Light Sources

Overview: Light Sources

Sources for Illumination, Excitation, Calibration

The development of Ocean Optics miniature fiber optic spectrometers created the need for comparably sized and priced accessories, including light sources. Since no such sources existed, we developed our own -- compact, modular sources complemented by the best bulbs for spectroscopy that our vendor partners can provide.

Sources for illumination cover various wavelength ranges to enable absorbance, reflectance and fluorescence measurements from the deep UV to the NIR. Compact light-emitting diodes produce output for fluorescence measurements. For fast, reliable spectrometer wavelength calibrations, we offer Mercury and Argon sources. Design features such as built-in filter slots, combined with optional accessories such as direct-attach cuvette holders, make sampling simple.

Ocean Optics Modular Light Source Options

Deuterium Light Sources: Used most often for UV absorbance and reflectance measurements.

Combination Deuterium and Tungsten Light Sources: Used as single illumination sources for measurements across broad wavelength ranges.

Pulsed Xenon Lamps: Used as long-life sources for absorbance, reflectance and fluorescence measurements, and for measuring optically or thermally labile samples.

Calibrated Light Sources: Used to calibrate the absolute spectral intensity of a system in irradiance applications.

Tungsten Halogen Light Sources: Used most often as standard VIS-NIR light sources for absorbance, reflectance of solid objects, and color measurement.

Light-emitting Diodes: Used as excitation sources for fluorescence. Feature minimal warm-up and high stability. Power is lower and spectral width is wider than with lasers.

Wavelength Calibration Sources: Used to calibrate the wavelength of spectrophotometric systems. The mercury argon source is for UV-NIR and the argon source is for VIS-NIR.

Type	Product	Wavelength Range	Output	Measurement Type	Page
Deuterium Tungsten Halogen	DH2000-BAL DH2000	~230-2000 nm	Continuous	Absorbance, Reflectance, Fluorescence, Transmission	122 123
Miniature Deuterium Tungsten Halogen	DT-MINI-2 DT-MINI DT-MINI-2-GS USB-DT	~200-2000 nm	Continuous	Absorbance, Transmission, Reflectance	125 125 125 124
Deuterium	D2000	~215-400 nm	Continuous	Absorbance, Reflectance, Fluorescence, Transmission	126
Xenon	PX-2 HPX-2000	220-750 nm 185-2000 nm	Pulsed Continuous	Absorbance, Reflectance, Fluorescence, Transmission	127
LEDs	LEDs (several wavelengths)	380, 395, 470, 475, 518, 590, 640 and 450-630 nm	Pulsed or Continuous	Fluorescence	130-131
Tungsten Halogen	LS-1 HL-2000	360-2000 nm 360-2000 nm	Continuous	Absorbance, Reflectance, Transmission	128 129
Calibrated Deuterium Tungsten Halogen	DH2000-CAL	~220-1050 nm	Continuous	Calibration (Radiometric)	132
Calibrated Tungsten Halogen	LS-1-CAL HL-2000-CAL	300-1050 nm 300-1050 nm	Continuous	Calibration (Radiometric)	133
Mercury Argon	HG-1 CAL-2000	253-1700 nm 253-1700 nm	Continuous	Calibration (Wavelength)	134
Argon	AR-1	700-1700 nm	Continuous	Calibration (Wavelength)	135

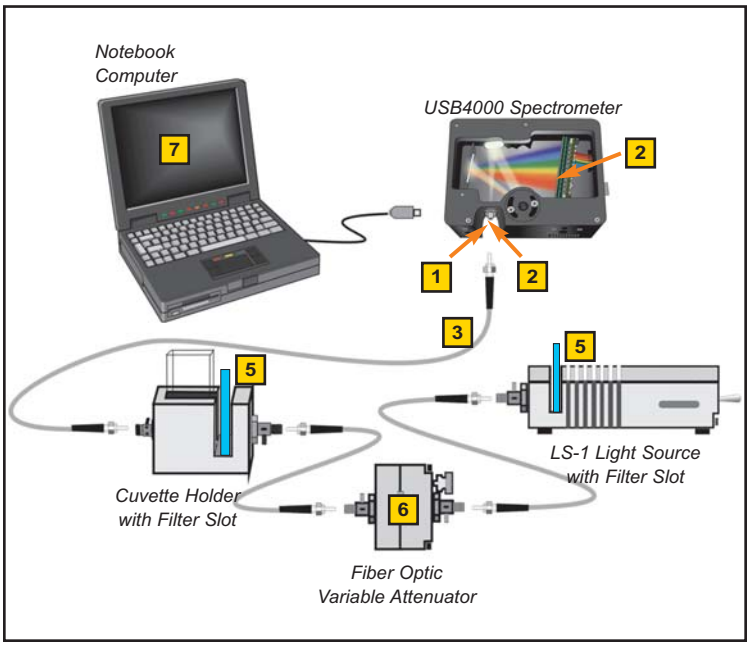
Overview: Light Sources

Ways to Modify Light

Our products provide you with many options for modifying the light transmitted to the spectrometer's detector. The illustration here is a fabricated configuration -- as few would have a setup exactly like it -- to demonstrate several ways in which you can modify light.

For high-intensity light-level applications such as laser characterization, more light will reach the spectrometer than likely can be detected successfully by the high-sensitivity CCD-array detector used in most of our spectrometers. Also, some absorbance experiments may require signal attenuation; too much light can saturate the reference measurement.

In some instances, saturation is avoided by using a different grating, changing the optical bench entrance aperture or adding neutral-density filters to the optical path. Another option is to adjust (via software) the spectrometer integration time to limit the interval during which the detector collects light.



1 Entrance Aperture: Slit

An installed slit acts as the entrance aperture to the optical bench and regulates the amount of light entering the optical bench. The slit size is specified by the user. Slits are optional, and range in size from 5 µm to 200 µm.

2 Installed Filters

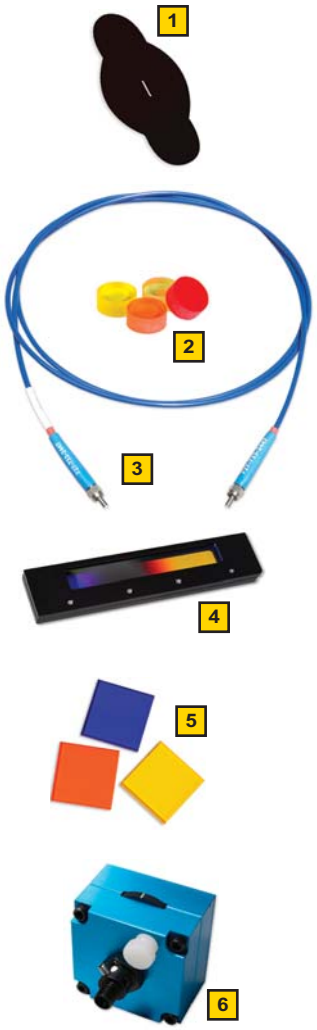
In addition to the variable longpass OFLV Filter -- an order-sorting filter applied to the detector's window -- we offer optional bandpass and longpass blocking filters to restrict radiation in certain wavelength regions.

3 Optical Fiber

Our optical fibers are available from 8 µm to 1000 µm in diameter. If you need a great deal of light for your application, you should select a large-diameter fiber. Also, in the absence of a slit, the fiber connected to the spectrometer acts as the optical bench entrance aperture.

4 Linear Variable Filters

Our high-pass, low-pass and adjustable-bandpass filters have excellent blocking characteristics and resistance to heat, making these filters ideal for spectrally shaping the light emitted from broadband sources.



5 Loose Filters

Our loose filters fit into our light sources, cuvette holders and in-line filter holders. High-pass Filters eliminate second- and third-order effects, test for stray light, and block excitation energy. Balancing Filters absorb energy in some regions while transmitting in others. Bandpass Filters pass energy in one region and block light above and below that region.

6 Fiber Optic Variable Attenuator

The FVA-UV Fiber Optic Variable Attenuator is an opto-mechanical device that helps control the amount of light transmitted between two fibers. The FVA-UV attenuates light uniformly at all wavelengths from the ultraviolet through the near-infrared.

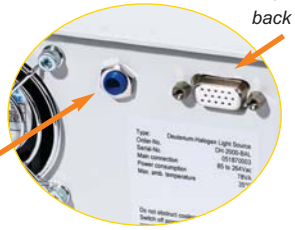
7 Integration Time

Integration Time is a setting in our software and is specified by the user. The integration time of the spectrometer is analogous to the shutter speed of a camera. The higher the value specified for the integration time, the longer the detector "looks" at the incoming photons. For more information about integration time, see any of our software manuals.

Balanced Deuterium Tungsten Source

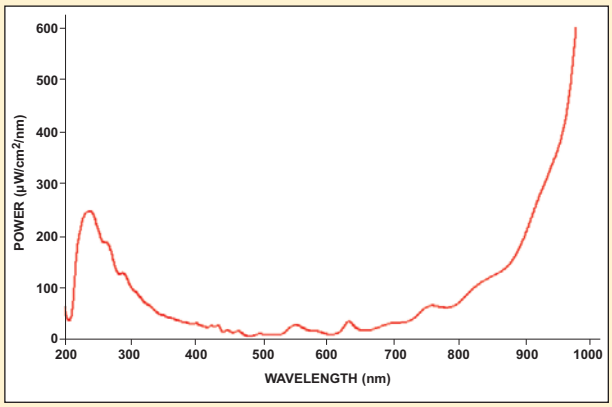
You can operate the shutter via a switch on the front of the light source . . .

. . . or via a TTL line from the back of the lamp.



Here, you can adjust the power for the tungsten bulb.

DH2000-BAL Spectral Output



Specifications	
Dimensions:	150 mm x 135 mm x 319 mm
Weight:	3.8 kg
Wavelength range:	230-400 nm (deuterium); 360-2000 nm (tungsten halogen)
Power consumption:	25 W (deuterium); 20 W (tungsten halogen); 190 W maximum
Power requirements:	85-264 V 50/60 Hz
Voltage:	Ignition 350 V/20°; tungsten bulb voltage is adjustable from 4.5 to 11.5 volts
Current:	Operating 85 V/0.3A
Stability:	<5 x 10^{-6} peak-to-peak (0.1-10.0 Hz)
Drift:	<0.01% per hour
Time to stable output:	20 minutes
Bulb life:	1,000 hours
Operating temperature:	5 °C - 35 °C
Humidity:	5-95% non-condensing at 40 °C
Electronic certifications:	CE; VDI/VDE 0160; EN 61010

UV-NIR Spectral Range with Balanced Output

We've applied our expertise in patterned dichroic filters to an innovation in light source technology to create the only combined-spectrum illumination source available that eliminates saturation and signal-to-noise problems associated with the D-alpha line in the deuterium source. The DH2000-BAL Deuterium Tungsten Halogen Light Source combines deuterium and tungsten halogen light sources in a single optical path, producing a powerful, stable output from 230-2000 nm.

About the D-alpha Line

All deuterium sources have a D-alpha line, revealed as a sharp peak in the visible portion of the spectrum, that produces "unbalanced" output in the deuterium and tungsten halogen sources. Correcting for this peak -- a sharp spectral feature near 655 nm -- is difficult. For example, if you adjust spectrometer integration time to reduce the intensity of this saturated peak, the efficiency of the system at ultraviolet wavelengths drops significantly, compromising the signal-to-noise of the spectrum. Also, spectrometer efficiency is typically greatest in the same general spectral range as the 655 nm line, exaggerating its effects.

Proprietary Filtering Technology

Using the same high-precision patterned dichroic filter technology that distinguishes our Linear Variable Filters (page 114), the DH2000-BAL:

- balances the intensity of the deuterium and tungsten halogen sources
- eliminates the D-alpha, D-beta and Fulcher lines
- eliminates problems associated with saturation
- produces a "smoother" spectrum across the entire wavelength range.

Upgrading Existing DH2000s with Kits

If you own a DH2000 and would like to upgrade the light source with the filtering technology used in the DH2000-BAL, but don't wish to purchase a new light source, you can order a DH-BAL-KIT (at left) and install the upgrade yourself.

For those owning a DH2000-S shuttered version of the lamp, specify the DH-BAL-KIT-S.

Optical Fibers

We recommend using our solarization-resistant optical fibers with the DH2000-BAL. See page 146 for details.

DH2000-BAL:	$3,588
DH-BAL-KIT:	$1,761
DH-BAL-KIT-S:	$1,761

Deuterium Tungsten Halogen Sources

UV-NIR Spectral Range

The DH2000 Deuterium Tungsten Halogen Light Source combines the continuous spectrum of deuterium and tungsten halogen light sources in a single optical path. The combined-spectrum light source produces a powerful, stable output from 215-2000 nm. In addition, deep-UV versions of the DH2000 are available, with a 190-2000 nm range.

Options & Accessories: Shutter & Filter Holder

Integrated shutters are available and can be driven either by a switch or by a TTL signal. Another option is to include a filter holder with the source (see inset), which accepts filters up to four millimeters in thickness and as large as 25-mm square or 25-mm round in diameter. All versions of the DH2000 have an SMA 905 Connector for easy coupling to our spectrometers and accessories via optical fiber.

Adjustable Power

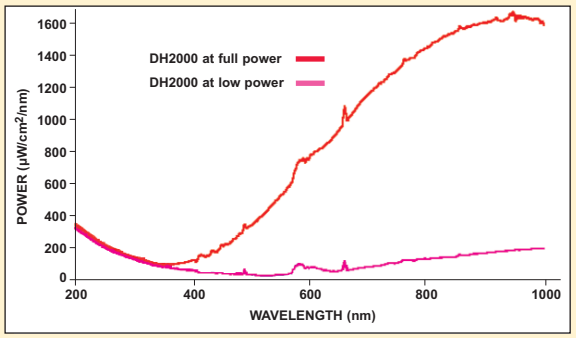
All versions of the DH2000 have a potentiometer on the back of the light source to adjust the intensity of the tungsten halogen output. This potentiometer allows you to adjust the optical power of the tungsten halogen light from 10-100%.

Optical Fibers

We recommend using our solarization-resistant optical fibers with all versions of the DH2000. See page 146 for details.

DH2000: $2,421

DH2000 Spectral Output



The spectral output of the DH2000 at full power is in red and the tungsten halogen bulb at low power is in pink.

Additional DH2000 Light Sources and Accessories

Item	Description	Price
DH2000-DUV	Uses a deep-UV deuterium bulb, which provides a 190-2000 nm wavelength range	$2,907
DH2000-S	Comes with a shutter controlled via a TTL signal or a manual switch up to 5 Hz	$3,049
DH2000-S-DUV	Uses a deep-UV deuterium bulb, which provides a 190-2000 nm wavelength range and comes with a shutter (controlled via a TTL signal or a manual switch up to 5 Hz)	$3,330
DH2000-FHS	Comes with a filter holder for filters up to 25-mm square or 25-mm round and 4-mm thick	$3,328
DH2000-FHS-DUV	Uses a deep-UV deuterium bulb, which provides a 190-2000 nm wavelength range; comes with a filter holder for filters up to 25-mm square or 25-mm round and 4-mm thick; and has a shutter controlled via TTL	$3,752
DH2000-S-DUV-TT	Uses a deep-UV deuterium bulb, which provides a 190-2000 nm wavelength range and comes with a shutter (controlled via an included external TTL line) for remote on/off of the deuterium and halogen bulbs	$3,755
DH2000-BH	Replacement tungsten halogen bulb for all versions of the DH2000	$158
DH2000-BD	Replacement deuterium bulb for DH2000, DH2000-S, DH2000-FHS	$649
DH2000-DUV-B	Deep-UV replacement deuterium bulb for DH2000-DUV, DH2000-S-DUV, DH2000-FHS-DUV	$775

Specifications

Dimensions:	150 mm x 135 mm x 319 mm	Stability:	<5 x 10^{-6} peak-to-peak (0.1-10.0 Hz)
Weight:	3.8 kg	Drift:	<0.01% per hour
Wavelength range:	190-2000 nm (deep-UV deuterium bulb & tungsten halogen bulb) or 215-2000 nm (standard deuterium bulb & tungsten halogen bulb)	Time to stable output:	20 minutes deuterium; 20 minutes tungsten halogen
		Bulb type:	Deuterium and tungsten halogen
		Bulb life:	1,000 hours
Power consumption:	25 W (deuterium); 20 W (tungsten halogen); 190 W maximum	Bulb aperture:	0.5 mm
Power requirements:	85-264 V 50/60 Hz	Operating temperature:	5 °C - 35 °C
Output:	100 W	Humidity:	5-95% without condensation at 40 °C
Voltage:	Ignition 350 V/20°; tungsten bulb adjustable 4.5-11.5 volts	Electronic certifications:	CE; VDI/VDE 0160; EN 61010
Current:	Operating 85 V/0.3A	Connector:	SMA 905

USB-DT Mini Deuterium Tungsten Source

Most Versatile Lamp We Offer

The USB-DT Deuterium Tungsten Light Source is our most versatile combination UV-VIS light source. There are several ways to use the USB-DT: as a stand-alone source, stacked atop the USB2000 or USB4000 Spectrometer via the USB-ADP-DT2 adapter, or connected to a spectrometer via a Breakout Box. Though the USB-DT can be stacked on top of the USB2000 or USB4000, it is not the kind of direct-attach source that eliminates fibers; the USB-DT requires fibers. This compact source is about the size of a deck of cards, provides stable, broadband output from 200-2000 nm, and requires a 5-volt wall transformer for power.

Software Control

When the USB-DT is stacked with the USB2000 or USB4000 or used with an HR2000+, HR4000 or QE65000 and the Breakout Box, you can control the following lamp functions through software:

- adjusting the intensity of the tungsten source
- activating the internal shutter to block the light path
- controlling on/off switch of each source independently
- utilizing a low-power shutdown mode
- saving settings in memory

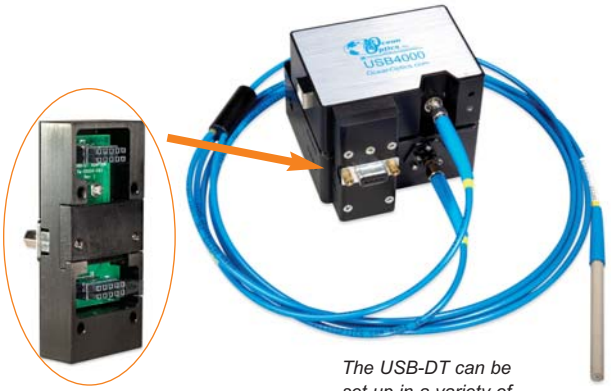
The USB-DT has a 15-pin connector for interfacing to the spectrometer.

Novel Deuterium Tungsten Halogen Sources

Our deuterium tungsten halogen sources combine the continuous spectrum of deuterium and tungsten halogen lamps in a single optical path. These combined-spectrum sources produce stable, continuous UV-VIS output that make them ideal for applications such as absorbance spectroscopy.

USB-DT:	$1,499
USB-DT-B Bulb:	$399
USB-ADP-DT2:	$75
HR4-BREAKOUT:	$199

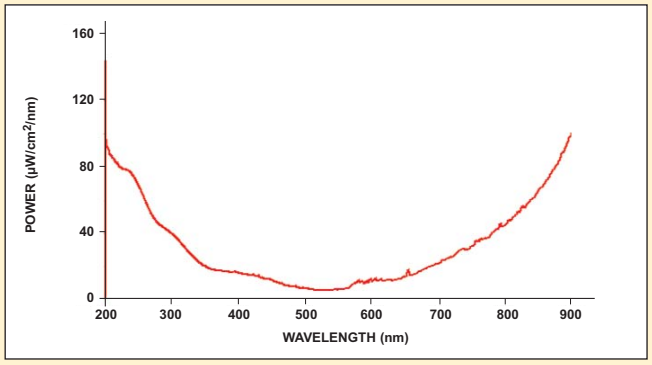
Spectrometer With USB-DT	Directly Stackable	Software Control of all USB-DT Functions
USB2000	Yes, with USB-ADP-DT2	Yes, when stacked atop the USB2000 with a USB-ADP-DT2
USB4000	Yes, with USB-ADP-DT2	Yes, when stacked atop the USB4000 with a USB-ADP-DT2
HR2000	No	No
HR2000+	No	Yes, when used with HR4-BREAKOUT
HR4000	No	Yes, when used with HR4-BREAKOUT
QE65000	No	Yes, when used with HR4-BREAKOUT



USB-ADP-DT2 Connector.

The USB-DT can be set up in a variety of ways. It can be stacked with the USB4000 via the USB-ADP-DT2 connector (above), or used as a stand-alone component with an Ocean Optics spectrometer.

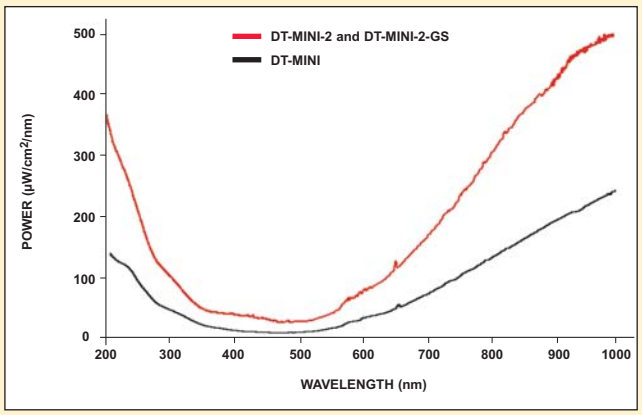
USB-DT Spectral Output



Specifications	
Dimensions:	81 mm x 90 mm x 37 mm
Weight:	260 g
Wavelength range:	200-2000 nm
Power consumption:	1.5 A @ 5 VDC
Output:	see Spectral Output graph at left
Stability:	0.5% peak-to-peak (after warm-up)
Time to stable output:	15 minutes
Bulb life:	800 hours for deuterium; 2,000 hours for tungsten
Connector:	SMA 905

Mini Deuterium Tungsten Sources

Spectral Output: DT-MINI-2 vs. DT-MINI



~200-2000 nm Spectral Range

Our DT-MINI-series Deuterium Tungsten Halogen Light Sources combine the continuous spectrum of a high-powered, RF-excited deuterium light source and a tungsten halogen light source in a single optical path. The combined-spectrum sources produce stable spectral output from ~200-2000, nm in a compact package.

0.5 mm Aperture: More Powerful Output

The original DT-MINI was our first foray into a compact and versatile UV-NIR light source, and is still a great choice for a range of applications and measurements. The advantage of the newer DT-MINI-2 is that it uses a bulb with a 0.5 mm diameter aperture, which results in more focused, uniform beam coupling to our optical fibers. Also, the DT-MINI-2 is only $100 more than the DT-MINI, which we will continue to offer.

Shutter Version

The DT-MINI-2-GS Deuterium Tungsten Halogen Light Source (lower left) also utilizes the bulb with the 0.5-mm diameter aperture. Its added feature is a shutter for blocking the light path, which can be controlled via a manual switch or TTL. There is also a switch for turning the deuterium source on and off, and one for turning the tungsten halogen source on and off (this can also be accomplished via TTL); each switch can be used independently of the other.

Rack-mount Version

Rack-mount versions of DT-MINI-series lamps are available. These sources can be hard-wired to a spectrometer channel and racked into a Dual Box, Rack Box or Desktop Box with other accessories. For more on rack-mount systems and enclosures, see page 62.

DT-MINI-2:	$1,499
DT-MINI-2-GS:	$1,754
DT-MINI:	$1,399
DT-MINI-2-B Bulb*:	$526
DT-MINI-B Bulb*:	$487

** The DT-MINI-2-B Bulb can only be used in the DT-MINI-2 and DT-MINI-2-GS sources. Likewise, the DT-MINI-B Bulb can only be used in the DT-MINI and DT-MINI-GS.*

Specifications

	DT-MINI-2	DT-MINI-2-GS
Dimensions:	153.4 mm x 104.9 mm x 40.9 mm	140 mm x 50 mm x 125 mm
Weight:	330 g	475 g
Wavelength range:	200-410 nm (deuterium); 360-2000 nm (tungsten halogen)	200-410 nm (deuterium); 360-2000 nm (tungsten halogen)
Power consumption:	350 mA @ 12 VDC	350 mA @ 12 VDC
Output:	3.8 watts (deuterium); 1.2 watts (tungsten halogen)	3.8 watts (deuterium); 1.2 watts (tungsten halogen)
Stability:	0.3% peak-to-peak (over 4 hours) after 30-minute warm-up	0.3% peak-to-peak (over 4 hours) after 30-minute warm-up
Time to stable output:	10 minutes (deuterium); 1 minute (tungsten halogen)	10 minutes (deuterium); 1 minute (tungsten halogen)
Bulb life:	~800 hours (deuterium); 2,000 hours (tungsten halogen)	~800 hours (deuterium); 2,000 hours (tungsten halogen)
Ignition delay:	<2.0 seconds (delay for cold start-up may be longer)	<2.0 seconds (delay for cold start-up may be longer)
Connector:	SMA 905	SMA 905

D2000 Deuterium Light Sources

UV Range + Great Performance

The D2000 Deuterium Light Source produces a powerful, stable output from 215-400 nm. A deep-UV version is available for wavelength coverage of 190-400 nm. The D2000 is an extremely stable source, with peak-to-peak stability of <0.005% and drift of only ±0.5% per hour.

Options & Accessories

All versions of the D2000 have an SMA 905 Connector for easy coupling to our spectrometers and fiber optic accessories, as well as safety goggles and a cover for blocking the light when the fiber is not attached. The 1,000-hour deuterium bulb used in the D2000 can be replaced easily.

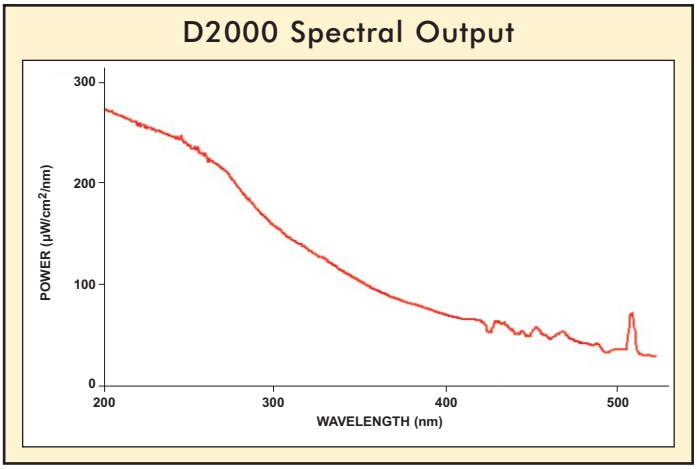
Shutter Option

The D2000 is available with an optional integrated shutter. You can operate the shutter via a manual switch on the front of the lamp. In addition, you can control the shutter electronically via software or a TTL signal from an output port on the back of the lamp.

Optical Fibers

We recommend using our solarization-resistant optical fibers with all versions of the D2000. See page 146 for details.

D2000: $2,003



Additional D2000 Light Sources and Accessories

Item	Description	Price
D2000-DUV	Uses a deep-UV deuterium bulb, which provides a 190-400 nm wavelength range	$2,475
D2000-S	Comes with a shutter (controlled via a TTL signal or switch)	$2,580
D2000-S-DUV	Uses a deep-UV deuterium bulb, which provides a 190-400 nm wavelength range, and comes with a shutter (controlled via a TTL signal or switch)	$2,873
DH2000-BD	Replacement deuterium bulb for the D2000 and the D2000-S	$649
DH2000-DUV-B	Replacement deuterium bulb for the D2000-DUV and the D2000-S-DUV	$775

Specifications

Dimensions:	150 mm x 135 mm x 319 mm	Voltage:	Ignition 350V/20°; operating 85 V/0.3A
Weight:	3.8 kg	Bulb life:	1,000 hours for standard or deep-UV bulb
Wavelength range:	215-400 nm (standard bulb); 190-400 nm (deep-UV bulb)	Bulb aperture:	Aperture 0.5 mm, numerical aperture 26°
Power consumption:	830 mA @ 230 VDC or 1660 mA @ 115 VDC	Operating temperature:	5 °C - 35 °C
Power requirements:	85-264 V 50/60 Hz	Humidity:	5-95% without condensation at 40 °C
Stability:	<0.005% at 250 nm peak-to-peak	Electronic certifications:	CE; VDI/VDE 0160; EN 61010
Drift:	±0.5% per hour at 250 nm	TTL-shutter input:	Up to 5 Hz maximum (shutter versions only)
Time to stable output:	20 minutes	Shutter speed:	10 millisecond minimum

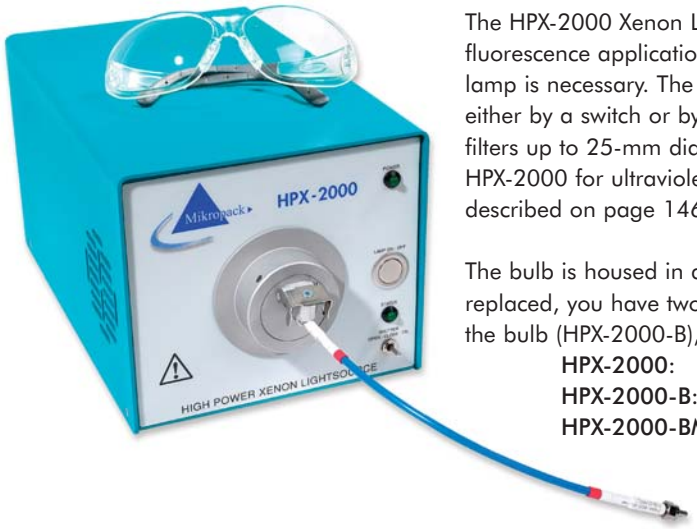
Xenon Pulsed & Continuous Sources

Pulsed & Continuous Xenon Light Source

The PX-2 Pulsed Xenon Lamp is a high flash rate, short-arc xenon lamp from 220-750 nm. The PX-2 is a great source for applications requiring absorbance, reflectance or fluorescence measurements, and is especially useful for measuring optically or thermally labile samples. The PX-2 is a low-power lamp with excellent pulse-to-pulse stability. It provides two trigger modes for software control of the flash rate. It comes with a regulated power supply and an interface cable to connect to the spectrometer.

PX-2: $769
PX-2-B Bulb: $379
USB-ADP-PX2: $50

High-powered Continuous-wave Xenon Source

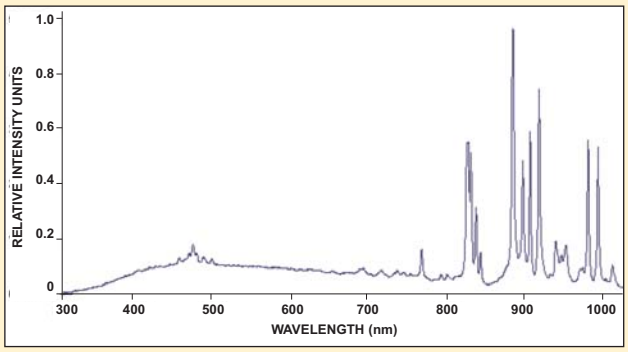


The HPX-2000 Xenon Light Source (185-2000 nm) is especially useful for fluorescence applications, and for other applications where a high-intensity lamp is necessary. The HPX-2000 has an integrated shutter, which can be driven either by a switch or by a TTL signal. It also comes equipped with a slot for filters up to 25-mm diameter or square, and up to 9-mm thick. (If operating the HPX-2000 for ultraviolet applications, use the solarization-resistant fiber described on page 146.)

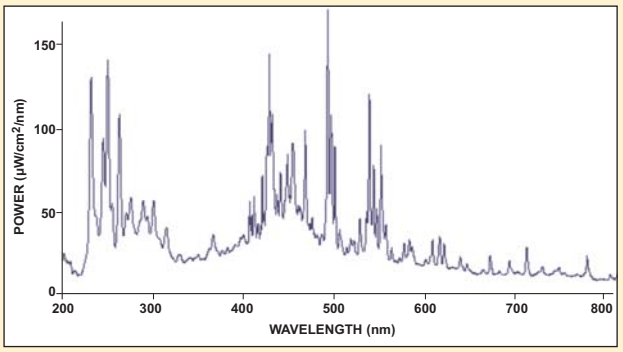
The bulb is housed in an easy-to-remove bulb module. If your bulb needs to be replaced, you have two options. You can send the module back to us to replace the bulb (HPX-2000-B), or you can order another bulb module (HPX-2000-BM).

HPX-2000: $6,006
HPX-2000-B: $1,158
HPX-2000-BM: $2,692

HPX-2000 Spectral Output



PX-2 Spectral Output



Specifications

	HPX-2000	PX-2
Dimensions:	145 mm x 165 mm x 260 mm	153.4 mm x 104.9 mm x 40.9 mm
Weight:	4.3 kg	370 g
Wavelength range:	185-2000 nm	220-750 nm
Power consumption:	50 W AC; 50/60 Hz; 110	1 A @ 12 VDC
Output*:	35 watts	45 microjoules per pulse maximum; 9.9 watts average power; 220 Hz pulse rate maximum
Bulb life:	1,000 hours minimum; 2,000 hours typical	10^9 pulses (estimated 230 days continuous operation at 50 Hz pulse rate)
Connector:	SMA 905	SMA 905
Trigger input:	External TTL positive pulse via 15-pin connector (shutter)	External TTL positive pulse via 15-pin connector
Pulse duration:	Not applicable	5 microseconds (at 1/3 height of pulse)

** Power output is measured with an integrating sphere. Power out of a fiber depends on fiber size.*

LS-1 Tungsten Halogen Sources

360-2000 nm Spectral Range

The LS-1 Tungsten Halogen Light Source is a versatile white-light source useful for absorbance, reflectance and color measurements for the VIS-NIR (360-2000 nm). The lamp offers high color temperature and efficient output.

Long Life

The LS-1 comes with a 900-hour bulb. Also available is the LS-1-LL, which comes with a 10,000-hour bulb for extra-long life bulb performance. LS-1 Light Sources come with a 12 VDC power supply (WT-12V).

Color-correcting & Signal-attenuating Accessories

The LS-1 is one of the most popular miniature spectroscopy light sources ever. As a result of customer feedback, we've enhanced our LS-1 offering to include components -- at no extra charge -- that allow users to modify the light source output:

- a 12.7-mm diameter color-correcting filter that can be installed into the light source to enhance the signal in the blue and NIR regions
- three PTFE discs of various thickness to create a diffuse source -- by attenuating the light 50%, 75% or 99% -- when spectrometer saturation is an issue

Maximum Flexibility

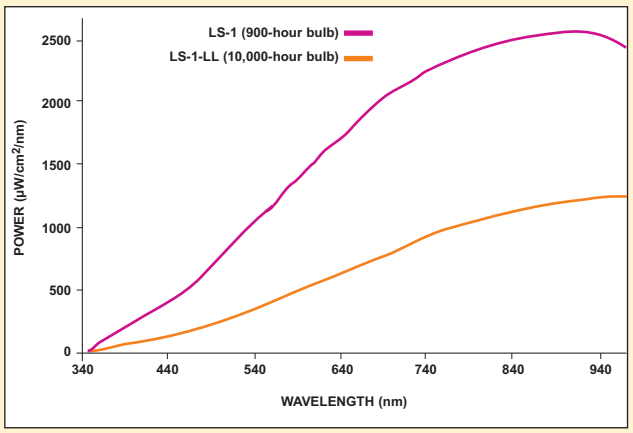
The LS-1 has an SMA 905 Connector for easy coupling to our spectrometers and accessories, including optical fibers, cuvette holders and probes. A built-in slot accepts optical filters up to three millimeters in thickness.

Rack-mountable

Install sources with spectrometers and other devices into a Rack Box or Desktop Box. For details, see page 62.

LS-1: $499
LS-1-LL: $549

LS-1 and LS-1-LL Spectral Output



Additional LS-1-series Light Sources and Accessories

Item	Description	Price
R-LS-1	Rack-mounted LS-1 with color-correcting filter and diffusers	$499
R-LS-1-LL	Rack-mounted LS-1-LL with color-correcting filter and diffusers	$549
LS-1-B	900-hour replacement bulb for LS-1	$45
LS-1-LL-B	10,000-hour replacement bulb for LS-1-LL	$55
OF2-LS	Additional filter set for use with LS-1 source includes: BG 34, GG 395 and OG 550 filters, as well as PTFE diffusing discs	$100

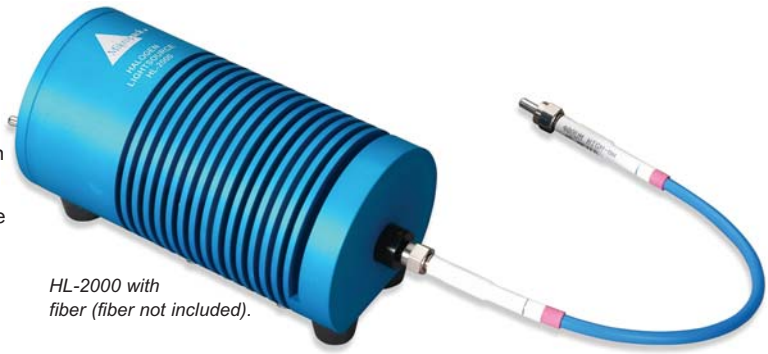
Specifications

Dimensions:	113.5 mm x 50.8 mm x 31.6 mm	Bulb type:	Tungsten halogen
Weight:	140 g	Bulb life:	900 hours (LS-1); 10,000 hours (LS-1-LL)
Wavelength range:	360-2000 nm	Bulb color temperature:	3100 K (900-hour bulb); 2800 K (10,000-hour bulb)
Power consumption:	600 mA @ 12 VDC	Connector:	SMA 905
Output:	6.5 watts (without a fiber)	Internal filter accessory:	BG 34 balancing filter
Current:	5 V, 1.3 A	External filter slot:	Accepts filters up to 3-mm thickness
Time to stable output:	~10 minutes	Spectral attenuation:	50%, 75% and 99% with PTFE disc accessories

HL-2000 Tungsten Halogen Sources

Great Versatility

The HL-2000 Tungsten Halogen Light Sources are versatile sources optimized from 360-2000 nm. The lamps feature adjustable focusing of the SMA 905 Connector to maximize light coupling into a fiber. A fan keeps the light sources cool and stable. The HL-2000 comes with a 1,500-hour bulb. A 10,000-hour long-life version is also available.



HL-2000 with fiber (fiber not included).

Filter Slot

A built-in filter slot on all standard HL-2000s accepts optical filters up to 25.4-mm round or up to 50.8-mm square and three millimeters thick. The HL-2000-LVF-HP version also accepts our LVF Linear Variable Filters (for more on the LVFs, see page 114.)

High-power Version

For applications requiring large-diameter optical fibers or fiber and probe bundles, a special high-power version of the HL-2000 is available. The bulb used in the HL-2000-HP is a 20-watt bulb. We recommend 1000 μm diameter optical fiber for use with the high-power versions of the HL-2000.

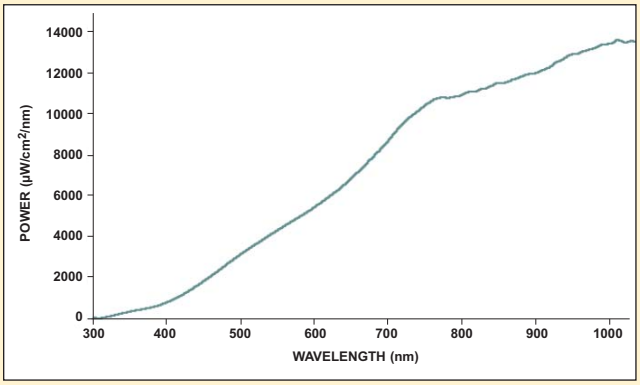
Attenuator & Shutter Option

The HL-2000-FHSA version of the HL-2000 includes a shutter and an attenuator that allows you to control the intensity of the light source from 0-100%. A locking screw allows you to manually fix the intensity position for the long term. In addition, you can opt to control the attenuator and the TTL shutter via RS-232 with the HL-2000-HP-232.

HL-2000: $635

HL-2000-HP-232 is being used to measure adaptive optics in observatories.

HL-2000 Spectral Output



Additional HL-2000 Light Sources & Bulbs

Item	Description	Price
HL-2000-LL	Long-life version (10,000-hour)	$688
HL-2000-FHSA	Includes filter holder, attenuator and shutter	$1,342
HL-2000-FHSA-LL	Includes filter holder, attenuator, shutter and long-life 10,000-hour bulb	$1,389
HL-2000-HP	High-powered, 20 W version	$1,089
HL-2000-HP-FHSA	High-powered, 20 W version with filter holder, attenuator and shutter	$1,655
HL-2000-HP-232	High-powered, 20 W version with RS-232 control in rack mount housing; comes with script for software control	$2,350
HL-2000-LVF-HP	High-powered, 20 W version with filter slot for Linear Variable Filters; comes with shutter and attenuator	$1,719
HL-2000-B	Standard 1,500-hour spare bulb	$83
HL-2000-B-LL	Long-life 10,000-hour spare bulb	$96
HL-2000-HP-B	High-power 1,000-hour spare bulb	$132

Specifications

	HL-2000	HL-2000-LL	HL-2000-HP	HL-2000-HP-232
Dimensions:	62 mm x 60 mm x 150 mm	62 mm x 60 mm x 150 mm	62 mm x 60 mm x 150 mm	70 mm x 100 mm x 160 mm
Weight:	500 g	500 g	500 g	600 g
Wavelength range:	360-2000 nm	360-2000 nm	360-2000 nm	360-2000 nm
Power consumption:	1.2 A @ 12 VDC	1.0 A @ 12 VDC	1.2 A @ 24 VDC	1.2 A @ 24 VDC
Output:	7 watts	7 watts	20 watts	20 watts
Stability:	0.5%	0.5%	0.5%	0.5%
Drift:	<0.3% per hour	<0.3% per hour	<0.3% per hour	<0.3% per hour
Time to stable output:	~5 minutes	~5 minutes	~5 minutes	~5 minutes
Bulb life:	1,500 hours	10,000 hours	1,000 hours	1,000 hours
Bulb color temperature:	2,960 K	2,800 K	3,000 K	3,000 K
Operating temperature:	5 °C - 35 °C	5 °C - 35 °C	5 °C - 35 °C	5 °C - 35 °C
Humidity:	5-95% at 40 °C	5-95% at 40 °C	5-95% at 40 °C	5-95% at 40 °C

Light Emitting Diodes

Choose your LED in a stand-alone housing (above) or mounted with a spectrometer and other accessories. We also sell the LEDs listed below individually in a 12.7-mm barrel (right) for easy installation and alignment.

Excellent Excitation Sources for Fluorescence

Our LED Light Sources produce either pulsed or continuous output for high-sensitivity fluorescence measurements. They were designed for use with our fluorescence spectrometers, such as the USB4000-FLG and USB4000-FL (pages 46-47), sensors and other accessories.

Software Operation & Synching with Detector

The LED Sources can be turned on/off through manual or software operation via SpectraSuite Spectroscopy Operating Software (page 80).

Stand-alone and Rack-mount Versions

Each LED Source connects to a spectrometer via an interface cable. First, decide if you want an LED in its own stand-alone housing (see top left) or if you want the LED racked with a spectrometer. Then, choose the LED distinguished by wavelength to install in the housing. For those with limited space, we can install two LEDs on one rack-mount card. You can also purchase just the LED; they come in easy-to-install barrels.

LED with Housing:	$499
LED Rack-mounted:	$499
LED Bulb alone:	$100

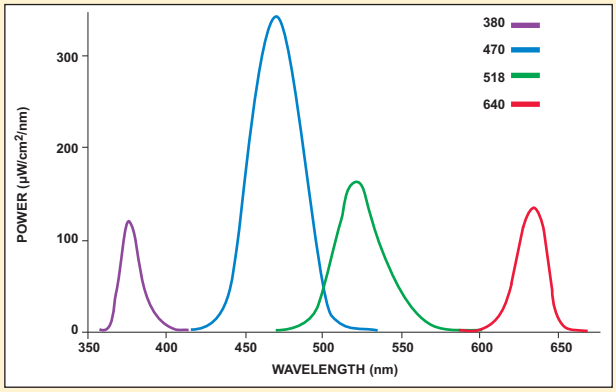
Additional LED Light Sources

You can order one of the LEDs listed below, either alone or installed in a housing/rack mount. We offer seven LEDs that can be used in the same housing. All LEDs can be used in pulsed or continuous mode through manual or software operation.

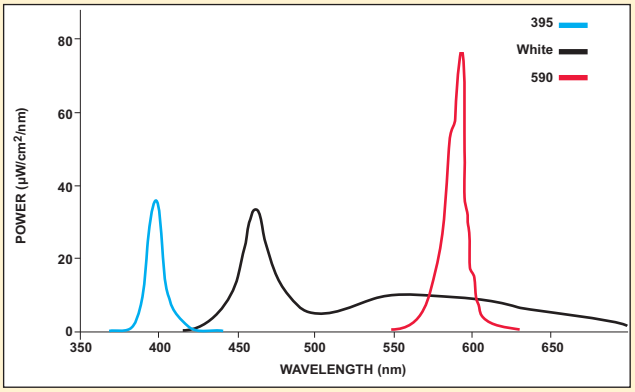
Item	Description	Color	Power*	Price of LED Alone	Price of LED with Housing
LED-380	380 nm wavelength UV LED	UV	45 µW	$100	$499
LED-395	395 nm wavelength VIS LED	Light Blue	25 µW	$100	$499
LED-470	470 nm wavelength VIS LED	Blue	35 µW	$100	$499
LED-518	518 nm wavelength VIS LED	Green	35 µW	$100	$499
LED-590	590 nm wavelength VIS LED	Yellow	40 µW	$100	$499
LED-640	640 nm wavelength VIS LED	Red	50 µW	$100	$499
LED-WHITE	450-630 nm wavelength VIS LED	White	50 µW	$100	$499
LED-KIT	Set of 6 LEDs: LED-380, LED-395, LED-518, LED-590, LED-640, LED-WHITE	Mixed	Mixed	$499	$998

** Power into a 600 µm Patch Cord Optical Fiber Assembly*

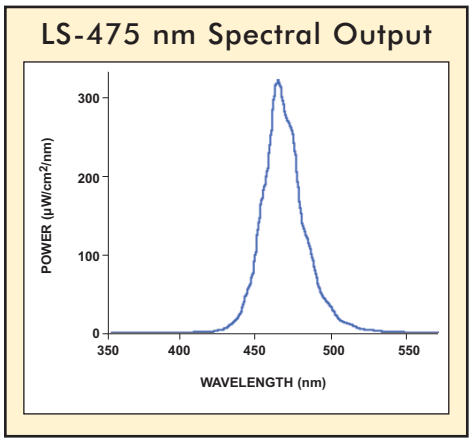
Spectral Output for LED Bulbs: 380 nm, 470 nm, 518 nm and 640 nm



Spectral Output for LED Bulbs: 395 nm, White, 590 nm



Pulsed Blue LED Light Source



Lamp Available for All Spectrometers

The LS-475 Blue LED Light Source produces pulsed or continuous spectral output centered at 475 nm. The LS-475 is designed as an excitation source for fluorescence measurements. The LS-475 often is paired with one of our preconfigured fluorescence spectrometers (pages 46-47).

Specifications	
Dimensions:	62 mm x 60 mm x 150 mm
Wavelength range:	460-490 nm
Power consumption:	25 mA @ 12 VDC
Output:	50 µW with a 600 µm optical fiber
Stability:	±1.0% drift after 2-minute warm-up
Connector:	SMA 905

High-stability & Fan-cooled

The LS-475 has a very stable output and keeps cool with a built-in fan. The lamp provides better than ±1.0% drift after a 2-minute warm-up time. It has an SMA 905 Connector for coupling to optical fiber assemblies and a filter slot that accepts 25.4-mm round or 50.8-mm square filters up to 3-mm thick. An 800 mA, 12 VDC power supply comes with the unit.

LS-475: $774

Direct-attach LED Light Source

Direct-attach Lamp for USB4000 Spectrometer

The USB-LS-450 and USB-LS-395 Pulsed LED Light Sources are designed as a direct-attach excitation source for USB2000 and USB4000 Spectrometers. The USB-LS-450 is an LED that produces either pulsed or continuous output centered at 470 nm -- the blue region. The USB-LS-395 is an LED that produces either pulsed or continuous output centered at 395 nm. Each LED connects to the spectrometer via a 10-pin connector. The USB2000 and USB4000 provide power to the LEDs and also enable synchronization functions. These sources are primarily used in fluorescence measurements and in our oxygen sensing systems. The 470 nm LED is great for exciting the FOXY and HIOXY oxygen sensing formulations, while the 395 nm LED is used for exciting the FOSPOR oxygen sensing formulation (pages 65-71).

Benefit for O_2 Sensor Users

The sources features a built-in, 24-bit A/D converter that is configured for a 100 ohm platinum temperature probe (The USB-LS-450-TP is seen at right with a direct-attach LED and a spectrometer.) These excitation sources have onboard memory that can be programmed to store temperature and oxygen calibration coefficients. If neither the 450 nor 395 LED fits your needs, you can purchase the USB-LS-LED and then specify one of the other LEDs we offer on page 130.

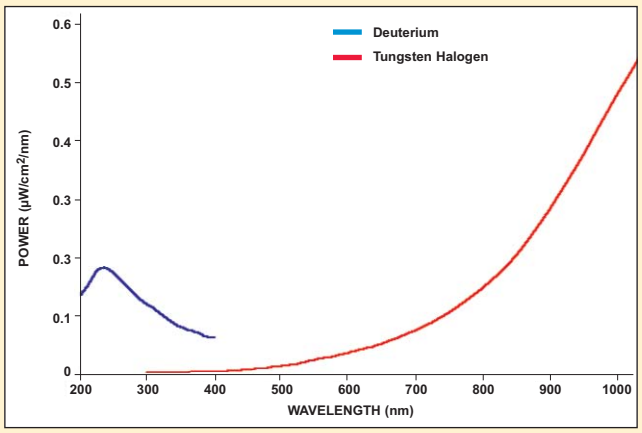
USB-LS-450: $549
USB-LS-395: $549
USB-LS-LED: $549
USB-LS-450-TP: $99

Specifications			
Dimensions:	89 mm x 57 mm x 34.5 mm	Wavelength range:	460-490 nm
Weight:	120 g	Power consumption:	60 mA @ 5 VDC
Stability:	±1.0% drift after 2-minute warm-up period	Output:	60 µW (minimum) into a 600 µm optical fiber

Radiometric Calibration Standards: UV-NIR

The DH2000-CAL is calibrated for use with either a CC-3-UV Cosine Corrector or with an optical fiber. The lamp comes with a CC-3-UV.

DH2000-CAL Spectral Output



These spectral output graphs were taken separately for the deuterium (200-400 nm) and the tungsten halogen bulbs (400-1100 nm).

Calibrated from 220-1050 nm

The DH2000-CAL Deuterium Tungsten Halogen Calibration Standard is a UV-NIR light source used to calibrate the absolute spectral response of a radiometric system. With the DH2000-CAL and our SpectraSuite Spectroscopy Operating Software, you can determine known absolute intensity values at wavelengths from 220-1050 nm.

Calibrated for Bare Fiber & Cosine Corrector

The DH2000-CAL is calibrated for use with optical fibers or a cosine corrector; the calibration data includes absolute intensities for wavelengths between 220-1050 nm at the fiber entrance port for both a bare fiber and an included CC-3-UV Cosine Corrector (page 104).

NIST-traceable Calibration Certificate

The DH2000-CAL is calibrated with a NIST-traceable standard. The DH2000-CAL comes with a calibration certificate and a diskette with a data file compatible with our software. The calibration data -- absolute spectral intensity values in $\mu W/cm^2/nm$ measured at the fiber port -- is provided for use with our SpectraSuite software (not included, see pages 80-81).

Recalibration of Your DH2000-CAL

The DH2000-CAL typically provides 50 hours of operation before recalibration is necessary. We recalibrate these lamps in-house. (For more information on the DH2000-RECAL service, contact an Applications Scientist.)

DH2000-CAL: $3,275
DH2000-RECAL: $399

In-house Calibration Service

Also, you don't need a DH2000-CAL to take advantage of our in-house SPEC-CAL-UV radiometric calibration service for UV spectrometers. The calibration is good for about one year, provided the optical fiber is not removed from the setup, as the system is calibrated for use with a specific fiber.

SPEC-CAL-UV: $499

Radiometric Calibration Sources are not illumination sources for spectroscopic measurements. Use the DH2000-BAL (page 122) for illumination.

Specifications

Dimensions:	150 mm x 135 mm x 319 mm	Stability:	<5 x 10^{-6} peak-to-peak (0.1-10.0 Hz)
Weight:	3.8 kg	Drift:	<0.01% per hour
Wavelength range:	220-1050 nm calibrated	Time to stable output:	20 minutes
Power consumption:	25 W (deuterium); 20 W (tungsten halogen); 190 W maximum	Operating temperature:	5 °C - 35 °C
		Humidity:	5-95% without condensation at 40 °C
Power requirements:	85-264 V 50/60 Hz	Electronic certifications:	CE; VDI/VDE 0160; EN 61010
Output:	100 watts	Connector:	SMA 905
Voltage:	350 V	Calibration accuracy:	±5%
Current:	Operating 85 V/0.3A	Calibration valid for:	50 hours

Radiometric Calibration Standards: VIS-NIR

Calibrated with Fiber & Cosine Corrector

The LS-1-CAL is designed for calibrating the absolute spectral response of a complete system consisting of a spectrometer and an optical fiber and/or a CC-3-UV Cosine Corrector (page 104). The HL-2000-CAL is also designed for calibrating a system consisting of a spectrometer and a cosine corrector. The calibration data for both the LS-1-CAL and the HL-2000-CAL includes absolute intensities for wavelengths between 300-1050 nm.

LS-1-CAL:	$749
HL-2000-CAL:	$871

The LS-1-CAL is calibrated for use with a fiber and/or a CC-3-UV Cosine Corrector (not included).

Calibrated for Use with Integrating Sphere

The LS-1-CAL-INT is designed for calibrating the absolute spectral response of a system that uses the FOIS-1 Fiber Optic Integrating Sphere (page 105) as the sampling optic. The LS-1-CAL-INT comes with a diffuser plug that fits into the sample port of the FOIS-1 to measure absolute spectral intensities of LEDs and other emission sources. The HL-2000-CAL-ISP is designed for calibrating the absolute spectral response of your system when using the ISP-50-8-I Integrating Sphere (page 105) as your sampling optic.

LS-1-CAL-INT:	$749
HL-2000-CAL-ISP:	$882

The LS-1-CAL-INT is calibrated specifically for use with the FOIS-1 Integrating Sphere. Notice the PTFE diffuser plug that's seated where an SMA 905 Connector is usually installed. This plug fits snugly into the sample port of the FOIS-1.

What's Included

Each of these radiometric sources comes with a regulated 12 VDC power supply. Also included is a calibration certificate and electronic files for use with our irradiance functions in SpectraSuite Spectroscopy Operating Software. Neither the LS-1-CAL nor the HL-2000-CAL lamps comes with a CC-3-UV Cosine Corrector.

Recalibrating Your Source

These calibrated sources provide 50 hours of operation before an in-house recalibration (called the LS-1-RECAL and the HL-2000-RECAL) is necessary.

LS-1-RECAL:	$199
HL-2000-RECAL:	$199

The HL-2000-CAL is used for calibrating most radiometric systems, while the HL-2000-CAL-ISP is used with ISP Integrating Spheres.

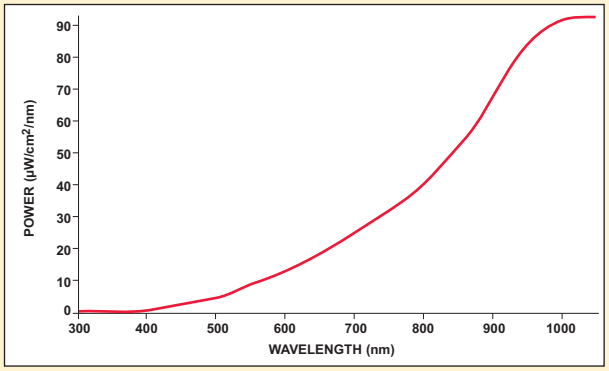
In-house Calibration

If you do not want to purchase one of these calibration sources, we offer in-house radiometric calibration services that calibrate the absolute spectral response of your system. The SPEC-CAL service is for 300-1050 nm and the SPEC-CAL-NIR service is for 900-2400 nm.

SPEC-CAL:	$499
SPEC-CAL-NIR:	$499

Specifications	
Power consumption:	600 mA @ 12 VDC
Wavelength range:	300-1050 nm (calibrated)
Output:	6.5 watts
Recalibration:	Required after 50 hours of operation
Time to stable output:	~20 minutes
Bulb color temperature:	3100 K for LS-1-CALs, 2800 K for HL-2000-CALs
Connector:	SMA 905 for fiber; 6.35-mm barrel for cosine corrector; PTFE plug for integrating sphere

LS-1-CAL Spectral Output



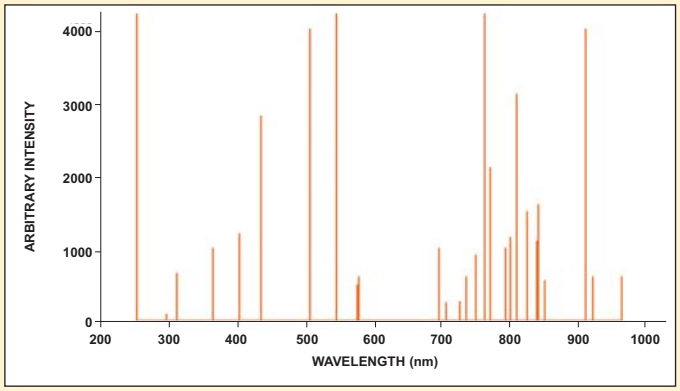
Above is the typical calibration output when using the LS-1-CAL or HL-2000-CAL with a CC-3 Cosine Corrector.

Wavelength Calibration Standards: UV-VIS

The HG-1.

The CAL-2000.

HG-1 & CAL-2000 Spectral Output



Mercury emission lines are <600 nm. Argon emission lines are >600 nm, and are shown on an exaggerated amplitude scale.

Wavelength Calibration Sources

The HG-1 and CAL-2000 Mercury Argon Calibration Sources are spectral wavelength calibration sources for spectrometer systems. The HG-1 and the CAL-2000 produce low-pressure mercury and argon atomic emission lines from 253-1700 nm for use in performing fast, reliable spectrometer wavelength calibrations. A list of mercury and argon spectral emission lines is printed on each lamp's housing.

Drift Occurs in all Spectrometers

Our spectrometers are carefully calibrated as part of our standard quality assurance process. However, as is the case with all optical benches, slight drifts in wavelength occur due to time and environmental conditions. If wavelength accuracy is an important part of your application, consider including calibration spectra with every experiment.

Convenient Operation

Wavelength calibration with the HG-1 or the CAL-2000 requires a power supply (included) and an optical fiber to connect from the source to your spectrometer. You will need a spreadsheet program such as Microsoft Excel or a calculator that performs third-order polynomial regressions.

Convenient Portability

Both calibration sources operate with a 12 VDC power supply (included) or a 9V battery (not included) for field use. Both sources feature an SMA 905 Connector for interfacing to optical fiber assemblies and have bulbs with a 3,500-hour lifetime. You can replace the bulb in the CAL-2000, but not in the HG-1.

HG-1:	**$399**
CAL-2000:	**$475**
CAL-2000-B Bulb:	**$191**

For as low as $250 per spectrometer channel, you can purchase the ASP Annual Service Package, which entitles you to a yearly spectrometer inspection, wavelength calibration, optical alignment, linearity calibration, signal-to-noise analysis and much more.

Specifications

	HG-1	CAL-2000
Dimensions:	125.7 mm x 70 mm x 25.8 mm	130 mm x 125 mm x 50 mm
Weight:	40 g	410 g
Wavelength range*:	253-1700 nm	253-1700 nm
Power consumption:	250 mA @ 12 VDC	250 mA @ 12 VDC
Power requirements:	12 VDC wall transformer (included) or 9 VDC battery (not included)	12 VDC wall transformer (included) or 9 VDC battery (not included)
Voltage:	600 volts at 30 kHz	600 volts at 30 kHz
Bulb life:	~3,500 hours (at 20 mA)	~3,500 hours (at 20 mA)
Time to stable output:	1 minute	1 minute
Connector:	SMA 905	SMA 905

** For performing wavelength calibrations for spectrometers in the VIS-NIR, consider using the AR-1 Argon Calibration Source on page 135.*

Wavelength Calibration Standard: NIR

Calibration Source for NIR Spectrometers

The AR-1 Argon Calibration Source is a spectral wavelength calibration source specifically designed for NIR spectrometers like our NIR256 and NIR-512 (see pages 30-31). The AR-1 produces low-pressure argon atomic emission lines from 696-1704 nm for use in performing fast, reliable spectrometer wavelength calibrations. The spectral emission lines are printed on the lamp's housing.

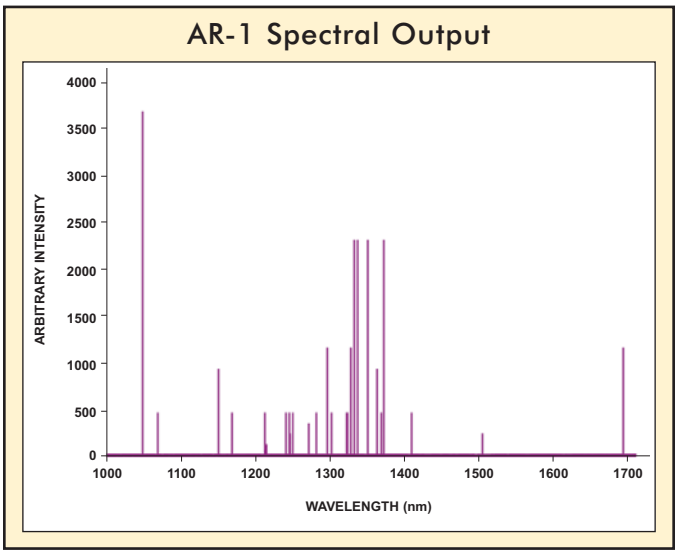
Convenient Operation

Our spectrometers are carefully calibrated as part of our standard quality assurance process. However, as is the case with all optical benches, slight drift in wavelength occurs due to time and environmental conditions. With the AR-1, you can recalibrate your spectrometer using a spreadsheet program such as Microsoft Excel or a calculator that performs third-order polynomial regressions.

Conveniently Portable

The AR-1 operates with a 12 VDC power supply (included) or a 9V battery (not included) for field use. The AR-1 features an SMA 905 Connector for interfacing to optical fiber assemblies.

AR-1: $399



Specifications	
Dimensions:	125.7 mm x 70 mm x 25.8 mm
Weight:	40 g
Wavelength range:	696-1704 nm
Power consumption:	250 mA @ 12 VDC
Power requirements:	12 VDC wall transformer (included) or 9 VDC battery (not included)
Voltage:	600 volts at 30 kHz
Bulb life:	~3,500 hours (at 20 mA)
Time to stable output:	~1 minute
Connector:	SMA 905

Cuvette Wavelength Calibration Adapter

The PS-HG1-ADP Wavelength Calibration Adapter is a 1-cm square fixture that fits into a 1-cm pathlength sample chamber and then connects to the HG-1 Mercury Argon Calibration Standard or the AR-1 Argon Wavelength Calibration Standard via optical fiber. (Neither Wavelength Calibration Standard nor optical fiber is included.) The adapter is designed for performing a wavelength calibration for a USB2000 or USB4000 Spectrometer and a direct-attach sampling system. However, the adapter can be used with any post-dispersive spectrometer and 1-cm cuvette holder, whether it's designed by Ocean Optics or another manufacturer.

PS-HG1-ADP: $259

Bulbs, Power Supplies & Accessories

Power Supplies*

Item	Description	Plug Style	Current	Regulated	Price
WT-12V	12-volt power supply, 110/220	Americas/Japan	800 milliamps	Yes	$25
WT-12V-R	12-volt power supply, 110/220	Americas/Japan	2.5 Amps	Yes	$100
WT-12V-E	12-volt power supply, 110/220	European	800 milliamps	Yes	$20
WT-12V-R-E	12-volt power supply, 110/220	European	2.5 Amps	Yes	$100
WT-24V	24-volt power supply, 110/220	Americas/Japan	2.5 Amps	Yes	$50

** Each Ocean Optics Sales, Service & Support location sells power supplies that best serves its region.*

WT-12V-E European Power Supply.

Bulbs for Ocean Optics Light Sources

Item	Description	Price
DH2000-BD	Spare or replacement deuterium bulb for D2000, DH2000 and DH2000-BAL sources	$650
DH2000-DUV-B	Spare or replacement deep-UV deuterium bulb for D2000-DUV and DH2000-DUV sources	$776
DH2000-BH	Spare or replacement tungsten halogen bulb for DH2000 and DH2000-BAL sources	$158
DT-MINI-B	Spare bulb for DT-MINI and DT-MINI-GS (white or blue bulb housing)	$487
DT-MINI-2-B	Spare bulb for DT-MINI-2 and DT-MINI-2-GS (yellow bulb housing)	$526
HL-2000-B	Spare or replacement tungsten halogen bulb for the HL-2000 (1,500-hour, 2,960 K)	$83
HL-2000-B-LL	Spare or replacement long-life tungsten halogen bulb for the HL-2000-LL (10,000-hour, 2,800 K)	$96
HL-2000-HP-B	Spare or replacement tungsten halogen bulb for all HL-2000-HPs	$132
HPX-2000-BM	Spare or replacement xenon bulb module for the HPX-2000	$2,692
HPX-2000-B	Spare or replacement xenon bulb for the HPX-2000	$1,158
LED-380	Interchangeable, 380-nm LED for LS-450	$100
LED-395	Interchangeable, 395-nm LED for LS-450	$100
LED-518	Interchangeable, 518-nm LED for LS-450	$100
LED-590	Interchangeable, 590-nm LED for LS-450	$100
LED-640	Interchangeable, 640-nm LED for LS-450	$100
LED-WHITE	Interchangeable, white LED for LS-450	$100
LED-KIT	LED kit with 380-nm, 395-nm, 518-nm, 590-nm, 640-nm and white LEDs, for LS-450	$499
LS-1-B	Spare or replacement tungsten halogen bulb for LS-1 (900-hour, 3100 K bulb)	$45
LS-1-LL-B	Spare or replacement long-life tungsten halogen bulb for LS-1 or LS-1-LL (10,000-hour, 2800 K bulb)	$55
PX-2-B	Spare or replacement xenon bulb for the PX-2	$379
USB-ISS-UV-B	Spare or replacement deuterium and tungsten bulb for USB-ISS-UV-VIS	$399
USB-ISS-VIS-B	Spare or replacement tungsten bulb for the USB-ISS-VIS source	$199
D-1000-B	Spare or replacement deuterium bulb for the D-1000	$525
D-1000-REM-B	Spare or replacement bulb for D-1000-REM systems	$425
DT-1000-B	Spare or replacement deuterium bulb for the DT-1000	$595
DT-1000-BT	Spare or replacement tungsten halogen bulb for the DT-1000	$135
DT-1000-REM-B	Spare or replacement bulb for DT-1000-REM systems	$485
DT-1000-BT-CE	CE-certified tungsten halogen bulb for the DT-1000	$135

The DH2000-BD deuterium bulb used in all D2000s and DH2000s.

The CAL-2000-B.

The DH2000-BH tungsten halogen bulb used in all DH2000s.

Bulb for the HL-2000.

The DT-MINI bulb unit.

The LS-1-B replacement bulb for the LS-1.

Other Light Source Accessories

Item	Description	Price
CBL-PX-2	Cable for connecting PX-2 to S2000 Spectrometer	$25
FCBARREL	6.35-mm outer diameter stainless steel barrel threaded for FC connectors that inserts into our 74-series Collimating Lenses	$29
FOT-SMA WRENCH	SMA wrench for easily attaching Laboratory-grade optical fibers to SMA 905 Connectors on Ocean Optics products	$10

Bulb module for the HPX-2000.