

SUTTER INSTRUMENT

2006

PRICES

Prices included herein are for items sold in the USA or Canada, F.O.B. Novato, California (exclusive of transportation, insurance, and applicable taxes), and are subject to change without notice. International prices are 5% higher. Please contact Sutter Instrument or your local representative for an overseas price quotation.

SHIPPING

Shipping charges are prepaid and added to our invoice. Unless otherwise specified when placing your order, we will use our best judgement in selecting a reliable and economical shipper of our choice.

RETURNS

Items ordered in error may be returned within 30 days of receipt and are subject to a 15% restocking fee. You are urged to retain the original shipping containers should there be a need to return the item. Please contact Sutter Instrument for a return authorization number.

QUALITY CONTROL

Sutter Instrument takes great pride in meeting the highest possible standards of quality and reliability. Each instrument undergoes a rigorous electronic and/or mechanical testing protocol during the production process. In the case of our micropipette pullers, every instrument is tested to assure its ability to consistently fabricate micropipettes with ultra-fine tips. A series of pipettes are pulled with each instrument and examined with our scanning electron microscope. No other manufacturer offers this level of quality control.

SERVICE & SUPPORT

We hope that our instruments and products continually meet your needs. However, should a problem arise, please contact our technical support staff to discuss the problem. If the instrument requires factory service, we will furnish shipping instructions. Items under warranty will be repaired free of any costs, for parts or service. Both delivery and return shipping costs are the responsibility of the owner.

WARRANTY INFORMATION

Sutter Instrument Company provides a limited warranty for one year from shipping date, on all Sutter made products and labor (except consumables and Uniblitz® shutter). To be covered under warranty, the instrument must have been operated in accordance with the instructions outlined in the instruction manual and in a manner that would be expected in the normal use of the product. Extended warranties may be purchased for an additional charge. Please contact Sutter for a quotation. Abuse, misuse, or unauthorized repairs will void any warranty.

PAYMENT METHODS

Payments may be made in U.S. Dollars in one of the following methods:

Major Credit Card: Master Card and VISA

Bank Draft drawn on a U.S. bank

International Money Order

Bank Wire Transfer

Irrevocable Letter of Credit (a processing fee will apply)

Outdated prices. Please see AutoMate Scientific web store for current prices.

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OPTICAL INSTRUMENTS



Precise mechanical movement and well engineered electronics have always been hallmarks of Sutter Instrument Company products. Fifteen 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 filter changing 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 a third filter wheel without the expense of an additional controller. 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 filters of larger diameter.

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 Company has responded with the **Lambda DG-4**, an integrated illumination system capable of switching wavelengths in less than 1.2 msec.

As demands for high throughput and lower exposure times have increased, the need for a stand-alone high power light source was met with the **Lambda LS**. Now, this 175 (or 300) Watt xenon lamp, cold mirror, and power supply is available in an efficient single cabinet design.

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.

LAMBDA DG-4/DG-5 HIGH SPEED WAVELENGTH SWITCHER



The **Lambda DG-4/DG-5** offers speed and versatility for experiments requiring rapid wavelength switching. 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 less than the 1.2msec vertical retrace period of a video signal, allowing the user to perform real-time video imaging. The high switching speed of the **Lambda DG-4/DG-5** facilitates the ability to follow fast changes in ion concentrations in dual wavelength ratio imaging applications and to monitor other concomitant changes in system studied 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**, 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 due to the absence of the slit function.

The dual galvanometer design of the **Lambda DG-4/DG-5** allows

tuning of the relative intensities at each wavelength. This adjustment, in variable wavelength devices with a single optical path, is difficult to obtain. Unlike monochromators and other wavelength selective systems, the **Lambda DG-4/DG-5** 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** 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. It is then directed, via a parabolic mirror, through one of the interference filter channels, is collected after the filter by another parabolic mirror and focused on a second scanning mirror which directs it to the liquid 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. A cold mirror modified to pass near-IR to 1000nm is also available.

A built-in shutter function will reduce light intensity by six orders of magnitude. For applications requiring mechanical shuttering, like time lapse experiments or very sensitive samples, the *SmartShutter* can be added to assure that the light is completely blocked.

The standard version of the **Lambda DG-4**, holds up to four 25mm interference filters. The **Lambda DG-5**, a five filter version, accommodates three 18mm and two 25mm filters. While the switching time between any two wavelengths is done in less than 1.2 ms, the dwell time at any wavelength

SPECIFICATIONS > LAMBDA DG-4



Output Range

330nm to 700nm - Ozone free
300nm to 700nm - Full spectrum (requires ozone removal)

Lamp Type

175 or 300 Watt ozone free or full xenon arc bulb spectrum

Lamp Lifetime

Expected lifetime 1,000 hours
(All bulbs warrantied for 500 hours.)

Power Consumption

350 Watts

Filter Diameter

DG-4: Four, 25mm (1 inch)
DG-5: Two, 1in (25mm) and
Three (18mm)

Dimensions

10in x 10in x 19in
25cm x 25cm x 48cm

Light Guide

2 meters long
3mm diameter

Weight

45lbs
20kg

Electrical

115/230 Volts
50/60 Hertz power line

is arbitrarily set by the user. The liquid light guide can be coupled to the illumination port of most microscopes using an optional adapter. Please refer to the "Microscope Adapters" section for further information.

FEATURES**> LAMBDA DG-4****Complete system for wavelength switching**

A built-in 175 or 300 Watt ozone-free xenon arc lamp makes the **Lambda DG-4 / DG-5** a complete excitation system, and eliminates problems associated with device integration.

Four or five interference filters can easily be installed in the **DG-4** or **DG-5**, 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** provides uniform spatial illumination, as well as vibration isolation from your microscope.

Integral shuttering

The **Lambda DG-4 / DG-5** provides a high speed shutter function with open/close times of 500 μ s. The shutter function reduces light intensity by 5 to 6 orders of magnitude, and can be enabled between filter transitions to prevent light transmission through intermediate filters. Mechanical filters can be added when complete light shuttering is required.

Integral neutral density filtering

Neutral density filtering is achieved under program control by offsetting the output galvanometer such that light is not centered on the liquid light pipe. Up to 15 logical filters can be defined with this method. Due to the scrambling effect of the light guide, the output still 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 4 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.

METHODS OF CONTROL**> LAMBDA DG-4****Direct Computer Control via Parallel or Serial Interface**

When operated in these modes, the **Lambda DG-4 / DG-5** 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 DG-4 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 change to the next filter in the buffer on a strobe pulse. Each subsequent pulse will cause a move to the next filter in the buffer on a TTL level strobe (trigger) pulse. After executing the last filter change in the string the system resets to the first filter and continues.

Video Sync Pulse

A video sync pulse can be used to initiate the filter change for each sequence stored in the ring buffer. Stand-alone operation of the **Lambda DG-4 / DG-5** is achieved in this mode using only a video sync input.

Video Sync with Strobe Low

In this mode, the system will implement a filter change on the video sync pulse, but only if the strobe line is held low. This allows a computer to override the sync pulse.

(View of Lambda DG-4 back panel)



US PRICES
> DG-4/DG-5

*International prices are 5% higher.
 Prices subject to change without notice.*

BASIC SYSTEM

DG-4/OF Includes Lambda DG-4 unit, pre-aligned 175 Watt **ozone free** xenon arc bulb, 4 slide-in filter holders, 1 neutral density filter holder, power cord, serial and parallel cables, liquid light guide, spanner wrench, and manual. **\$ 17,900**

DG-4/OF30 Same as DG-4/OF, except 300 W bulb. **\$ 18,900**

DG-4/FS Same as DG-4, except **full spectrum** 175W bulb. **\$ 17,900**

DG-4/FS30 Same as DG-4/FS, except 300 W bulb. **\$ 18,900**

DG-5/OF Same as DG-4/OF, except with 5 filter positions and an additional 18 mm flat wrench. Three positions are 18mm and two are 25 mm. **\$ 17,900**

DG-5/FS Same as DG-4/FS, except with 5 filter positions and an additional 18 mm flat wrench. Three positions are 18mm and two are 25 mm. **\$ 17,900**

ACCESSORIES

O661176 Ozone free 175 Watt xenon bulb (attenuated output below 340nm) **\$ 630**

O661301 Ozone free 300 Watt xenon bulb (attenuated output below 340nm) **\$ 630**

O661175 Full spectrum 175 Watt xenon bulb **\$ 630**

O661300 Full spectrum 300 Watt xenon bulb **\$ 630**

O661115 Housing and heat sink for bulb (bulb will be installed when ordered at the same time as housing) **\$ 250**

DG-IF Interference filter holder (25mm) **\$ 52**

DG-IF/18 Interference filter holder (18mm) **\$ 52**

DG-ND Neutral density filter holder **\$ 52**

Mounting adapters for Nikon, Zeiss, Leica and Olympus microscopes are available. Please see the microscope adapter list at the end of this section. Please call Sutter Instrument for pricing and further information.

US PRICES
> DG-4/DG-5
ACCESSORIES (continued)

O724025	UV light enhanced galvanometer mirror**	\$ 350
X100160	Retaining ring (25mm)	\$ 12
X100150	Filter spacer (25 mm)	\$ 6
X100120	Interference filter cup (25 mm)	\$ 17
X664162	Neutral density filter cup (25 mm)	\$ 14
X100158	Retaining ring (18mm)	\$ 12
X100148	Filter spacer (18 mm)	\$ 6
X100118	Interference filter cup (18 mm)	\$ 17
CMAC	Serial cable for Macintosh	\$ 100

Mounting adapters for Nikon, Zeiss, Leica and Olympus microscopes are available. Please see the microscope adapter list at the end of this section. Please call Sutter Instrument for pricing and further information.

*** Must order two for a complete set. \$90 each when ordered with new DG-4/DG-5.*

LAMBDA 10-3

OPTICAL FILTER CHANGER



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

The **Lambda 10-3** controls a variety of standard Sutter filter wheels including the popular 10 position 25mm wheel, a lighter 4 position 25mm wheel, a 10 position 32mm, 5 position 50mm, and a compact belt-drive 4 position wheel. 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 40msec switching time with the traditional 25mm 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 33msec. 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.

In addition to filter wheels, the **Lambda 10-3** controller supports our stepper-motor controlled SmartShutter 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, Keller ports, 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 *SmartShutter* 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 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 *SmartShutter* features. These configurations can be programmed through the keypad making it easy

to use the previous shutter commands to access the *SmartShutter* 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 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 **Lambda 10-3** USB interface supports multiple simultaneous USB devices, allowing a user to run in tandem as many units as they have USB ports.

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.

SPECIFICATIONS

> LAMBDA 10-3

Dimensions of Control Box

8.2 in x 5.9 in x 5.1 in
14.9 cm x 20.8 cm x 13 cm

Weight

20lbs
11kg

Electrical

120/240 Volts
50/60 Hertz power line
75 Watts max



FEATURES
> LAMBDA 10-3

40 msec between adjacent filters
(10 position wheel)

33 msec between adjacent filters
(4 position wheel)

Controls three wheels and up to
two optional shutters

Can accommodate *SmartShutter*
and Uniblitz® shutter

Command set compatible with
Lambda 10-2

Automatically detects installed
hardware

Serial and USB interfaces

Can control a variety of 25 mm,
32 mm & 50mm wheels

Chopper drives

Universal power supply

US PRICES
> LAMBDA 10-3
CONTROLLER

LB10-3
Includes one Lambda 10-3 controller unit, serial and USB cables,
power cable and manual **\$ 2,400**

WHEELS

LB10-NW
10 position 25mm filter wheel without shutter **\$ 2,750**

US PRICES (CONTINUED) *International prices are 5% higher.*
> LAMBDA 10-3 *Prices subject to change without notice.*

LB10-NWIQ
10 position 25mm filter wheel with *SmartShutter* **\$ 3,500**

LB10-NWS
10 position 25mm filter wheel with Uniblitz® shutter **\$ 3,350**

LB10-NWE
10 position 25mm filter wheel set up for emission **\$ 2,500**

LB10-W32
10 position 32mm filter wheel without shutter **\$ 3,000**

LB10-W32IQ
10 position 32mm filter wheel with *SmartShutter* **\$ 4,500**

LB10-W32S
10 position 32mm filter wheel with Uniblitz® shutter **\$ 4,025**

LB10-WHS4
4 position 25mm filter wheel without shutter **\$ 2,800**

LB10-W50
5 position 50mm filter wheel without shutter **\$ 3,500**

LB4-W
Belt drive 4 position 25mm filter wheel without shutter **\$ 2,800**

SMARTSHUTTER

IQ25-W
25mm *SmartShutter* with housing to fit filter wheel **\$ 950**

IQ25-SA
25mm *SmartShutter* with stand-alone housing **\$ 950**

IQ25-LS
25mm *SmartShutter* with housing to fit Lambda LS **\$ 950**

IQ25-DG
25mm *SmartShutter* with housing to fit Lambda
DG-4/DG-5 **\$ 950**

IQ35-W
35mm *SmartShutter* with housing to fit filter wheel **\$ 1,250**

IQ35-SA
35mm *SmartShutter* with stand-alone housing **\$ 1,250**

US PRICES (CONTINUED)
> LAMBDA 10-3

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CABLES AND ACCESSORIES

Cable:

CIQ-2
 One 25 pin connector to two 9 pin connectors (Connects up to
 2 stand alone shutters to controller) **\$ 100**

SLIDE-IN*

Slide-in filter holder for 25mm wheel with shutter **\$ 52**

DROP-IN**

Drop-in filter holder for 25mm wheel without shutter **\$ 32**

LLG

Liquid light guide (2 meters, 3mm diameter) C-mount,
 lens, and lens tube **\$ 1,400**

SHUTTER

25mm replacement shutter for Uniblitz® shutter (not an upgrade)
\$ 370

SHUTTER/32

35mm replacement Uniblitz® shutter (not an upgrade) **\$ 750**

*Mounting adapters for Nikon, Zeiss, Leica and Olympus
 microscopes are available. Please see the Microscope Adapters page
 on page 114 or contact Sutter Instrument for pricing and further information.*

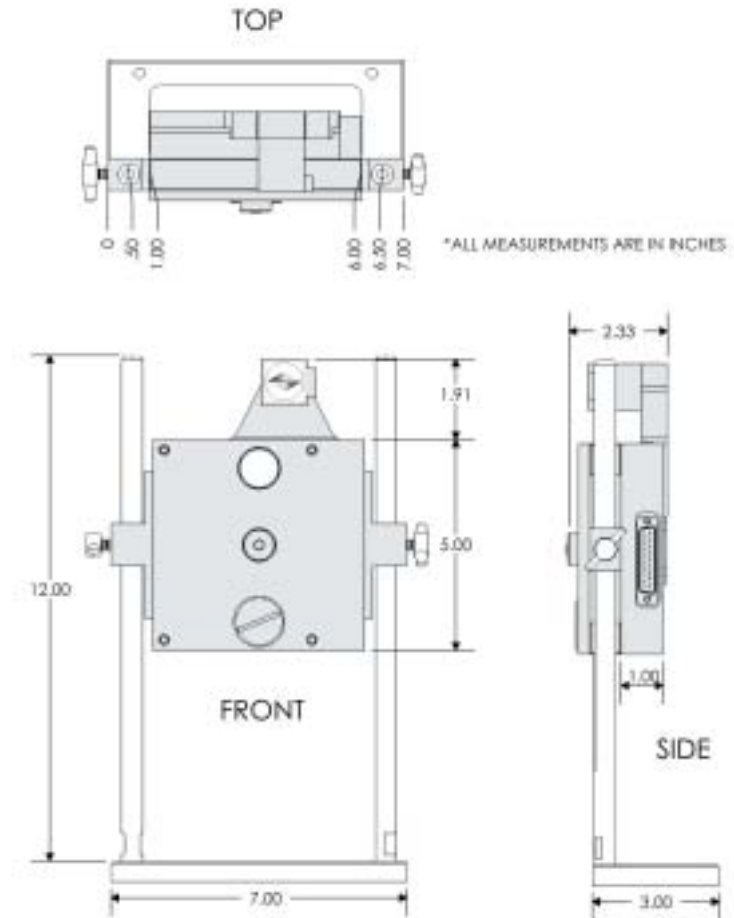
OEM wheels available

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 50mm, 32mm and
 25mm filters. Our technical staff will be happy to discuss with you spe-
 cial application requirements.

** Slide-in filter holders are for use with 10 position 25mm wheel with
 shutter.*

*** Drop-in filter holders are for use with 10 position 25mm wheel
 without shutter.*

MECHANICAL DRAWINGS LAMBDA 10-NWIQ



(Shown with optional shutter)

LAMBDA 10-2 OPTICAL FILTER CHANGER



The **Lambda 10-2** is the ideal choice for researchers whose applications are intolerant of electrical noise. The low-noise linear electronics of the controller assure that only DC voltages are present on the motor windings when the wheels are not moving. The **Lambda 10-2** is capable of independently operating up to two filter wheels and two Uniblitz shutters. The reliable, smooth operation of the **Lambda 10-2** has made it highly suitable for research applications involving fluorescence microscopy, ratio imaging, spectrophotometry, and visual physiology. The controller electronics are designed around three embedded chips; one slave for each wheel and a master for control and communication. 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.

The **Lambda 10-2** system can hold up to ten optical filters (25mm in diameter and up to 9mm thick) which are easily loaded through an access port on the housing. Additional filters (e.g. heat and/or neutral density filters) may be inserted manually at two other locations in the optical path. The optical ports on both sides of the unit are internally threaded as C-mounts (32 threads per inch). When mounted in an upright position, the center of the optical port can be positioned from 11cm to 53cm above the mounting surface. Slide-in filter holders are optionally available

for inverted configurations. A second wheel can be added to the system with no need for additional mechanical or electronic changes.

Eight user selectable speeds are provided. Filter to adjacent filter time can be set from 55 to 1200msec, depending on the number and the weight of the filters mounted in the wheel. Integral shutter drivers will open the optional shutter in 10msec. The use of a direct drive stepper-motor with advanced microstepping technology and intelligent acceleration and deceleration algorithms assures the fastest possible moves for a given inertial load, while minimizing vibrations.

The **Lambda 10-2** consists of a 10-position filter wheel, a rack mountable controller, a support base and mounting rods, a controller/filter wheel interface cable, parallel and serial interface cables, two drop-in filter holders, spanner wrench, and manual. Microscope adapters for most Nikon, Olympus, Zeiss, and Leica scopes can be purchased separately.

An optional liquid light guide output

is available for applications requiring absolute vibration isolation, and/or uniform spatial illumination. The two meter long guide mounts directly onto the output port of the wheel. Transmission through the guide is better than 70% from 375nm to 575nm. Adapters to connect the light guide to your microscope port are available as an option.

OTHER MODELS

The **Lambda 10-2/32**, was designed to remedy the problem of vignetting that may occur with a 25mm filter format in certain microscope systems. The system features a modified **Lambda 10-2** controller but includes a ten position wheel that accommodates 32mm diameter filters, up to 9mm thick. The best filter to adjacent filter switching speed in this system is achieved in 75 msec. A shutter for the system is optionally available. A T-mount format is used for mounting the wheel onto your microscope. Contact Sutter Instrument for information on available T-mount adapters.

SPECIFICATIONS > LAMBDA 10-2

Filter Diameter

1in
25mm

Weight

25lbs
11kg

Dimensions

Controller 16in x 11in x 3.5in
41cm x 28cm x 9cm

Electrical

115/230 Volts
50/60 Hertz power line

Filter wheel 5in x 5in x 2.25in
13cm x 13cm x 6cm



FEATURES
> LAMBDA 10-2

55msec between adjacent filters.
 Parallel and serial interfaces.
 Simultaneous and independent control of two wheels.
 Dual integral shutter drivers.
 Linear power supply

OPTIONS
> LAMBDA 10-2

Additional wheel.
 Built-in shutter.
 Dual wheels mounted in series.
 Slide-in filter holders.
 Microscope mounting adaptors.
 Table-top controller box.
 Liquid light guide.

OTHER MODELS

The **Lambda 10-232**, was designed to remedy the problem of vignetting that may occur with a 25mm filter format in certain microscope systems. The system features a modified Lambda 10-2 controller but includes a ten position wheel that accommodates 32mm diameter filters, up to 9mm thick. The best filter to adjacent filter switching speed in this system is achieved in 75 msec. A shutter for the system is optionally available. A T-mount format is used for mounting the wheel onto your microscope. Contact Sutter Instrument for information on available T-mount adaptors.

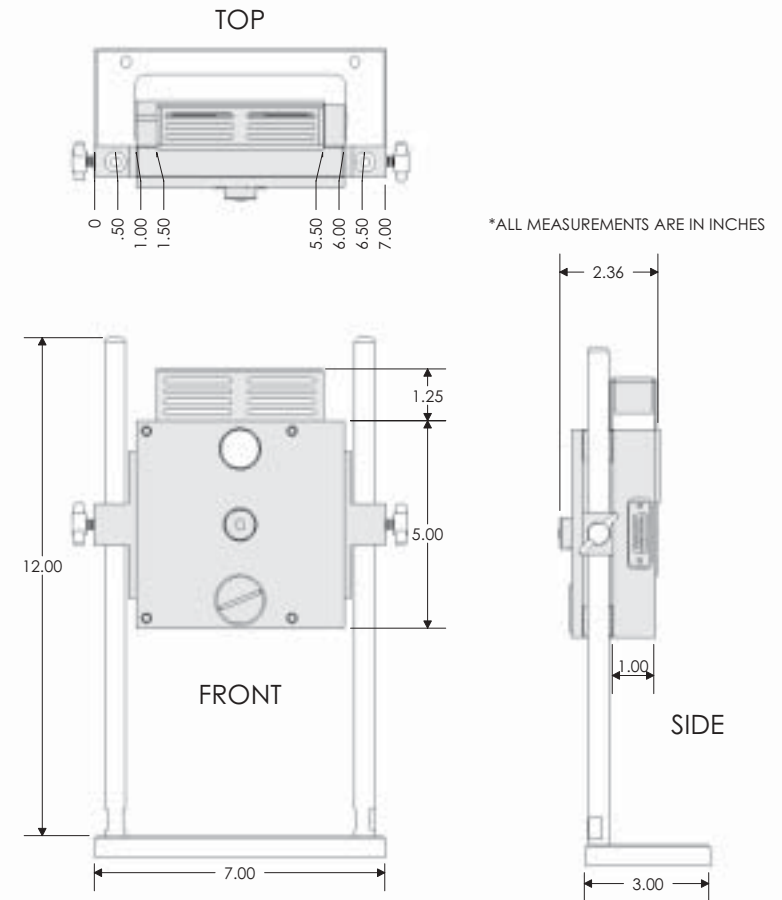
OEM wheels available

For OEM applications, the **Lambda 10-2** can readily be modified to meet your specific requirements. By utilizing the 10-2 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 50mm, 32mm and 25mm filters. Our technical staff will be happy to discuss with you special application requirements.

OEM wheels available

For OEM applications, the **Lambda 10-2** can readily be modified to meet your specific requirements. By utilizing the 10-2 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 50mm, 32mm and 25mm filters. Our technical staff will be happy to discuss with you special application requirements.

MECHANICAL DRAWINGS LAMBDA 10-NWS


(Shown with optional shutter)

US PRICES
> LAMBDA 10-2

*International prices are 5% higher.
Prices subject to change without notice.*

SYSTEMS

LB10-2 Includes one 25mm filter wheel without shutter, support base with mounting rods, rack mount¹ controller unit with wheel drive cable, parallel and serial interface cables for connection to PC, two drop-in filter holders, spanner wrench, 10 blanking discs, power cord, and manual **\$ 5,150**

LB10-2S Same as above—with Uniblitz® shutter assembly and two slide-in filter holders. **\$ 5,750**

LB10-232 Same as LB10-2 except with 32mm, T-mount threaded filter wheel (no drop-in filters) and modified 10-2 controller **\$ 5,400**

LB10-232S Same as LB10-232 except with Uniblitz® shutter (no drop-in or slide-in filters) and modified 10-2 controller **\$ 6,425**

LB10-250 Same as LB10-2 except with 50mm, 5 position wheel **\$ 5,900**

DUAL WHEELS IN SERIES

DUAL This option permanently modifies a two wheeled Lambda 10-2 system to allow face to face mounting of the filterwheels in series. This modification must be made at the factory, and requires ordering a second filterwheel along with the basic Lambda 10-2 system. No drop-in filters can be used in this configuration, but one slide-in filter can be used if the second wheel is ordered with a shutter **\$ 315**

1) Tabletop controller box available on request.

US PRICES (CONTINUED)
> LAMBDA 10-2

*International prices are 5% higher.
Prices subject to change without notice.*

WHEELS

LB10-NW	10 position 25mm filter wheel without shutter	\$ 2,750
LB10-NWS	10 position 25mm filter wheel with Uniblitz® shutter	\$ 3,350
LB10-W32	32mm filter wheel without shutter	\$ 3,000
LB10-W32S	32mm filter wheel with Uniblitz® shutter	\$ 4,025
LB10-W50	50mm, 5 position wheel without shutter	\$ 3,500

ACCESSORIES

SLIDE-IN²	Slide-in filter holder for 25mm wheel	\$ 52
DROP-IN³	Drop-in filter holder for 25mm wheel	\$ 32
DROP-IN/32	32mm drop-in filter holder	\$ 32
LLG	Liquid light guide (2 meters, 3mm diameter), C-mount, lens, and lens tube	\$ 1,400
SHUTTER	Uniblitz® shutter (not an upgrade)	\$ 370
CMAC	Serial cable for Macintosh	\$ 100
CLAM10	25 pin breakout to BNC cable	\$ 100
CSHUTTER	Shutter breakout cable	\$ 100
SHUTTER/32	35mm replacement Uniblitz® shutter (not an upgrade)	\$ 750

Mounting adapters for Nikon, Zeiss, Leica and Olympus microscopes are available. Please call Sutter Instrument for pricing and further information. Also, please see the adapter list at the end of this section.

2) Slide-in filter holders are for use with Lambda 10-2 **with** shutter.

3) Drop-in filter holders are for use with Lambda 10-2 **without** shutter.

LAMBDA 10-B

OPTICAL FILTER CHANGER



(shown with LB10-NW1Q)

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 40msec between adjacent filters. When used with the high-speed 4 position wheels, the **Lambda 10-B** achieves switching times of less than 31msec. It features both USB and serial port interfaces as well as keypad control. The **Lambda 10-B** is capable of controlling both the **SmartShutter** as well as the Uniblitz® shutter. The **Lambda 10-B** is a low-cost alternative to the **Lambda 10-2** and ideal for imaging applications requiring a

single filter wheel.

The **Lambda 10-B** can operate with switching times as brief as 40msec with our standard 25mm filter wheel as well as our 32mm 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 25mm 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.

SPECIFICATIONS

> LAMBDA 10-B

Dimensions of Control Box
8.2 in x 5.9 in x 5.1 in
14.9 cm x 20.8 cm x 13 cm

Weight
20lbs
11kg

Electrical
100/240 Volts
50/60 Hertz power line
75 Watts max.



FEATURES

> LAMBDA 10-B

40 msec between adjacent filters (10 position wheel)

31 msec between adjacent filters (4 position wheel)

Serial and USB interfaces

Can control a variety of 25mm, 32mm, and 50mm wheels

Controls one wheel and one optional shutter

Can accommodate *SmartShutter* and Uniblitz® shutter

Command set compatible with Lambda 10-C

Chopper drives

Universal power supply

Our 32mm wheel was designed to remedy the problem of vignetting that may occur with a 25mm filter format in certain microscope systems, and can achieve the same 40ms switching times as our 25mm wheel. For applications requiring a larger aperture opening, there is a 5 position 50mm filter wheel. If additional speed is required, we offer a high-speed, 4 position 25mm wheel which is capable of achieving 31ms 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 **SmartShutter** or the Uniblitz shutter.

US PRICES
> LAMBDA 10-B

*International prices are 5% higher.
Prices subject to change without notice.*

BASIC SYSTEM

LB10-B

Includes one 10 position 25mm filter wheel, support base with mounting rods, 2 drop-in filter holders, controller unit, spanner wrench, mounting hardware, serial and USB cables, power cable and manual (shutter not included) **\$ 4,250**

LB10-BS

Same as above with Uniblitz® shutter assembly and two slide-in filter holders (drop-in filter holders omitted) **\$ 4,850**

COMPONENTS

LB10-B/IQ

Lambda 10-B control unit **\$ 1,500**

LB10-NW

10 position 25mm filter wheel without shutter **\$ 2,750**

LB10-NWIQ

10 position 25mm filter wheel with SmartShutter **\$ 3,500**

LB10-NWS

10 position 25mm filter wheel with shutter **\$ 3,350**

LB10-NWE

10 position 25mm filter wheel set up for emission **\$ 2,500**

LB10-W32

10 position 32mm filter wheel without shutter **\$ 3,000**

LB10-W32IQ

10 position 32mm filter wheel with SmartShutter **\$ 4,500**

LB10-W32S

10 position 32mm filter wheel with shutter **\$ 4,025**

LB10-WHS4

4 position 25mm filter wheel without shutter **\$ 2,800**

LB10-W50

5 position 50mm filter wheel without shutter **\$ 3,500**

LB4-W

Belt drive 4 position 25mm filter wheel without shutter **\$ 2,800**

US PRICES
> LAMBDA 10-B

*International prices are 5% higher.
Prices subject to change without notice.*

ACCESSORIES

SLIDE-IN¹	Slide-in filter holder for 25mm wheel	\$ 52
DROP-IN²	Drop-in filter holder for 25mm wheel	\$ 32
LLG	Liquid light guide, C-mount, lens and lens tube	\$ 1,400
SHUTTER	25mm replacement Uniblitz® (not an upgrade)	\$ 370
SHUTTER/32	35mm replacement Uniblitz® shutter (not an upgrade)	\$ 750

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

Please call Sutter Instrument for pricing and further information. Also, please see the adapter list at the end of this section.

- 1) Slide-in filter holders are for use with the wheel **with** a shutter.
- 2) Drop-in filter holders are for use with the wheel **without** a shutter.

SMARTSHUTTER™ STEPPER-MOTOR DRIVEN SHUTTER



(Shown with LB10-B/IQ controller)

The **SmartShutter** 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 **SmartShutter** 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 and extending the life of the shutter.

The **SmartShutter** 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 **SmartShutter**, in either the 25mm or 35mm version, operates with open/close times of 8msec from the command (3msec from the start of motion). Since our robust design does not rely on overdriving the windings, we can achieve

continuous operation at frequencies up to 35 Hz for the 25mm version, and 20 Hz for the 35mm model. Because the shutter blade is stopped by the action of the motor rather than mechanical stops, SmartShutter units tested for over 10 million cycles show no sign of failure.

The microprocessor-based controller provides exceptional versatility and is adaptable to various modes of operation and function. The **SmartShutter** 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 **SmartShutter** 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. This unit is offered with a USB port, TTL in and TTL out. The **Lambda SC** allows programmable control over the exposure time, and the delay between trigger and shutter opening.

FEATURES > SMARTSHUTTER

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



Originally designed to be integrated into our 25mm and 32mm filter wheels, housings are also available for stand-alone units and for use with our **Lambda LS** and **Lambda DG-4/DG-5** optical products. The modularity of the **SmartShutter** assures that repairs, should they be necessary, are simple and economical.

US PRICES
> SMARTSHUTTER

*International prices are 5% higher.
Prices subject to change without notice.*

CONTROLLER
LB10-B/IQ

Includes one Lambda 10-B control unit, serial and USB cables, power cable and manual **\$ 1,500**

LB-SC

Includes one Lambda SC control unit, USB cable, power cord and manual **\$ 750**

SMARTSHUTTER
IQ25-W

25mm *SmartShutter* with housing to fit filter wheel **\$ 950**

IQ25-SA

25mm *SmartShutter* with stand-alone housing **\$ 950**

IQ25-LS

25mm *SmartShutter* with housing to fit Lambda LS **\$ 950**

IQ25-DG

25mm *SmartShutter* with housing to fit Lambda DG-4/DG-5 **\$ 950**

IQ35-W

35mm *SmartShutter* with housing to fit filter wheel **\$ 1,250**

IQ35-SA

35mm *SmartShutter* with stand-alone housing **\$ 1,250**

IQ50-SA

50mm *SmartShutter* with stand-alone housing **\$ 1,250**

CABLES
CIQ-2

One 25 pin connector to two 9 pin connectors **\$ 100**
(Connects up to 2 stand alone shutters to LB10-B/IQ controller)

FSWITCH

One foot switch with BNC connector **\$ 100**

LAMBDA SC

SMARTSHUTTER CONTROLLER



(Shown with IQ35-SA and stand)

The **Lambda SC** is a full-featured microprocessor controlled shutter driver for the **SmartShutter**. 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, and the delay between trigger and shutter opening.

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. 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 trig-

ger pulse, and can be interrupted by using a stop command.

Because the **SmartShutter** 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 **SmartShutter**. 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.

US PRICES > LAMBDA SC

*International prices are 5% higher.
Prices subject to change without notice.*

CONTROLLER



LB-SC

Lambda SC control unit, serial and USB cables, power cable and manual

\$ 750

SMARTSHUTTER

IQ25-SA

25mm *SmartShutter* with stand-alone housing

\$ 950

IQ25-LS

25mm *SmartShutter* for mounting in Lambda LS

\$ 950

IQ25-DG

25mm *SmartShutter* for mounting in DG-4/DG-5

\$ 950

IQ35-SA

35mm *SmartShutter* with stand-alone housing

\$ 1,250

IQ50-SA

50mm *SmartShutter* with stand-alone housing

\$ 1,250

ACCESSORIES

FSWITCH

One foot switch with BNC connector

\$ 100

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

LAMBDA LS

STAND-ALONE XENON ARC LAMP AND POWER SUPPLY



(Shown with optional
liquid light guide)

The **Lambda LS** is a stand-alone 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 340nm to a cutoff of 700nm determined by the cold mirror. An optional enhanced UV bulb produces output much lower into the UV (cut off near 200nm). 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.

SPECIFICATIONS > LAMBDA LS

Output Range

Standard bulb 340nm to IR
(optional full-spectrum bulb)
200nm to IR

Lamp Type

175 or 300 Watt xenon (pre-aligned to produce collimated output)

Radiant Output

25 Watts (175W lamp) (broad-band, full beam)

Lamp Life

1000 hours (Bulb carries a warranty for 500 hours. Longer life depends on application. Expected life is 1000 hours.)

Power Consumption

175 Watts

Dimensions

10.5in x 9.5in x 10in
26.7cm x 24.1cm x 25.4cm

Weight

10.5lbs
4.8kg

Electrical

115/230 Volts
50/60 Hertz power line

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 stand-alone lamp housing-power supply enclosure.

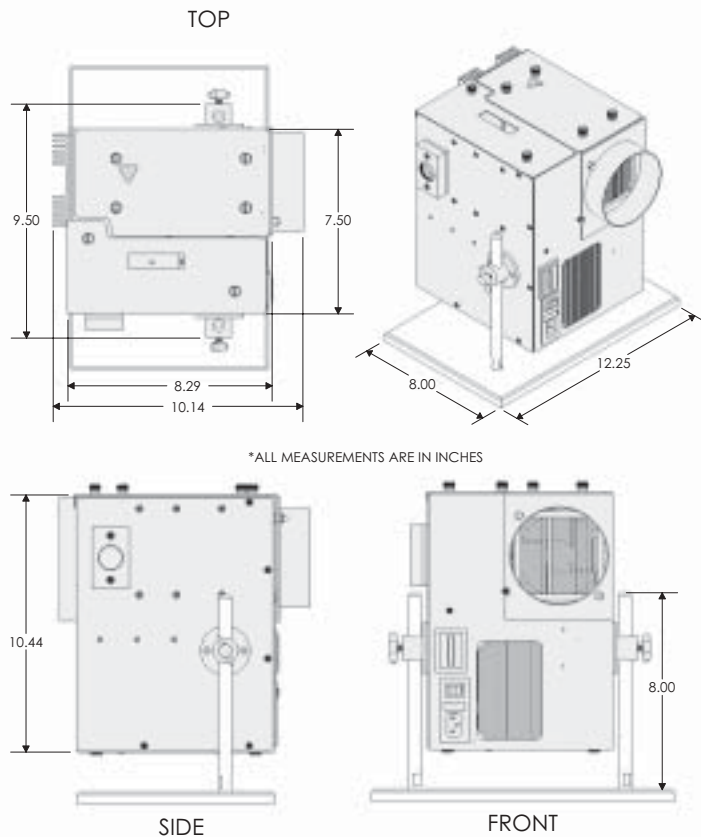
Pre-aligned bulb eliminates common focusing problems.

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 *SmartShutter* 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 adapter section in this catalog.





(There is additional depth when second filterwheel is attached)

US PRICES
> LAMBDA LS

*International prices are 5% higher.
 Prices subject to change without notice.*

BASIC SYSTEM

LB-LS/FS17 Includes 175Watt **full spectrum** lamp, cold mirror, power supply and lamp housing, support base with mounting rods, drop-in filter holder, and manual **\$ 4,750**

LB-LS/OF17 Includes 175Watt **ozone free** lamp, cold mirror, power supply and lamp housing, support base with mounting rods, drop-in filter holder, and manual **\$ 4,750**

LB-LS/FS30 Includes 300Watt **full spectrum** lamp, cold mirror, power supply and lamp housing, support base with mounting rods, drop-in filter holder and manual **\$ 4,950**

LB-LS/OF30 Includes 300Watt **ozone free** lamp, cold mirror, power supply and lamp housing, support base with mounting rods, drop-in filter holder and manual **\$ 4,950**

BULBS

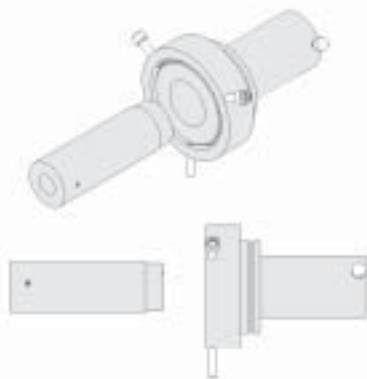
O661176	Ozone free 175 Watt xenon bulb (attenuated output below 340nm)	\$ 630
O661175	Full spectrum 175Watt xenon bulb	\$ 630
O661126	Ozone free 125 Watt xenon bulb, replacement for early LS units (attenuated output below 340nm)	\$ 630
O661125	Full spectrum 125 Watt xenon bulb, replacement for early LS units	\$ 630
O661301	Ozone free 300 Watt xenon bulb (attenuated output below 340nm)	
O661300	Full spectrum 300Watt xenon bulb	\$ 630
O661115	Housing and heat sink for bulb (bulb will be installed when ordering at same time as housing)	\$ 250

ACCESSORIES

LLG	Liquid light guide and coupling adaptor (2 meters, 3mm dia.), C-mount, lens and lens to be	\$ 1,400
DROP-IN	Drop-in filterholder (25mm)	\$ 32

Mounting adapters for Nikon, Zeiss, Leica and Olympus microscopes are available. Please call Sutter Instrument for pricing or more information. Also, please see the new adapter list at the end of this section.

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 25mm apertures, and a prefix of 32 for wheels with a 32mm aperture.

The lamp housing adapter (suffix LH) is only required when the LLG (Liquid Light Guide) is ordered and used with a filter wheel and microscope lamp housing.

Lambda DG-4

The **Lambda DG-4** will only require a light guide adapter (prefix LG).

Lambda LS

It is recommended that the **Lambda LS** be used with the optional **LLG** (Liquid Light Guide) and a light guide adapter (prefix LG).

SmartShutter

The **SmartShutter** can be mounted on the microscope excitation and emission ports using our standard adapters. For easy reference:

- IQ25 Excitation or Emission - use adapters that begin with 10
- IQ35 Excitation or Emission - use adapters that begin with 32
- IQ25 & IQ35 Transmitted light - use adapters ending with TL

MICROSCOPE ADAPTERS

Scope/ Model	Type of adapter	Catalog number	List price
OLYMPUS			
BX-50 / BX-51 (Y50)			
BX-60 / BX-61			
	EXCITATION	10-Y50-EC	\$ 370
	EMISSION	10-Y50-EM	\$ 525
	LAMP HOUSING	10-Y50-LH	\$ 185
	LIGHT GUIDE	LG-Y50	\$ 525
	TRANSMITTED (25mm)	25-Y50-TL	\$ 370
	TRANSMITTED (35mm)	35-Y50-TL	\$ 370
IX-70 / IX-50 (Y70)			
	EXCITATION	10-Y70-EC	\$ 370
	EMISSION (side port of scope needs modification at Sutter)	10-Y70-EM	\$ 525
	LAMP HOUSING	10-Y70-LH	\$ 185
	LIGHT GUIDE	LG-Y70	\$ 525
	TRANSMITTED (25mm)	25-Y70-TL	\$ 370
	TRANSMITTED (35mm)	35-Y70-TL	\$ 370
	SHUTTER TO TRANSMITTED (25mm)	25-Y71-TL	\$ 370
IX-51 / IX71 / IX-81 (Y71)			
	EXCITATION	10-Y71-EC	\$ 370
	EMISSION	10-Y71-EM	\$ 525
	LAMP HOUSING	10-Y71-LH	\$ 185
	LIGHT GUIDE	LG-Y71	\$ 525
	TRANSMITTED (25mm)	25-Y71-TL	\$ 370
	TRANSMITTED (35mm)	35-Y71-TL	\$ 370
NIKON			
TMD (N10)	Please contact Sutter to discuss your needs.		
DIAPHOT 200/300 (N20)			
	EXCITATION	10-N20-EC	\$ 315
	EMISSION (needs 1x relay lens)	10-N20-EM	\$ 370
	LAMP HOUSING	10-N20-LH	\$ 158
	LIGHT GUIDE	LG-N20	\$ 735

MICROSCOPE ADAPTERS

Scope/ Model	Type of adapter	Catalog number	List price
NIKON (CONTINUED)			
TE200/300 (N25)			
	EXCITATION	10-N25-EC	\$ 315
	EXCITATION-32mm	32-N25-EC	\$ 315
	EMISSION (needs 1x relay lens)	10-N25-EM	\$ 370
	LAMP HOUSING	10-N25-LH	\$ 158
	BOTTOM (QUANTUM)	10-N25-QB	\$ 370
	LIGHT GUIDE	LG-N25	\$ 735
TE2000 (N27)			
	EXCITATION	10-N27-EC	\$ 315
	EXCITATION-32mm	32-N27-EC	\$ 315
	EMISSION	10-N27-EM	\$ 370
	TRANSMITTED-35mm	35-N27-TL	\$ 315
	LAMP HOUSING	10-N27-LH	\$ 158
	LIGHT GUIDE	LG-N27	\$ 735
OPTIPHOT (N30)	Please contact Sutter to discuss your needs		
E400 & E600 (N40)			
	EXCITATION	10-N40-EC	\$ 525
	EXCITATION-32mm	32-N40-EC	\$ 315
	LAMP HOUSING	10-N40-LH	\$ 260
	LIGHT GUIDE	LG-N40	\$ 525
E800 & E1000 (N80)			
	EXCITATION	10-N80-EC	\$ 315
	EXCITATION-32mm	32-N80-EC	\$ 315
	EMISSION	10-N80-EM	\$ 370
	EMISSION-32mm	32-N80-EM	\$ 370
	LAMP HOUSING	10-N80-LH	\$ 158
	LIGHT GUIDE	LG-N80	\$ 525
80i (N85)			
	EXCITATION	10-N85-EC	\$ 420
	EMISSION	10-N85-EM	\$ 370
	LIGHT GUIDE	LG-N85	\$ 630

MICROSCOPE ADAPTERS

Scope/ Model	Type of adapter	Catalog number	List price
ZEISS			
AXIOSKOP (Z20) (also axioplan)			
	EXCITATION	10-Z20-EC	\$ 210
	EMISSION	10-Z20-EM	\$ 420
	LAMP HOUSING	10-Z20-LH	\$ 105
	LIGHT GUIDE	LG-Z20	\$ 525
AXIOSKOP 2 & 2 FS (Z25)			
	EXCITATION	10-Z25-EC	\$ 210
	EMISSION	10-Z25-EM	\$ 420
	LAMP HOUSING	10-Z25-LH	\$ 105
	LIGHT GUIDE	LG-Z25	\$ 525
AXIOVERT 35 and 100 series (Z30)			
	EXCITATION	10-Z30-EC	\$ 210
	LAMP HOUSING	10-Z30-LH	\$ 105
	LIGHT GUIDE		
	(replaces epi-illuminator)	LG-Z30	\$ 525
	KELLER PORT	10-Z30-KP	\$ 370
	KELLER PORT (100M SCOPE)	10-Z30-KP-M	\$ 370
	SIDE PORT	10-Z30-SP	\$ 420
	TRINOCULAR HEAD	10-Z30-TH	\$ 420
AXIOPLAN 2 (Z50)			
	(Please contact Sutter to discuss your needs)		
AXIOVERT 200 (Z35)			
	EXCITATION	10-Z35-EC	\$ 210
	LAMP HOUSING	10-Z35-LH	\$ 105
	EXCITATION – 32mm	32-Z35-EC	\$ 315
	EMISSION (side port on left)	10-Z35-EM	\$ 630
	200M – EMISSION (side port on left)	10-Z35-EM-M	\$ 630
	KELLER PORT	10-Z35-KP	\$ 525
	LIGHT GUIDE		
	(replaces epi-illuminator)	LG-Z35	\$ 525

MICROSCOPE ADAPTERS

Scope/ Model	Type of adapter	Catalog number	List price
LEICA			
DMR (L10)			
	EXCITATION	10-L10-EC	\$ 315
	EXCITATION - 32 mm	32-L10-EC	\$ 315
	EMISSION	10-L10-EM	\$ 525
	LAMP HOUSING	10-L10-LH	\$ 158
	LIGHT GUIDE	LG-L10	\$ 525
DMIRB & DMIRE2 (L20)			
	EXCITATION	10-L20-EC	\$ 315
	EXCITATION - 32mm	32-L20-EC	\$ 315
	EMISSION*	10-L20-EM	\$ 525
	LAMP HOUSING	10-L20-LH	\$ 158
	LIGHT GUIDE*	LG-L20	\$ 625
DM 4000/5000/6000 (L30)			
	EXCITATION	10-L30-EC	\$ 315
	EXCITATION - 32mm	32-L30-EC	\$ 315
	EMISSION	10-L30-EM	\$ 525
	LIGHT GUIDE	LG-L30	\$ 735
DMI 6000 B (L40)			
	LIGHT GUIDE*	LG-L40	\$ 735

* please phone Sutter prior to ordering.

OTHER ADAPTERS

CARV (J20)			
	EXCITATION	10-J20-EC	\$ 525
	EMISSION	10-J20-EM	\$ 1,050
	LIGHT GUIDE	LG-J20	\$ 735

MICROINJECTION



When Sutter Instrument set out to develop a brand new microinjection system, we were presented with a very specific set of challenges:

1. To create a micromanipulator with highly-responsive movement that was intuitive and simple to use, yet complete with time- and labor-saving features,

2. To devise a pneumatic microinjector with an integral compressor capable of injecting at high pressures, but also of gentle suction for holding and transfer operations,

3. To offer a syringe-based micrometer-style microinjector that was extremely responsive, could be used

with air, oil or water, and that was simple to dismantle and troubleshoot, and,

4. To be able to offer these products at a competitive price while maintaining the quality expected of a Sutter product.

Using our 30 years of experience and expertise in motorized micropositioning, air pressure control and electro-mechanical design, we have created the **XenoWorks™ Microinjection System**.

The new **XenoWorks Microinjection System** has been designed to meet the needs of a wide variety of applications for the manipulation of cells

and embryonic tissues. By combining micromanipulators, microinjectors and microscope mounting adapters, systems can be configured for a wide variety of applications including:

- Zygote pronuclear microinjection
- Embryonic stem cell blastocyst transfer
- Nuclear and cytoplasmic transfer
- Piezo impact microinjection
- Intracytoplasmic sperm injection
- Adherent cell microinjection

Real, tactile keys have been used rather than membrane switches, rotary controls turn smoothly and responsively, and high-visibility LED displays are used. Our intent is for an investigator already familiar with

traditional microinjection systems, whether mechanical, hydraulic or electronic, to be able to begin using **XenoWorks** with as little learning time as possible. It is, in a word, intuitive.

On the next page are listed some of the more common applications for which **XenoWorks** is ideal. Please contact us to discuss your specific needs.

The configuration of any microinjection system will depend upon the application for which it is used. Some common applications and system configurations are:

Zygote pronuclear DNA microinjection

The microinjection of DNA into the pronucleus of a newly-fertilized mammalian egg is now a common and highly efficient method of creating transgenic offspring.

Pronuclear microinjection was first described in the mouse, but now many different transgenic animals have been created in this way. Because the micropipette used for injection has an internal diameter typically less than one micron, relatively high pressure (>3000 hPa) is required to inject the DNA solution. Two micromanipulators are required, one to hold the zygote and one to inject the DNA. Gentle negative pressure is used on the holding side, while pulses of high pressure are used to inject 1–2 picoliters of DNA solution into the pronucleus. The **XenoWorks Digital microinjector** is ideal for this application, having simultaneous holding and high-pressure injecting capabilities. Suggested system configuration:

1 x Micromanipulator (Right) BRMR
1 x Micromanipulator (Left) BRML
1 x Digital Microinjector BRE110/
BRE220
2 x Microscope Adapter

Embryonic Stem Cell Transfer into Blastocysts

Animals, usually mice, can be engineered with a specific gene function reduced or knocked out altogether by introducing genetically altered embryonic stem cells into the cavity of a blastocyst so that the stem cells contribute to the embryo. The resulting live animal is a chimera of both genotypes. Subsequent selective interbreeding of manipulated animals results in pure-bred gene “knock-outs” or “knock-downs” and can be used for subsequent gene function studies. This operation requires two micromanipulators, one for holding the blastocyst and one for transferring the cells. Both holding and transfer functions require gentle positive and negative pressure for which the **Digital Microinjector** is ideal. Alternatively, two **Analog Microinjectors** may be substituted. Suggested system configuration:

1 x Micromanipulator (Right) BRMR
1 x Micromanipulator (Left) BRML
1 x Digital Microinjector BRE110/
BRE220 **or**
2 x Analog Microinjector BRI
2 x Microscope Adapter

Intracytoplasmic Sperm Injection

Intracytoplasmic sperm injection (ICSI) can be employed for veterinary in-vitro fertilization during rare species preservation or for any veterinary assisted conception. ICSI may also be used as a gene transfer technique when sperm are co-injected with exogenous DNA (see also Piezo-assisted ICSI, below). Typically, two micromanipulators are used, one for oocyte

holding and one for sperm aspiration and injection. Each micromanipulator grips a single micropipette holder with a microinjector attached. Since low positive and negative pressures are required for the delicate task of oocyte holding and sperm injection, an ICSI workstation should be configured with two **Analog Microinjectors**. Suggested system configuration:

1 x Micromanipulator (Right) BRMR
1 x Micromanipulator (Left) BRML
2 x Analog Microinjector BRI
2 x Microscope Adapter

Piezo-assisted ICSI

This relatively new technique can be employed for assisted conception in animals in which standard ICSI fails, such as mice. Piezo-assisted microinjection has also been employed as a gene transfer method, where sperm are coated in exogenous DNA and injected into oocytes. The microinjection workstation required for this technique is very similar to standard ICSI, but with the addition of a piezo impact drive attached to the injecting micropipette holder. The device vibrates the injecting micropipette axially and drills its way into the oocyte. This method has been shown to increase success rates. Because the micropipette is vibrating at minute amplitude but high frequency, it is vital to use a mechanically stable micromanipulator, which will not vibrate in sympathy. The more stable the micromanipulator, the more efficient the energy transfer from the piezo impact drive to the micropipette tip. Some piezo-assisted microinjection protocols currently require a bead

of mercury inside injecting micropipette. Please note that mercury should not be used in conjunction with the **Digital Microinjector**, though the **Analog Microinjector** is ideal for this purpose. Suggested system configuration:

1 x Micromanipulator (Right) BRMR
1 x Micromanipulator (Left) BRML
2 x Analog Microinjector BRI
2 x Microscope Adapter

Microinjection of Cultured, Adherent Cells

Cultured cell lines such as 3T3, CHO and HeLa can be microinjected while attached to a Petri dish. The procedure is best viewed through phase-contrast optics; a single micromanipulator and a single high-pressure microinjection channel are required. The tip of a sharp (inner diameter less than 1 micron) micropipette is brought down on top of a single cell and a pulse of high (100–1000 hPa) pressure applied. The cell membrane is ruptured and the cell can be seen to inflate slightly. Volumes injected are typically less than 5% of the cell volume. Success rates vary widely depending upon the type and volume of compound injected, the culture conditions and the cell line used. The high-pressure function of the **Digital Microinjector** and the smooth, fine control of the micromanipulator are particularly well-suited to this application. Suggested system configuration:

1 x Micromanipulator (Right) BRMR
1 x Digital Microinjector
BRE110/BRE220
1 x Microscope Adapter

Somatic Cell Nuclear Transfer

The enucleation of an oocyte followed by the transplantation of a somatic cell is a method of producing genetically identical copies (clones) of the animal from which the donor cell was taken. Generally, two micromanipulators are required, one for holding the oocyte and one for the enucleating and injecting procedures. Each micromanipulator grips a single micropipette holder with a microinjector attached. Oocyte holding, enucleation and somatic cell transplantation require gentle, low positive and negative pressure, making the **Analog Microinjector** ideal. Suggested system configuration:

1 x Micromanipulator (Right) BRMR
1 x Micromanipulator (Left) BRML
2 x Analog Microinjector BRI
2 x Microscope Adapter

Please contact Sutter Instrument for help and advice with these and any other microinjection needs.

XENOWORKS MICROMANIPULATOR



The **XenoWorks Micromanipulator** has been designed around our hugely-successful **MP-285** electrophysiology micromanipulator, with the addition of a smooth-moving adjustable inverted joystick. Because the motor drive is based on an electrophysiology design, the **XenoWorks micromanipulator** is extremely stable and resistant to ambient vibration. This stability also makes this manipulator an ideal platform for use in conjunction with the **PrimeTech PMM-150FU piezo impact drive** (see page 136), for applications such as mouse nuclear transfer and intracytoplasmic sperm injection.

The joystick offers an unprecedented level of user comfort during opera-

tion. The use of an inverted joystick in conjunction with an almost zero-profile base allows the operator to rest their hands and forearms on the bench surface, reducing the risk of repetitive strain injuries. The function keys can be located and activated by touch, obviating the need to look away from the microscope, saving time.

Another time saving feature is the "Setup" function. Activating the setup function places the micromanipulator in the optimum position prior to beginning work (halfway on the Y-axis, three-quarters down on the Z-axis and three-quarters inwards on the X-axis). Once the manipulator is in the default setup position, the micropipette tip will already be

projecting into the microscope's optical path, reducing the time taken to find the pipette tip down the microscope. This also ensures that there is adequate travel range in all axes of motion prior to starting work.

The manipulator uses a pre-programmed "Home" position for fast micropipette exchange, and the ability to determine a "Work" position which can be returned to with the press of a button.

The manipulator requires no programming and next to no learning time once set up and configured for a particular microscope.

FEATURES > XENOWORKS MICROMANIPULATOR

Height and tension adjustable inverted joystick for optimal ergonomics

Exceptionally smooth and responsive micropipette movement

Variable movement range – 6 settings from coarse to ultra-fine

User-definable memory positions, including "Work" and Z-axis lower limit

A wide 25mm of travel in three axes

SPECIFICATIONS > XENOWORKS MICROMANIPULATOR

Travel

25mm on all three axes

Maximum Resolution

62.5nm/microstep

Maximum Speed

5.5mm/sec

Range

X & Y Axis (1 joystick swing)	Z Axis (1 rotation)
C 12,700 μm	3,200 μm
1 3,300 μm	800 μm
2 880 μm	400 μm
3 400 μm	200 μm
4 200 μm	100 μm
5 100 μm	50 μm

Joystick

- Inverted joystick with integral declutch
- Height and resistance adjustable
- Independent axis-polarity inversion
- 6-position rotary range control
- 'Setup' function
- 1 user-defined set point ('Work'),
- 1 user-defined axis limit ('Z-floor'),
- 2 preset points ('Home' and 'Setup')

Dimensions

Motor drive:

112mm x 185mm x 145mm

Joystick:

265mm x 240mm x 226mm

Control:

407mm x 280mm x 101mm

Electrical

115/230 Volts AC, 50/60Hertz powerline

US PRICES*International prices are 5% higher.***> XENOWORKS MICROMANIPULATOR****BRML**

XenoWorks Micromanipulator (Left). Includes: 3 axis motor drive (left-hand configuration), motor drive base plate, controller, joystick user-interface, connecting cables, and manual. **\$ 11,900**

BRMR

XenoWorks Micromanipulator (Right). Includes: 3 axis motor drive (right-hand configuration), motor drive base plate, controller, joystick user-interface, connecting cables, and manual. **\$ 11,900**

XENOWORKS MICROSCOPE ADAPTERS

BR-L20 Leica DM-IRB/E/IRE2 adapter **\$ 475**

BR-L30 Leica DM-IL adapter **\$ 475**

BR-N10 Nikon TMD adapter **\$ 475**

BR-N25 Nikon TE200/300 adapter **\$ 475**

BR-N27 Nikon TE2000 adapter **\$ 475**

BR-Y50 Olympus IX50/70 adapter **\$ 475**

BR-Y51 Olympus IX51/71/81 adapter **\$ 475**

BR-Z30 Zeiss Axiovert 100/135 adapter **\$ 475**

BR-Z35 Zeiss Axiovert 200 adapter **\$ 475**

Prices subject to change without notice.

XENOWORKS DIGITAL MICROINJECTOR



Designed primarily for transgenic mammal workstations, the **XenoWorks Digital Microinjector** is capable of holding oocytes and early embryos immobile while simultaneously providing a separate pressure channel for pronuclear microinjection of DNA or the gentle control of embryonic stem cells as they are transferred into blastocysts. The microinjector employs two independent pressure control channels.

The self-contained vacuum channel for gentle suspension-cell holding applications can be switched on and off as needed, and a responsive rotary control is used to dial the pressure up or down according to the degree of hold required.

A second channel is available which is capable of delivering both high-pressure for solution injection, and gentle positive/negative pressure for transfer of embryonic stem cells. Two modes of injection are available on this channel; in Constant Flow mode, the inject pressure set is applied to the micropipette tip for as long as the hand- or foot-switch is held down. In Pulse mode, the inject pressure is applied for a precisely timed duration, which can be set in 0.1 second increments. Both injection duration and pressure are easily selectable using rotary controls on the remote interface.

Optimal ergonomics are again a prime consideration; the remote control unit provides access to all keys and rotary controls necessary to manipulate the parameters in the two pressure channels, while the separate compressor module can be shelf- or floor-mounted away from the microscope to eliminate vibration interference.

SPECIFICATIONS > XENOWORKS MICROINJECTOR

Hold Function

Hold pressure:
-350 to +350 hPa

Inject Function

Inject modes: Transient or timed
Inject pressure: 0 to 5600 hPa in 70 hPa increments
Injection time: 0 to 10 seconds in 0.1sec increments
Inject activation: Transient; hand or foot switch
Clear pressure: Ramps from current Inject value to 5600 hPa at 1000 hPa/sec

Transfer Function

Transfer pressure:
-175 to +175 hPa

Maximum Pressure

5600 hPa (Inject channel)

Controls

Tactile keys, rotary optical encoders 3 x 7-segment LED display

Tubing 2m ETFE

Micropipette Holder

Diameter: 4mm
Accepts 1mm capillary glass (other sizes can be accommodated upon request)

Electrical

BRE110: 100-120 Volts, 60Hertz
BRE220: 220-240 Volts, 50Hertz

Dimensions

Size:
Compressor module
407mm x 440mm x 150mm,
User interface module
164mm x 123mm x 70mm
Weight:
Compressor module: 1504g,
User interface module: 42g

FEATURES > XENOWORKS MICROINJECTOR

Four injection modes:
Hold, Transfer, Inject, Clear

Two independent pressure
channels

Rotary controls for continuous
pressure adjustment

Integral compressor with
remote control pad

US PRICES*International prices are 5% higher.***> XENOWORKS DIGITAL MICROINJECTOR****BRE110**

XenoWorks Digital Microinjector (110V). Includes: compressor module, user-interface module, 2 micropipette holders with 2m ETFE tubing and fittings, spare tubing, connecting cables, and manual.

\$ 6,900**BRE220**

XenoWorks Digital Microinjector (220V). Includes: compressor module, user-interface module, 2 micropipette holders with 2m ETFE tubing and fittings, spare tubing, connecting cables, and manual.

\$ 6,900**BR-DT**

XenoWorks digital tubing kit

\$ 80**BR-MH**

XenoWorks micropipette holder

\$ 175

XENOWORKS ANALOG MICROINJECTOR



The **Xenoworks Analog Microinjector** has been designed with ease of troubleshooting in mind. While fluid-filled hydraulic microinjectors are the most responsive method of manipulating cells and cellular components, over time they can develop leaks and air bubbles which need to be sealed or purged. The design of the **Analog Microinjector** allows the tubing to be easily separated from the syringe and main injector body and stripped to its components; tubing and connectors. Parts such

as spare tubing are readily available from Sutter (spare tubing and fittings are supplied with each injector) and are quick and simple to fit using commonly available Luer-lock and ferrule connectors. Tubing length can be altered according to users' needs and ancillary devices such as three-way valves may be fitted so that, for example, a single injector can control two micropipettes (for applications such as blastomere biopsy).

The **Analog Microinjector** comes equipped with either a 100 μ l, 500 μ l or 1000 μ l syringe as requested.

FEATURES > XENOWORKS ANALOG MICROINJECTOR

- Highly stable, drift-free
- Coaxial coarse and fine displacement (10:1 ratio) for fast filling and precision control
- Adjustable height control
- Interchangeable syringes (500 μ l standard, 100 μ l and 1000 μ l options)
- Effective with air, oil, and water

SPECIFICATIONS > XENOWORKS MICROINJECTOR

- Coarse:Fine Ratio**
10:1
- Displacement/Turn**
500 μ l syringe:
5.2 μ l coarse, 0.5 μ l fine
1000 μ l syringe:
10.4 μ l coarse, 1.04 μ l fine
- Tubing**
1m ETFE
- Micropipette Holder**
Diameter: 4mm
Accepts: 1mm capillary glass
(other sizes can be accommodated upon request)

US PRICES > XENOWORKS ANALOG MICROINJECTOR

BRI XenoWorks Analog Microinjector. Includes: microinjector drive, 1 micropipette holder with tubing and fittings, spare tubing, 500 microliter syringe (100 or 1000 microliter syringe available upon request).	\$ 1,650
BR-MH XenoWorks micropipette holder	\$ 175
BR-AT XenoWorks analog tubing kit	\$ 55
V001183 100 μ l gas-tight syringe	\$ 110
V001185 500 μ l gas-tight syringe	\$ 110
V001186 1000 μ l gas-tight syringe	\$ 110

PRIMETECH PMM-150FU PIEZO IMPACT DRIVE



Sutter Instrument offers the **PrimeTech PMM-150FU** piezo impact drive for challenging microinjection applications such as mouse nuclear transfer, intracytoplasmic sperm injection (ICSI) and blastocyst injection. Oocyte plasma membranes, particularly those of the mouse, are particularly sensitive to microinjection, which tends to result in oocyte death. Initially designed for porcine oocyte injection, the **PrimeTech PMM** was adapted for use in the mouse in 1995 (Kimura and Yanagimachi, 1995), and since then has become the gold standard for mouse nuclear transfer and ICSI.

The **PMM-150FU** harnesses the “piezoelectric effect”: the tiny, but extremely rapid distortion of a piezoelectric crystal lattice when an electrical current is applied to it. This causes the micropipette holder, which is placed in direct contact with the piezo element to vibrate. Two modes of piezo “drilling” are available with the **PMM-150FU**: A continuous train of pulses of desired frequency and amplitude are used to vibrate the micropipette, gently penetrating the zona pellucida of an oocyte or embryo, then a single pulse, again of desired amplitude, is used to break the oolemma and inject the oocyte. This approach makes it pos-

Kimura, Y. and R. Yanagimachi, 1995. Intracytoplasmic sperm injection in the mouse. *Biol. Reprod.* 52, 709-720

US PRICES > PMM-150FU

*International prices are 5% higher.
Prices subject to change without notice.*

PMM-150FU piezo impact drive.

Includes: Controller, operation box, piezo impact drive unit, micropipette holder, tubing and pressure fittings, **XenoWorks Micromanipulator** adapter **\$ 13,600**

BR-BXW

Replacement XenoWorks micromanipulator adapter* **\$ 250**

V010200

PrimeTech injection holder IH-3 **\$ 25**

V010210

Spacer set for IH-3, Includes steel collar, 10 x 6mm silicon seal **\$ 25**

V200240

Tubing set for IH-3, Includes 1m PTFE tube, 2 x Luer connector **\$ 25**

**Adapters for other brands of micromanipulator are also available.*

sible to achieve up to 100% survival of injected oocytes.

Included

XenoWorks Micromanipulator-specific micropipette holder clamp

PrimeTech factory warranty

Full technical support for piezo impact applications

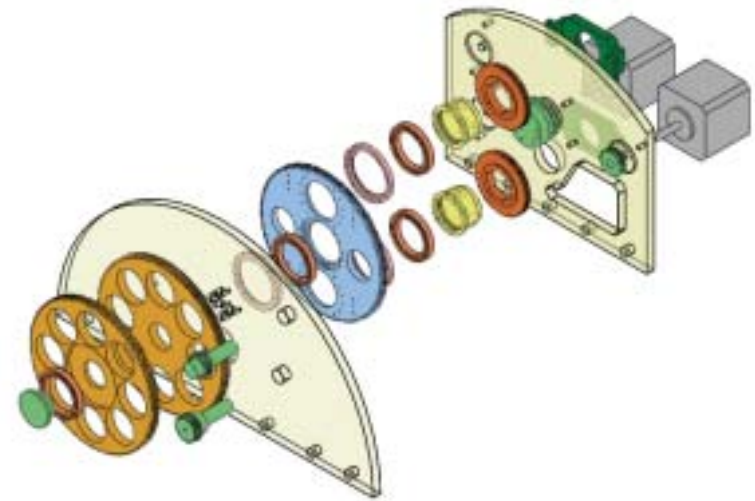
OEM PRODUCTS



Customization of our optical product line for unique applications has become a specialty for Sutter Instrument. Our production facilities include in-house electronic design, circuit board layout, embedded systems programming, and state-of-the-art CNC machining and turning centers for volume production of precision mechanical components. This expertise gives Sutter the ability to provide timely, cost-effective engineering and manufacturing solutions for Original Equipment Manufacturers (OEMs). (The proven performance and reliability of our optical filter wheel systems has made them a desirable choice for a range

of OEM applications. Examples of custom designs include 5 position and 10 position wheels with 2 inch filters, 12 position arrays, compact belt-driven filterwheels, cryogenic and high vacuum filterwheels, rotating polarizers, an RS-485 serial bus allowing 16 controllers to share a single serial port on a host computer, and mounting adapters for a wide range of microscopes. Sutter currently has several significant OEM contracts and will continue to establish new OEM relationships. Please for more information about custom filter changing devices.

SAMPLE OEM PROJECT



(A sample design project shown above: A cryogenic dual wheel with twin adjustable rotating polarizers for use in infrared astronomy)