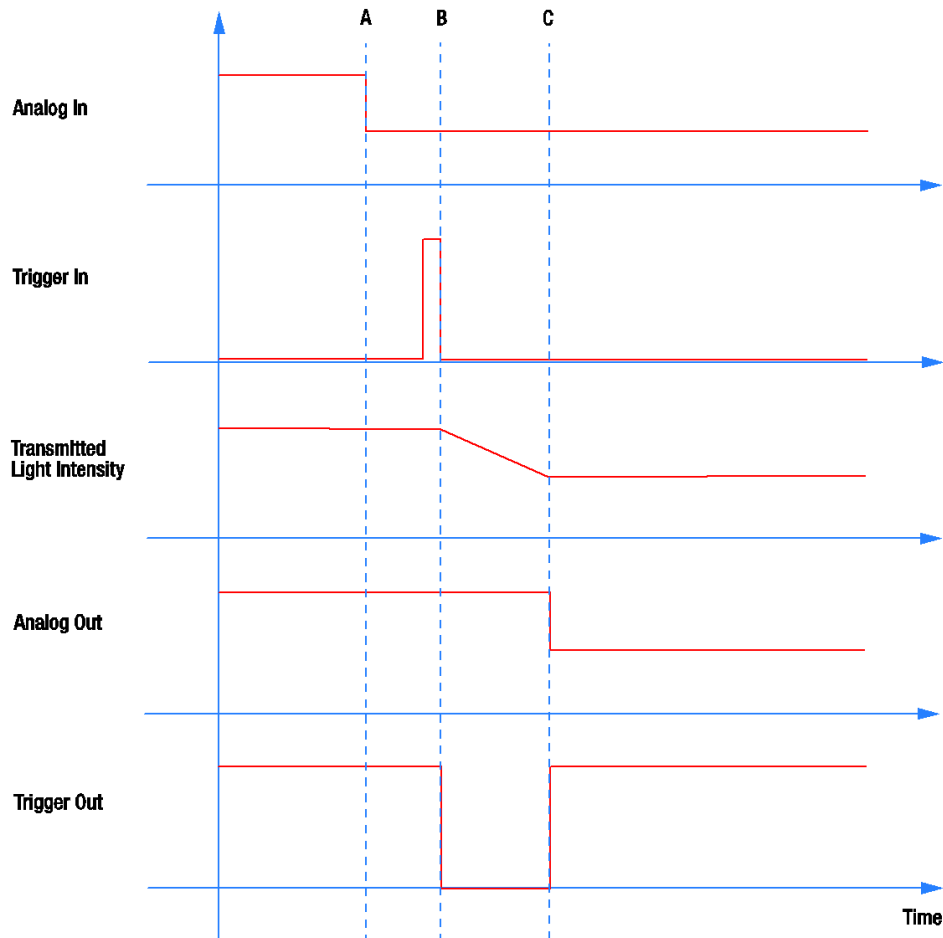
A.   Voltage on ANALOG IN changes;

B.   A pulse comes on TRIGGER IN; light source starts to change its intensity percentage setting at the falling edge of the pulse; the TRIGGER OUT switches from High to Low;

C.   Light source finishes intensity adjustment; TRIGGER OUT switches from low to high; ANALOG OUT gives a voltage according to the new intensity setting.

5.6.   Operation Modes

The HPLS300 series features three different operation modes: open loop, closed loop, and Eco mode. The light source is set to open loop mode before shipping. The operation mode can only be changed via the software GUI or the command lines as described in Chapter 8.

5.6.1. Open Loop Mode

The HPLS300 series light sources are shipped pre-set to open loop mode by default. In open loop, the bulb module of the light source will be running at a constant current that is ~90% of the current limit specified for the bulb module. There is no stabilization on its output light intensity; thus, users will see a gradual shift in the light intensity during operation.

Throughout the lifetime of a bulb module, its light intensity will slowly decrease. The bulb module has a typical lifetime of 6000 hours, which is defined as the time period for the maximum output light intensity of the bulb module to reduce to 50% of its initial value.

5.6.2. Closed Loop Mode

The HPLS300 series features a closed loop mode which stabilizes the light source at 80% of its maximum light intensity in open loop mode.

In closed loop mode, the light source utilizes a photodetector to monitor the bulb's optical intensity level. A feedback loop is used to and adjust the driving current to compensate for any measured drift. In this mode, the output intensity will drift during operation. Closed loop mode provides a more stable transmission intensity than can be achieved in open loop mode.

When set to closed loop mode, a letter "C" will appear on the LCD screen of the light source, as shown in Figure 11.
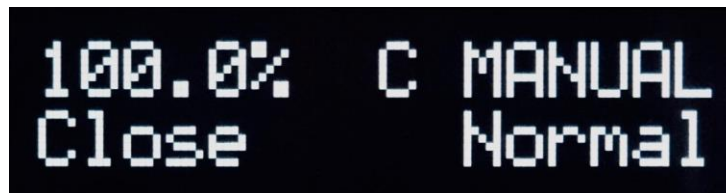
Figure 11   Operation Screen in Closed Loop Mode

5.6.3. Eco Mode

Eco mode is designed to provide a light source with stabilized output for the maximum time period. In Eco mode, the light source is stabilized at 50% of its maximum intensity achievable in open loop mode. It utilizes the same feedback loop employed in closed loop mode. Due to the reduced optical intensity (50%), the bulb module suffers much less heat stress in Eco mode than in the other modes. This has the effect lengthening its lifetime beyond that which can be achieved when operating in open loop or closed loop modes.

When set to Eco mode, a letter "E" will appear on the LCD screen of the light source, as shown in Figure 12.
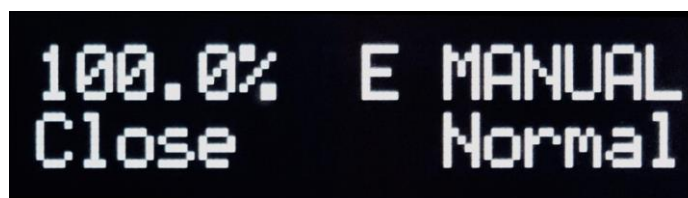
Figure 12   Operation Screen in Eco Mode

5.7.   Stability and Noise

Figure 13 and Figure 14 present detailed light intensity measurements performed for sources operating in open and closed loop modes for 48 hours. The closed loop mode data also applies to operation in Eco mode. Measurements taken before the LLG record only the variation of the intensity emitted by the bulb. Measurements taken after the LLG also include the effects of travelling through the LLG. The LLG acts to homogenize the light it transmits and also gradually become less transmissive when exposed to UV light. Closed loop mode compensates for variations in bulb intensity but cannot compensate for an LLG that progressively becomes more attenuating.
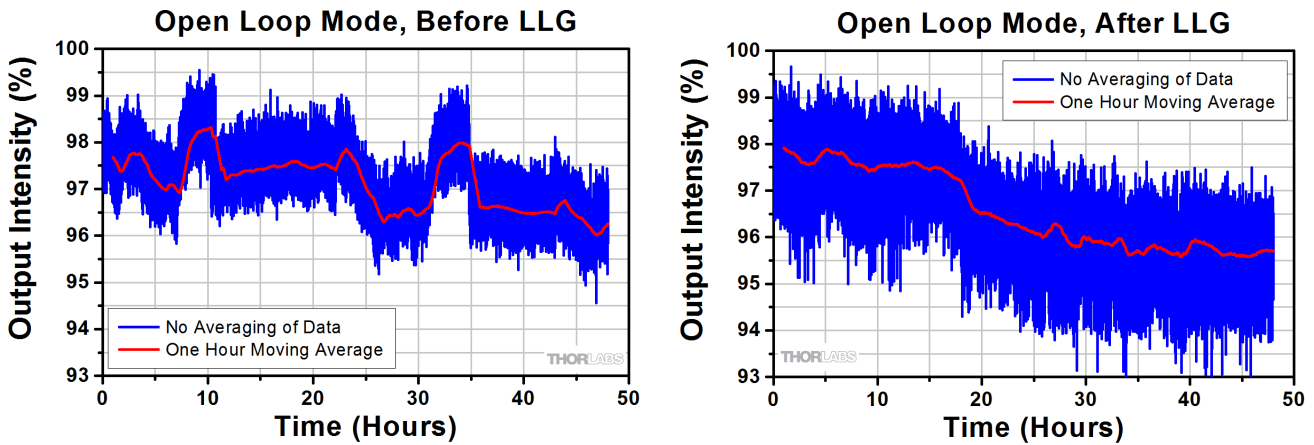
Figure 13   Open loop mode measurements of the output light intensity percentage display taken just before the input end face of the LLG (left) and just after the output end face.
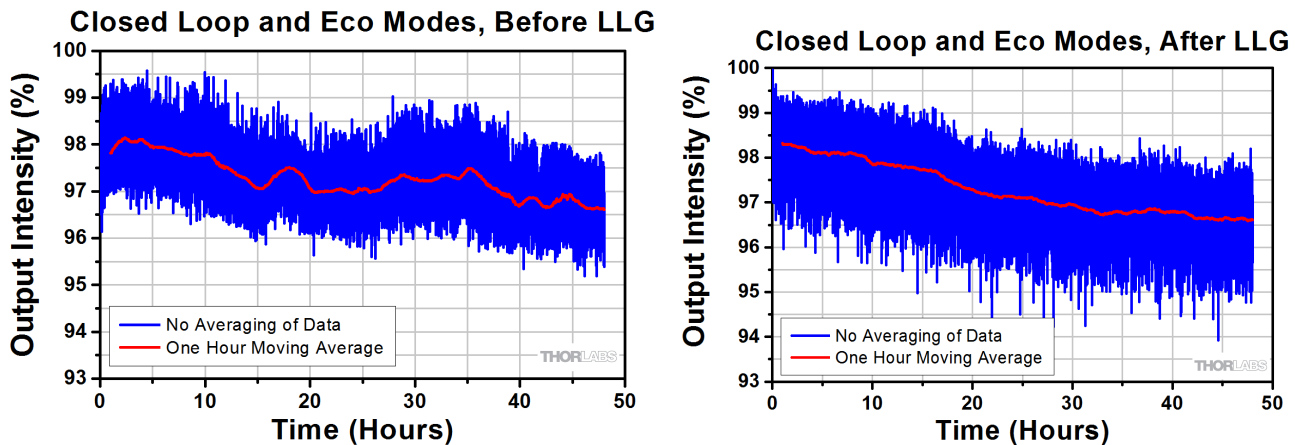
Figure 14   Closed loop mode measurements of the output light intensity percentage display taken just before the input end face of the LLG (left) and just after the output end face.

5.8.   Warning and Errors

The HPLS343 and HPLS345 light sources have two different types of malfunction states: warning and error.

Warning refers to a state of minor malfunction. The light source is still operational under a state of warning, but it may not perform as expected or according to specifications.

In a warning state, the LED on the top of the power switch glows purple, and the warning message will be displayed on the right bottom of the LCD screen.

There are two types of warning messages:

1.   **No LLG:** The liquid light guide is disconnected or not properly inserted into the LLG port. When the warning appears, the shutter of the light source will remain closed. Properly connecting the light guide will clear this warning.
2.   **LLG Hot**: The temperature at the tip of the liquid light guide is higher than 45 °C. When this warning appears, the light source is still fully functional. The liquid light guide can operate for a short term at temperatures over 45 °C and less than 60 °C. If the warning message does not clear within an hour, it will be upgraded to an error. To clear the error, close the shutter and remove the liquid light guide from the light source. Allow the LLG to cool down for at least 30 minutes.

In an error state, a possible fatal error has occurred to the light source. All functions of the light source will be disabled until the error is cleared. The LED on the top of the power switch glows red, and the error message will be displayed on the LCD screen.

There are 3 types of error states:

1.   **Lamp too hot:** The bulb module is overheated. The bulb module will be automatically switched off in this state. To clear this error, shut down the light source and wait at least 20 minutes for it to cool down. Make sure the ventilation openings on the housing of the light source are not blocked or near any external heat source.
2.   **LLG too hot**: The temperature at the tip of the liquid light guide has reached 60 ^{o}C or has been over 45 °C for more than one hour. To clear this error, remove the liquid light guide from the light source and allow the LLG to cool down for at least 30 minutes.
3.   **Lamp fail:** The bulb module failed to ignite. To clear the error, power-cycle the light source. If the error persists, it usually means that the bulb module has reached the end of its life; replacement is needed.

Chapter 6   Maintenance

6.1.   Fuse Replacement

The fuse is located in the fuse drawer below the power inlet. To replace the fuse, press the two clips on the drawer and pull it out, as shown in Figure 15.

Figure 15   Fuse Location of HPSL300 Series Light Sources

Take out the used fuse and put in the new one. Please use 5 A, 250 VAC, Type "T", slow blow fuse only.

6.2.   Bulb Module Replacement

⚠	**WARNING**	⚠
	Always power off the unit before opening the housing.	

⚠	**WARNING**	⚠
	The surface temperature of the bulb module may reach over 75 °C during operation. Always wait at least 10 minutes after turning off the light source for cool down before performing a bulb module replacement. When performing a bulb module replacement, wearing protective gloves is highly recommended.	

The bulb module used in HPLS300 series light sources has a typical lifetime of 6000 hours. After reaching its lifetime the bulb module will need to be replaced.

NOTE: 6000 hours is the typical time period for the maximum output light intensity of the bulb module to decrease to 50% of the initial value. It is not an absolute measurement of bulb lifetime. The actual lifetime of each bulb module may vary from unit to unit. Thorlabs provides a one year warranty on the bulb modules.

To replace the bulb module, first remove the six cap screws on the back panel with the included 2 mm hex key. Then remove the red cover by sliding it backwards.

Figure 16   Remove the six screws on the back panel.

Figure 17   Slide the red cover backwards to take it out.

The bulb module is located at the top half of the light source, on the right side (when facing the front panel).
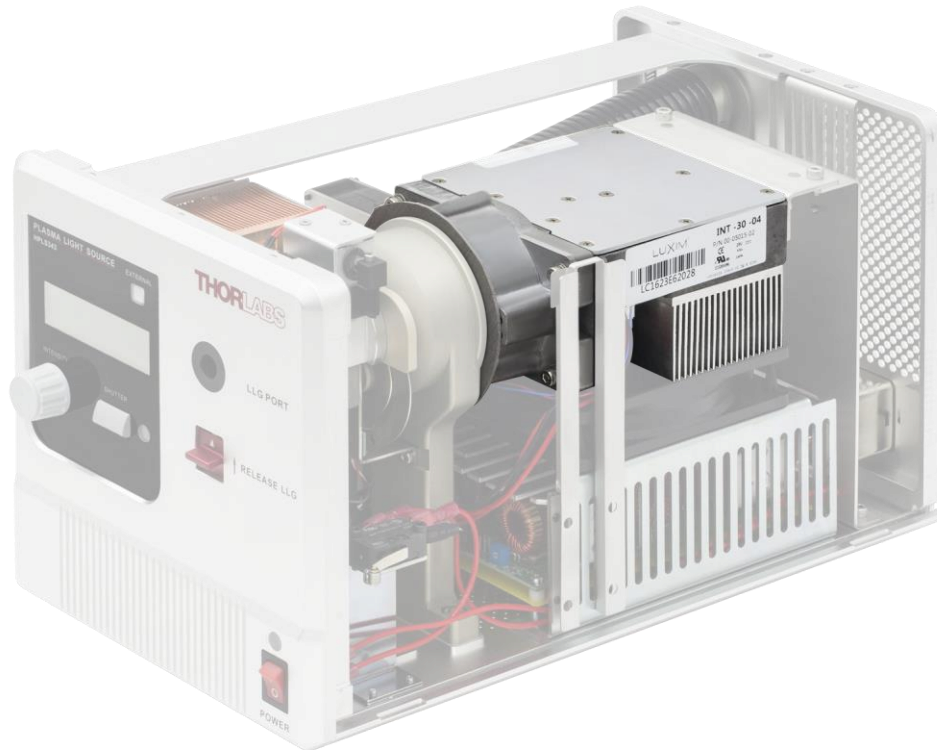
Figure 18   Bulb Module Installed in the Light Source

Use the included 3 mm hex key to remove the two cap crews close to the back panel.

Figure 19   Remove Two Cap Screws on the Back

There are two cables connected to the bulb module from beneath, as shown in Figure 20.
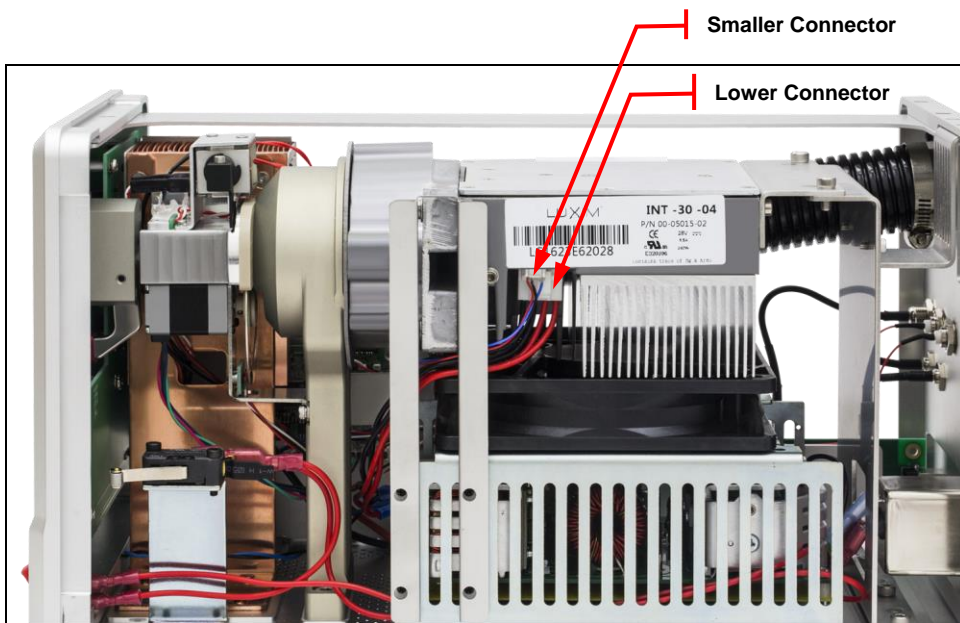
Figure 20   Wire Connectors under the Bulb Module

Disconnect the smaller cable by pressing the clip and pulling the connector carefully downward.
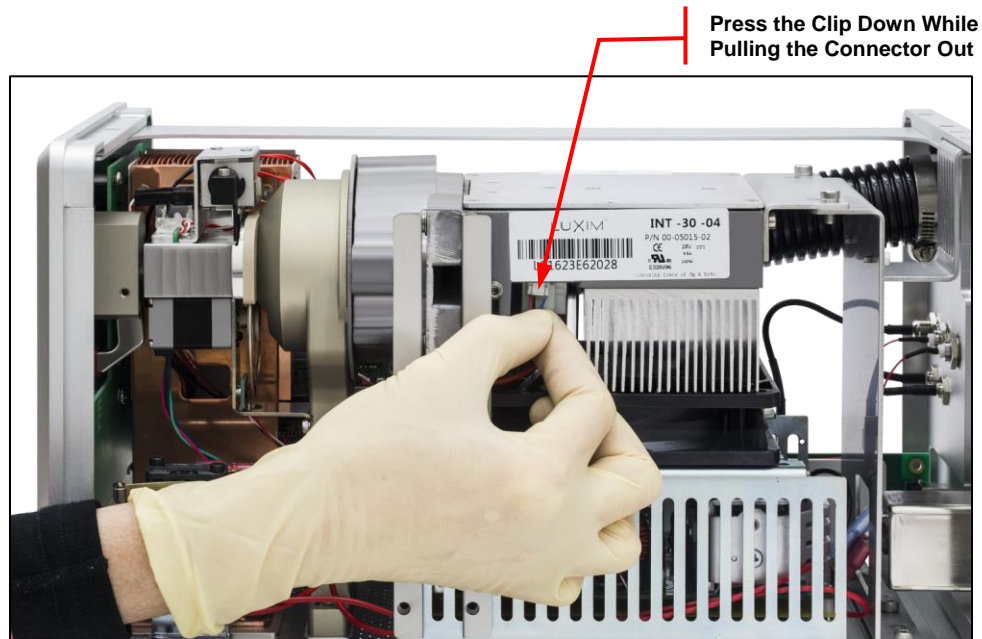
Figure 21   Remove the Smaller Cable First

Hold the bulb module firmly and slide it backwards until it completely disconnects from the lens holder in front of it.
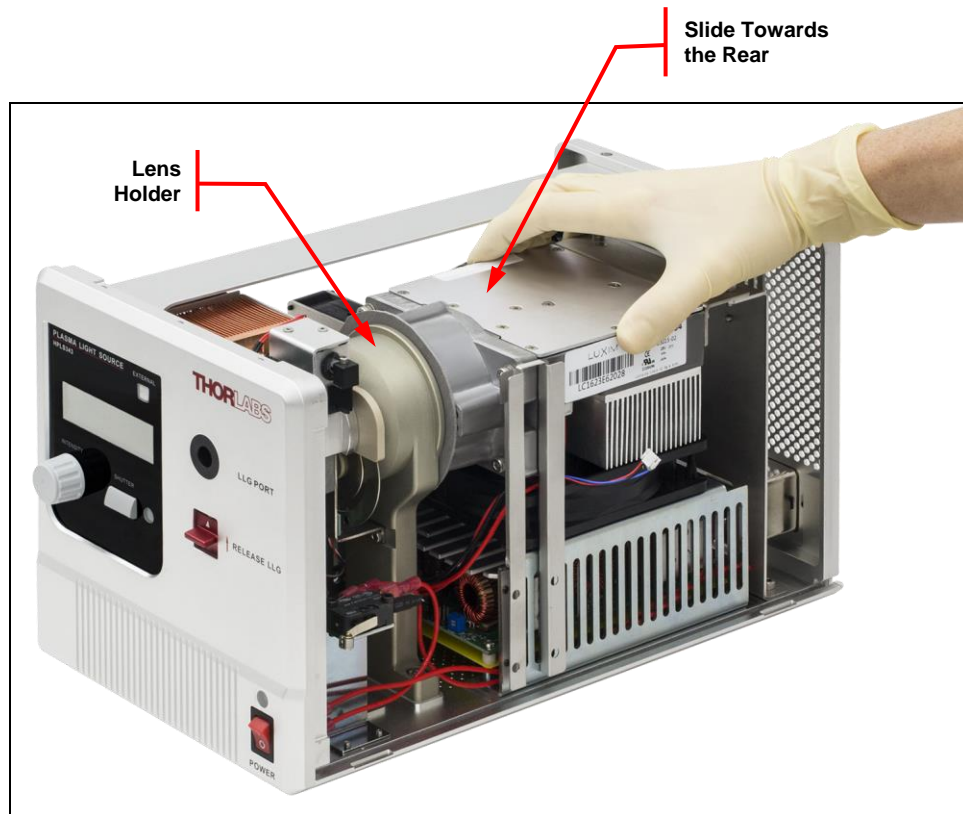
Figure 22   Disconnect the Bulb Module with the Lens Holder

Use one hand to slightly lift the bulb module and the other another hand grasp the larger connector beneath the bulb module. Press the clip on the connector and pull downward to disconnect.
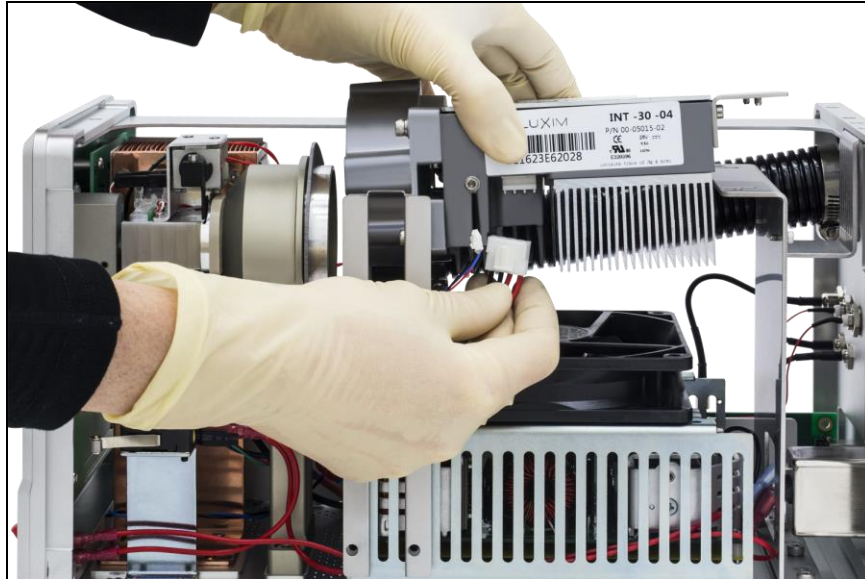
Figure 23   Disconnect the Larger Connector

Now the bulb module has been completely disconnected with the light source unit. Take it out and put it in its original packaging.

To install the new bulb module, follow this procedure:

1. Take the new bulb module out of its package and remove the dust cap from the front lens.
2. Connect the large cable beneath the bulb module first, as shown in Figure 23.
3. As shown in Figure 22, slide the bulb module forward so the lens holder inside the light source is firmly inserted in the front opening of the bulb module.
4. Connect the small cable beneath the bulb module, as shown in Figure 21.
5. Thread in the two cap screws and tighten with included 3 mm hex key, as shown in Figure 19.
6. Put back the red cover and the six cap crews on the back panel, securing them using the included 2 mm hex key.

6.3.   Firmware Update

The firmware update tool for HPLS300 series light sources and the most up-to-date firmware is available at **www.thorlabs.com**. Before updating the firmware, download and install the firmware update tool and download the latest firmware zip file.

Connect the light source to a PC via USB, and switch on the device while holding down the "SHUTTER" button on the front panel. This operation will let the device enter "Firmware Update Mode".

While the device is in firmware update mode, start the firmware update tool and follow the on-screen instructions to finish updating the firmware.

Chapter 7   Software GUI

Software enabling remote control of the HPLS300 series light sources is available for download from the Thorlabs website. The software package installs drivers and a GUI and is compatible with Windows® 7 and 10 as detailed on the Thorlabs website. After installing the software package and connecting the host PC to the light source via the USB port on the back panel, the PC can control the light source using either a command-line interface, discussed in Chapter 8, or through a GUI.

The GUI's controls duplicate most front panel functions on the GUI including intensity adjustment, shutter control, and toggling between manual and external control modes.

In addition, the GUI provides users with direct temperatures reading of both the bulb module (lamp temperature) and the tip of liquid light guide (LLG temperature). Changing the operation mode (open loop, closed loop, and Eco mode) is also possible on the GUI. In the sequence window on the right part of the GUI, the user can also input, play, save, and load a sequence of lamp settings.

The GUI is only operational in manual control mode; it is disabled when external control via the ports on the back panel is active. The software GUI and front panel controls are enabled at the same time. Both constantly read the light source's status and update their displayed information accordingly (e.g. any adjustments made to the light source using the front panel is registered by and used to update the status of the GUI).

Chapter 8   Command Line Operation

8.1.   Command-Line Interface Overview

The HPLS300 series light sources can be controlled by a command-line language through the USB port. Users can either use a terminal emulator or write their own program to control the unit. The command 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 light source 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 parameters are 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) has been sent.

The basic structure of the interface is a keyword followed by either an equals 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) or by pressing the Enter key on the computer.

The command structure is as follows:

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

Here, "keyword" defines the function and "argument" as a numerical value followed by a carriage return (CR). Note that some commands might have more than one argument, 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 below 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`.

8.2. Command Summary

The table below lists all the available commands for the operation of HPLS343/345.

Command	Syntax	Description
Get Commands	?	List the available commands
Get ID	*idn? or *IDN?	Returns the model number, hardware and firmware versions
Get SN	SN?	Returns device SN
Get Bulb Module SN	LSN?	Get Bulb Module SN
Get Device State	ST?	Returns device state (1=initial, 2=normal, 3=error, 4= warning)
Get Power Intensity	INT?	Gets current power intensity percentage
Set Power Intensity	INT=n	Set the power intensity percentage (0.1 to 100.0)
Shutter Control	SHT=n	Control shutter open/closed (1=closed, 2=open)
Get Shutter State	SHT?	Return the shutter state (1=closed, 2=open)
Get Bulb Module Temperature	LAT?	Return bulb Module temperature
Get Light Guide Temperature	LLG?	Return the temperature of LLG tip
Get Control Mode	MOD?	Returns control mode (1=local, 2=external)
Set Control Mode	MOD=n	Set control mode (1=local, 2=external)
Get Operation Mode	LAD?	Returns operation mode (1=close loop, 2=open loop, 3=eco)
Set Operation Mode	LAD=n	Set operation mode (1=close loop, 2=open loop, 3=eco)
Get Bulb Module On/Off Status	LON?	Returns bulb module on/off status (0=off, 1=on)
Set Bulb Module On/Off	LON=n	Set Bulb Module on/off (0=off, 1=on)
Get Error Message	ERR ?	Returns the error message (B0=1, bulb module temperature too high; B1=1, bulb module fail; B2=1, LLG temperature too high)
Get Warning Message	WAR ?	Returns the warning message (B0=1, LLG disconnected; B1=1, LLG hot)

8.3.   Description of Commands

8.3.1. ? – Get Device Commands

Get all device available commands.

Return:

```
?, List available commands
*idn?or*IDN?, Get device ID
SN?, Get device SN
LSN?, Get lamp SN
ST?, Get device status (1: initial, 2: normal, 3: error, 4: warning)
INT?, Get power intensity (0.0 to 100.0)
INT=n, Set power intensity (n = 0.0 to 100.0)
SHT?, Get shutter status (1: closed, 2: open)
SHT=n, Set shutter status (1: closed, 2: open)
LAT?, Get lamp temperature
LLG?, Get light guide temperature
MOD?, Get control mode (1: local, 2: remote)
MOD=n, Set control mode (1: local, 2: remote)
LAD?, Get Lamp mode (1: close loop, 2: open loop, 3: eco)
LAD=n, Set lamp mode (1: close loop, 2: open loop, 3: eco)
LON?, Get lamp on/off status (0: off, 1: on)
LON=n, Set lamp on/off (0: off, 1: on)
ERR?, Get error message
WAR?, Get warning message
```

8.3.2. *idn? or *IDN? – Device Information

Queries the device part number, hardware and firmware versions.

Return:

```
THORLABS HPLS300 SNxxxxxxxx HWx.x FWx.x
```

Where `SN` is the series number; `HW` is the hardware version; and `FW` is the firmware version.

8.3.3. SN? – Device Serial Number

Queries the device serial number.

Return:

```
SN=xxxxxxxx
```

Where `xxxxxxxx` is the device series number.

8.3.4. LSN? – Bulb Module Serial Number

Queries serial number of the bulb module

Return:

```
LSN=xxxxxxxxxxxx
```

Where `xxxxxxxxxxxx` is the bulb module serial number

8.3.5. ST? – Device Status

Queries the device status

Return:

`ST=n`

The value of `n` can be one of the following status:

n=1: Intializing;
n=2: Normal;
n=3: Error;
n=4: Warning

8.3.6. INT=n; INT? – Device Power Intensity

The `INT` command can be used to set or query the device power intensity percentage.

INT=n

Sets the device power intensity. The value of n must be from 0.1 to 100.0 in %.

INT?

Queries current device power intensity

Return:

`INT=n`

Where `n` is current device power intensity percentage.

Please notice that the largest delay of output power intensity reaching to the set point is about 3s.

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

8.3.7. SHT=n; SHT? – Shutter

The `SHT` command can be used to set or query the shutter status.

SHT=n

Sets the shutter on/off. The value of `n` can be one of the following:

n=1: Close shutter
n=2: Open shutter

SHT?

Queries current shutter status

Return:

`SHT=n`

Where `n` is current shutter status

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

8.3.8. LAT? – Bulb Module Temperature

Queries current lamp temperature

Return:

`LAT=n`

Where `n` is the value of lamp temperature in °C.

8.3.9. LLG? – Light Guide Temperature

Queries current light guide temperature.

Return:

`LLG=n`

Where `n` is the value of light guide temperature in °C.

8.3.10. MOD=n; MOD? – Device Control Mode

The `MOD` command is used to set or query the device control mode. There are two available modes: local and external.

MOD=n

Sets the device control mode. The value of `n` can be one of the following:

n=1: Local
n=2: External

MOD?

Queries current device control mode.

Return:

`MOD=n`

Where `n` is current device control mode.

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

8.3.11. LAD=n; LAD? – Operation Mode

The `LAD` command is used to set or query the device operation mode.

LAD=n

Sets the lamp control mode. The value of `n` can be one of the following:

n=1: Closed loop
n=2: Open loop
n=3: Eco

LAD?

Queries the operation mode.

Return:

`LAD=n`

Where `n` is the operation mode.

NOTE: When the light source is working under closed loop mode, the max output light intensity is about 80% of working under open loop mode; while light source is working under Eco mode, the max output light intensity is about 50% of working under open loop mode.

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

8.3.12. LON=n; LON? – Bulb Module ON/OFF

The `LON` command is used to set or query the bulb module on/off status.

LON=n

Turn the bulb module on or off. The value of `n` can be one of the following:

n=0: bulb module turn off
n=1: bulb module turn on

LON?

Queries the bulb module on/off status.

Return:

`LON=n`

Where n is the bulb module on/off status.

NOTE: This command is a separate on/off command to turn on/off the bulb module, regardless the shutter state. Normally, the bulb module need about 30s to stabilize its output power after turning back on. Frequently turning on and off the bulb module may impact its life. We do not recommend using this command for frequently on/off switch, or modulation of the beam.

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

8.3.13. ERR? – Error message

The ERR? command queries current device error message.

Return:

ERR=n

Where n is an 8-bit number which reports the detailed error message. When converted into binary form, n has the following Boolean structure:

n = 0000 0000

0000 0001 = bulb module temperature too high

0000 0010 = bulb module fail

0000 0100 = LLG temperature too high

More than one error indication can be supported.

NOTE: The device should be restarted for normal operation after it reports "Lamp fail".

8.3.14. WAR? – Warning Message

The WAR? command queries current device warning message.

Return:

WAR=n

Where n is an 8-bit number which reports the detailed warning message. When converted into binary form, n has the following Boolean structure:

n = 0000 0000

0000 0001 = LLG disconnected

0000 0010 = LLG hot

More than one warning indication can be supported.

Chapter 9   Specifications

Specification	HPLS343	HPLS345
Wavelength Range	350 - 800 nm	
Color Temperature[1]	6000 K	
Color Rendering Index (CRI)[1]	94	
LLG Core Diameter	3 mm	5 mm
LLG Numerical Aperture (NA)	0.59	
Typical Output Light Power[2]	4 W	7.0 W
Minimum Output Light Power[2]	3.5 W	6.0 W
Output Power Drift[3]	0.2% per °C; 0.05% per hour	
Transmitted Intensity, Range Tunable by Attenuator	0.1% to 100%	
Output Power Stability[4]	0.5% (Typ.) 0.6% (Max)	
Output Intensity non-linearity	<2%	
Bulb Module Lifetime[5]	6000 h (Typ.)	
Intensity Switch Time	<3 s (10% to 90% Intensity)	
Shutter Switch Time	5 ms	
Maximum Shutter Repetition Rate	1 Hz (Long Term) 10 Hz (Burst)	
Power Supply	90 to 264 VAC, 47 to 63 Hz, 325 VA	
Operating Temperature	10 to 30 ˚C (Open and Closed Loop) 10 to 35 ˚C (Eco Mode)	
Storage Temperature	-15 to 70 °C	
Dimensions (L x W x H)	14.23" x 7.40" x 7.87" (361.5 mm x 188.0 mm x 200.0 mm)	

---

[1] *Prior to LLG*

[2] *Measured at Liquid Light Guide Tip at Beginning of Life Time*

[3] *Typical Value, Including the Deterioration of the LLG*

[4] *Typical Value of Standard Deviation over One Hour, Measured at Liquid Light Guide Output Tip*

[5] *Typical Value of Time for Maximum Output Intensity to Drop to 50% of Original Value*

Chapter 10   Mechanical Drawing

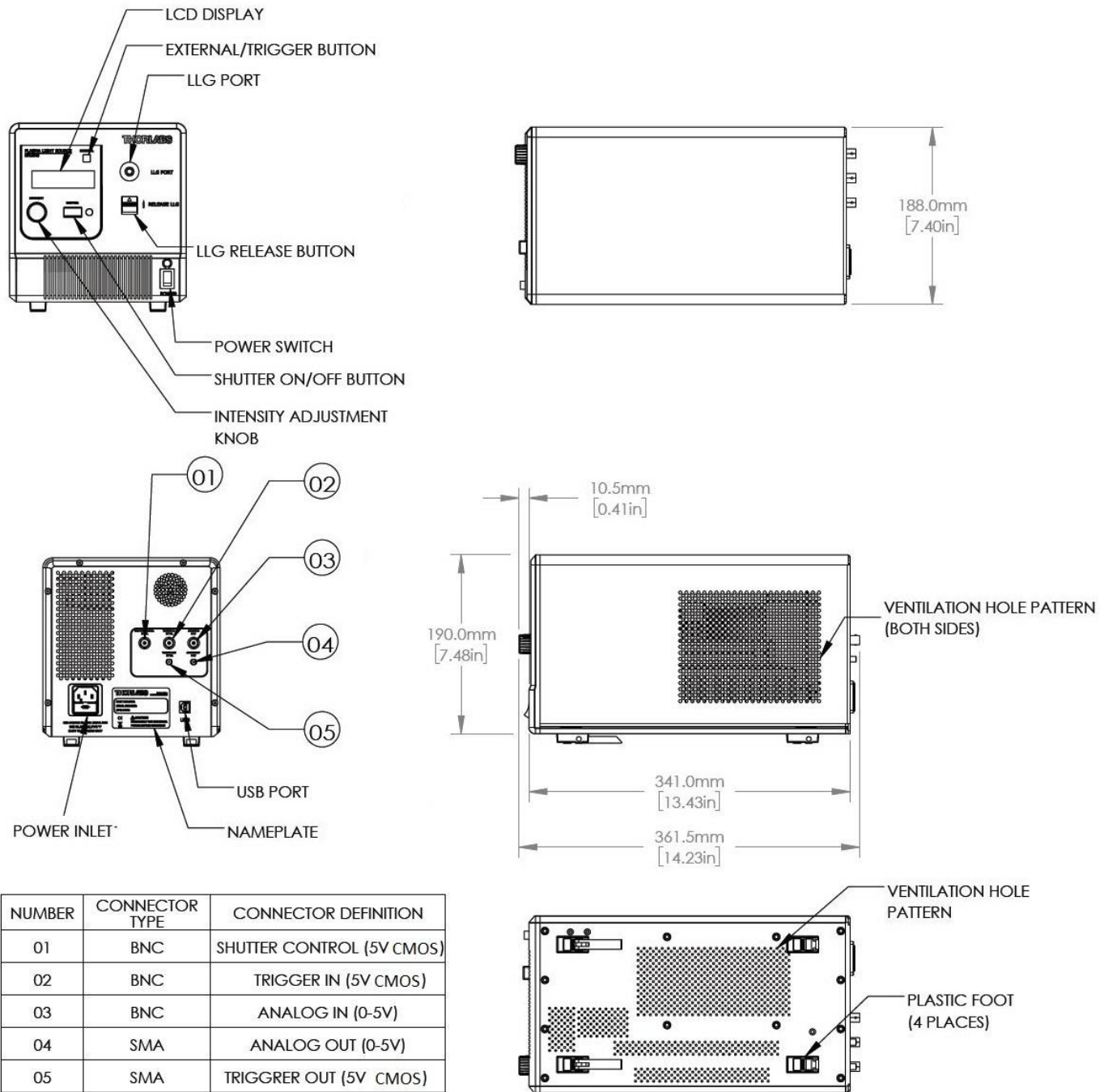| NUMBER	CONNECTOR TYPE	CONNECTOR DEFINITION
01	BNC	SHUTTER CONTROL (5V CMOS)
02	BNC	TRIGGER IN (5V CMOS)
03	BNC	ANALOG IN (0-5V)
04	SMA	ANALOG OUT (0-5V)
05	SMA	TRIGGRER OUT (5V CMOS)

Figure 24   Mechanical Drawing

Chapter 11 Certifications and Compliances

CE

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):

2014/35/EU	Low Voltage Directive (LVD)
2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2011/65/EU	RoHS 2 Directive
2009/125/EC	Ecodesign Directive

hereby declare that:

Model: **HPLS343, HPLS345**
Equipment: **Plasma Light Source**

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

EN 61010-1:2010
EN 55011:2009/A1:2010 (Class A)
EN 61326-1:2013
EN 61326-2-1:2013
EN 61326-2-2:2013
EN 61000-3-2:2014
EN 61000-3-3:2013
EN 61000-4-2:2009
EN 61000-4-3:2006+A1:2008+A2:2010
EN 61000-4-4:2012
EN 61000-4-5:2014
EN 61000-4-6:2014
EN 61000-4-8:2010
EN 61000-4-11:2004
EN 62471:2008 (Exempt Group)

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: 3. July 2017

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:

Plasma Light Source

Model No.:   **HPLS343, HPLS345**

fulfills the requirements of the standard

CISPR PUB. 22, FCC Part 15 Subpart B Class A(Verification)

and therefore corresponds to the regulations of the directive.

Signed: on: 19. December 2016

Name: Shanshan Song
Position: General Manager

Chapter 12   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
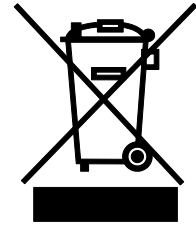
Wheelie Bin Logo

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 13   Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.

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