

LAMBDA HPX-L5

HIGH-POWER LED LIGHT SOURCE SYSTEM
(AIR COOLED WITH LIQUID LIGHT GUIDE)

OPERATION MANUAL

REV. 1.05 ((20210128))



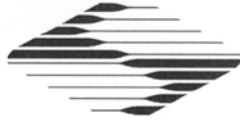
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CE EU Declaration of Conformity

Application of Council Directives:
2014/30/EU (EMC), 2014/35/EU (LVD), and 2015/863/EU (RoHS 3)

Manufacturer's Name: Sutter Instrument Company

Manufacturer's Address: One Digital Drive
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Equipment Tested: Lambda HPX-L5 High-Power LED Light Source System (Air Cooled)

Model(s): HPX-L5, HPX-L5UV, HPX-L5DC

Conforms to Standards: EMC Emissions: EN 61326-1:2013, including:
EN 55011: 2009 Class A;
EN 61000-3-2:2015, & EN 61000-3-3:2014

EMC Immunity: EN 61000-4-2:2009, EN 61000-4-3:2011,
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

LVD (Safety): EN 61010-1:2010

Photobiological Safety of Lamps & Lamp Systems:
EN 62471: 2008 / IEC 62471, Ed 1.0 (2006-07)

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Test Report(s): 20150902-01, SI_HPXL5_TF-A_(20150930), SI_EMCLBHPXL5_20160713;
20200520_REACH and RoHS Compliance Statement

Sutter Instrument Company hereby declares that the equipment specified above was tested and conforms to the EU Directives and Standards listed above, and further certifies conformation to the requirements of the European Union's Restriction on Hazardous Substances in Electronic Equipment Directive 2015/863 (2011/65/EU Annex II) for RoHS 3.

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DISCLAIMER

The **Lambda HPX-L5** is a high-power LED illumination or light source device. The purpose of the system is to be an illuminator for microscopes. No other use is recommended.

This instrument is designed for use in a laboratory environment. It is not intended, nor should it be used in human experimentation or applied to humans in any way. This is not a medical device.

Unless otherwise indicated in this manual or by Sutter Instrument Technical Support for reconfiguration, do not open or attempt to repair the instrument.


Do not allow unauthorized and/or untrained operative to use this device.

Any misuse will be the sole responsibility of the user/owner and Sutter Instrument Company assumes no implied or inferred liability for direct or consequential damages from this instrument if it is operated or used in any way other than for which it is designed.

SAFETY WARNINGS AND PRECAUTIONS



Electrical

- Operate the Lambda HPX-L5 using 110 – 240 VAC., 50-60 Hz line voltage. This instrument is designed for use in a laboratory environment that has low electrical noise and mechanical vibration. Surge suppression is always recommended.

-  **Fuse Replacement:** Replace only with the same type and rating:
2 Amp, 250V, 5 x 20mm, Time Delay fuse (EIC 60127-2)
(Example: Bussmann GDC-2A or S506-2A (RoHS))

A spare fuse is located in the power input module.

Avoiding Electrical Shock and Fire-related Injury

-  Always use the grounded power supply cord set provided to connect the system's power adapter to a grounded/earthed outlet (3-prong). This is required to protect you from injury in the event that an electrical hazard occurs.
- Do not disassemble the system. Refer servicing to qualified personnel.
-  To prevent fire or shock hazard do not expose the unit to rain or moisture.




Electromagnetic Interference

To comply with FDA and CE electromagnetic immunity and interference standards; and to reduce the electromagnetic coupling between this and other equipment in your lab always use the type and length of interconnect cables provided with the unit for the interconnection of its components (see the Technical Specifications appendix for more details).

Operational

Failure to comply with any of the following precautions may damage this device.

- Operate only in a location where there is a free flow of fresh air on all sides.
NEVER ALLOW THE FREE FLOW OF AIR TO BE RESTRICTED.

- This instrument is designed for operation in a laboratory environment (Pollution Degree I) that is free from mechanical vibrations, electrical noise, and transients.
-  **DO NOT CONNECT OR DISCONNECT THE LIQUID LIGHT GUIDE BETWEEN THE HPX-L5 AND MICROSCOPE ADAPTER (OR THE ADAPTER FROM THE MICROSCOPE) WHILE POWER IS ON.**
- Operate this instrument only according to the instructions included in this manual.
- Do not operate if there is any obvious damage to any part of the instrument.
-  Do not operate this instrument near flammable materials. The use of any hazardous materials with this instrument is not recommended and, if undertaken, is done so at the users' own risk.
-  Do not operate if there is any obvious damage to any part of the instrument.

Avoiding Physical Injury while Powered up and Emitting Light.



WARNING

DO NOT LOOK DIRECTLY INTO THE OUTPUT OF THE LIGHT APERTURE OF THE HIGH-POWER LED IN THE CONTROLLER, THE CONNECTED LIQUID LIGHT GUIDE, OR THE ATTACHED MICROSCOPE ADAPTER! Always direct the output of the light aperture into the microscope using the appropriate adapters, directed away from anyone's eyes, and not directed toward any reflective surface.

-  **INFRARED AND ULTRAVIOLET RADIATION:** The infrared and ultraviolet radiation generated by this lamp can cause significant skin burns and eye damage.

Other

- Retain the original packaging for future transport of the instrument.
- Sutter Instrument reserves the right to change specifications without prior notice.
- This device is intended only for research purposes.

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1. INTRODUCTION

1.1 Features Summary

VIBRATION-FREE COUPLING VIA LIQUID LIGHT GUIDE
 DIMMING VIA PWM OR CURRENT CONTROL
 LONG STABLE LAMP LIFE
 FRONT MOUNTED CONNECTORS FOR EASE OF ACCESS
 TTL AND ANALOG CONTROL
 INTEGRAL SHUTTERING

1.2 Description

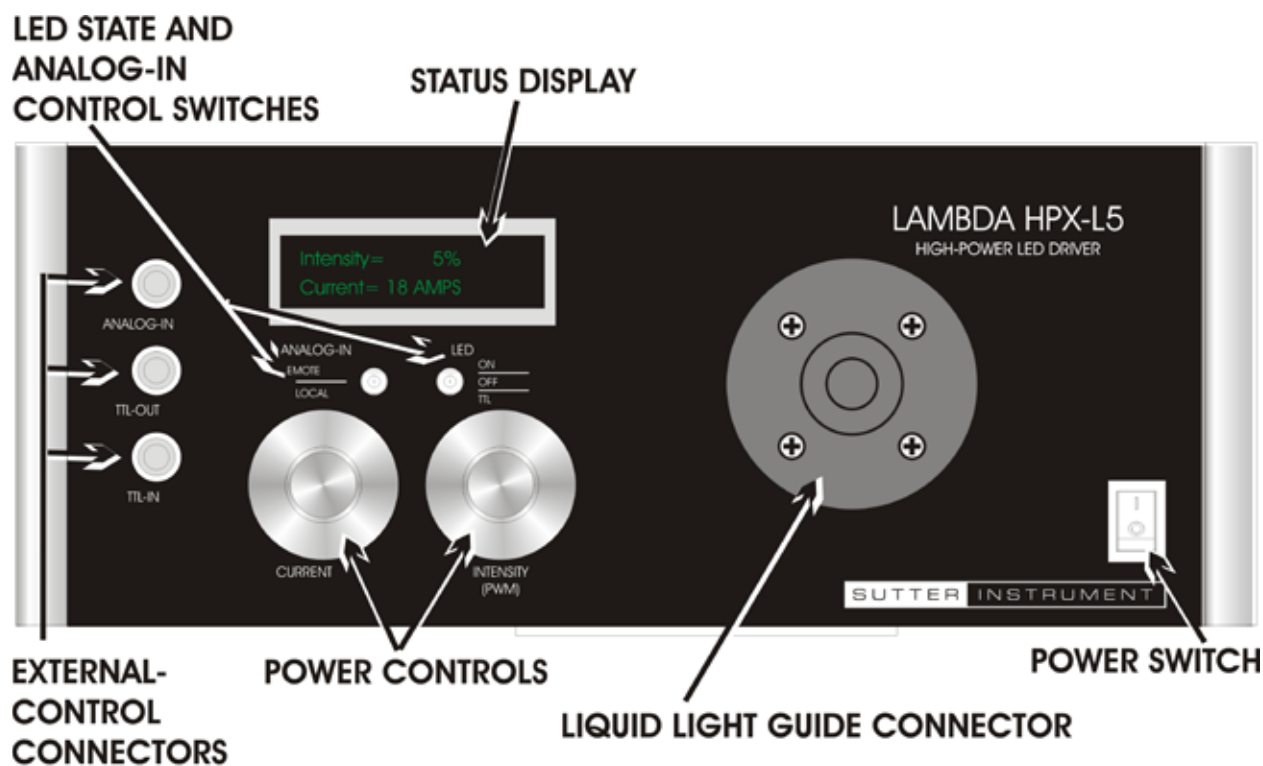


Figure 1-1. Lambda HPX-L5 indicators, controls, and connectors.

The Lambda HPX-L5 is liquid light guide coupled version of the Lambda HPX high-output LED light source (illuminator). The liquid light guide allows for LED cooling via an internal heatsink with a whisper fan, thus requiring less maintenance than the liquid-cooled direct-mount version. Designed around a single 90W 3mm LED die, the Lambda HPX-L5 provides light output comparable to a 150W xenon arc lamp when using the same liquid light guide.

The Lambda HPX-L5 is optimized for coupling to an optional 5mm liquid light guide, and off-the-shelf microscope adapter. The HPX is expected to retain 95% of its original output at 5,000 hours, and 80% after 10,000 hours.

Because LEDs exhibit color shift with current change, the Lambda HPX was designed to dim the LED using either PWM (Pulse Width Modulation) or current control. PWM control is generally preferred for most applications as it allows the LED to run cooler. PWM switching is at 28 KHz, high enough for use with most high-speed cameras. For those with applications intolerant of any pulsed output, dimming via current control is also available. PWM and Current control are conveniently monitored and manually controlled via the display and control knobs on the front panel of the MPX-L5. Integral shuttering time is 10 microseconds to turn on and off. TTL input and output allows for triggering from either software or directly from another device such as a camera or digital I/O board. PWM can also be controlled externally via analog input. Active temperature monitoring ensures that the LED life is maximized.

Light output is in the visible spectrum from 400-729 nm. Special order units are available with 630, 530, 460, and 405 nm wavelength specific LEDs. A two-channel system with any combination of wavelengths can be configured by combining a Lambda HPX and Lambda TLED/TLED+.

1.3 Technical Support

Sutter Instrument Company at no charge provides unlimited technical support to our customers. Our technical support staff is available between the hours of 8:00 AM and 5:00 PM (Pacific Time) at **(415) 883-0128**. You may also e-mail your queries to **info@sutter.com**. Furthermore, as this manual is currently under construction, if there are any areas that you feel should be covered in detail, we would like to hear from you.

2. INSTALLATION

2.1 Unpacking

The Lambda HPX and associated hardware comes packed in a single carton. The following is a list of the components found there. If you believe that any of these components are missing or show obvious signs of damage from shipping, please contact the factory.

1. Controller cabinet with factory-installed high-power LED assembly, control circuitry, and power supply.
2. Power Cord
3. Liquid Light Guide
4. Microscope-specific Collimating adapter (if ordered)
5. Manual

2.2 Installation Instructions

1. Turn power switch to OFF (“0”) position.
2. Plug power cable into the mains outlet.
3. Fully insert the liquid light guide into the connector on the front panel and tighten down the thumbscrew.
4. Follow the instructions included with the microscope-collimating adapter for connecting the other end of the liquid light guide to the microscope.



CAUTION: PLEASE NOTE THAT THE LIGHT GUIDE HAS A MINIMUM-BENDING RADIUS OF 40 MM (ABOUT 1.6 INCHES).

5. The Analog-IN and/or TTL-IN connections can be made to an external signaling source at this stage if desired.

Once verifying all the connections, the system is ready to be turned on.



WARNING: DO NOT LOOK DIRECTLY INTO THE LIGHT GUIDE! The output of the light or the light guide should be directed into the microscope using the appropriate adapters, directed away from anyone’s eyes, and not directed toward any reflective surface.

2.3 Configuring Input and Output TTL Logic

Input and output TTL logic is configured using the first three switches of the four-switch DIP bank located on the control board inside the controller cabinet. To access the DIP switch bank, remove left-side panel (left-side while viewing the front panel) by unscrewing the six screws.



Figure 2-1. Lambda HPX-series left-side panel removed for access to configuration DIP switches.

While viewing the left side of the cabinet, the location of the DIP switch bank on the vertically mounted control board as shown in the following figure.

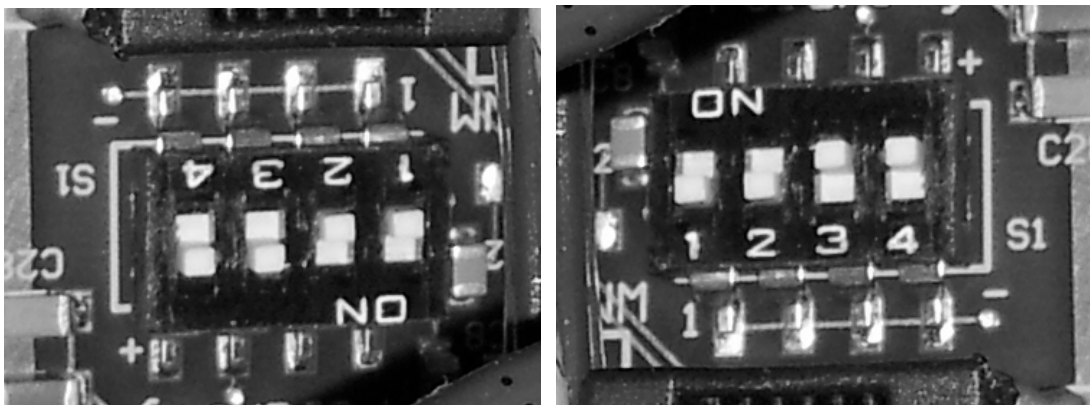


Figure 2-2. Configuration DIP switch bank as viewed head on and top-down.

The switches on the DIP bank are numbered 1 through 4 left to right. The definitions of these switches and their positions are described in the following paragraphs and are summarized in the table that follows.

2.3.1 TTL IN to TTL OUT Logic (Switch 1)

DIP Switch 1 determines the TTL OUT logic as synchronized with TTL IN.

When ON (default), the state of TTL OUT is the **same** as that of TTL IN (i.e., when TTL IN goes low, TTL OUT also goes low; when TTL IN goes high, TTL OUT also goes high).

When OFF, the state of TTL OUT is the **inverse** of that of TTL IN (i.e., when TTL IN goes low, TTL OUT then goes high; when TTL IN goes high, TTL OUT then goes low).

2.3.2 LED On/Off State Control by TTL IN (Switch 2)

DIP Switch 2 determines how the state at TTL IN determines the on/off state of the lamp when the LED Control Switch is in the TTL position.

When ON, TTL IN going HIGH turns the LED on; TTL IN going LOW turns the LED off.

When OFF (default), TTL IN going LOW turns the LED on; TTL IN going HIGH turns the LED off.

2.3.3 LED On/Off State while Transitioning Between LED Switch Positions ON and TTL (Switch 3)

DIP Switch 3 determines the on/off state of the lamp when switching between manually adjustable and TTL modes (from the LED switch's ON or OFF position to TTL).

When ON (default), lamp turns on.

When OFF, lamp turns off.

After switching from manual control to TTL, TTL control of the lamp's on/off state resumes on the next transition of logic state at TTL IN.

Note that because the OFF position of the LED switch is located in between ON and TTL, the lamp turns off while traversing the OFF position when switching from ON to TTL.

2.3.4 Firmware and Lambda HPX Model (Switch 4)

The position of DIP Switch 4 informs the control board's firmware of the specific Lambda HPX model it is controlling. This switch must be ON (Lambda HPX-L5 (air-cooled lamp with liquid light guide)).

Table 2-1. DIP Switch configuration settings.

Switch	Function	Position	Definition
1	TTL OUT logic	ON*	Same as TTL IN: TTL IN=low → TTL OUT=low; TTL IN=high → TTL OUT=high
		OFF	Inverse of TTL IN: TTL IN=low → TTL OUT=high; TTL IN=high → TTL OUT=low
2	TTL IN logic	ON	TTL IN=high turns lamp on
		OFF*	TTL IN=low turns lamp on
3	Lamp state when switching from manual control to TTL	ON*	Lamp turns on (Notes 1 and 2)
		OFF	Lamp turns off (Note 1)
4	Lambda HPX model-specific operation (Note 3)	ON*	Lambda HPX-L5
		OFF	Lambda HPX

“*” = Default

NOTES:

1. After switching from manual mode (LED switch position ON or OFF) to TTL mode (LED switch position TTL), TTL control of the lamp's on/off state will resume with the next change of logic state at TTL IN.
2. While using the LED switch to switch from ON to TTL, the lamp turns off while transitioning through the OFF position (the OFF position is located in between ON and TTL).
3. Switch 4 must be ON for proper operation of the Lambda HPX-L5 (forced air-cooled lamp with liquid light guide).

3. OPERATIONS

This chapter describes the operation of the Lambda HPX-L5. The locations of the individual indicators, controls, and connectors are indicated in the following figure.

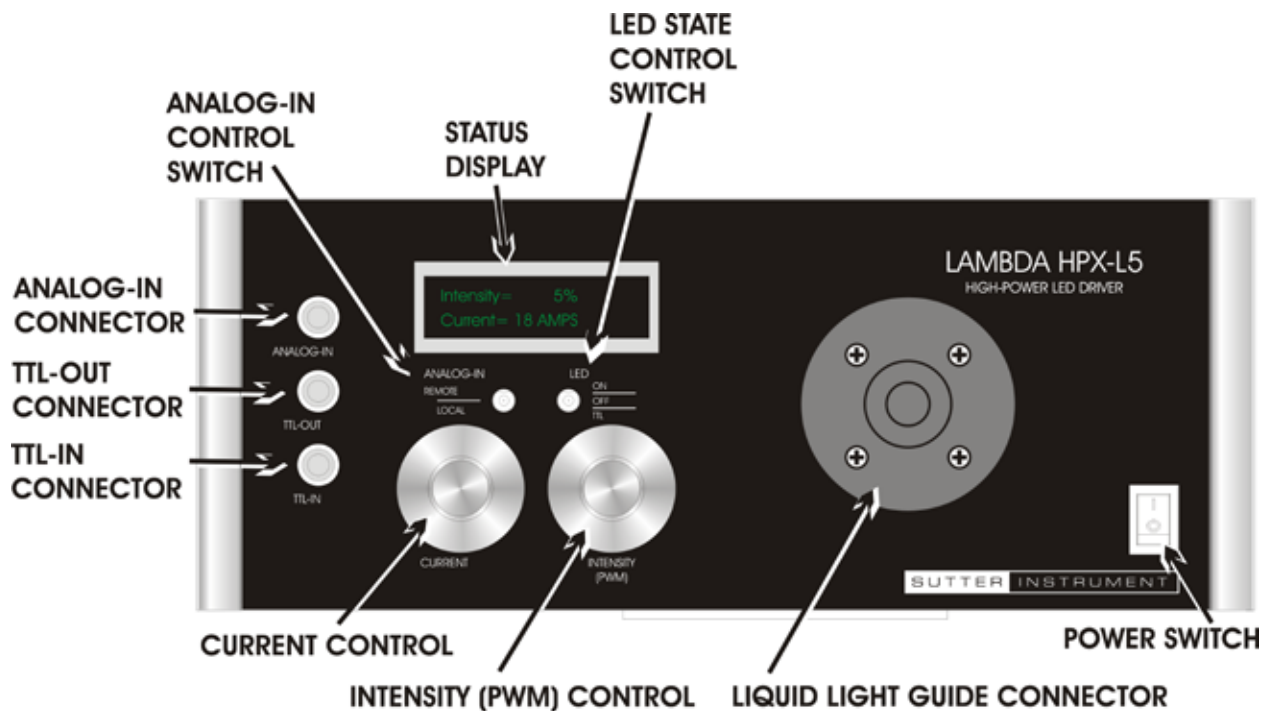


Figure 3-1. Locations of individual indicators, controls, and connectors on the Lambda HPX-L5 controller.

3.1 Indicators

3.1.1 Status Display

Displays intensity as a percentage and current level in terms of amperes.

```
Intensity = 5%
Current = 18 AMPS
```

Figure 3-2. Status display.

Intensity ranges from 0 to 100%.

Current ranges from 4 to 18 Amps.

3.2 Controls

3.2.1 Power Switch

Main power switch turns unit off/on.

3.2.2 LED Control Switch

This is a three-position toggle switch that is used to manually turn the LED on, off, or activate TTL switching through the TTL-IN BNC connector.

ON: Manually turns on the LED for manual control.

OFF: The intensity of the LED is controlled via voltage range of 0-5 VDC applied to ANALOG-IN.

TTL: LED on/off state is controlled by TTL triggering (via TTL-IN). Note that remote analog control (via ANALOG-IN) is turned off when using TTL-IN.

3.2.3 ANALOG-IN Control Switch

Selects between LED dimming control through the ANALOG-IN BNC connector (REMOTE) or manually using the INTENSITY (PWM) control knob (LOC-1).

REMOTE: Allows for the dimmed state of the LED to be controlled by a voltage (0 – 5 VDC) applied to ANALOG-IN. The LED Control Switch must be set to OFF in order for dimming via analog remote input to function properly. When controlling the LED's dimmed state in this mode, the status display turns blue.

LOC-1: Allows the INTENSITY (PWM) knob to control the dimmed state of the LED. For the INTENSITY (PWM) knob to be effective, the LED Control Switch must be set to ON or TTL.

3.2.4 INTENSITY (PWM) Control Knob

Intensity (PWM) Knob: This knob dims the LED via Pulse Width Modulation. In essence, the LED is being switched at 30KHz. This is the preferable mode of dimming for most applications, as the LED will run cooler, and exhibit no color shift in the spectral output as the light is dimmed. For the INTENSITY (PWM) knob to be effective, the LED Control Switch must be set to ON or TTL.

The control of the intensity via PWM can also be controlled externally by connecting a 0-5 VDC source to ANALOG-IN connector. This external control is enabled by turning the ANALOG-IN switch to the LOC-1 position and the LED switch to either ON or TTL. Note that when PWM intensity control is set up for external control, the INTENSITY (PWM) knob is disabled.

3.2.5 CURRENT Control Knob

Current Knob: Dims LED by adjusting the current delivered to the LED. Current control may cause color shift in the LED's spectral output. However, current-controlled dimming may be preferable in situations involving the use of ultra high-speed cameras. For the CURRENT knob to be effective, the LED Control Switch must be set to ON or TTL.

Note that the CURRENT knob is functional regardless of the positions of the LED and ANALOG-IN switches, and manual or external state of intensity via PWM (manually adjusting INTENSITY (PWM) knob or applying 0-5 VDC on ANALOG-IN input).

3.3 Connectors

3.3.1 Liquid Light Guide Connector

Provides the interface between the high-power LED (mounted inside the cabinet immediately behind the connector) and the liquid light guide for which this connector is designed to accommodate.

3.3.2 ANALOG-IN BNC Connector

An analog input from 0-5v controls intensity through PWM dimming.

3.3.3 TTL-IN BNC Connector

Allows for the control of the LED like a shutter. When the LED switch is in the TTL position, TTL-IN is gated low, which keeps the LED in the OFF state. Once TTL-IN receives a high signal, the LED turns on for the duration that TTL-IN is held high.

3.3.4 TTL-OUT BNC Connector

Outputs a triggering signal for external software. When the LED is off, TTL-OUT is high; when the LED is on, TTL-OUT is held low the duration that the LED is on.

3.4 Fault Conditions

The Lambda HPX-L5 is equipped with a temperature monitor to maximize the life of the LED. Should a fault occur, the screen turns red and the lamp is automatically turned off. If the screen turns red, and the text is unchanged, the LED temperature has exceeded its safe operating temperature. If the corner of the screen displays “Fan” when turning red, it means that the fan has failed, and is no longer turning.

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4. MAINTENANCE

4.1 Routine Maintenance

Routine cleaning of the Lambda HPX-L5 system is required to prevent excessive dust accumulations. Wipe all exterior surfaces with a dry, soft, cotton cloth.

Periodically inspect all cables ensuring that all connections are made well, and connectors are evenly seated.

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APPENDIX A. LIMITED WARRANTY

- Sutter Instrument Company limits the warranty on this instrument to repair and replacement of defective components for two years from date of shipment, provided the instrument has been operated in accordance with the instructions outlined in this manual.
- Abuse, misuse, or unauthorized repairs will void this warranty.
- Warranty work will be performed only at the factory.
- The cost of shipment both ways is paid for by Sutter Instrument during the first three months this warranty is in effect, after which the cost is the responsibility of the customer.
- The limited warranty is as stated above and no implied or inferred liability for direct or consequential damages is intended.
- An extended warranty for up to three additional years can be purchased at the time of ordering, or until the original warranty expires. For pricing and other information, please contact Sutter Instrument.

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APPENDIX B. ACCESSORIES

4.3 High-Power LED Assemblies

The following high-powered LED assemblies are available.

WC-L5-HPX	LED, Cool White
460-L5-HPX	LED, 460nm
530-L5-HPX	LED, 530nm
630-L5-HPX	LED, 630nm

Please contact Sutter Information for wavelength availability and other information.

4.4 Microscope Adapters

Liquid light guide adaptors for various microscopes are available. Please contact Sutter Instrument for more information.

4.5 TTL Triggering

A USB-controlled trigger box is available for TTL control of the Lambda HPX series. Please contact Sutter Instrument for more information.

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APPENDIX C. FUSE REPLACEMENT

In the event that the controller fails to power up when the power switch is turned on, check the line power fuses to see if either or both have blown. The fuses are located in the fuse holder on the power entry module on the back of the controller. To remove the fuse holder first unplug the power cord from the power entry module. Press down on the lever that is located just above the fuse holder and below the power receptacle and pry the holder straight out of the power entry module.

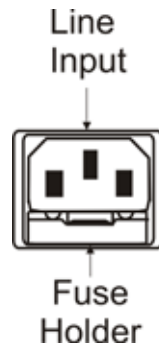


Figure 4-1. Power entry module and fuse location on the rear panel of the Lambda HPX-L5 controller.

The fuse holder holds two fuses. Both fuses are of the same type and rating. If either fuse is blown, it is recommended that both fuses be replaced.

The type and rating of both fuses are as follows:

**5 x 20 mm glass tube, Time Delay (IEC 60127-2, Sheet III)
T2A, 250V
(Examples: Bussmann GDC-2A, GMC-2A or S506-2-R (RoHS); or
Littelfuse 218 200 or 218 200P (RoHS))**

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APPENDIX D. TECHNICAL SPECIFICATIONS



Shuttering:

Turn on time: $10 \mu s$

Turn off Time $10 \mu s$

PWM frequency: 28 KHz

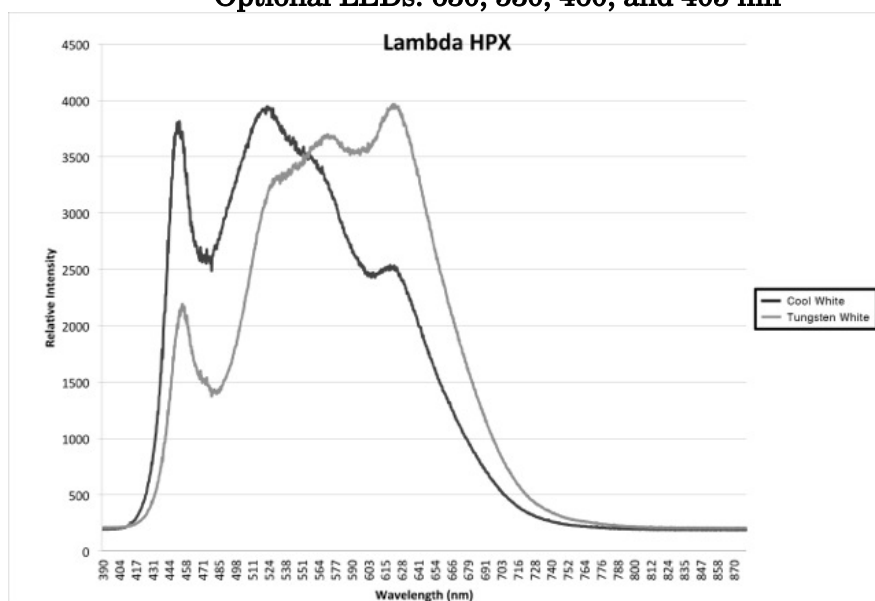
Light Output: 400 – 700 nm (white light)

Lamp life: >25,000 hours at 80% original output

Input / Output: TTL and analog

Dimming: PWM or Current Control

LED Wavelength: Cool white
Optional LEDs: 630, 530, 460, and 405 nm



Electrical:

Input (Mains) 100 - 240 VAC, 50/60 Hz .

Maximum power consumption: 150W

Mains fuses T2.0A, 250V, 5 x 20mm, Time Delay fuse (EIC 60127-2)

(E.g., Bussmann GDC S506-2-R or S506-2A
(RoHS))

Other:

Dimensions

Controller 12.25 x 9 x 5.25 in (311 x 229 x 133 mm)

Head (attaches to scope) 2.5 x 3 in (64 x 76 x 127 mm)

**Length of cabling between
Head and Control Box** 4 ft (1.2 m)

Weight

Controller 8.8 lb (4 kg)

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NOTES