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OPTICAL INSTRUMENTS

Precise mechanical movement and well engineered electronics have always been hallmarks of Sutter Instrument products. Over twenty years ago, our entrance into the optical products market capitalized on these attributes when we set out to produce a reliable, fast, electronically quiet, computer controlled filter wheel. The result was the Lambda 10, which met all of our original performance goals, and proved itself as a very rugged and reliable instrument.

The success of the Lambda 10 led to the development of a new generation of wavelength switching products, and one of the widest ranges of accessories in the industry. Our current design, the Lambda 10-3 controller, allows for the use of three filter wheels without the expense of additional controllers. The Lambda 10-B has also been added as a lower cost alternative for those who do not require all the features of the Lambda 10-3. Both of these controllers can be coupled to our original filter wheel, as well as our latest line of wheels which have been designed for 25 mm as well as larger diameter filters.

Taking advantage of the latest in thin-film filter technology, Sutter has incorporated tunable filters into a single and 5-position filter changer, the Lambda VF-1™ and Lambda VF-5™, providing access to any center bandpass from 338 mm to 900 nm in nanometer increments.

When the Lambda 10 was first introduced, most imaging systems could not keep up with its 55 msec switching time. As technology has advanced in the field

of imaging, demand has increased for faster wavelength switching speed. Sutter Instrument has responded with the Lambda DG-4 PLUS , an integrated illumination system capable of switching wavelengths in less than 0.5 msec.

As demands for high throughput and lower exposure times have increased, the need for a standalone high power light source was met with the Lambda LS. This integrated 175 (or 300) Watt xenon arc lamp, cold mirror, and power supply system is available in an efficient single cabinet design.

Sutter Instrument developed and designed the *Smart*Shutter® to address the need for a robust and reliable shutter to serve as a component in our imaging line or as a standalone solution for optical applications. The *Smart*Shutter offers the most sophisticated shutter control available. Microprocessor control of the stepper-motor allows the user to optimize movement for speed or smoothness, produce a variable aperture, and achieve open/close times of 8 msec from trigger. The *Smart*Shutter is compatible with the Lambda 10-3, Lambda 10-B/IQ, and Lambda SC controllers.

Customization of our optical product line for unique applications has become a specialty for Sutter Instrument. New technology has been incorporated in various custom and OEM filterwheels. For example, for systems using a large number of filter wheels, Sutter Instrument developed an RS-485 serial bus to allow up to 16 controllers to share a single serial port on a host computer. Sutter Instrument has also developed sensor and motor technology for a system of filter wheels running at liquid helium temperatures for use with astronomical telescopes. Please contact us directly for more information about custom filter changing devices.

LIGHT SOURCE COMPARISON CHART

This chart of light source options and capabilities will assist you in selecting the product best suited to your application. Sutter product managers are happy to discuss your particular technical requirements in order to ensure you receive the best light source for your research needs. Please contact Sutter for further assistance.

	Light Source	Fluorescent Microscopy	Calcium Imaging	FURA	Optogenetics	Transmitted Light	PHASE	DIC	Hyper Spectral Imaging	Ultra High Speed Wavelength Selection	High Speed Wavelength Selection	Wavelength Selection
Lambda OBC	LED	■	■	■	■					■	■	■
Lambda 421 / Lambda 821	LED	■	■	■	■					■	■	■
Lambda DG-4 Plus	Xenon	■	■	■	■					■	■	■
Lambda LS	Xenon	■	■	■	■						■	■
Lambda XL	Xenon-Plasma	■	■	■	■						■	■
Lambda HPX	LED	■			■							
Lambda HPX-L5	LED	■			■							
Lambda TLED/TLED+	white LED				■	■	■	■				
Lambda FLED	LED	■	■		■							
Lambda FLED-DC	LED	■	■	■	■					■	■	■
Filter Wheel	N/A	■	■	■	■						■	■

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FILTER WHEEL CONTROLLER COMPARISON CHART

Features	Lambda 10-3	Lambda 10-B
Maximum # of Wheels	3	1
Maximum # of Shutters	3[1]	2[1]
Shutter Type		
*Smart*Shutter®	■	■
Uniblitz®	■	■
Filter Diameter (mm)		
12/25/32/50[2]	■	■
Minimum Switching Time[3] (ms)		
40 ms — 25 mm wheel	■	■
50 ms — 32 mm wheel	■	■
31 ms — 4-position 25 mm	■	■
Power Supply	Chopper	Chopper
Computer Interface		
Serial	■	■
Parallel	■	
USB	■	■
TTL In/Out	Yes	Yes

1. The Lambda 10-3 can be used to drive up to 3 filter wheels and 2 shutters, or 3 shutters and 2 filter wheels. The Lambda 10-B, two shutters or one wheel and one shutter.
2. The controller automatically detects the installed hardware.
3. Minimum switching time between adjacent filters depends on the filter load. The given values are for a load of 2 filters.

LAMBDA OBC
OPTICAL BEAM COMBINER

(Shown: LB-OBC-LLG)

FEATURES LAMBDA OBC

- Up to 4 channel ultra high-speed LED light source (<25 µsec)
- LLG or direct mount connection options for all common microscopes
- Capable of combining any combination of LEDs or any liquid light guide delivered light sources
- Easy to reconfigure
- LEDs driven by our proven FLED controllers

COMMON APPLICATIONS LAMBDA OBC

- Fluorescent microscopy
- Calcium imaging
- FURA
- Optogenetics
- High-speed wavelength selection

2018 R&D 100 WINNER

Patent No. 8,988,779

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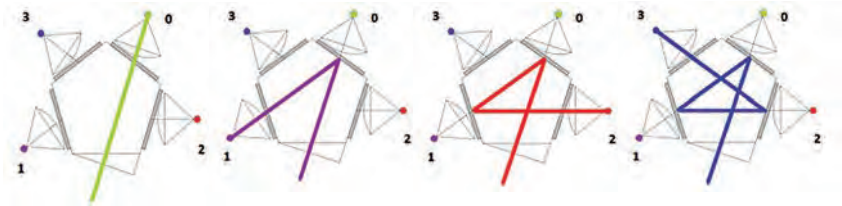
The Lambda OBC (optical beam combiner) is a new, patented, concept for combining separate light sources with different spectra into a single common output beam. Each separate light source is collimated before entering the optical path through a bandpass filter. The filters for each light source also function as mirrors that reflect the collimated beams from the previous light sources. In the diagram below the optical paths are outlined for each position including the reflections that occur:



Optical path for each light source position from 0 through 3. The position number of the light sources are labeled based on the number of total reflections.

Traditionally, combining more than two light sources required the use of a dichroic ladder. Dichroic mirrors, which switch from transmission to reflection at one point in the spectrum, allow the combining of separate light sources, provided that those sources do not have overlapping wavelengths. The downside of this approach is that light sources cannot be easily changed.

Dichroic ladders also demand careful attention to the order in which the light sources are introduced into the optical path to avoid having the light blocked by the next dichroic in line. Typically, additional bandpass filters must be added in front of each light source before the dichroic, to select the desired range of wavelengths for each source. Each filter and dichroic used in the ladder decreases the total light output of the system.

FEATURES
Capable of combining any light source
Any suitable filter can be placed in any of 4 positions without concern for the order
Directly mount to the microscope epi-illuminator
Wavelength selection and beam reflection using Semrock®-STR Filters

The Pentagon shape of the Lambda OBC was designed to keep the size of the beam combiner small and the optical path short and efficient. Thin-film bandpass filters, such as Semrock's STR, reflect greater than 90% of out-of-band light. If the band pass of each light source does not overlap, it is possible to use the filters for both attenuation and reflection of the light from the other sources. By arranging the filters and sources into a pentagon, we could combine four light sources in a compact design with lower losses than previously achievable. As an added benefit, the last position in the optical train does not require any filter, since no other input reflects from that position. This input can be used with any sort of light source if you are aware of the possible losses if there are filters in use that overlap this light source. The fifth side of the pentagon becomes the output for the combined sources. The filters are easily exchangeable and are installed on small sliders inside the core of the pentagon. Filters and associated light sources can be arranged in any order around the pentagon.

Notes:

- The light from position #0 goes directly to the device output without being reflected. This position might be preferred for the source with the greatest desired output.
- The filter for the fourth light source is not used as a reflective surface and could be omitted if a broad-band source were desired.
- In configurations with fewer than 4 light sources, sources should be filled from lowest to highest number of reflections to ensure the greatest light output.
- The optical path for each input is tilted by 18 degrees relative to the filter for that port. This will cause a small shift in the band pass toward shorter wavelengths. While it would be ideal to have a coating optimized for this application, we have found that stock -STR filters can be used if you correct for the shift in the band pass when selecting the filters. This lends itself to combining narrow-band sources such as LEDs and lasers with a broad-band sources such as an arc lamps or white light LEDs. In the case of LEDs, wavelengths can be shuttered at the speed of the individual source. Sutter Instrument HPX and FLED products can switch in 10-25 microseconds respectively.

The Lambda OBC is designed for ultimate flexibility and expandability. Should your illumination needs change over time, a simple configuration change and possibly additional filters can produce an entirely different output.

SPECIFICATIONS OBC

Output Range	(330 nm to 960 nm) Depending the LED's selected for use
Shuttering	Turn ON/OFF time: <25 µs
Noise/Short Term Stability	0.01 %
LED Life	>50,000 hours
Dimensions	*Control Box – FLED:* 4 in x 3.25 in x 4.1 in 10.2 cm x 8.3 cm x 10.2 cm *Lambda OBC – with 4 LEDs:* 9.65 in x 9.25 in x 3 in 24.5 cm x 23.5 cm x 7.5 cm
Weight	*Control Box – FLED:* 2.2 lbs 1 kg *Lambda OBC – with 4 LEDs:* 4.7 lbs 2.13 kg
Electrical	120/240 Volts 50/60 Hertz power line

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OPTICAL BEAM COMBINER

Includes Lambda OBC optical beam combining pentagon that accommodates up to 4 LED modules (purchased separately).

- **LB-OBC-N** Lambda Optical Beam Combiner for Nikon
- **LB-OBC-Y** Lambda Optical Beam Combiner for Olympus
- **LB-OBC-Z** Lambda Optical Beam Combiner for Zeiss
- **LB-OBC-L** Lambda Optical Beam Combiner for Leica
- **LB-OBC-C** Lambda Optical Beam Combiner for C-mount
- **LB-OBC-LLG** Lambda Optical Beam Combiner with 3 mm series 380 liquid light guide

CONTROLLER FOR LED MODULES

One Lambda FLED controller is needed for each LED ordered (part numbers OBC-XXX). Up to 4 controllers can be used with the Optical Beam Combiner.

- **FLED-E** Lambda FLED Controller (one needed for each LED module ordered (part numbers OBC-XXX).

LED MODULES FOR LAMBDA OBC

The LED modules consist of the LED and the appropriate Semrock®-STR excitation filter for the output of the LED. Four LED modules can be installed in the Optical Beam Combiner at one time, however, the purchase of additional LED modules adds versatility to the system as you can reconfigure the Lambda OBC by substituting wavelengths as needed for your application.

- **OBC-340** LED, 340 nm for Optical Beam Combiner
- **OBC-365** LED, 365 nm for Optical Beam Combiner
- **OBC-385** LED, 385 nm for Optical Beam Combiner
- **OBC-410** LED, 410 nm for Optical Beam Combiner
- **OBC-440** LED, 440 nm for Optical Beam Combiner
- **OBC-460** LED, 460 nm for Optical Beam Combiner
- **OBC-480** LED, 480 nm for Optical Beam Combiner
- **OBC-506** LED, 506 nm for Optical Beam Combiner
- **OBC-530** LED, 530 nm for Optical Beam Combiner
- **OBC-561** LED, 561 nm for Optical Beam Combiner
- **OBC-590** LED, 590 nm for Optical Beam Combiner
- **OBC-617** LED, 617 nm for Optical Beam Combiner
- **OBC-630** LED, 630 nm for Optical Beam Combiner
- **OBC-660** LED, 660 nm for Optical Beam Combiner
- **OBC-740** LED, 740 nm for Optical Beam Combiner
- **OBC-810** LED, 810 nm for Optical Beam Combiner
- **OBC-850** LED, 850 nm for Optical Beam Combiner
- **OBC-940** LED, 940 nm for Optical Beam Combiner
- **OBC-W5** LED, White Light for Optical Beam Combiner

LAMBDA 421

OPTICAL BEAM COMBINING SYSTEM

(Shown: Lambda 421)

FEATURES LAMBDA 421

- Versatile 4-channel Ultra high-speed LED light source
- Unique optical design allows for simple spectral flexibility
- Wide variety of available LED's between 340-900 nm

COMMON APPLICATIONS LAMBDA 421

- Fluorescent microscopy
- Calcium imaging
- FURA
- Optogenetics
- High-speed wavelength selection

Patent No. 8,988,779

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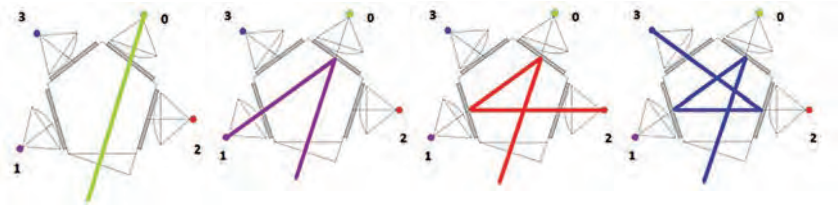
The Lambda 421 beam combiner is a new, patented, concept for combining separate light sources with different spectra into a single common output beam. Each separate light source is collimated before entering the optical path through a bandpass filter. The filters for each light source also function as mirrors that reflect the collimated beams from the previous light sources. In the diagram below the optical paths are outlined for each position including the reflections that occur:



Optical path for each light source position from 0 through 3. The position number of the light sources are labeled based on the number of total reflections.

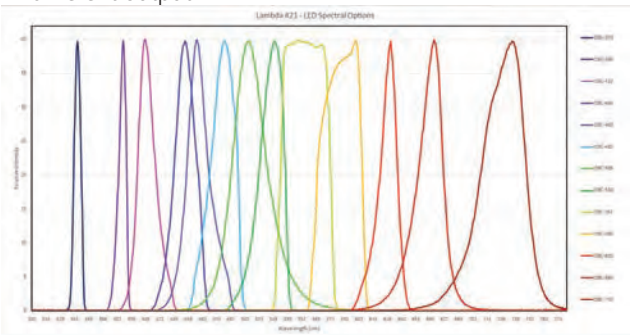
Traditionally, combining more than two light sources required the use of a dichroic ladder. Dichroic mirrors, which switch from transmission to reflection at one point in the spectrum, allow the combining of separate light sources, provided that those sources do not have overlapping wavelengths. The downside of this approach is that light sources cannot be easily changed.

Dichroic ladders also demand careful attention to the order in which the light sources are introduced into the optical path to avoid having the light blocked by the next dichroic in line. Typically, additional bandpass filters must be added in front of each light source before the dichroic, to select the desired range of wavelengths for each source. Each filter and dichroic used in the ladder decreases the total light output of the system.

The Lambda 421 was designed to keep the size of the beam combiner small and the optical path short and efficient. Thin-film bandpass filters, such as Semrock's STR, reflect greater than 90% of out-of-band light. If the band pass of each light source does not overlap, it is possible to use the filters for both attenuation and reflection of the light from the other sources. By arranging the filters and sources into a pentagon, we were able to combine four light sources in a compact design with lower losses than previously achievable. As an added benefit, the last position in the optical train does not require any filter, since no other input reflects from that position. This input can be used with any sort of light source as long as you are aware of the possible losses if there are filters in use that overlap this light source. The fifth side of the pentagon becomes the output for the combined sources. The filters are easily exchangeable and are installed on small sliders inside the core of the pentagon. Filters and associated light sources can be arranged in any order around the pentagon.

Notes:

- The light from position #0 goes directly to the device output without being reflected. This position might be preferred for the source with the greatest desired output.
- The filter for the fourth light source is not used as a reflective surface and could be omitted if a broad-band source were desired.
- In configurations with fewer than 4 light sources, sources should be filled from lowest to highest number of reflections to ensure the greatest light output.
- The optical path for each input is tilted by 18 degrees relative to the filter for that port. This will cause a small shift in the band pass toward shorter wavelengths. While it would be ideal to have a coating optimized for this application, we have found that stock -STR filters can be used if you correct for the shift in the band pass when selecting the filters. This lends itself to combining narrow-band sources such as LEDs and lasers with a broad-band sources such as an arc lamps or white light LEDs. In the case of LEDs, wavelengths can be shuttered at the speed of the individual source. Sutter Instrument HPX and TLED products can switch in 1 0-25 microseconds respectively, making the Lambda 421 one of, if not the fastest wavelength switcher on the market. The Lambda optical beam combiner is designed for flexibility and expandability. Should your illumination need change over time a simple configuration change and possibly additional filters can produce an entirely different output.



Lambda 421 - LED Spectra Options

SPECIFICATIONS LAMBDA 421

Output Range	(330 nm to 960 nm) Depending the LED's selected for use
Shuttering	Turn ON/OFF time: <25 µs
Noise/Short Term Stability	0.01 %
LED Life	>50,000 hours
Control Box Dimensions	15.75 in x 11 in x 7.5 in 40 cm x 27.9 cm x 19.05 cm
Weight	17.8 lbs 8.07 kg
Electrical	120/240 Volts 50/60 Hertz power line

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LAMBDA 421 OPTICAL BEAM COMBINER AND CONTROLLER

Includes controller, LED unit with liquid light guide, cables, and power cord. The instrument accepts up to 4 LED modules (listed below) and can easily be reconfigured. The LED modules consist of the LED and the appropriate Semrock®-STR excitation filter for the output of the LED.

- **LB-421** Lambda 421 Optical Beam Combiner and controller

LED MODULES FOR LAMBDA 421

- **OBC-340** LED, 340 nm for Optical Beam Combiner
- **OBC-365** LED, 365 nm for Optical Beam Combiner
- **OBC-385** LED, 385 nm for Optical Beam Combiner
- **OBC-410** LED, 410 nm for Optical Beam Combiner
- **OBC-440** LED, 440 nm for Optical Beam Combiner
- **OBC-460** LED, 460 nm for Optical Beam Combiner
- **OBC-480** LED, 480 nm for Optical Beam Combiner
- **OBC-506** LED, 506 nm for Optical Beam Combiner
- **OBC-530** LED, 530 nm for Optical Beam Combiner
- **OBC-561** LED, 561 nm for Optical Beam Combiner
- **OBC-590** LED, 590 nm for Optical Beam Combiner
- **OBC-617** LED, 617 nm for Optical Beam Combiner
- **OBC-630** LED, 630 nm for Optical Beam Combiner
- **OBC-660** LED, 660 nm for Optical Beam Combiner
- **OBC-740** LED, 740 nm for Optical Beam Combiner
- **OBC-810** LED, 810 nm for Optical Beam Combiner
- **OBC-850** LED, 850 nm for Optical Beam Combiner
- **OBC-940** LED, 940 nm for Optical Beam Combiner
- **OBC-W5** LED, White Light for Optical Beam Combiner

Mounting adapters for Nikon, Zeiss, Leica and Olympus microscopes are available. Please call Sutter Instrument for pricing and further information. Also, please see the Microscope Adapters section of this catalog.

LAMBDA 821

OPTICAL BEAM COMBINING SYSTEM

FEATURES LAMBDA 821

- Capable of combining any light source
- Any suitable filter can be placed in any of 7 positions without concern for the order
- Wavelength selection and beam reflection using Semrock® STR Filters

COMMON APPLICATIONS LAMBDA 821

- Fluorescent microscopy
- Calcium imaging
- FURA
- Optogenetics
- High-speed wavelength selection

Patent No. 8,988,779

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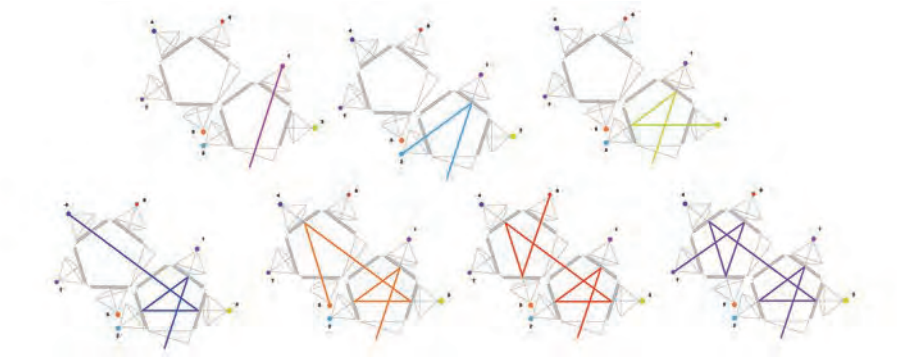
The Lambda 821 beam combiner is a new, patented, concept for combining separate light sources with different spectra into a single common output beam. Each separate light source is collimated before entering the optical path through a bandpass filter. The filters for each light source also function as mirrors that reflect the collimated beams from the previous light sources. In the diagram below the optical paths are outlined for each position including the reflections that occur:



Optical path for each light source position from 0 through 7

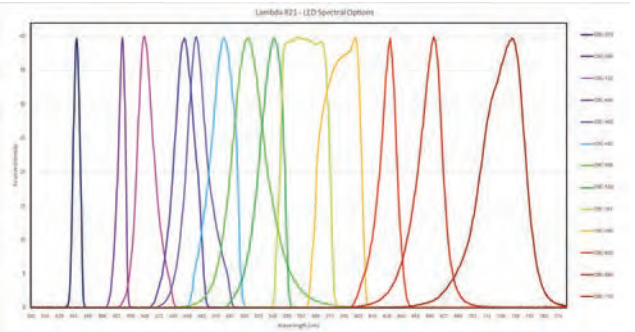
Traditionally, combining more than two light sources required the use of a dichroic ladder. Dichroic mirrors, which switch from transmission to reflection at one point in the spectrum, allow the combining of separate light sources, provided that those sources do not have overlapping wavelengths. The downside of this approach is that light sources cannot be easily changed. Dichroic ladders also demand careful attention to the order in which the light sources are introduced into the optical path to avoid having the light blocked by the next dichroic in line. Typically, additional bandpass filters must be added in front of each light source before the dichroic, to select the desired range of wavelengths for each source. Each filter and dichroic used in the ladder decreases the total light output of the system.

Dichroic ladders also demand careful attention to the order in which the light sources are introduced into the optical path to avoid having the light blocked by the next dichroic in line. Typically, additional bandpass filters must be added in front of each light source before the dichroic, to select the desired range of wavelengths for each source. Each filter and dichroic used in the ladder decreases the total light output of the system.

The Lambda 821 was designed to keep the size of the beam combiner small and the optical path short and efficient. Thin-film bandpass filters, such as Semrock's STR, reflect greater than 90% of out-of-band light. If the band pass of each light source does not overlap, it is possible to use the filters for both attenuation and reflection of the light from the other sources. By arranging the filters and sources into a pentagon, we were able to combine four light sources in a compact design with lower losses than previously achievable. As an added benefit, the last position in the optical train does not require any filter, since no other input reflects from that position. This input can be used with any sort of light source as long as you are aware of the possible losses if there are filters in use that overlap this light source. The fifth side of the pentagon becomes the output for the combined sources. The filters are easily exchangeable and are installed on small sliders inside the core of the pentagon. Filters and associated light sources can be arranged in any order around the pentagon.

Notes:

- The light from position #1 goes directly to the device output without being reflected. This position might be preferred for the source with the greatest desired output.
- The filter for the fourth light source is not used as a reflective surface and could be omitted if a broad-band source were desired.
- In configurations with fewer than 7 light sources, sources should be filled from lowest to highest number of reflections to ensure the greatest light output.
- The optical path for each input is tilted by 18 degrees relative to the filter for that port. This will cause a small shift in the band pass toward shorter wavelengths. While it would be ideal to have a coating optimized for this application, we have found that stock -STR filters can be used if you correct for the shift in the band pass when selecting the filters. This lends itself to combining narrow-band sources such as LEDs and lasers with a broad-band sources such as an arc lamps or white light LEDs. In the case of LEDs, wavelengths can be shuttered at the speed of the individual source. Sutter Instrument Lambda 821 can switch in <25 microseconds, making the Lambda 821 one of the fastest wavelength switchers on the market. The Lambda optical beam combiner is designed for flexibility and expandability. Should your illumination need change over time a simple configuration change and possibly additional filters can produce an entirely different output.



Lambda 821 - LED Spectra Options

SPECIFICATIONS LAMBDA 821

Output Range	(330 nm to 960 nm) Depending the LED's selected for use
Shuttering	Turn ON/OFF time: <25 µs
Noise/Short Term Stability	0.01 %
LED Life	>50,000 hours
Control Box Dimensions	7 in x 19 in x 10.5 in 17.7 cm x 48.25 cm x 26.5 cm
Weight	23 lbs 10.45 kg
Electrical	120/240 Volts 50/60 Hertz power line

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LAMBDA 821 OPTICAL BEAM COMBINER AND CONTROLLER

Includes controller, LED unit with liquid light guide, cables, and power cord. The instrument accepts up to 7 LED modules (listed below) and can easily be reconfigured. The LED modules consist of the LED and the appropriate Semrock®-STR excitation filter for the output of the LED. Modules are sold separately & listed below.

- **LB-821** Lambda 821 Optical Beam Combiner and controller

LED MODULES FOR LAMBDA 821

- **OBC-340** LED, 340 nm for Optical Beam Combiner
- **OBC-365** LED, 365 nm for Optical Beam Combiner
- **OBC-385** LED, 385 nm for Optical Beam Combiner
- **OBC-410** LED, 410 nm for Optical Beam Combiner
- **OBC-440** LED, 440 nm for Optical Beam Combiner
- **OBC-460** LED, 460 nm for Optical Beam Combiner
- **OBC-480** LED, 480 nm for Optical Beam Combiner
- **OBC-506** LED, 506 nm for Optical Beam Combiner
- **OBC-530** LED, 530 nm for Optical Beam Combiner
- **OBC-561** LED, 561 nm for Optical Beam Combiner
- **OBC-590** LED, 590 nm for Optical Beam Combiner
- **OBC-617** LED, 617 nm for Optical Beam Combiner
- **OBC-630** LED, 630 nm for Optical Beam Combiner
- **OBC-660** LED, 660 nm for Optical Beam Combiner
- **OBC-740** LED, 740 nm for Optical Beam Combiner
- **OBC-810** LED, 810 nm for Optical Beam Combiner
- **OBC-850** LED, 850 nm for Optical Beam Combiner
- **OBC-940** LED, 940 nm for Optical Beam Combiner
- **OBC-W5** LED, White Light for Optical Beam Combiner

Mounting adapters for Nikon, Zeiss, Leica and Olympus microscopes are available. Please call Sutter Instrument for pricing and further information. Also, please see the Microscope Adapters section of this catalog.

LAMBDA LS

STANDALONE XENON ARC LAMP AND POWER SUPPLY

(Shown with optional light guide and lens tube)

FEATURES LAMBDA LS

- Xenon lamps provide light levels which exceed those of standard microscope fluorescence lamps
- Equipped with a cold mirror to eliminate IR heating of downstream optical components
- Compact standalone lamp housing power supply enclosure
- Pre-aligned bulb eliminates common focusing problems
- Integrated hour meter for convenient monitoring of lamp life
- Modular construction allows use of optional liquid light guide for flexible direction of light output
- Easily accommodates Sutter Instrument filter wheels or *Smart*Shutter® within the body of the lamp.
- Can be coupled via a liquid light guide to many standard microscopes (Nikon, Zeiss, Leica and Olympus). Microscope coupling requires special adapters (not included). Please see the Microscope Adapter section in this catalog.

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The Lambda LS is a standalone lighting system consisting of a xenon arc lamp, lamp housing, cold mirror and power supply in a single enclosure. The Lambda LS is designed to be used with a liquid light guide which transmits remarkably flat, intense, illumination to the optical train of the user's microscope or other instrumentation. The lamp's cabinet accommodates a standard Sutter Instrument filter wheel that slides easily in and out of a slot in the light path. If desired, a second filterwheel can be mounted on the outside of the cabinet. When used with appropriate adapters, the light guide output is compatible with most common microscope systems. Unlike the arc lamps used with most fluorescence microscopes, the xenon bulb is pre-aligned using a parabolic mirror and does not require alignment, focusing or collimation. In the standard configuration, the Lambda LS bulb is capable of producing light output from 330 nm to a cutoff of 650 nm determined by the cold mirror. An optional enhanced UV bulb produces output much lower into the UV (cut off near 200 nm). As with any UV generating light source, the optional bulb generates significant quantities of ozone and must be used in an adequately ventilated environment.

The Lambda LS utilizes a compact design, which places power supply, lamp house, arc lamp and cold mirror in a single enclosure. This system eliminates a common failure associated with standard arc lamp designs: when using a remote power supply aging may lead to a decreased ability to light the lamp due to loss of the insulating characteristics of the lengthy high-tension line. As with all our equipment, the power supply has been designed to minimize electrical noise that can be picked up by physiological recording equipment.

The liquid light guide can be coupled to the illumination port of most microscopes using an adapter which can be purchased separately. Please refer to the "Microscope Adapters" section for further information. Extended output ranges are possible with various cold mirror and light guide combinations. Phone Sutter to discuss your specific application requirements.

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COMMON APPLICATIONS LAMBDA LS

- Fluorescent microscopy
- Calcium imaging
- FURA
- Optogenetics
- High-speed wavelength selection

SPECIFICATIONS LAMBDA LS

Output Range	330 nm to 650 nm — Ozone free 200 mm to 650 mm — Full spectrum (Note: full spectrum produces ozone)
Lamp Type	175 or 300 Watt Xenon (pre-aligned to produce collimated output)
Radiant Output	2.5 Watts (175 W lamp) 4.5 Watts (300 W lamp) (broadband, full beam)
Lamp Life	1000 hours (Bulb carries a prorated warranty for 500 hours. Longer life depends on application. Expected life is 1000 hours)
Power Consumption	175 Watts or 300 Watts
Dimensions	10.5 in x 9.5 in x 10 in 26.7 cm x 24.1 cm x 25.4 cm
Weight	10.5 lbs 4.8 kg
Electrical	120/240 Volts 50/60 Hertz power line

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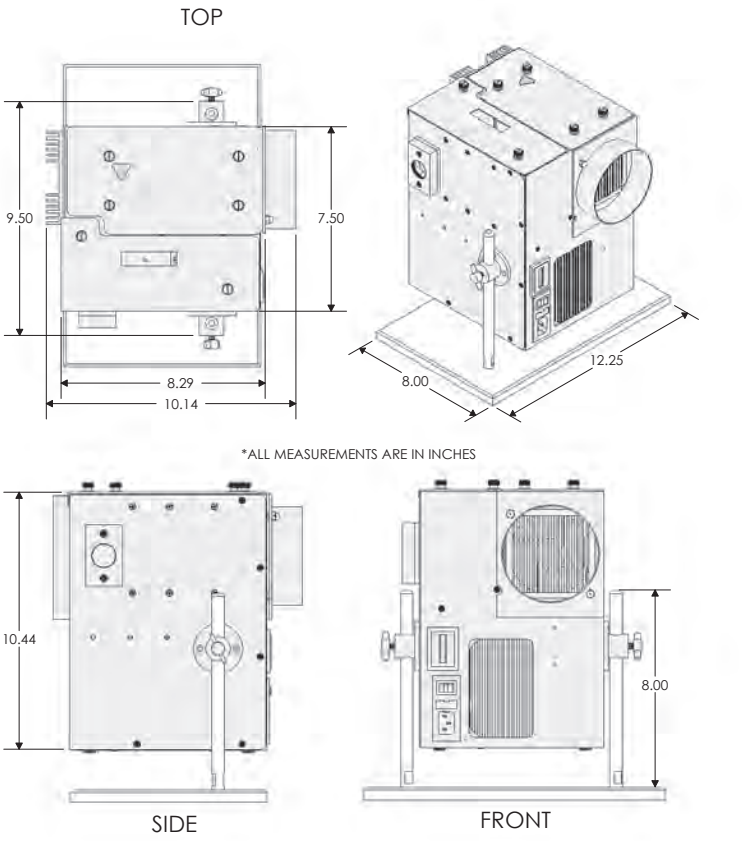

(There is additional depth when second filterwheel is attached)

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LAMBDA LS

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LAMBDA LS BASIC SYSTEM

Includes a xenon lamp, cold mirror, power supply and lamp housing, support base with mounting rods, drop-in filter holder and manual.

- **LS-OF30** Lambda LS with 300 Watt **ozone free** lamp
- **LS-FS30*** Lambda LS with 300 Watt **full spectrum** lamp
- **LS-OF17** Lambda LS with 175 Watt **ozone free** lamp
- **LS-OF30R**[1] Lambda LS with 300 Watt **ozone free** lamp and cold mirror that reflects to 780 nm
- **LS-OF30IR**[2] Lambda LS with 300 Watt **ozone free** lamp and cold mirror that reflects to 1100 nm
- **LS-FS30UV**[3,*] Lambda LS with 300 Watt **full spectrum** lamp and cold mirror that reflects to 275 nm

**Note: Full spectrum bulbs produce ozone. Please be certain that you have ventilation. Contact Sutter for details.*

[1] *Order with LLG/380*
[2] *Order with LLG/2000 or LLG/380*
[3] *Order with LLG/250*

FILTER WHEELS & SHUTTER

- **LB10-NWIQ/LS** 10 position 25 mm filter wheel with *Smart*Shutter®
- **LB10-NW**** 10 position 25 mm filter wheel (can be mounted inside Lambda LS or outside if used as a second wheel)
- **IQ-25/LS** 25 mm *Smart*Shutter for mounting in Lambda LS

*** Will need to purchase additional controller if using as a second wheel.*

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ACCESSORIES

LLG	Liquid light guide and coupling adapter (2 meters, 3 mm dia.), C-mount, lens and lens tube
LLG/380[1]	Liquid light guide and coupling adapter (2 meters, 3 mm dia.), C-mount, lens and lens tube
LLG/2000[2]	Liquid light guide and coupling adapter (2 meters, 3 mm dia.), C-mount, lens and lens tube
LLG/250[3]	Liquid light guide (2 meters, 3 mm dia.), C-mount, lens and lens tube
LLGPLUS[4]	Liquid light guide (2 meters, 3 mm dia.), heatsink, C-mount, lens and lens tube
LLGPLUS/380[4]	Liquid light guide (2 meters, 3 mm dia.), heatsink, C-mount, lens and lens tube
LLGPLUS/2000[4]	Liquid light guide (2 meters, 3 mm dia.), heatsink, C-mount, lens and lens tube
DROP-IN	Drop-in filter holder (25 mm)
O777655[5]	Replacement 3 mm light guide (300 series)
O777651[6]	Replacement 3 mm light guide (380 series)

Mounting adapters for Nikon, Zeiss, Leica and Olympus microscopes are available. Please see the Microscope Adapter list at the end of this section.

[1] *Supports transmission into near IR.*
[2] *Supports transmission into near IR. No output below 420 nm*
[3] *Supports transmission into near UV.*
[4] *Extends the lifetime of the LLG when the Lambda LS is used without a Smart*Shutter®.
[5] *Maximum UV transmission.*
[6] *Allows light input into near IR*

BULBS*

O661176	Ozone free 175 Watt xenon bulb (attenuated output below 340 nm)
O661301	Ozone free 300 Watt xenon bulb (attenuated output below 340 nm)
O661300**	Full spectrum 300 Watt xenon bulb
O661115	Housing and heat sink for bulb will be installed when ordered with bulb (Not sold separately)

**Please note that the bulbs below do not include the outer blue housing. If you would like to purchase the bulb with housing, include part number 0661115 with your order.*

*** Full spectrum bulbs produce ozone. Please be certain that you have ventilation. Contact Sutter for details.*

LAMBDA XL

EXTENDED LIFE LIGHT SOURCE

FEATURES LAMBDA XL

- 10,000 hour expected lifetime*
- No high-voltage pulse
- Built-in driver for filterwheel and *Smart*Shutter®
- Very stable output
- Compact standalone design
- USB interface

**Bulb carries a prorated 2-year warranty*

COMMON APPLICATIONS LAMBDA XL

- Fluorescent microscopy
- Calcium imaging
- FURA
- Optogenetics
- High-speed wavelength selection

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The Lambda XL is a broad spectrum, highly stable light source (1% peak-to-peak fluctuations). The connection to the microscope is made through a liquid light guide, which assures output uniformity in the field of view. Two light guide options are available, one optimized for the near UV-visible and the other for the visible-near IR regions.

The output at the end of the light guide is similar to that of our popular 300 Watt Lambda LS xenon arc light source. The lamp module is expected to last in excess of 10,000 hours and expected to maintain at least 50% of the original intensity.

The compact, standalone cabinet design contains the bulb, lamp housing, power supply and optics in a single enclosure. The new design also includes a filter wheel and *Smart*Shutter® driver, making it a versatile choice for fluorescence imaging applications. The Sutter filter wheel with *Smart*Shutter or the standalone *Smart*Shutter can be accommodated within the body of the Lambda XL. Filters with an absorbing layer are likely to be damaged by the extraordinary power of the Lambda XL and are not recommended for use with this product.

The light intensity can be adjusted to different levels of attenuation. When the optional filter wheel is used, each filter position can be associated with its own programmable attenuation level, selected every time the filter is called.

Mounting adapters for Nikon, Olympus, Zeiss and Leica microscopes are available.

SPECIFICATIONS LAMBDA XL

Output Range	330 nm to 700 nm
Lamp Expected Life	10,000 hours
Dimensions	9.4 in x 7.6 in x 12.6 in 23.9 cm x 19.3 cm x 32 cm
Weight	16.35 lbs 7.4 kg
Electrical	120/240 Volts 50/60 Hertz power line

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LAMBDA XL

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BASIC SYSTEM

■ **LB-XL**	Includes the Lambda XL light source, power cord, and manual

ACCESSORIES

■ **LLG/XL**	Liquid light guide and heat sink (2 meters, 3 mm diameter)
■ **LLG/5XL**[1]	Liquid light guide and heat sink (2 meters, 5 mm diameter)
■ **LLG/XL380**[2]	Liquid light guide and heat sink (2 meters, 3 mm diameter)
■ **LLG/5XL380**[2]	Liquid light guide and heat sink (2 meters, 5 mm diameter)
■ **IQ25-XL**	25mm *Smart*Shutter® with housing to fit Lambda XL
■ **LB10-NWIQ/XL**	10 position 25 mm fiter wheel with *Smart*Shutter for mounting in Lambda XL
■ **LB10-WHS4IQ/XL**	4 position 25 mm fiter wheel with *Smart*Shutter for mounting in Lambda XL
■ **O800115**[3]	Replacement lamp
■ **O777648**	Replacement 5 mm light guide (380 series)
■ **O777656**[4]	Replacement 5 mm light guide (300 series)

Mounting adapters for Nikon, Zeiss, Leica and Olympus microscopes are available. Please see the Microscope Adapter list at the end of this section or contact Sutter Instrument for pricing and further information.

[1] This lightguide offers a larger field of view but less intensity per unit area.

[2] Allows higher output into the near IR.

[3] Requires installation and realignment at Sutter.

[4] Maximum UV transmission.

LAMBDA HPX

LIQUID COOLED LED LIGHT SOURCE

FEATURES LAMBDA HPX

- Pre-filled liquid cooling
- Dimming via PWM or current control
- Lifetime >50,000 hours
- Front mounted connectors for ease of access
- TTL and Analog controls
- Integral shuttering
- White light and UV combination available

COMMON APPLICATIONS LAMBDA HPX

- Fluorescent microscopy
- Optogenetics

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The Lambda HPX represents the latest generation of liquid-cooled high-output LED light sources. Designed around a single 90 W 4.25 mm LED die, the Lambda HPX provides light output comparable to a 200 W xenon arc lamp. A quiet, vibration-free liquid cooling head (pre-filled at the factory) allows us to maintain the low junction temperatures required to reach the manufacturer's projected bulb life of 60,000 hours. The HPX is expected to retain 95% of its original output at 5000 hours, and 80% after 10,000 hours. The lightweight precision-machined LED head is designed to mount directly on the epi port of a microscope using an included microscope adapter (specify at time of order). This affords the maximum amount of light coupled directly to the scope, without the losses associated with a liquid light guide.

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 will be preferable for most applications, and 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 pulsed output, dimming via current control is also available. PWM and current information are conveniently displayed on the front panel display, and are manually selectable via control knobs. Integral shuttering time is 10 microseconds to turn on or off.

PWM can also be controlled externally via analog input. TTL input and output allows for triggering from either software or directly from another device such as a camera or digital IO board. The LED cable and cooling lines are easily removable from the chassis with no-drip quick connectors. This allows for easy set up and routing of cables through your setup. Active temperature monitoring ensures that the LED life will be maximized.

Light output is in the visible spectrum from 430 nm to 700 nm. A cool white LED is available. Special order units are available with 630 nm, 530 nm, 460 nm, 405 nm, 385 nm, and 365 nm wavelength specific LEDs. The Lambda HPX can also be combined with our FLED to create a two-channel system with any combination of wavelengths.

SPECIFICATIONS LAMBDA HPX

Output Range	White light (430 nm to 700 nm)
Shuttering	Turn on time: 10 µs Turn off time: 10 µs
LED Life	>50,000 hours
Noise/Short Term Stability	0.02%
PWM Frequency	28 kHz
Input/Output	TTL & Analog
Standard White LEDs	Cool White
Optional LEDs	630 nm, 530 nm, 460 nm, and 405 nm
Dimming	PWM or Current Control
Dimensions	*Control Box:* 12.25 in x 9 in x 5.25 in 311 mm x 229 mm x 133 mm *Head (attaches to scope):* 2.5 in x 3 in x 5 in 64 mm x 76 mm x 127 mm *Length of cabling between Head and Control Box:* 4 ft 1.2 m
Weight	12.5 lbs 5.7 kg
Electrical	120/240 Volts 50/60 Hertz power line 150 Watts max.

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LAMBDA HPX

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LAMBDA HPX Includes the Lambda HPX LED light source, microscope adapter, and cables.

- **HPX-Y**[1] Lambda HPX LED light source for Olympus
- **HPX-N**[1] Lambda HPX LED light source for Nikon
- **HPX-Z**[1] Lambda HPX LED light source for Zeiss
- **HPX-L**[1] Lambda HPX LED light source for Leica

AVAILABLE WAVELENGTHS

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

LAMBDA HPXUV Includes the Lambda HPXUV Ultraviolet LED light source, microscope adapter, and cables.

- **HPXUV-Y**[1] Lambda HPX UV LED light source for Olympus
- **HPXUV-N**[1] Lambda HPX UV LED light source for Nikon
- **HPXUV-Z**[1] Lambda HPX UV LED light source for Zeiss
- **HPXUV-L**[1] Lambda HPX UV LED light source for Leica
- **HPXUV-C**[1] Lambda HPX UV LED light source with C-mount

AVAILABLE WAVELENGTHS

- **365-HPX** UV LED, 365 nm
- **385-HPX** UV LED, 385 nm
- **405-HPX** UV LED, 405 nm

LAMBDA HPX-DC* Includes the Lambda HPX LED light source with cool white LED, Lambda FLED with Ultraviolet LED, and cables.

- **HPX-DC-Y** Lambda HPX and FLED for Olympus
- **HPX-DC-N** Lambda HPX and FLED for Nikon
- **HPX-DC-Z** Lambda HPX and FLED for Zeiss
- **HPX-DC-L** Lambda HPX and FLED for Leica

** Suitable for additional DAPI channel.*

ACCESSORIES LAMBDA HPX

- **TRIGGER**[2] USB trigger box

[1] Select one wavelength when ordering.
[2] Compatible with Micro-Manager software

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LAMBDA HPX-L5

HIGH-OUTPUT LED LIGHT SOURCE

FEATURES LAMBDA HPX-L5

- Vibration-free coupling via liquid light guide
- Dimming via PWM or current control
- Lifetime >50,000 hours
- Front mounted connectors for ease of access
- TTL and Analog controls
- Integral shuttering
- White light and UV combination available

COMMON APPLICATIONS LAMBDA HPX-L5

- Fluorescent microscopy
- Optogenetics

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The Lambda HPX-L5 was created as a liquid light guide coupled version of the HPX, our newest high power LED light source. The liquid light guide allows for LED cooling via an internal heatsink with a whisper fan. This requires less maintenance that the liquid-cooled direct mount version. Designed around a single 90 W 3 mm LED die, the Lambda HPX-L5 provides light output comparable to a 150 W Xenon arc lamp when using the same light guide. The Lambda HPX-L5 is optimized for coupling to an optional 5 mm liquid light guide, and off-the-shelf microscope adapter. The HPX-L5 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 or current control. PWM will be preferable for most applications, and 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 information are conveniently displayed on the front panel display, and are manually selectable via control knobs. Integral shuttering time is 10 microseconds to turn on or off. TTL input and output allows for triggering from either software or directly from another device such as a camera or digital IO board. PWM can also be controlled externally via analog input. Active temperature monitoring ensures that the LED life will be maximized.

Light output is in the visible spectrum from 430 nm to 700 nm. Special order units are available with 630 nm, 530 nm, 460 nm, and 405 nm wavelength specific LEDs. The Lambda HPX-L5 can also be combined with our FLED to create a two-channel system with any combination of wavelengths.

SPECIFICATIONS LAMBDA HPX-L5

Output Range	White light (430 nm to 700 nm)
Shuttering	Turn on time: 10 µs Turn off time: 10 µs
LED Life	> 50,000 hours
Noise/Short Term Stability	0.02%
PWM Frequency	28 kHz
Input/Output	TTL & Analog
Standard White LEDs	Cool White
Optional LEDs	405 nm, 460 nm, 530 nm, and 630 nm
Dimming	PWM or Current Control
Dimensions	*Control Box:* 12.25 in x 9 in D 5.25 in 311 mm x 229 mm x 133 mm *Head (attaches to scope):* 2.5 in x 3 in x 5 in 64 mm x 76 mm x 127 mm *Length of cabling between Head and Control Box:* 4 ft 1.2 m
Weight	8.8 lbs 4 kg
Electrical	120/240 Volts 50/60 Hertz power line 150 Watts max.

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LAMBDA HPX-L5

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LAMBDA HPX-L5 Includes the Lambda HPX-L5 LED light source, liquid light guide, and cables (select one wavelength when ordering).

- **HPX-L5**[1] Lambda HPX-L5 LED light source

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

LAMBDA HPX-L5UV Includes the Lambda HPX-L5UV LED light source, and cables. liquid light guide, and cables.

- **HPX-L5UV**[1] Lambda HPX-L5UV LED light source

  AVAILABLE WAVELENGTHS
- **405-HPX-L5** LED, 405 nm

LAMBDA HPX-L5DC* Includes the Lambda HPX-L5 LED light source with cool white LED, Lambda FLED with UV LED, and cables.

- **HPX-L5DC-Y**[1] Lambda HPX and FLED for Olympus
- **HPX-L5DC-N**[1] Lambda HPX and FLED for Nikon
- **HPX-L5DC-Z**[1] Lambda HPX and FLED for Zeiss
- **HPX-L5DC-L**[1] Lambda HPX and FLED for Leica

** Suitable for additional DAPI channel.*

ACCESSORIES LAMBDA HPX-L5

- **0777648** Liquid light guide (2 meters, 5 mm diameter)
- **TRIGGER**[2] USB trigger box

[1] You will need a mounting adapter for your microscope
[2] Compatible with Micro-Manager software

Mounting adapters for Nikon, Zeis, Leica and Olympus microscopes are available. Please see the Microscope Adapter list at the end of this section.

LAMBDA TLED / TLED+

LED TRANSMITTED LIGHT SOURCE

FEATURES LAMBDA TLED / TLED+

- >50,000 hour lifetime
- <25 µsecs On-Off time
- TTL control (with polarity switch)
- Very stable output
- Compact standalone design
- Easy installation

COMMON APPLICATIONS LAMBDA TLED / TLED+

- Transmitted light
- Phase Contrast
- Differential Interface Contrast (DIC)
- Optogenetics

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The Lambda TLED and TLED+ are standalone LED light sources that can be used with the transmitted light path of a microscope or in other applications with similar requirements.

This basic system consists of an LED mounted on a special black-anodized aluminum heat sink and a controller. The Lambda TLED and TLED+ controllers are powered by a rugged modular universal power supply. The controllers provide intensity control and on-off control via a toggle switch or TTL logic. The on-off time is <25 µsecs when using TTL control. In addition to digital input control, the Lambda TLED+ has analog input to modulate the LED intensity. The Lambda TLED and TLED+ are expected to have stable output that will last in excess of 50,000 hours.

The Lambda TLED and TLED+ can be ordered with a high-output white light LED, making it a suitable light source for contrast methods, including Phase, and Differential Interference Contrast (DIC).

Each Lambda TLED/TLED+ system includes an optical mounting adapter for the microscope and detailed installation instructions. Mounting adapters are designed to fit most models of Nikon, Olympus, Zeiss and Leica microscopes. Custom adapters for the Lambda TLED/TLED+ are available at an additional cost.

The TLED-FT is a powerful and compact array of 9 LEDs used to deliver a homogenized beam of light to the sample. Useful for illuminating a 96 well plate, the TLED-FT is available in blue, green, red and white light configurations. The TLED controller provides stable, adjustable light intensity by switch or TTL. Ideal for optogenetics, and transparent samples.

The TLED-RL is a ring light illuminator for stereo microscopes with lenses up to 65 mm in outside diameter. The ring light is composed of a circular assembly of many white light LEDs that provides even and direct illumination of the sample.

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SPECIFICATIONS LAMBDA TLED / TLED+

- **Output Range** White light (400 nm to 700 nm)
- **LED Life** >50,000 hours
- **Noise/Short Term Stability** 0.01%
- **Control Box Dimensions**
  - TLED: 3 in x 3.5 in x 4.1 in
    7.6 cm x 8.9 cm x 10.2 cm
  - TLED+: 4 in x 3.25 in x 4.1 in
    10.2 cm x 8.3 cm x 10.2 cm
- **Weight** 2.2 lbs
  1 kg
- **Electrical** 120/240 Volts
  50/60 Hertz power line
  75 Watts max

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ACCESSORIES LAMBDA TLED / TLED+

- **TRIGGER[1]** USB trigger box

[1] *Compatible with Micro-Manager software*

(Shown: TLED-FT)

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LAMBDA TLED / TLED+

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TLED	Includes Lambda TLED light source, TLED controller, white light LED, and power supply.
■ **TLED-N**	Lambda TLED for Nikon
■ **TLED-N40**	Lambda TLED for Nikon E400/E600
■ **TLED-N50**	Lambda TLED for Nikon AZ100
■ **TLED-N65**	Lambda TLED for Nikon FN1
■ **TLED-Y**	Lambda TLED for Olympus
■ **TLED-Z**	Lambda TLED for Zeiss
■ **TLED-L**	Lambda TLED for Leica
■ **TLED-C**	Lambda TLED with C-mount
TLED+	Includes Lambda TLED+ light source, TLED+ controller, white light LED, and power supply.
■ **TLEDPLUS-N**	Lambda TLED+ for Nikon
■ **TLEDPLUS-N25**[1]	Lambda TLED+ for Nikon TE200/300, Diaphot 200/300
■ **TLEDPLUS-Y**	Lambda TLED+ for Olympus
■ **TLEDPLUS-Z**	Lambda TLED+ for Zeiss
■ **TLEDPLUS-L**	Lambda TLED+ for Leica
■ **TLEDPLUS-C**	Lambda TLED+ with C-mount
TLED-RGB	Includes Lambda TLED-RGB light source, TLED controller and power supply.
■ **TLED-RGB-N**	Lambda TLED-RGB for Nikon
■ **TLED-RGB-Y**	Lambda TLED-RGB for Olympus
■ **TLED-RGB-L**	Lambda TLED-RGB for Leica
TLED-FT	LED Light array
■ **TLED-FT**	Lambda TLED-FT Light array
TLED-RL	Includes Lambda TLED-RL light source, TLED controller and ring light.
■ **TLED-RL**	Lambda TLED-RL reflected light illuminator

[*] *Custom mounting adapters are available for all models at an additional cost. Contact Sutter for details.*

[1] *Replaces the epi-illuminator.*

LAMBDA FLED
FLUORESCENT LIGHT SOURCE

FEATURES LAMBDA FLED

- >50,000 hour lifetime
- <25 µsecs On-Off time
- TTL control (with polarity switch)
- Very stable output
- Compact standalone design
- Easy installation

COMMON APPLICATIONS LAMBDA FLED

- Fluorescent microscopy
- Ultra high-speed wavelength selection (FLED-DC)

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The Lambda FLED was designed as a high-power LED driver for fluorescence microscopy. Based on our proven TLED+ design, the FLED has been optimized for single-channel, high-current LEDs used as excitation light sources.

The basic system consists of an LED mounted on a special black-anodized aluminum heat sink and a controller. The controller is CNC machined from solid aluminum billet, and powered by a rugged modular universal power supply. The FLED provides intensity control and on-off control via a toggle switch or TTL logic. The on-off time is less than 25 µsecs when using TTL control. In addition to digital input control, the Lambda FLED has an analog input to modulate the LED intensity. The Lambda FLED is expected to have stable output that will last more than 50,000 hours.

The Lambda FLED can be ordered with several different wavelength-specific LEDs that range from 365 nm to 940 nm. Please call us if you require a wavelength is not listed.

Our dual channel Lambda FLED option combines two high power LEDs into a single light path. The FLED-DC allows the use of two channels for fluorescence imaging. Both channels are driven by individual FLED controllers and can be triggered, also individually, by a TTL signal. For greater than two LEDs in a setup, please see our Lambda 421 or Lambda OBC.

Product	Wavelength options (nm)*	External Control
FLED	340, 365, 385, 410, 440, 460, 480, 506, 530, 561, 590, 630, 660, 740, 850, 940	Digital (BNC) / Analog (SMA)

* other wavelengths available upon request

Each Lambda FLED system includes an optical mounting adapter for the excitation port of the microscope and detailed installation instructions. Mounting adapters are designed to fit most models of Nikon, Olympus, Zeiss and Leica microscopes. Custom adapters are available at an additional cost.

SPECIFICATIONS LAMBDA FLED

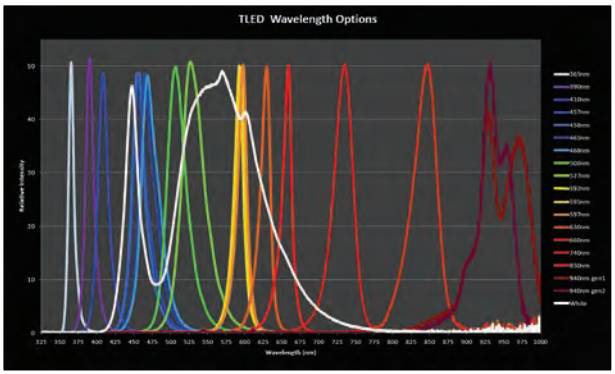
- **Output Range** White light (400 nm to 700 nm)
- **LED Life** >50,000 hours
- **Noise/Short Term Stability** 0.01%
- **Control Box Dimensions** FLED 4 in x 3.25 in x 4.1 in
  10.2 cm x 8.3 cm x 10.2 cm
- **Weight** 2.2 lbs
  1 kg
- **Electrical** 120/240 Volts
  50/60 Hertz power line
  75 Watts max

CE

ACCESSORIES LAMBDA FLED

- **TRIGGER**[1] USB trigger box

[1] *Compatible with Micro-Manager software*



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LAMBDA FLED

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LAMBDA FLED Single Channel LED Light Source

Includes Lambda FLED light source, FLED controller and power supply. Please select one wavelength when ordering.

- **FLED-N** Lambda FLED for Nikon
- **FLED-N25**[1] Lambda FLED for Nikon TE200/E300, Diaphot 200/300
- **FLED-N50** Lambda FLED for Nikon AZ100
- **FLED-Y** Lambda FLED for Olympus
- **FLED-Z** Lambda FLED for Zeiss
- **FLED-L** Lambda FLED for Leica
- **FLED-C**[2] Lambda FLED with C-mount

AVAILABLE WAVELENGTHS* (in nm)

340, 365, 385, 410, 440, 460, 480, 506, 530, 561, 590, 630, 660, 740, 850, 940

LAMBDA FLED-DC Dual Channel LED Light Source

Includes Lambda FLED light source, 2 FLED controllers, and power supplies. Please select two wavelengths of your choice.

- **FLED-DC-N** Dual Channel Lambda FLED and 2 controllers for Nikon
- **FLED-DC-Y** Dual Channel Lambda FLED and 2 controllers for Olympus
- **FLED-DC-Z** Dual Channel Lambda FLED and 2 controllers for Zeiss
- **FLED-DC-L** Dual Channel Lambda FLED and 2 controllers for Leica
- **FLED-DC-C** Dual Channel Lambda FLED and 2 controllers with C-mount
- **FLED-DC-SOM** Dual Channel Lambda FLED and 2 controllers for SOM®

AVAILABLE WAVELENGTH COMBINATIONS* (in nm)

340, 365, 385, 410, 440, 460, 480, 506, 530, 561, 590, 630 660, 740, 850, 940, White

** Other wavelengths and wavelength combinations may be available. Custom mounting adpters available on all models at an additional cost. Contact Sutter for further details.*

[1] Replaces the epi-illuminator.

[2] Suitable for SOM microscope.

LAMBDA DG-4 / DG-5 PLUS

HIGH-SPEED WAVELENGTH SWITCHER

FEATURES
LAMBDA DG-4 / DG-5 PLUS

- USB support
- Built-in *Smart*Shutter® control
- Expanded menu options and enhanced triggering
- Complete system for wavelength switching
- Integral shuttering
- Integral neutral density filtering
- Two outputs for monitoring filter position
- Turbo blanking
- Strobe-pulsed ring buffer control
- Direct computer control via parallel, serial or USB interface
- Switches in 0.5 msec

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The Lambda DG-4/DG-5 PLUS is a complete illumination system offering speed and versatility for experiments requiring rapid wavelength switching. New digital servo technology allows faster filter switching and 30% greater light output than the first generation DG-4/DG-5. The instrument retains all the advantages of interference filter based systems, yet eliminates the temporal constraints imposed by traditional filter changing devices like filter wheels. Switching between any two wavelengths is achieved in 0.5 msec, allowing the user to perform real-time video imaging. The high switching speed of the Lambda DG-4/DG-5 PLUS facilitates the ability to follow fast changes in ion concentrations in dual wavelength ratio imaging applications and to monitor other concomitant changes in the studied system at additional wavelengths.

Narrow bandpass systems, such as single cavity interference filters, grating monochromators, and A.O. modulators, pass unwanted harmonics of the desired wavelength. Also, with variable wavelength devices, it is not always possible to obtain sufficient blocking of out-of-band wavelengths. Modern interference filters, as used in the Lambda DG-4/DG-5 PLUS, do not pass harmonics and have integral blocking characteristics 1000 times better than typical monochromator systems. For the same full width at half maximum (FWHM), interference filters have a narrower spectral bandpass than monochromators due to the absence of the slit function.

The dual galvanometer design of the Lambda DG-4/DG-5 PLUS allows tuning of the relative intensities at each wavelength. This adjustment is difficult to obtain in variable wavelength devices with a single optical path. Unlike monochromators and other wavelength selective systems, the Lambda DG-4/DG-5 PLUS can be used as a source of white light when required.

How it works:
This unique optical design of the Lambda DG-4/DG-5 PLUS is based on dual scanning galvanometers utilizing interference filters for wavelength selection. The light from the xenon arc lamp is focused on the first galvanometer mirror which directs it via a parabolic mirror, through one of the interference filter channels. Following the filter, a second parabolic and a second galvanometer mirror collect and redirect the light into the light guide. A cold mirror in the beginning of the light path eliminates the IR radiation, reducing significantly the amount of heat absorbed by the optics and the sample. Cold mirrors modified to pass near-IR to 780 to 880 nm are also available.

A built-in shutter function allows reduction of light intensity by five to six orders of magnitude. For applications requiring mechanical shuttering, like time lapse experiments or very sensitive samples, an optional *Smart*Shutter® can be installed in the device to assure that the light is completely blocked. A newly integrated *Smart*Shutter controller eliminates the need to purchase a separate control device.

The standard system, the Lambda DG-4 PLUS, holds up to four 25 mm interference filters. The Lambda DG-5 PLUS, a five filter version, accommodates three 18 mm and two 25 mm filters. While the switching time between any two wavelengths is done in less than 0.5 msec, the dwell time at any wavelength is arbitrarily set by the user.

The liquid light guide can be coupled to the illumination port of most microscopes using an adapter which can be purchased separately. Please refer to the "Microscope Adapters" section for further information.Extended output ranges are possible with various cold mirror and light guide combinations. Phone Sutter to discuss your specific application requirements.

COMMON APPLICATIONS LAMBDA DG-4 / DG-5 PLUS

- Fluorescent microscopy
- Calcium imaging
- FURA
- Optogenetics
- Ultra high-speed wavelength selection

SPECIFICATIONS LAMBDA DG-4 / DG-5 PLUS

Lamp Type	300 Watt ozone free or full spectrum xenon arc bulb (pre-aligned to produce collimated output)
Output Range	330 nm to 650 nm – Ozone free 200 nm to 650 nm – Full spectrum (Note: full spectrum produces ozone)
Lamp Life	1000 hours (Bulb carries a prorated warranty for 500 hours. Longer life depends on application. Expected life is 1000 hours)
Power Consumption	350 Watts
Filter Diameter	DG-4 PLUS: Four, 25 mm (1 in) DG-5 PLUS: Two, 25 mm (1 in) and Three 18mm
Dimensions	10 in x 10 in x 19 in 25 cm x 25 cm x 48 cm
Light Guide	2 meters long 3 mm diameter
Weight	45 lbs 20 kg
Electrical	115/230 Volts 50/60 Hertz power line

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COMPLETE SYSTEM FOR WAVELENGTH SWITCHING

The Lambda DG-4 / DG-5 PLUS is a complete integrated 175 (or 300) Watt light source and wavelength switching excitation system.

Four or five interference filters can be easily installed in the DG-4 PLUS or DG-5 PLUS, respectively. An additional standard neutral density filter can be inserted in the common path of the light.

The light guide output from the Lambda DG-4 / DG-5 PLUS provides uniform spatial illumination, as well as vibration isolation from your microscope.

A cold mirror assembly eliminates IR radiation, extending the lifetime of the optics and the light guide, and preventing the exposure of the sample to IR when white light is necessary.

INTEGRAL SHUTTERING

The Lambda DG-4 / DG-5 PLUS provides a high-speed shutter function with open/close times of 500 µs. The shutter function reduces light intensity by 5 to 6 orders of magnitude.

If complete light shuttering is required, a mechanical shutter (i.e. *Smart*Shutter®) can be incorporated into the Lambda DG-4 / DG-5 PLUS.

INTEGRAL NEUTRAL DENSITY FILTERING

Neutral density filtering is achieved by offsetting the output galvanometer such that the light is not centered on the liquid light guide. Up to 15 logical filters can be defined with this method. Due to the scrambling effect of the light guide, the output has excellent uniformity.

Direct insertion of neutral density optical filters is also possible in the filter holders at any of the four optical channels. A final neutral density optical filter can be placed in the exiting light path which will reduce the light output from all optical channels.

TWO OUTPUTS FOR MONITORING FILTER POSITION

A 4 bit TTL signal transmits the current optical channel (filter) position.

A digital-to-analog converter (DAC) output produces a voltage showing which filter is in use.

TURBO BLANKING

The turbo blanking feature is designed for situations when the switching is done between non-adjacent filter positions. When the instrument is in this mode, the input and output galvanometer mirrors move out of sync, thus preventing the sample from being exposed to light of unwanted wavelength during switching and shuttering.

METHODS OF CONTROL
LAMBDA DG-4 / DG-5 PLUS

DIRECT COMPUTER CONTROL VIA USB, PARALLEL OR SERIAL INTERFACE

When operated in these modes, the Lambda DG-4 / DG-5 PLUS control commands are a subset of our Lambda 10-2 controller and will operate with software written for the Lambda 10-2.

If you plan to control the device with other interfaces, please contact Sutter for specific issues.

STROBE-PULSED RING BUFFER CONTROL

A sequence of up to 32 filter values can be loaded into a ring buffer via keypad or computer. The system will switch to the next filter in the buffer on a TTL level (trigger) strobe pulse. After executing the last filter change in the string, the system resets to the first filter and continues.

(View of back panel)

APPLICATIONS

- Fluorescence microscopy
- Ratio imaging
- Fura 2
- Optogenetics
- Mosaic® / PAGFP
- Mosaic Channel Rhodopsin

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LAMBDA DG-4 / DG-5 PLUS

*U.S. prices available at **www.sutter.com**. International prices vary by country. Contact a distributor or Sutter Instrument for a quotation. Prices subject to change without notice.*

DG-4 / DG-5 PLUS BASIC SYSTEM WITH IMPROVED GALVOS

Includes main unit with 300 W pre-aligned xenon arc bulb, 4 slide-in filter holders (25 mm), 1 neutral density filter holder (25 mm), power cord, serial and parallel cables, liquid light guide, spanner wrench, and manual. (DG-5 PLUS includes an additional 18 mm filter holder and flat wrench. Three positions are 18 mm, and two are 25 mm in diameter).

- **DG-4PLUS/OF30** DG-4 PLUS with 300 Watt ozone-free bulb
- **DG-4PLUS/FS30*** DG-4 PLUS with 300 Watt full spectrum bulb
- **DG-5PLUS/OF30** DG-5 PLUS with 300 Watt ozone-free bulb
- **DG-5PLUS/FS30*** DG-5 PLUS with 300 Watt full spectrum bulb

SPECIALTY DG-4

- **DG-4/T[1]** DG-4 PLUS with tungsten bulb

[1] Power supply is supplied by the customer.

**Note: Full spectrum bulbs produce ozone. Please be certain that you have ventilation. Contact Sutter for details.*

ACCESSORIES LAMBDA DG-4 / DG-5 PLUS

- **O661176[1]** Ozone free 175 Watt xenon bulb (useful wavelength range 330 nm – 700 nm)
- **O661301** Ozone free 300 Watt xenon bulb (useful wavelength range 330 nm – 700 nm)
- **O661175[1]** Full spectrum 175 Watt xenon bulb (useful wavelength range 300 nm – 700 nm)
- **O661300** Full spectrum 300 Watt xenon bulb (useful wavelength range 300nm – 700 nm)
- **O661115** Housing and heat sinks for bulb (bulb will be installed when ordered at the same time as housing)
- **IQ25-DG** 25 mm *Smart*Shutter® to fit Lambda DG-4 / DG-5 (requires controller)
- **DG-IF** Interference filter holder (25 mm)
- **DG-IF/18** Interference filter holder (18 mm)
- **DG-ND** Neutral density filter holder
- **X100160** Retaining ring (25 mm)
- **X100150** Filter spacer (25 mm)
- **X100120** Interference filter cup (25 mm)
- **X664162** Neutral density filter cup (25 mm)
- **X100158** Retaining ring (18 mm)
- **X100148** Filter spacer (18 mm)
- **X100118** Interference filter cup (18 mm)
- **CMAC** Serial cable for Mac
- **X664176** 18 mm brass spanner key
- **X100560** 25 mm spanner wrench

[1] 175 W bulbs are for the earlier model DG-4/DG-5.

Mounting adapters for Nikon, Zeiss, Olympus and Leica microscopes are available. Please see the Microscope Adapter list at the end of this section.

LAMBDA VF-5™ / VF-1™ /
TUNABLE FILTER CHANGERS

(Shown: Lambda VF-5)

FEATURES LAMBDA VF-5 / VF-1

- Patented white light output capability
- Wavelength range as wide as 338 nm to 900 nm
- Access any center-wavelength in nanometer increments
- Images pass through filters making it suitable for both excitation and emission
- Easily switch between flurophore combinations
- Optional liquid light guide offers absolute vibration isolation
- All the advantages of thin-film technology – high transmission, steep spectral edges, high out-of-band blocking
- Polarization independence (s and p nearly identical)

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Sutter Instrument has developed several filter changers specially designed for wavelength selection over a wide spectral range to any given nanometer value. The Lambda VF-5™, and Lambda VF-1™, employ the innovative VersaChrome® thin-film filter technology from Semrock® to provide outstanding bandpass characteristics such as high transmission (close to 100%), steep edges and out-of-band blocking. Since these filters pass an image, they are equally suitable for emission and excitation paths.

How It Works

A specific wavelength within the wide spectral range of each filter is obtained by adjusting the angle of incidence from 0 to 60 degrees. This tuning causes little or no change in spectral performance of the filter regardless of the state of polarization of the light passing through the filter. The current VersaChrome series has 7 filters covering 338 nm to 900 nm. By simply selecting the desired center-wavelength on the controller, users can select any combination of filters for the Lambda VF-5 (which holds up to 5 filters) or any single filter in the series for the Lambda VF-1.

The controller for these new tunable filter changers is a special version of our Lambda 10-B. Users can select the desired center wavelength in 1 nm increments from the keypad, or via the serial or USB ports. This allows control of the Lambda VF instruments with minimal changes to existing software supporting the popular Lambda 10-B controller. A sequence of wavelengths can be stored in the controller and the TTL input can then be used to trigger selection of the wavelengths in the sequence step-to-step. The firmware includes filter-specific data for each of the VersaChrome filters in the series.

The Lambda VF-5

Along with the ability to select any wavelength in the range covered by any combination of 5 VersaChrome filters, the Lambda VF-5 has a patented white-light output mode that allows the user to access the full spectral output of the excitation light source when it is required. White-light output is achieved by capturing the rejected light from the VersaChrome filter at a 45 degree angle and then combining the two beams on the output side of the VF-5. If this configuration is desired, it requires an additional custom light guide and SmartShutter® system.

When using the Lambda VF-5 for emission applications, we suggest installation of the 5 filters with the longer center-wavelengths covering from 430 nm to 800 nm. For excitation applications, we suggest installing the 5 filters with the shortest wavelengths covering 338 nm to 620 nm. For special applications, any combination of 5 filters could be installed in the Lambda VF-5. The compact Lambda VF-1 accepts any single filter in the series. The single VersaChrome filter installed in the Lambda VF-1 can be changed as needed.

VersaChrome® is a registered trademark of Semrock®, an IDEX company

The Lambda VF-1

The Lambda VF-1™ accepts any single filter in the series, which can be exchanged with other filters as needed. This model offers faster switching times as well as a more compact and affordable system. When used with the Lambda VF-1, the controller is able to also control a separate filter wheel or *Smart*Shutter®.

* Patent # 8,733,978, B2

(Shown: Lambda VF-1)

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COMMON APPLICATIONS LAMBDA VF-5 / VF-1

- Fluorescent microscopy
- Calcium imaging
- FURA
- Optogenetics
- Hyperspectral imaging wavelength selection

SPECIFICATIONS LAMBDA VF-5 / VF-1

Lambda VF-1™	2.8 in x 2.8 in x 4.4 in 7 cm x 7 cm x 11 cm 3.3 lbs 1.5 kg
Lambda VF-5™	9.4 in x 6 in x 5 in 23.8 cm x 15.2 cm x 12.7 cm 11.7 lbs 5.3 kg
Controller	6 in x 8.25 in x 5.25 in 15.2 cm x 21 cm x 13 cm 2.6 lbs 1.1 kg
Electrical	120/240 Volts 50/60 Hertz power line 75 Watts max

CE

LAMBDA VF-5 / VF-1

*U.S. prices available at **www.sutter.com**. International prices vary by country. Contact a distributor or Sutter Instrument for a quotation. Prices subject to change without notice.*

BASIC SYSTEM

- **VF-1**[1] Includes the Lambda VF-1™, a single VersaChrome® filter, Lambda 10-B control unit, serial and USB cables, power cable and manual
- **VF-5**[1] Includes the Lambda VF-5™, five VersaChrome® filters, Lambda 10-B control unit, serial and USB cables, power cable and manual

[1] *Please select filter(s) when ordering.*

VERSACHROME® FILTERS* – ORIGINAL SERIES

- **CO-O573380** Tunable filter, 380–338 nm with 16 nm bandwidth
- **CO-O573440** Tunable filter, 440–388 nm with 16 nm bandwidth
- **CO-O573490** Tunable filter, 490–429 nm with 15 nm bandwidth
- **CO-O573550** Tunable filter, 550–487 nm with 15 nm bandwidth
- **CO-O573620** Tunable filter, 620–547 nm with 14 nm bandwidth
- **CO-O573700** Tunable filter, 700–615 nm with 13 nm bandwidth
- **CO-O573800** Tunable filter, 800–699 nm with 12 nm bandwidth

** The ranges described above are the designed performance values for the VersaChrome coatings. The Semrock® catalog tuning ranges will be narrower due to different criteria.*

ACCESSORIES

- **O629950** Male-to-male C-mount adapter for mounting *Smart*Shutter® to Lambda VF-5 / VF-1
- **VF5-WL** Lambda VF-5™ white light kit
- **VF5-EMMSN-ADP** Emission adapter

VersaChrome® is a registered trademark of Semrock®

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LAMBDA 10-3
OPTICAL FILTER CHANGER

FEATURES LAMBDA 10-3

- As fast as 40 msec between adjacent filters (10 position wheel)
- As fast as 30 msec between adjacent filters (4 position wheel)
- As fast as 28 msec with a fully loaded wheel using STR filter from Semrock
- Can control three wheels and two shutters, or two wheels and three shutters
- Can accommodate *Smart*Shutter® and Uniblitz® shutter
- 7 speed settings to optimize movement
- Command set compatible with Lambda 10-2
- Automatically detects installed hardware
- Serial, parallel and USB interfaces
- Can control a variety of 25 mm, 32 mm and 50 mm wheels
- Chopper drives
- Universal power supply

COMMON APPLICATIONS LAMBDA 10-3

- Fluorescent microscopy
- Calcium imaging
- FURA
- Optogenetics
- High-speed wavelength selection

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The Lambda 10-3 is the latest generation of Sutter's high performance filter wheel changers. The controller now offers faster switching times, synchronous independent control of 3 filter wheels and 2 shutters (or 2 filter wheels and 3 shutters), and expanded communication interface options. Recent advances in motor technology allow the Lambda 10-3 to achieve switching times of 40 msec between adjacent filters. In addition, the controller commands can now be accessed via USB, serial, parallel, and keypad interfaces.

The Lambda 10-3 controls a variety of standard Sutter filter wheels including the popular 10 position 25 mm wheel, a lighter 4 position 25 mm wheel, a 10 position 32 mm wheel, 5 position 50 mm wheel, and a compact belt-drive 4 position wheel. The embedded controllers automatically detect the equipment installed and the source of the external commands, so there are no jumper wires or switches to set. There are seven speed settings available to optimize the rate of movement in accordance with the load of the wheel. The Lambda 10-3 can operate up to 40 msec switching time with the traditional 25 mm filter wheel as well as our newer, high-speed 32 mm version. The 4 position wheel (LB10-NWHS4) provides additional speed and can achieve switching times of less than 33 msec. Nearly all of our filter wheels employ a direct drive system. This design eliminates problems with belt slippage and backlash, assuring that our wheels are exceptionally robust.

Each wheel will accommodate filters from 1 mm to 9 mm in thickness, allowing multiple filters to be used in each position. For instance, this allows users to insert a neutral density filter along with an interference filter in a single position. We have designed the body of the filter wheel with a trap to eliminate light scatter. For added stability, non-emission filter wheels come with a sturdy support stand and 12 inch rods. In addition to filter wheels, the Lambda 10-3 controller supports our patented stepper-motor controlled *Smart*Shutter® as well as the Uniblitz® shutter. Either shutter can be mounted directly onto the wheel, providing a compact wheel/shutter package for systems with mounting constraints.

Both shuttered and non-shuttered filter wheels can be installed directly on the microscope in a number of locations: excitation, emission, Infinity path, and the trinocular head. Up to two excitation and/or neutral density filter wheels can be used with the Lambda LS xenon light source and liquid light guide, in vibration sensitive systems. The *Smart*Shutter can be mounted independently from the wheel in any location in the light path (including the Lambda LS and Lambda DG-4/DG-5), and driven in a standalone configuration by the Lambda 10-3 controller. The microscope specific adapters necessary for any configuration of wheels and shutter are listed in the Microscope Adapters section of the catalog.

The Lambda 10-3 commands are a superset of the Lambda 10-2, thus integrating all previously available features into the new design. Additional commands are incorporated to access the third wheel as well as the special *Smart*Shutter® features. These configurations can be programmed through the keypad making it easy to use the previous shutter commands to access the *Smart*Shutter specific functions such as the neutral density or the 'soft' shutter mode.

Filter selection can be made directly from the keypad or from a computer via the serial, parallel, or USB port. The controller determines the shortest route to the selected filter and an acceleration/deceleration algorithm minimizes vibrations during the movement of the wheel. Internal sensors ensure correct filter positioning and current filter position is displayed on the front panel. The serial port accepts RS-232 level signals through a DB-9 connector. USB input is made through a standard connector and can be directly connected to a PC USB port.

The universal power supply will automatically switch to accommodate the line voltage – no user adjustment is required. An optional liquid light guide is available for applications requiring absolute vibration isolation, and/or spatial illumination uniformity.

GETTING FASTER FILTER SWITCHING TIMES WITH MANY FILTERS INSTALLED
The Sutter filter wheel systems have always been optimized for fast switching of a lightly loaded wheel. When many thick filters are installed, the added mass requires an increase in the time required to switch from one filter to another. Switching times improve significantly with filters made on a thin substrate that do not require a thick layer of additional glass to obtain the desired blocking. Semrock® has the required coating technology to offer filters with substrates down to 2 mm in thickness.

We have now taken the additional step of designing a special threaded ring that Semrock can install in place of their typical plain filter cells. Filters mounted in these rings can be threaded directly into the body of our filter wheels when our standard filter cups have been removed. Semrock filters actually weigh less than the filter cup and retaining ring normally used to mount filters in the Sutter wheels. Thus, if you remove our filter cups and mount the new threaded filters directly in the wheel, even a fully loaded wheel will be able to run at speeds that previously could only be used with just 2 filters installed.

The STR Semrock filters are available in both 25 mm and 32 mm versions and should be purchased directly from Semrock. If you are installing these filters in a Sutter wheel that has filter cups, you will need to remove the cup from the position you intend to use to mount the threaded filter. Contact Sutter for details. When installing the new threaded filters, you will want to use the new wrench designed for this purpose.

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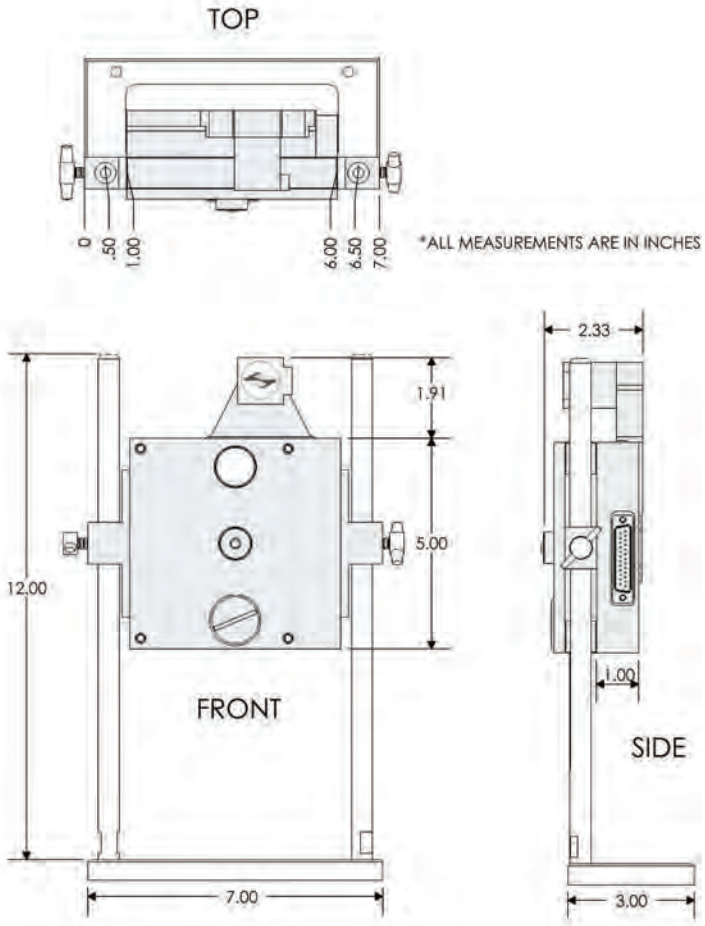
- **Control Box Dimensions** — 15.75 in x 11 in x 4 in
  40 cm x 28 cm x 10.2 cm
- **Weight** — 20 lbs
  11 kg
- **Electrical** — 120/240 Volts
  50/60 Hertz power line
  75 Watts max

CE

MECHANICAL DRAWINGS LAMBDA 10-NWIQ



(Shown with optional Smart Shutter®*)*

LAMBDA 10-3

*U.S. prices available at **www.sutter.com**. International prices vary by country. Contact a distributor or Sutter Instrument for a quotation. Prices subject to change without notice.*

CONTROLLER

LB10-3	Includes one Lambda 10-3 controller unit, serial, parallel and USB cables, power cable and manual

WHEELS

25 mm Filter Wheels — 10-position

LB10-NW	10-position 25 mm filter wheel without shutter
LB10-NWIQ	10-position 25 mm filter wheel with *Smart*Shutter®
LB10-NWS	10-position 25 mm filter wheel with Uniblitz® shutter
LB10-NWE	10-position 25 mm filter wheel set up for emission

25 mm Filter Wheels — 4-position

LB10-WHS4	4-position 25 mm filter wheel without shutter
LB10-WHS4IQ	4-position 25 mm filter wheel with *Smart*Shutter
LB10-WHS4E	4-position 25 mm filter wheel set up for emission

Thin Filter Wheels — 10-position

LB10-TW[1]	10-position 25 mm thin wheel without shutter
LB10-TWIQ[1]	10-position 25 mm thin wheel with *Smart*Shutter
LB10-TWE[1]	10-position 25 mm thin wheel set up for emission
LB10-TW32[1]	10-position 32 mm thin wheel without shutter

25 mm Dual Filter Wheels

LB10-WD	Back to back mounting of two 25 mm filter wheels without shutter. No drop-in filter holders
LB10-WDIQ	Back to back mounting of two 25 mm filter wheels with *Smart*Shutter and one slide-in filter holder
LB10-WDS	Back to back mounting of two 25 mm filter wheels with one Uniblitz shutter and one slide-in filter holder

32 mm Filter Wheels — 10-position

LB10-W32	10-position 32 mm filter wheel without shutter
LB10-W32IQ	10-position 32 mm filter wheel with *Smart*Shutter
LB10-W32S	10-position 32 mm filter wheel with Uniblitz shutter
LB10-TW32[1]	10-position 32 mm thin wheel without shutter
LB10-W32-Y73[2]	32 mm emission wheel for Olympus IX73/83

50 mm Filter Wheel — 5-position

LB10-W50	5-position 50 mm filter wheel without shutter

Specialty Wheels

LB10-W12	10-position 12.5 mm filter wheel without shutter
LB4-W	Belt drive 4-position 25 mm filter wheel without shutter
LB10-NWE-N29B	10-position 25 mm emission for bottom port of Nikon Ti
LB10-NWE-Z40[3]	10-position 25 mm emission for Zeiss Axio Observer
LB5-W32E-Y73	5-position 32 mm emission wheel for Olympus IX73/83
LB5-W32E-N31	5-position 32 mm emission wheel for Nikon Ti2
LB6-W32E-Y73	6-position 32 mm emission wheel for Olympus IX73/83
LB6-W32E-N31	6-position 32 mm emission wheel for Nikon Ti2

[1] Must be used with Semrock® filters that have Sutter threaded ring.
[2] Includes emisison adapter
[3] Left port only

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*SMART*SHUTTER®

- **IQ12-SA** 12.5 mm *Smart*Shutter with standalone housing
- **IQ12-AN** 12.5 mm hard anodized *Smart*Shutter
- **IQ25-SA**[1] 25 mm *Smart*Shutter with standalone housing
- **IQ25-W**[2] 25 mm *Smart*Shutter with housing to fit filter wheel
- **IQ25-WU** 25 mm *Smart*Shutter to retrofit non-shuttered filter wheel
- **IQ25-LS** 25 mm *Smart*Shutter with housing to fit Lambda LS
- **IQ25-DG** 25 mm *Smart*Shutter to fit in Lambda DG-4/DG-5
- **IQ35-W** 35 mm *Smart*Shutter with housing to fit filter wheel
- **IQ35-SA** 35 mm *Smart*Shutter with standalone housing

Mounting adapters for Nikon, Zeiss, Leica and Olympus microscopes are available. Please see the Microscope Adapters section of the catalog or contact Sutter Instrument for pricing and further information.

[1] Where vignetting may be an issue, we recommend the 35mm shutter.
[2] For upgrading a 25 mm filter wheel with existing Uniblitz® shutter to SmartShutter.

*U.S. prices available at **www.sutter.com**. International prices vary by country. Contact a distributor or Sutter Instrument for a quotation. Prices subject to change without notice.*

CABLES AND ACCESSORIES

CIQ-2	One 25-pin connector to two 9-pin connectors (Allows connection of one standalone *Smart*Shutter® to controller)
FSWITCH	Foot switch with BNC connector – Changes state of shutter with foot press as long as foot press is maintained
FSTOGGLE	Foot switch with BNC connector – Alternates open/close with each foot press
SLIDE-IN[1]	Slide-in filter holder for 25 mm wheel
DROP-IN[2]	Drop-in filter holder for 25 mm wheel
DROP-IN/32	Drop-in filter holder for LB10-W32IQ
X100120	25 mm filter cup
X100145[3]	25 mm angled filter spacer
X100150	25 mm spacer
X100160	25 mm retaining ring
X100122	32 mm filter cup
X100152	32 mm spacer
X100162	32 mm retaining ring
X100124	50 mm filter cup
X100126	50 mm short filter cup
X100154	50 mm spacer
X100164	50 mm retaining ring
LLG	Liquid light guide (2 meters, 3 mm diameter) C-mount, lens, and lens tube
SHUTTER	25 mm replacement shutter for Uniblitz® shutter (not an upgrade)
W620005	9-pin male/female serial cable
W620007	15-pin shielded cable for standard filter wheel
W620009	25-pin cable for wheels with *Smart*Shutter
W621520	USB cable
X100111	35 mm replacement Uniblitz shutter (not an upgrade)
X100208	8 inch guide rod for stand (each)
X100210	12 inch guide rod for stand (each)
X100212	22 inch guide rod for stand (each)
X100560	25 mm spanner wrench
X100555	25 mm thin wheel spanner wrench
X100565	32 mm spanner wrench
X100558	32 mm thin wheel spanner wrench
X100567	50 mm spanner wrench

*[1] Slide-in filter holders are for wheels **with** a shutter.*
*[2] Drop-in filter holders are for wheels **without** a shutter.*
[3] Two spacers are required for each filter position.

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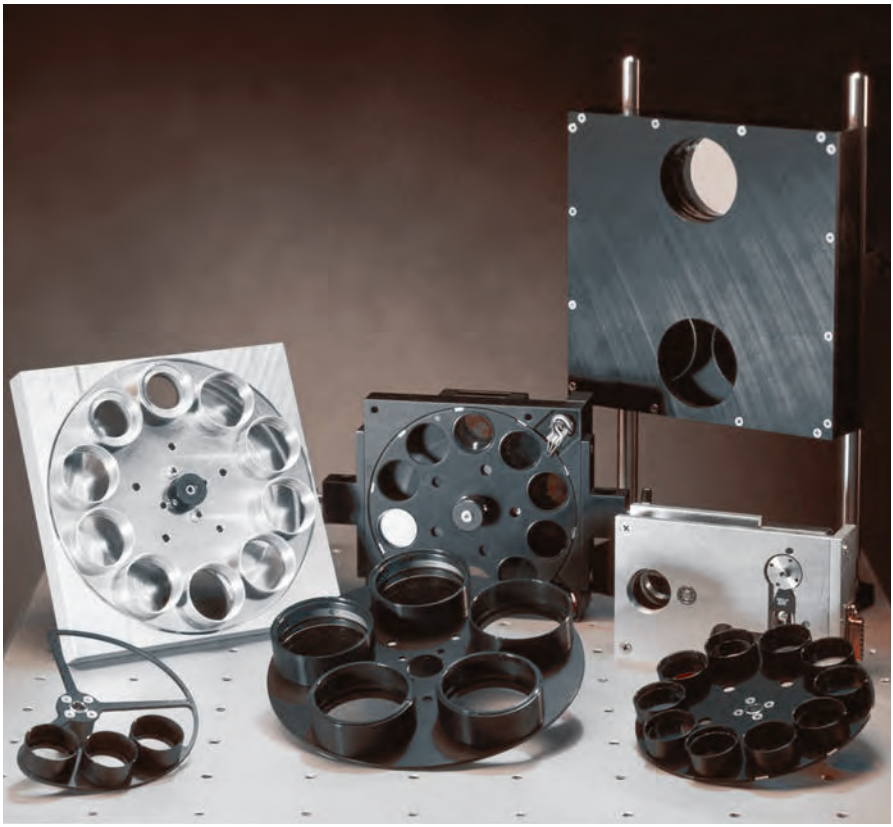
OEM WHEELS AVAILABLE

For OEM applications, the Lambda 10-3 can readily be modified to meet your specific requirements. By utilizing the 10-3 controller to drive customized wheels, we can provide an economical solution to your OEM design specification. To date we have made custom 2-, 3-, 4-, 5-, 10- and 12-position wheels and have designed for 50 mm, 32 mm and 25 mm filters. Our technical staff will be happy to discuss with you special application requirements.



LAMBDA 10-B
OPTICAL FILTER CHANGER

(Shown with LB10-NWIQ)

FEATURES LAMBDA 10-B

- As fast as 40 msec between adjacent filters (10-position wheel)
- As fast as 30 msec between adjacent filters (4-position wheel)
- As fast as 28 msec with a fully loaded wheel using STR filter from Semrock®
- Serial and USB interfaces
- Can control a variety of 25 mm, 32 mm, and 50 mm wheels
- Controls one wheel and one optional shutter, or two *Smart*Shutter®
- Can accommodate *Smart*Shutter and Uniblitz® shutter
- Chopper drives
- Universal power supply

COMMON APPLICATIONS LAMBDA 10-B

- Fluorescent microscopy
- Calcium imaging
- FURA
- Optogenetics
- High-speed wavelength selection

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The Lambda 10-B is a high performance, microprocessor-controlled filter wheel for imaging applications requiring a single filter wheel. The latest release in Sutter's optical filter changer product line, the Lambda 10-B, uses recent advances in motor technology to achieve switching times of 40 msec between adjacent filters. When used with the high-speed 4-position wheels, the Lambda 10-B achieves switching times of less than 31 msec. It features both USB and serial port interfaces as well as keypad control. The Lambda 10-B is capable of controlling both the *Smart*Shutter® as well as the Uniblitz® shutter. The Lambda 10-B is a low-cost alternative and ideal for imaging applications requiring a single filter wheel.

The Lambda 10-B can operate with switching times as brief as 40 msec with our standard 25 mm filter wheel as well as our 32 mm wheel. The user can select from seven speeds, allowing the speed to be adjusted in accordance with the load of the wheel. Except for the 4-position compact wheel, our filter wheels employ a direct drive system – a feature that prevents belt slippage or backlash. An optional shutter installation is also available.

Filter selection can be made directly from the keypad or from a computer via the serial or USB port. The Lambda 10-B controller determines the shortest route to the selected filter and an acceleration/deceleration algorithm minimizes vibrations during the movement of the wheel. The current filter position is displayed on the front panel. Internal sensors monitor the position of the filter wheel to insure that the correct filter is in place. The drive uses switching mode current regulation, which is more economical than the linear supply of the Lambda 10-2. Although this is not a problem with most imaging applications, the Lambda 10-2 may be more appropriate for systems where electrophysiology is performed.

Both serial and USB input ports are provided to allow complete and easy control from a remote computer. The serial port accepts RS232 level signals through a DB-9 connector. USB input is made through a standard connector and can be directly connected to a USB port. The Lambda 10-B's USB port interface supports multiple USB devices simultaneously, allowing a user to run in tandem as many units as USB ports. The universal power supply will automatically switch to accommodate local line voltage.

OPTIONS:
The basic system for the Lambda 10-B includes our popular 10-position 25 mm filter wheel. A significant advantage of the Lambda 10-B controller is that it can accommodate a variety of Sutter filter wheels to suit your particular requirements. The controller will automatically detect and determine the model of wheel installed and adjust for the number of positions and filter size.

Our 32 mm wheel was designed to remedy the problem of vignetting that may occur with a 25 mm filter format in certain microscope systems, and can achieve the same 40 msec switching times as our 25 mm wheel.

For applications requiring a larger aperture opening, there is a 5-position 50 mm filter wheel. If additional speed is required, we offer a high-speed, 4-position 25 mm wheel which is capable of achieving 31 msec switching times between adjacent filters. An optional liquid light guide is available for applications requiring absolute vibration isolation, and/or spatial uniformity independent of wavelength. The Lambda 10-B is also capable of controlling either the *Smart*Shutter® or the Uniblitz shutter.

GETTING FASTER FILTER SWITCHING TIMES WITH MANY FILTERS INSTALLED
The Sutter filter wheel systems have always been optimized for fast switching of a lightly loaded wheel. When many thick filters are installed, the added mass requires an increase in the time required to switch from one filter to another. Switching times improve significantly with filters made on a thin substrate that do not require a thick layer of additional glass to obtain the desired blocking. Semrock® has the required coating technology to offer filters with substrates down to 2 mm in thickness.

We have now taken the additional step of designing a special threaded ring that Semrock can install in place of their typical plain filter cells. Filters mounted in these rings can be threaded directly into the body of our filter wheels when our standard filter cups have been removed. Semrock filters actually weigh less than the filter cup and retaining ring normally used to mount filters in the Sutter wheels. Thus, if you remove our filter cups and mount the new threaded filters directly in the wheel, even a fully loaded wheel will be able to run at speeds that previously could only be used with just 2 filters installed.

The STR Semrock filters are available in both 25 mm and 32 mm versions and should be purchased directly from Semrock. If you are installing these filters in a Sutter wheel that has filter cups, you will need to remove the cup from the position you intend to use to mount the threaded filter. Contact Sutter for details. When installing the new threaded filters, you will want to use the new wrench designed for this purpose.

SPECIFICATIONS LAMBDA 10-B

Control Box Dimensions	6 in x 8.25 in x 5.25 in 15.2 cm x 21 cm x 13.3 cm
Weight	2.6 lbs 1.1 kg
Electrical	120/240 Volts 50/60 Hertz power line 75 Watts max

CE

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CONTROLLER

LB10-B/IQ[1]	Lambda 10-B control unit, serial and USB cables, power cord and manual

WHEELS

25 mm Filter Wheels — 10-position

LB10-NW	10-position 25 mm filter wheel without shutter
LB10-NWIQ	10-position 25 mm filter wheel with *Smart*Shutter®
LB10-NWS	10-position 25 mm filter wheel with Uniblitz® shutter
LB10-NWE	10-position 25 mm filter wheel set up for emission

25 mm Filter Wheels — 4-position

LB10-WHS4	4-position 25 mm filter wheel without shutter
LB10-WHS4IQ	4-position 25 mm filter wheel with *Smart*Shutter
LB10-WHS4E	4-position 25 mm filter wheel set up for emission

Thin Filter Wheels — 10-position

LB10-TW[2]	10-position 25 mm thin wheel without shutter
LB10-TWIQ[2]	10-position 25 mm thin wheel with *Smart*Shutter
LB10-TWE[2]	10-position 25 mm thin wheel set up for emission
LB10-TW32[2]	10-position 32 mm thin wheel without shutter

Filter Wheels — 10-position

LB10-W32	10-position 32 mm filter wheel without shutter
LB10-W32IQ	10-position 32 mm filter wheel with *Smart*Shutter
LB10-W32S	10-position 32 mm filter wheel with Uniblitz shutter
LB10-TW32[2]	10-position 32 mm thin wheel without shutter
LB10-W32-Y73[3]	32 mm emission wheel for Olympus IX73/83

50 mm Filter Wheel — 5-position

LB10-W50	5-position 50 mm filter wheel without shutter

Specialty Wheels

LB10-W12	10-position 12.5 mm filter wheel without shutter
LB4-W	Belt drive 4-position 25 mm filter wheel without shutter
LB10-NWE-N29B	10-pos. 25 mm emission for bottom port of Nikon Ti
LB10-NWE-Z40[4]	10-position 25 mm emission for Zeiss Axio Observer
LB5-W32E-Y73	5-position 32 mm emission wheel for Olympus IX73/83
LB5-W32E-N31	5-position 32 mm emission wheel for Nikon Ti2

[1] CIQ-2 cable provided when ordered with standalone shutter.
[2] Must be used with Semrock® filters that have Sutter threaded ring.
[3] Includes emission adapter.
[4] Left port onlly.

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LAMBDA 10-B

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*SMART*SHUTTER®

IQ12-SA	12.5 mm *Smart*Shutter® with standalone housing
IQ12-AN	12.5 mm hard anodized *Smart*Shutter
IQ25-SA[1]	25 mm *Smart*Shutter with standalone housing
IQ25-W[2]	25 mm *Smart*Shutter with housing to fit filter wheel
IQ25-WU	25 mm *Smart*Shutter to retrofit non-shuttered filter wheel
IQ25-LS	25 mm *Smart*Shutter with housing to fit Lambda LS
IQ25-DG	25 mm *Smart*Shutter to fit in Lambda DG-4/DG-5
IQ35-W	35 mm *Smart*Shutter with housing to fit filter wheel
IQ35-SA	35 mm *Smart*Shutter with standalone housing
IQ50-SA	50 mm *Smart*Shutter with standalone housing

ACCESSORIES

CIQ-2	One 25 pin connector to two 9 pin connectors (Connects up to 2 standalone shutters to LB10-B/IQ controller)
FSWITCH	Foot switch with BNC connector – Changes state of shutter with foot press as long as foot press is maintained
FSTOGGLE	Foot switch with BNC connector – Alternates open/close with each foot press
W620005	9-pin male/female serial cable
W620007	15-pin shielded cable for standard filter wheel
W621512	25-pin cable for wheels with *Smart*Shutter
W621520	USB cable
SLIDE-IN[3]	Slide-in filter holder for 25 mm wheel
DROP-IN[4]	Drop-in filter holder for 25 mm wheel
DROP-IN/32	32 mm drop-in filter holder for LB10-W32IQ
X100120	25 mm filter cup
X100145[5]	25 mm angled filter spacer
X100150	25 mm spacer
X100160	25 mm retaining ring
X100122	32 mm filter cup
X100152	32 mm spacer
X100162	32 mm retaining ring
X100124	50 mm filter cup
X100126	50 mm short filter cup
X100154	50 mm spacer
X100164	50 mm retaining ring

[1] *Where vignetting may be an issue, we recommend the 35 mm shutter.*

[2] *For upgrading a 25 mm filter wheel with existing Uniblitz® shutter to Smart*Shutter.

[3] *Slide-in filter holders are for wheels **with** a shutter.*

[4] *Drop-in filter holders are for wheels **without** a shutter.*

[5] *Two spacers are required for each filter position.*

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ACCESSORIES – continued

- **LLG** — Liquid light guide (2 meters, 3 mm diameter), C-mount, lens, and lens tube
- **SHUTTER** — 25 mm replacement shutter for Uniblitz® shutter (not an upgrade)
- **X100111** — 35 mm replacement Uniblitz shutter (not an upgrade)
- **X100208** — 8 inch guide rod for stand (each)
- **X100210** — 12 inch guide rod for stand (each)
- **X100212** — 22 inch guide rod for stand (each)
- **X100560** — 25 mm spanner wrench
- **X100555** — 25 mm thin wheel spanner wrench
- **X100565** — 32 mm spanner wrench
- **X100558** — 32 mm thin wheel spanner wrench
- **X100567** — 50 mm spanner wrench

SHUTTER MOUNTING POST

Stainless steel 1/2 in diameter. One end is ¼-20 (M6) tapped hole. Other end is #8-32 (M4) removable threaded stud. Can be used with 25 mm *Smart*Shutter, or 35 mm when used with the PMA-IQ35.

- **O620120** — 1 in / 25 mm long post
- **O620122** — 1.5 in / 38 mm long post
- **O620123** — 2 in / 50 mm long post
- **PMA-IQ35** — 35 mm post mount adapter

POST HOLDER

- **O620125** — Holder and spring loaded thumbscrew for mounting post

POST BASE PLATE

- **O620140** — 2 in x 3 in x 3/8 in base plate. Suitable for Imperial or Metric tables, posts, and post holders

POST COLLAR

- **O620150** — Slip-on collar, 1 in OD x 0.5 in ID

Mounting adapters for Nikon, Zeiss, Leica and Olympus microscopes are available. Please call Sutter Instrument for pricing and further information. Also, please see the Microscope Adapters section of this catalog.

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LAMBDA SC

*SMART*SHUTTER® CONTROLLER

(Shown with IQ35-SA and stand)

FEATURES *SMART*SHUTTER

- Robust design
- Life tested to 100 million cycles
- Modular repairable design
- Opening time 8 msec from trigger (for 25 mm and 35 mm versions)
- Continuous operation frequencies as high as 40 Hz
- Standalone or use with Sutter filter wheel
- Mountable in Lambda LS and Lambda DG-4 / DG-5

FEATURES LAMBDA SC

- Microprocessor based controller
- Serial, USB and TTL interfaces
- User can produce a variable aperture by selecting the degree of shutter opening
- "Soft" action mode provides minimum vibration
- TTL activation of the shutter can be set to high, low, or Toggle on rising/ falling edge
- Programmable delay and exposure intervals of up to 5 hours with millisecond resolution
- Commands can run continuously or loop a specified number of times
- Programmable delayed sync out
- Universal power supply

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The Lambda SC is a full-featured micro-processor controlled shutter driver for the *Smart*Shutter®. It supports the same shutter command set used for our other Lambda controllers and offers enhanced performance through additional modes of operation. The additional operating modes allow programmable control over the exposure time, the delay between exposures, the number of exposures, the mode of triggering and the mode of shutter operation. The Lambda SC utility program allows computer control and configuration of multiple SC controllers through serial or USB ports.

In the Lambda 10 family of filter wheel controllers, shutter timing is controlled directly by the time of occurrence of commands or TTL input. In most cases, the system software used with these controllers has provisions for controlling the timing of the shutter. The Lambda SC shutter controller may be used in applications that would benefit from enhanced control options built into the controller. A convenient toggle switch on the front panel has three positions: OPEN (shutter will open regardless of other inputs), CLOSED (shutter will close regardless of other inputs) and AUTO. In the AUTO position, the controller can be operated remotely from a computer through the USB port, or opened and closed using a logic level input.

In the free running mode, the shutter will open and close repeatedly. The time between closing and reopening can either be directly timed, or set as an interval for the entire cycle. Delay and exposure intervals can be set by the user for up to 5 hours with millisecond resolution. This mode can be set to continuously run or loop for a specific number of cycles. The mode is initiated from power up, or a trigger pulse, and can be interrupted by using a stop command.

Because the *Smart*Shutter incorporates a microprocessor controlled motor/wiper design, the trajectory of each move can be controlled and the motion of the blade optimized for speed or for smoothness. When speed is the most important condition, the user can select the fast mode. If the modest amount of vibration in the fast mode is objectionable and speed is not important, the “soft” mode can be selected, moving the blade slower through the overall travel.

The neutral density mode results in a partial opening of the *Smart*Shutter. Any one of the 144 steps from a fully closed to fully open can be selected. Using this variable aperture opening along with a liquid light guide acts to spatially homogenize the light to produce a uniform spatial illumination that’s independent of the geometry of the input illumination.

The *Smart*Shutter can be coupled to the illumination ports of most microscopes using an adapter which can be purchased separately. Please refer to the “Microscope Adapters” section for further information. An optical black coating option for the shutter blade is available to eliminate reflection. Please phone Sutter for details.

SPECIFICATIONS LAMBDA SC

- **Dimensions** 8.5 in x 5.25 in x 2 in
  21.6 cm x 13.5 cm x 5 cm
- **Weight** 1.7 lbs
  0.77 kg
- **Electrical** 120/240 Volts
  50/60 Hertz power line
  75 Watts max

CE

LAMBDA SC

*U.S. prices available at **www.sutter.com**. International prices vary by country. Contact a distributor or Sutter Instrument for a quotation. Prices subject to change without notice.*

CONTROLLER

- **LB-SC** Includes one Lambda SC control unit, serial and USB cable, power cord and manual

*SMART*SHUTTER

- **IQ12-SA** 12.5 mm *Smart*Shutter® with standalone housing
- **IQ12-AN** 12.5 mm hard anodized *Smart*Shutter
- **IQ25-SA**[1] 25 mm *Smart*Shutter with standalone housing
- **IQ25-LS** 25 mm *Smart*Shutter with housing to fit Lambda LS
- **IQ25-DG** 25 mm *Smart*Shutter to fit in Lambda DG-4 / DG-5
- **IQ35-W** 35 mm *Smart*Shutter with housing to fit filter wheel
- **IQ35-SA** 35 mm *Smart*Shutter with standalone housing
- **IQ50-SA** 50 mm *Smart*Shutter with standalone housing

[1] *Where vignetting may be an issue, we recommend the 35mm shutter.*

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CABLES AND ACCESSORIES

- **W621520** USB cable
- **W620005** 9-pin male/female *Smart*Shutter® (no wheel)
- **FSWITCH** Foot switch with BNC connector – Changes state of shutter with foot press as long as foot press is maintained
- **FSTOGGLE** Foot switch with BNC connector – Alternates open/close with each foot press

SHUTTER MOUNT POSTS

Stainless steel 1/2 in diameter. One end is ¼-20 (M6) tapped hole. Other end is #8-32 (M4) removable threaded stud. Can be used with 25 mm *Smart*Shutter, or 35 mm when used with the PMA-IQ35.

- **O620120** 1 in / 25 mm long post
- **O620122** 1.5 in / 38 mm long post
- **O620123** 2 in / 50 mm long post
- **O620124** 3 in / 76 mm long post
- **O620117** 4 in / 100 mm long post
- **O620119** 8 in / 203 mm long post
- **PMA-IQ35** 35 mm post mount adapter

POST HOLDER

- **O620125** 1 in / 25 mm holder & spring loaded thumbscrew for post
- **O620130** 2 in / 50 mm holder & spring loaded thumbscrew for post
- **O620134** 4 in / 100 mm holder & spring loaded thumbscrew for post
- **O620136** 6 in / 152 mm holder & spring loaded thumbscrew for post

POST BASE PLATE

Suitable for Imperial or Metric tables, posts, and post holders.

- **O620143** 1 in x 2.3 in x 3/8 in base plate.
- **O620140** 2 in x 3 in x 3/8 in base plate.

POST COLLAR

- **O620150** Slip-on collar, 1 in OD x 0.5 in ID

Mounting adapters for Nikon, Zeiss, Leica and Olympus microscopes are available. Please call Sutter Instrument for pricing and further information.Also, please see the Microscope Adapters section of this catalog.

*SMART*SHUTTER®

STEPPER-MOTOR DRIVEN SHUTTER

(Shown with LB10-B/IQ controller)

FEATURES *SMART*SHUTTER®

- Robust design
- Life tested to 100 million cycles
- Modular repairable design
- Opening time 8 msec from trigger (for 25 mm and 35 mm versions)
- Continuous operation frequencies as high as 40 Hz
- Standalone or use with Sutter filter wheel
- Mountable in Lambda LS, Lambda DG-4 / DG-5, and Lambda XL
- Microprocessor based controller
- "Soft" action mode provides minimum vibration
- Selection partial opening function for neutral density
- Serial, USB and TTL interfaces
- Manual input via keypad (on LB10-B/IQ)
- Universal power supply
- *Patent No. 7,253,575*

CE

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The *Smart*Shutter® is designed to complement our growing line of optical products and sets a new standard for shutter performance and reliability. In the traditional shutter design there are two or more "leaves" that rub against each other. Given time, the blades will wear down, bind, and the shutter will fail to open. The *Smart*Shutter is designed with only one moving part, which virtually eliminates the effects of wear and markedly improves performance. In the traditional shutter design there is an additional issue of the leaves binding in extreme temperature conditions. To solve this problem our shutter blade has the ability to perform well under very high temperature conditions, extending the life of the shutter.

The *Smart*Shutter incorporates a new high-performance motor drive and precision stepper-motor to provide added control and durability. Traditional shutters use a solenoid actuator requiring a high initial opening voltage for rapid opening of the shutter. This can overheat or burn out the coil of the shutter if the shutter is opened too frequently. With our microprocessor controlled motor/wiper design, we can control the trajectory of each move and optimize the motion of the blade for speed or for smoothness. The *Smart*Shutter, in either the 25 mm or 35 mm version, operates with open/close times of 8 msec from the command (3 msec from the start of motion). Since our robust design does not rely on over-driving the windings, we can achieve continuous operation at certain frequencies up to 40 Hz for the 25 mm version, and 20 Hz for the 35 mm model. While the 25 mm *Smart*Shutter can run at frequencies up to 40 Hz, some repetition rates may excite undesirable resonances that interfere with proper operation. A small adjustment in frequency will normally correct this.

Because the shutter blade is stopped by the action of the motor rather than mechanical stops, *Smart*Shutter units tested for over 100 million cycles show no sign of failure. The standard *Smart*Shutter blade is made of untreated aluminum. Non-reflective coatings are available upon request and are not recommended for use with arc lamps.

The microprocessor-based controller provides exceptional versatility and is adaptable to various modes of operation and function. The *Smart*Shutter can be programmed for a variety of movement profiles or to produce a variable aperture by determining the degree of shutter opening. When used in our Lambda LS xenon light source and coupled with a liquid light guide, the shutter acts as a programmable neutral density filter. In addition, while the impulse of our shutter is minimal, a "soft" action mode can be selected to decrease vibration.

The LB10-B/IQ controller for the *Smart*Shutter is capable of driving up to two shutters. To support this function a TTL input is supplied for remote triggering of the shutter, as well as a TTL output to support remote triggering of external devices such as a camera. The controller can also be operated locally (manually) from the controller keypad or remotely from a computer through either the USB or serial port.

A dedicated single shutter controller, the Lambda SC is also available and provides a USB port, serial port, TTL in and TTL sync out. The Lambda SC allows programmable control over the exposure time, and the delay between trigger and shutter opening.

Originally designed to be integrated into our 25 mm and 32 mm filter wheels, housings are also available for standalone units and for use in our Lambda LS, Lambda XL, and Lambda DG-4/DG-5 optical products. The standard *Smart*Shutter blade is made of untreated aluminum. Non-reflective coatings are available upon request and are not recommended for use with arc lamps. The modularity of the *Smart*Shutter assures that repairs, should they be necessary, are simple and economical.

*SMART*SHUTTER®

*U.S. prices available at **www.sutter.com**. International prices vary by country. Contact a distributor or Sutter Instrument for a quotation. Prices subject to change without notice.*

CONTROLLER

LB10-B/IQ	Lambda 10-B control unit, serial and USB cables, power cord and manual
LB-SC	Includes one Lambda SC control unit, serial and USB cable, power cord and manual

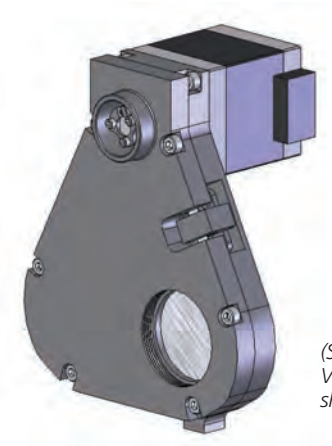
*SMART*SHUTTER

IQ12-SA	12.5 mm *Smart*Shutter® with standalone housing
IQ12-AN	12.5 mm hard anodized *Smart*Shutter
IQ25-SA[1]	25 mm *Smart*Shutter with standalone housing
IQ25-W[2]	25 mm *Smart*Shutter with housing to fit filter wheel
IQ25-WU	25 mm *Smart*Shutter to retrofit non-shuttered filter wheel
IQ25-LS	25 mm *Smart*Shutter with housing to fit Lambda LS
IQ25-DG	25 mm *Smart*Shutter to fit in Lambda DG-4 / DG-5
IQ35-W	35 mm *Smart*Shutter with housing to fit filter wheel
IQ35-SA	35 mm *Smart*Shutter with standalone housing
IQ50-SA[3]	50 mm *Smart*Shutter with standalone housing

[1] Where vignetting may be an issue, we recommend the 35 mm shutter.

*[2] For upgrading a 25 mm filter wheel with existing Uniblitz® shutter to *Smart*Shutter.*

[3] Compatible with Lambda SC controller.



(Shown: IQ25-SA.
Visit our website for images of other shutters.)

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CABLES AND ACCESSORIES

- **CIQ-2** One 25-pin connector to two 9-pin connectors (Connects up to 2 standalone shutters to LB10-B/IQ controller)
- **W621520** USB cable
- **W620005** 9-pin male/female *Smart*Shutter® (no wheel)
- **FSWITCH** Foot switch with BNC connector – Changes state of shutter with foot press as long as foot press is maintained
- **FSTOGGLE** Foot switch with BNC connector – Alternates open/close with each foot press

SHUTTER MOUNT POSTS

Stainless steel 1/2 in diameter. One end is ¼-20 (M6) tapped hole. Other end is #8-32 (M4) removable threaded stud. Can be used with 25 mm *Smart*Shutter, or 35 mm when used with the PMA-IQ35.

- **O620120** 1 in / 25 mm long post
- **O620122** 1.5 in / 38 mm long post
- **O620123** 2 in / 50 mm long post
- **O620124** 3 in / 76 mm long post
- **O620117** 4 in / 100 mm long post
- **O620119** 8 in / 203 mm long post
- **PMA-IQ35** 35 mm post mount adapter

POST HOLDER

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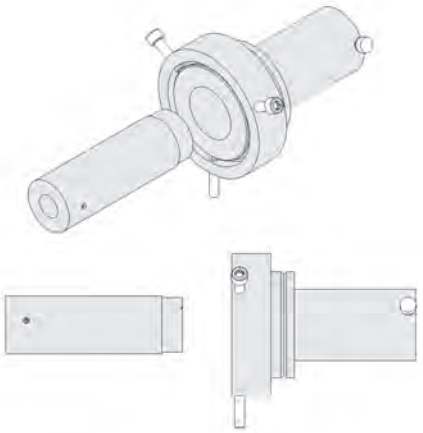
POST COLLAR

- **O620150** Slip-on collar, 1 in OD x 0.5 in ID

Mounting adapters for Nikon, Zeiss, Leica and Olympus microscopes are available. Please call Sutter Instrument for pricing and further information. Also, please see the Microscope Adapters section of this catalog.

MICROSCOPE ADAPTERS



ORDERING INFORMATION

It is advisable to contact Sutter Instrument to discuss your adapter needs prior to purchasing. All prices are U.S. prices. Pricing in other countries may vary.

LAMBDA FILTERWHEELS
Excitation adapters (suffix EC) include all components necessary for mounting our filter wheels between the microscope lamp housing and excitation port. Please select adapters with a prefix of 10 for wheels with a 25 mm aperture, and a prefix of 32 for wheels with a 32 mm aperture.

LAMBDA DG-4 / DG-5 PLUS
The Lambda DG-4 / DG-5 PLUS will only require a light guide adapter (prefix LG).

LAMBDA LS and LAMBDA HPX-L5
It is recommended that these instruments be used with the optional Liquid Light Guide and a light guide adapter (prefix LG).

LARGE FORMAT LIGHT GUIDE ADAPTERS
The large format light guide adapter (suffix LF) is necessary when a demagnification lens is present in the emission path to eliminate vignetting in the camera. This adapter is also recommended for those customers wishing to eliminate vignetting in the eyepiece.

LAMBDA VF-5™, VF-1™, VF-10, and VF-1™ Edge
Please phone Sutter to discuss your microscope and/or mounting requirements.

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*SMART*SHUTTER®

The *Smart*Shutter® can be mounted on the microscope excitation and transmitted light ports using our standard adapters. For easy reference:

IQ25 Excitation – use adapters that begin with 10
IQ35 Excitation – use adapters that begin with 32
IQ25 & IQ35 Transmitted light – use adapters ending with TL

MICROSCOPE ADAPTERS

OLYMPUS IX-70 / IX-50 (Y70) *Please contact Sutter to discuss your needs.*

BX-50 / BX-60 (Y50)

10-Y50-EC	EXCITATION
32-Y50-EC	EXCITATION – 32 mm
10-Y50-EM	EMISSION
LG-Y50	LIGHT GUIDE
LG-Y50-LF	LIGHT GUIDE – Large Format
25-Y50-TL	TRANSMITTED – 25 mm
35-Y50-TL	TRANSMITTED – 35 mm

BX-51 / BX-61 (Y51)

10-Y51-EC	EXCITATION
32-Y51-EC	EXCITATION – 32 mm
10-Y51-EM	EMISSION
LG-Y51	LIGHT GUIDE
LG-Y51-LF	LIGHT GUIDE – Large Format
25-Y51-TL	TRANSMITTED – 25 mm
35-Y51-TL	TRANSMITTED – 35 mm
SMA-Y51	FIBER COLLIMATING

BX-53 / BX-63 (Y53)

10-Y53-EC	EXCITATION
32-Y53-EC	EXCITATION – 32 mm
10-Y53-EM	EMISSION
10-Y53-IEM	EMISSION – Infinity
LG-Y53	LIGHT GUIDE
LG-Y53-LF	LIGHT GUIDE – Large Format
25-Y53-TL	TRANSMITTED – 25 mm
35-Y53-TL	TRANSMITTED – 35 mm

IX-51 / IX71 / IX-81 (Y71)

10-Y71-EC	EXCITATION
32-Y71-EC	EXCITATION – 32 mm
10-Y71-EM	EMISSION
10-Y71-SU	STAGE UP (IX71 only)
LG-Y71[1]	LIGHT GUIDE
LG-Y71-LF	LIGHT GUIDE – Large Format
25-Y71-TL	TRANSMITTED – 25 mm
35-Y71-TL	TRANSMITTED – 35 mm

IX-73 / IX-83 (Y73)

10-Y73-EC	EXCITATION
32-Y73-EC	EXCITATION – 32 mm
10-Y73-EM	EMISSION
LG-Y73[1]	LIGHT GUIDE
LG-Y73-LF	LIGHT GUIDE – Large Format
25-Y73-TL	TRANSMITTED – 25 mm
35-Y73-TL	TRANSMITTED – 35 mm
Y73-UD[2]	UP/DOWN SCOPE ADAPTER

[1] *Replaces the epi-illuminator*
[2] *Contact Sutter for details*

MICROSCOPE ADAPTERS

OLYMPUS (CONTINUED)

OPTICAL DECKS

OD-Y73-7	OPTICAL DECK – NARROW
OD-Y73-15	OPTICAL DECK – WIDE
OD-Y73-R	RIGHT SIDE EXTENSION – 5" x 9"
OD-Y73-L	LEFT SIDE EXTENSION – 5" x 5"

NIKON

TMD (N10)
TS100 (N15)
DIAPHOT 200/300 (N20)
OPTIPHOT (N30)
Please contact Sutter to discuss your needs.

TE200/300 (N25)

10-N25-EC	EXCITATION
32-N25-EC	EXCITATION – 32 mm
10-N25-EM	EMISSION (needs 1x relay lens)
35-N25-TL*	TRANSMITTED – 35 mm
10-N25-QB	BOTTOM (QUANTUM)
LG-N25[1]	LIGHT GUIDE

TE2000 (N27)

10-N27-EC	EXCITATION
32-N27-EC	EXCITATION – 32 mm
10-N27-EM	EMISSION
35-N27-TL	TRANSMITTED – 35 mm
LG-N27[1]	LIGHT GUIDE
LG-N27-LF	LIGHT GUIDE – Large Format
10-N27-SU[3]	STAGE UP

Ti (N29)

10-N29-EC	EXCITATION
32-N29-EC	EXCITATION – 32 mm
10-N29-EM	EMISSION
35-N29-TL	TRANSMITTED – 35 mm
LG-N29[1]	LIGHT GUIDE
LG-N29-LF	LIGHT GUIDE – Large Format
10-N29-SU[2]	STAGE UP
10-N29-SB[4]	STAGE UP – Bracket only
MA-N29[5]	MOSAIC

[1] Replaces the epi-illuminator
[2] For use with infinity path emission wheel applications only. Not applicable for any other applications.
[3] Places wheel in infinity path below the dichroic cassette
[4] For use in conjunction with standard Nikon 70 mm stage up kit (MED532000)
[5] For use with Mosaic and TIRF attachment

**Please contact Sutter to discuss solutions and early model Nikon scope adapters.*

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NIKON (CONTINUED)

Ti2 (N31)

10-N31-EC	EXCITATION
32-N31-EC	EXCITATION – 32 mm
10-N31-EM	EMISSION
35-N31-TL	TRANSMITTED – 35 mm
LG-N31[1]	LIGHT GUIDE
LG-N31-LF	LIGHT GUIDE – Large Format
LG-N31-SF	LIGHT GUIDE – Small Format
10-N31-SB[2]	STAGE UP – Bracket only

E400 & E600 (N40)

10-N40-EC[4]	EXCITATION
32-N40-EC[4]	EXCITATION – 32 mm
10-N40-EM	EMISSION
LG-N40[5]	LIGHT GUIDE
LG-N40-R[6]	LIGHT GUIDE

AZ 100 (N50)

LG-N50	LIGHT GUIDE

FN1 (N65)

10-N65-EC	EXCITATION
32-N65-EC	EXCITATION – 32 mm
10-N65-EM	EMISSION
LG-N65-LF	LIGHT GUIDE – Large Format

E800 & E1000 (N80)

10-N80-EC	EXCITATION
32-N80-EC	EXCITATION – 32 mm
10-N80-EM	EMISSION
LG-N80	LIGHT GUIDE

50i / 80i / 90i / Ni(N85)

10-N85-EC	EXCITATION
32-N85-EC	EXCITATION – 32 mm
10-N85-EM[7]	EMISSION
10-N85-IN[8]	EMISSION – INFINITY
LG-N85	LIGHT GUIDE
LG-N85-LF	LIGHT GUIDE – Large Format
35-N85-TL	TRANSMITTED – 35 mm

[1] Replaces the epi-illuminator
[2] For use in conjunction with standard Nikon 70 mm stage up kit (MED532000)
[3] We'll need to know which epi-illuminator you have
[4] For use with sliding dichroic illuminator
[5] For use with rotating dichroic illuminator
[6] Compatible with trinocular head that uses the Y-T photo tube. All other need infinity emission adapter.
[7] Puts filter wheel in emission infinity path

MICROSCOPE ADAPTERS

ZEISS

AXIOSKOP 2 & 2 FS (Z25)

10-Z25-EC	EXCITATION
10-Z25-EM[1]	EMISSION
35-Z25-TL	TRANSMITTED – 35 mm
LG-Z25	LIGHT GUIDE

AXIOVERT 35 and 100 series (Z30)

10-Z30-EC	EXCITATION
LG-Z30[2]	LIGHT GUIDE
10-Z30-KP	KELLER PORT
10-Z30-KP-M	KELLER PORT (100M SCOPE)
10-Z30-SP	SIDE PORT
10-Z30-TH	TRINOCULAR HEAD
10-Z30-TH-M	TRINOCULAR HEAD (135M SCOPE)

AXIOVERT 200 (Z35)

10-Z35-EC	EXCITATION
32-Z35-EC	EXCITATION – 32 mm
10-Z35-EM	EMISSION (side port on left)
10-Z35-EM-M	EMISSION – motorized
35-Z35-TL	TRANSMITTED – 35 mm
10-Z35-KP	KELLER PORT
LG-Z35	LIGHT GUIDE
LG-Z35-LF	LIGHT GUIDE – Large Format

AXIO OBSERVER (Z40)

10-Z40-EC	EXCITATION
32-Z40-EC	EXCITATION – 32 mm
10-X10-EM[3]	EMISSION (adapter only)
10-X20-EM	EMISSION (with relay optical system)
LG-Z40[2]	LIGHT GUIDE
LG-Z40-LF	LIGHT GUIDE – Large Format
25-Z40-TL	TRANSMITTED – 25 mm
35-Z40-TL	TRANSMITTED – 35 mm
SMA-240	FIBER COLLIMATING

AXIO IMAGER (Z45)
AXIO EXAMINER

10-Z45-EC	EXCITATION
32-Z45-EC	EXCITATION – 32 mm
10-X10-EM[3]	EMISSION (adapter only)
10-X20-EM	EMISSION (with relay optical system)
LG-Z45	LIGHT GUIDE
LG-Z45-LF	LIGHT GUIDE – Large Format
25-Z45-TL	TRANSMITTED – 25 mm
	TRANSMITTED – 35 mm

AXIOPLAN 2 (Z50)
Please contact Sutter to discuss your needs

[1] Please specify standard or ergonomic trinocular head
[2] Replaces the epi-illuminator
[3] Will need to be used with a relay optical system

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MICROSCOPE ADAPTERS

LEICA

DMR (L10)

10-L10-EC	EXCITATION
32-L10-EC	EXCITATION – 32 mm
10-L10-EM	EMISSION
LG-L10	LIGHT GUIDE

DMIRB & DMIRE2 (L20)

10-L20-EC	EXCITATION
32-L20-EC	EXCITATION – 32 mm
10-L20-EM[1]	EMISSION
LG-L20[1]	LIGHT GUIDE
LG-L20-LF	LIGHT GUIDE – Large Format

DM 4000/5000/6000 (L30)

10-L30-EC	EXCITATION
32-L30-EC	EXCITATION – 32 mm
10-L30-EM	EMISSION
LG-L30	LIGHT GUIDE
LG-L30-LF	LIGHT GUIDE – Large Format

DM 6000 FS (L35)

10-L35-EC	EXCITATION
32-L35-EC	EXCITATION – 32 mm
10-L35-EM	EMISSION
LG-L35	LIGHT GUIDE
LG-L35-LF	LIGHT GUIDE – Large Format

DMI 4000/5000/6000 (L40)

10-L40-EC	EXCITATION
32-L40-EC	EXCITATION – 32 mm
10-L40-EM	EMISSION
35-L40-TL	TRANSMITTED – 35 mm
LG-L40[2]	LIGHT GUIDE
LG-L40-LF	LIGHT GUIDE – Large Format

DMi8

10-L45-EC	EXCITATION
32-L45-EC	EXCITATION – 32 mm
10-L45-EM	EMISSION
35-L45-TL	TRANSMITTED – 35 mm
LG-L45	LIGHT GUIDE
LG-L45-LF	LIGHT GUIDE – Large Format

OTHER ADAPTERS

YOKOGAWA CSU-X1(J15)

10-J15-EM[3]	EMISSION
10-J30-EM	EMISSION – 3 degree angle

SUTTER LAMBDA VF-5/VF-1

10-X20-EM	EMISSION (with relay optical system)

CARV (J20)

CARV II	*Please contact Sutter to discuss your needs.*

[1] *Please specify standard or ergonomic trinocular head*
[2] *Replaces the epi-illuminator*
[3] *Fits both emission ports*