LS-450 Series Blue LED Pulsed Light Sources

The LS-450 Series Blue LED Pulsed Light Sources are compact, low-cost light-emitting diodes that produce pulsed or continuous spectral output at 470 nm – the blue region – for high-sensitivity emission fluorescence measurements.

The LS-450 light source can be combined with other sampling optics for a variety of fluorescence applications.

The LS-450 series consists of the following light sources:

- LS-450 (stand-alone version)
- R-LS-450 (rack-mount version)
- R-LS-450-2 (rack-mount version with 2 LEDs)
- USB-LS-450 (connects directly to USB spectrometers, documented separately)

LS-450 Stand-alone Version

Included Materials

- LS-450 light source
- DB-15 accessory cable
- Power supply

Connecting the LS-450

To connect the LS-450, follow the steps below:

1. Plug the wall transformer into a standard 110V outlet.
2. Connect the power cord to the power input on the LS-450.
3. Connect an optical fiber to the SMA 905 connector on the LS-450.
4. Connect the other end of the optical fiber to the SMA 905 connector on your spectrometer or sampling device.

LS-450 Blue LED Pulsed Light Source - Stand-alone Version

Operation

To use the LS-450, connect the light source by following the instructions above, then proceed:

Using Continuous Mode

To operate the LS-450 in Continuous mode, follow the steps below:

1. Move the switch on the back of the LS-450 to the "contin" setting. This means that the light coming out of the LS-450 is continuous.
2. Move the switch on the back of the LS-450 to the "off" setting to turn the lamp off.

Using Pulsed Mode

To operate the LS-450 in Pulsed mode, follow the steps below:

1. Connect one end of the DB-15 accessory connector to the back of the LS-450.

2. Connect the other end of the DB-15 accessory connector to the 15-pin connector or adapter on your spectrometer. For more information, see the *Pulsed Mode Connection Guide* section later in this document.

3. Move the switch on the back of the LS-450 to the "pulsed" setting to enable pulsed mode operation.

4. Configure Pulsed mode for your spectrometer. See the Pulsed Mode Connection Guide section later in this document for more information.

5. Set the integration time in the OOIBase32 software so that a constant number of flashes occur for every integration cycle. If you are using the S2000 spectrometer, you will need to set the integration time to ensure a constant number of flashes per integration cycle. See the *Pulsed Mode Connection Guide* section later in this document for a configuration table for the S2000 spectrometer.

   See the *OOIBase32 Spectrometer Operating Software Online Help System* for more information on setting the integration time.

Note:	USB-based spectrometers automatically flash the lamp once per millisecond. Thus, there are always a constant number of flashes regardless of the integration time configured.

Pulsed Mode Connection Guide

Follow the instructions below for your specific spectrometer to configure Pulsed mode on the LS-450:

S2000

1. Open the S2000 spectrometer housing and remove the spectrometer from the housing. Do not tamper with the optical bench.

Note:	If you have more than one channel in your system, you may have to disconnect the channels from one another. The master spectrometer is always on the bottom of a multiple channel system.

2. Locate Jumper Block 3 (labeled JP3) on the green circuit board. This jumper block consists of 10 pins, which are labeled by rows (/16, /14, /12, /10, and 2).

3. Attach the jumper to the appropriate pins to configure the number of pulses per second for your A/D converter. The table below illustrates the possible number of pulses per second for each A/D converter:

S2000 JP3 Pin Row	ADC2000-PCI Frequency (Hz)	ADC1000 Frequency (Hz)
/16	30.4	15.2
/14	120	60.8
/12	488	244.0
/10	1952	976.0
2	Controlled by flash delay in software	

(Continued)

4. Ensure that there are a constant number of flashes for every integration time by adjusting the integration time in OOIBase to a figure in the table below.

S2000 JP3 Pin Row	ADC2000-PCI Acceptable Int. Times	ADC1000 Acceptable Int. Times
/16	32	64
/14	8	16
/12	2	4
/10	2	4
2	Integration time must be a multiple of flash delay	

USB2000

1. Obtain and connect the USB-ADP-PX2 serial adapter to the 10-pin accessory connector on the USB2000 spectrometer.

2. Follow the instructions in the Using Pulse Mode section to connect the LS-450 to the spectrometer, connecting the DB-15 to the USB-ADP-PX2.

3. Open OOIBase32 and configure the desired integration time.

4. Select the Strobe/Lamp Enable check box on the Acquisition Parameters toolbar.

When the Strobe/Lamp Enable option is selected in OOIBase, the USB2000 spectrometer will pulse the lamp at 1 msec intervals, ensuring a consistent pulse rate regardless of the configured integration time.

HR2000

1. Obtain and connect the USB-ADP-PX2 serial adapter to the 10 pins on the right side of the 20-pin accessory connector on the HR2000 spectrometer.

20	18	16	14	12	10	8	6	4	2
19	17	15	13	11	9	7	5	3	1

Pinout Diagram of 20-pin Connector on HR2000 Spectrometer

Note: It is important that you connect the serial adapter to the correct side of the HR2000. Pulsed mode will not function unless this connection is accurate.

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2. Follow the instructions in the Using Pulse Mode section to connect the LS-450 to the spectrometer, connecting the DB-15 to the USB-ADP-PX2.

3. Open OOIBase32 and configure the desired integration time.

4. Select the Strobe/Lamp Enable check box on the Acquisition Parameters toolbar.

When the Strobe/Lamp Enable option is selected in OOIBase, the HR2000 spectrometer will pulse the lamp at 1 msec intervals, ensuring a consistent pulse rate regardless of the configured integration time.

R-LS-450 Rack-mount Blue LED Pulsed Light Sources

The R-LS-450 Blue LED Pulsed Light Source is the rack-mount version of the LS-450. You can configure the R-LS-450 to operate in continuous wave mode via manual operation as well as through the software. You can also configure the R-LS-450 to operate in pulsed mode through manual operation and through the software.

Ocean Optics ships the R-LS-450 with following jumper configuration:

- Jumper over pins in JP1
- Jumper over manual pins in JP3
- Jumper over 2^{10} pins in JP2 (fastest pulse rate available)

To modify these jumper settings, consult the Operation section that follows.

R-LS-450-2 Dual Rack-mount Blue LED Pulsed Light Source

Operation

You can configure the lamp using a switch and three jumper blocks on the circuit board of the R-LS-450 and, if applicable, one jumper block on the S2000 spectrometer. The following section details the variety of configurations available with the R-LS-450. You need to determine the best mode of operation for your setup and configure your system appropriately.

S1 Switch

The S1 switch is a three-position switch on the R-LS-450. The switch can be moved into the following positions:

- Continuous wave operation
- Off
- Pulsed operation

Note: If you are using a USB-based spectrometer, instructions specifically for the S2000 spectrometer will not apply.
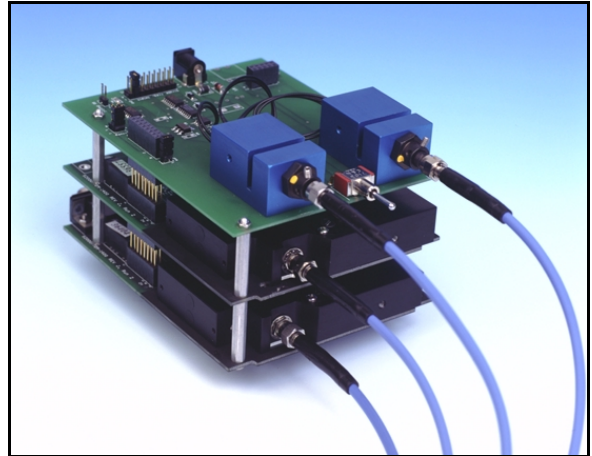
Jumper Block 1 (JP1)

JP1 consists of only one set of pins. If you configure other jumper blocks correctly, a jumper over JP1 allows you to turn the R-LS-450 on and off via the Strobe Enable/Disable feature in OOIBase32. This feature is only available with a "J" or later version of the S2000 spectrometer (USB-based spectrometers have a fixed pulse rate of 1 ms).

Note: To find out if you have a J-series or later S2000, look at the third character in your S2000 serial number.

Jumper Block 2 (JP2)

JP2 consists of nine sets of pins. You can configure the number of pulses per seconds by changing which pins are jumped in JP2. However, pulses per second are also dependent on the master frequency of the A/D converter you are using.

The table on the following page contains information on the function of each set of pins in JP2.

- Jumping the CW pins makes the R-LS-450 operate continuously. This means that there is no pulsing of the light source. Other jumper blocks must be configured correctly for this setting to work properly.

- Jumping sets 2^{16}, 2^{15}, 2^{14}, 2^{13}, 2^{12}, 2^{11}, and 2^{10} controls the pulse rate per second of the R-LS-450, depending on the A/D converter you are using to interface to the spectrometer (see the table below for pulse rates).

- Jumping the CS pins controls the pulse rate via the spectrometer's Continuous Strobe Setting in OOIBase32 software (see the *Using JP3 on the S2000* section that follows for more information).

Pins on JP2	Function	ADC1000 Frequency (Hz)	ADC2000-PCI Frequency (Hz)
CW	Continuous mode	0	0
2^{16}	Divide by 2^{16}	15.2	30.4
2^{15}	Divide by 2^{15}	30.4	60.8
2^{14}	Divide by 2^{14}	60.8	122.0
2^{13}	Divide by 2^{13}	122.0	244.0
2^{12}	Divide by 2^{12}	244.0	488.0
2^{11}	Divide by 2^{11}	488.0	976.0
2^{10}	Divide by 2^{10}	976.0	1952.0
CS	Continuous Strobe	Software Controlled	Software Controlled

Jumper Block 3 (JP3)

JP3 consists of two sets of pins. The jumper position determines the source of power control (manual or remote) for the R-LS-450. Jumping the Remote pins allows you to control the R-LS-450 through the software (if other jumper blocks are configured correctly).

R-LS-450 Operation Matrix

The following operation matrix will help you determine which jumper settings you require:

S1 Switch	JP1	JP3	LED Status
Off	No jumper	No jumper	Off
CW	No jumper	No jumper	Continuously on
CW	Jumpered	Jumper Remote pins	Continuous wave mode controlled by software (See the *Continuous Wave Mode with the S2000's JP3* section for more information)
CW	Jumpered	Jumper Manual pins	Continuously on
Pulsed	No jumper	No jumper	Pulse rate determined by JP2 on the R-LS-450 board (See the JP2 table for pulse rates)
Pulsed	Jumpered	Jumper Remote pins	Pulse mode controlled by software (See the *Pulsed Mode with the S2000's JP3* section for more information)
Pulsed	Jumpered	Jumper Manual pins	Pulse rate determined by JP2 on the R-LS-450 board (See the JP2 table for pulse rates)

Using Jumper Block 3 (JP3) on the S2000

You can also configure functionality on the R-LS-450 through JP3 on the S2000 circuit board (if you are using the S2000 spectrometer). JP3 on the S2000 spectrometer allows you to control the R-LS-450 through the OOIBase32 software.

Continuous Wave Mode with JP3 on the S2000

You can turn the lamp of the R-LS-450 on and off (using JP3 of the S2000) while the unit is in continuous wave mode using the Strobe Enable function in OOIBase32 ONLY if the following conditions are met:

- The switch is turned to continuous wave mode
- The pins in JP1 on the R-LS-450 are jumpered
- The CW pins in JP2 of the R-LS-450 are jumpered
- The Remote pins in JP3 of the R-LS-450 are jumpered
- The two pins in JP3 of the S2000 spectrometer are jumpered

Pulsed Mode with JP3 on the S2000

You can control the pulses per second of the R-LS-450 (using JP3 of the S2000) ONLY if the following conditions are met:

- The switch is turned to pulsed mode
- The pins in JP1 of the R-LS-450 are jumpered
- The CS pins in JP2 of the R-LS-450 are jumpered
- The Remote pins in JP3 of the R-LS-450 are jumpered
- The pins labeled /16, /14, /12, or /10 (depending on the pulse rate you need) in JP3 of the S2000 spectrometer are jumpered.

The pulses per second are also dependent upon the frequency of your A/D converter. See the table below for options.

S2000 JP3 Pin Row	ADC2000-PCI Frequency (Hz)	ADC1000 Frequency (Hz)
/16	30.4	15.2
/14	120	60.8
/12	488	244.0
/10	1952	976.0
2	Controlled by flash delay in software	

You can control the pulses per second of the R-LS-450 through the Flash Delay function in the OOIBase32 software if the following conditions are met:

- The switch is turned to Pulse mode
- The pins in JP1 on the R-LS-450 are jumpered
- The CS pins in JP2 on the R-LS-450 are jumpered
- The Remote pins in JP3 on the R-LS-450 are jumpered
- The pins labeled "2" in JP3 on the S2000 spectrometer are jumpered

Setting the Integration Time with the R-LS-450 and the S2000

When using any of the pulsed modes and the R-LS-450, you must ensure that a constant number of flashes occur for every integration cycle to ensure a continuous and stable signal. Set the integration time in the OOIBase32 software.

To achieve a constant number of flashes per integration cycle, the integration time you select must be a multiple of the times shown in the table below (depending on the A/D converter you are using).

S2000 JP3 Pin Row	ADC2000-PCI Acceptable Int. Times	ADC1000 Acceptable Int. Times
/16	32	64
/14	8	16
/12	2	4
/10	2	4
2	Integration time must be a multiple of flash delay	

Note: USB-based spectrometers automatically flash the lamp once per millisecond. Thus, there are always a constant number of flashes regardless of the integration time configured.

R-LS-450-2 Users

The instructions for controlling the R-LS-450-2 are exactly the same as those for the R-LS-450. The R-LS-450-2 has two LEDs, and the jumper configurations described in this manual will control both bulbs simultaneously. There is no way to control each bulb individually.

USB-LS-450 Blue LED Pulsed Light Source

Functionally similar to the LS-450, the USB-LS-450 attaches directly to the 10-pin accessory connector of the USB2000 Spectrometer. Its small-footprint design combines with the portability of the USB2000 to form a complete, self-contained light source and spectrometer combination.

The USB-LS-450 features the following design innovations:

Simplified LED-Spectrometer Interface – USB-LS-450 connects to the USB2000 Spectrometer, which connects directly to the USB port of any desktop or notebook PC.

Small Footprint – USB-LS-450 and spectrometer combination is about the size of a deck and a half of playing cards.

On-board Memory for O2 Measurements – FOXY Fiber Optic Oxygen Sensor users can conveniently store oxygen and temperature calibration coefficients.

No External Power Requirements – Spectrometer and USB-LS-450 draw power from the host PC.

Temperature Probe Connectivity – 4-pin connector on the side of the USB-LS-450 allows quick interface of the USB-LS-450-TP Temperature Probe used in the FOXY line of fiber optic oxygen sensors.

USB-LS-450 (bottom) connected to the USB2000 Spectrometer

USB-LS-450 Included Materials

- USB-LS-450 Blue LED Pulsed Light Source
- Allen wrench (to adjust collimating lens)

USB-LS-450 Setup

Follow the steps below to install the USB-LS-450:

1. Align the male 10-pin accessory input on the USB-LS-450 with the 10-pin accessory connector on the USB2000 Spectrometer.

2. Secure the USB2000 and the USB-LS-450 together by firmly interfacing the 10-pin accessory connectors.

3. Insert the silver thumbscrew through the interface plate of the USB-LS-450 and tighten the thumbscrew to secure the USB-LS-450 and the USB2000 together.

USB-LS-450 Specifications

USB-LS-450 LED Specifications

Item	Specification
Power output:	Minimum of 60 µW into a 600 µm optical fiber
LED drive current:	20 mA +/- 0.15 mA
Maximum modulation frequency:	1 kHz
0.5% stability time:	Less than 1 minute
Temperature-dependent drift:	+0.1%/°C

Temperature Measurement Specifications

Item	Specification
Precision:	Better than 0.1 °C
Accuracy:	Better than 0.5 °C
Maximum Data Rate:	15 samples per second

Power Specifications

| Item	Specification
Input voltage range:	3.0 to 8.0 volts
Quiescent range:	~20 mA
Current with lamp on:	~20 mA

USB-LS-450 Pin and Interface Information

The USB-LS-450 features a 10-pin accessory input (for the USB2000) and a 4-pin accessory connector (for the USB-LS-450-TP).

10-pin Accessory Input

The 10-pin accessory Input on the USB-LS-450 provides unaltered connections to the 10-pin accessory connector on the USB2000 Spectrometer. Use this connector to configure external triggering options on the USB2000 when the USB-LS-450 is connected to the spectrometer. Consult the External Triggering Options document at http://www.oceanoptics.com/technical/externaltriggering.pdf for more information on specific pin information on the USB2000.

Note: If you have the 4/20mA (USB-LS450-4/20) output option, the 4-20mA signal transmits on pin 8 of the 10-pin accessory input. The ground transmits on pin 6.
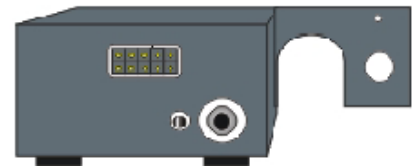
*Front view of the USB-LS-450 with 10-pin accessory input*

Pinout diagram of the 10-pin connector on the USB2000

4-pin USB-LS-450-TP Connector

The 4-pin USB-LS-450-TP connector is located on the side of the USB-LS-450. It is a round connector approximately 1 cm in diameter. The USB-LS-450-TP Temperature Probe plugs directly into this connector.

Consult the Fiber Optic Sensors Manual for more information on the USB-LS-450-TP.
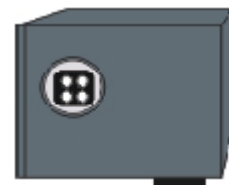
Side view of the USB-LS-450 with 4-pin USB-LS-450-TP connector

LS-450 Series Technical Specifications

Lamp Specifications

	LS-450, R-LS-450, R-LS-450-2	**USB-LS-450**
Physical dimensions:	90 mm x 50 mm x 32 mm (LS-450 only)	89 mm x 102 mm x 38 mm
Power consumption:	25 mA @ 12 VDC	60 mA @ 5 VDC
Power output (minimum):	50 µW into 600 µm fiber	60 µW into 600 µm fiber
Stability:	<1.0% after 2-minute warm-up	<1.0% after 2-minute warm-up
LED drive current:	20 mA, 5 mA switchable	20 mA +/-0.15 mA

Absolute Spectral Output for LS-450 Blue LED Bulbs
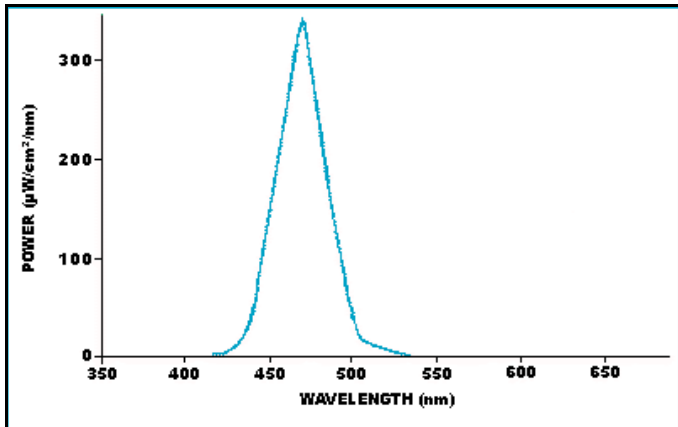
Pinout Information

The following graphic and table illustrate the pinout information for the LS-450 light source:
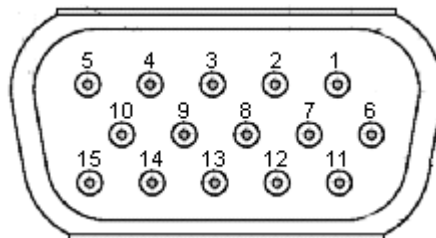
15-pin connector on LS-450

Pin Number	Description
2	Continuous strobe
10	Ground

This information applies only to the LS-450 model.

Bulb Replacement for LS-450 Series Light Sources

The LS-450 and R-LS-450 light sources come with a standard LED that emits blue light at approximately 450-470 nm (see Absolute Spectral Output graphic above). However, the LS-450 and R-LS-450 can accommodate LEDs of different wavelengths, which are sold as accessories to the units.

Note: This section is not applicable to the USB-LS-450.

The LED is mounted in a silver reflector barrel, which allows easy insertion into and removal from the optical housing of the LS-450 and R-LS-450. The reflector barrel also optimizes any stray LED light, resulting in increased signal strength. Thus, you should never remove the LED from the reflector barrel.

To change the LED on the LS-450 and R-LS-450, you will need the following tools:

- 3/32 Allen wrench (LS-450 only)
- 1/20 Allen wrench

Changing a Bulb in the LS-450

To change the bulb in the LS-450, follow the steps below:

1. Ensure that the unit is off and that power is disconnected from the LS-450.

2. Use the 1/20 Allen wrench to loosen the small setscrew located on the bottom of the unit (between the set of "fins" that protrude from the sides of the unit). If you remove the screw fully, place it in a safe place until you replace it later in this procedure.

3. Use the 3/32 Allen wrench to remove the two screws on the bottom right and left corners of the rear end of the LS-450. This allows the LS-450 to be separated into two pieces. Place these screws in a safe area.

4. Pull the two halves apart gently until they are approximately 1.5" apart. This should expose two thin black wires that are holding the unit together. These wires connect to a small socket on the LED (located in the front half of the unit).

5. Slide the LED barrel out of the front portion of the LS-450. If the unit does not slide out easily, you will need to further loosen the setscrew (see Step 2).

6. Remove the blue filter, seated directly in front of the blue LED. Place the filter to the side. You will only need this filter when using the blue LED.

7. Unplug the blue LED from the connection socket. Remove the socket by gently pulling the insulated black wire back from the rear of the barrel. The socket should unplug easily

   Note: If you want to reinsert the default blue LED in the future, identify the original LED orientation with a small amount of liquid paper.

8. Seat the socket of the replacement LED firmly into the rear of the barrel (where the anode and cathode lead pins are located). The orientation of the LED should be marked with a white dot on the side of the barrel (cathode side) OR by differing pin lengths (the short pin is the cathode side of the LED).

9. Place the new LED barrel back into the optical housing of the LS-450 and tighten the setscrew on the bottom (loosened in Step 2) so that the barrel is firmly set in the housing.

10. Reattach the two sides of the LS-450 together and replace the two screws you removed in Step 3. Ensure that the black socket wires do not stray out of the LS-450 enclosure when you reconnect the unit.

11. Plug the unit into the 12 V power supply and turn the unit on. If the new LED does not illuminate when the switch is in the On position, consult the troubleshooting tips at the end of this section.

Changing a Bulb in the R-LS-450

To change the bulb in the R-LS-450, follow the steps below:

1. Ensure that the unit is off and that power is disconnected from the R-LS-450.

2. Use the 1/20 Allen wrench to loosen the small setscrew located on the side of the blue optical housing. If you remove the screw fully, place it in a safe place until you replace it later in this procedure.

   The LED and barrel are housed within the blue optical housing. This housing also contains the SMA fiber connection. There are two thin black wires connected to a socket, which is in turn plugged in to the rear end of the LED barrel.

3. Slide the LED barrel out of the blue optical housing. The barrel should slide easily. If it does not, you will need to further loosen the setscrew (Step 2) and retry.

4. Remove the blue filter, seated directly in front of the blue LED. Place the filter to the side. You will only need this filter when using the blue LED.

5. Unplug the blue LED from the connection socket. Remove the socket by gently pulling the insulated black wire back from the rear of the barrel. The socket should unplug easily

Note:	If you want to reinsert the default blue LED in the future, identify the original LED orientation with a small amount of liquid paper.

6. Seat the socket of the replacement LED firmly into the rear of the barrel (where the anode and cathode lead pins are located). The orientation of the LED should be marked with a white dot on the side of the barrel (cathode side) OR by differing pin lengths (the short pin is the cathode side of the LED).

   There is also a diagram of the LED on the circuit board of the R-LS-450, which illustrates the socket orientation relative to the LED. This diagram is located next to where the two black wires connect to the circuit board.

7. Return the LED barrel back into the blue optical housing of the R-LS-450.

8. Push the barrel all the way into the blue optical housing and tighten the setscrew on the side (loosened in Step 2) so that the barrel is firmly set in the housing.

9. Plug the unit into the 12 V power supply and turn the unit on. If the LED illuminates, installation was successful. Return the R-LS-450 to the original rack unit.

   If the new LED does not illuminate when the switch is in the On position, consult the troubleshooting tips at the end of this section.

Troubleshooting

If the replacement LED does not illuminate when the switch is in the On position, check the following items:

- Is the power supply in use correct? The light sources require a 12 V power supply with a 2.1mm center-positive jack.

- Is the power supply plugged into an outlet that is enabled and standard for the power supply you are using?

- Is the LED in the correct orientation in respect to the socket (Anode and Cathode)?

If these items are correct and the light source is not emitting light at the proper wavelength (or at all), please contact Ocean Optics Technical Support at **techsupport@oceanoptics.com** or at (727) 733-2447.