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Monday through Friday

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SUTTER INSTRUMENT COMPANY 2004

SUTTER INSTRUMENT COMPANY

30 YEARS OF
PRECISION INSTRUMENTATION
FOR THE SCIENCES
1974 - 2004

2004

CUSTOMER SERVICE

For phone orders, quotation requests,
and technical support:

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WEBSITE

www.sutter.com

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. Prices in other countries may vary. 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 parts (except consumables and shutter) and labor. 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. Abuse, misuse, or unauthorized repairs will void this 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)

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MICROPIPETTE FABRICATION

Glass micropipettes are precisely constructed micro-tools forming the basis of a myriad of scientific investigative techniques. Yet, the simplicity of a piece of glass tubing belies the complexity of technique that is required to produce repeatedly and accurately the micropipette characteristics a researcher desires. Sutter Instrument Company has endeavored for more than 25 years to produce the most sophisticated instruments available for fabricating glass micropipettes. Our expertise in micropipette fabrication techniques has been utilized by countless numbers of individuals who have applied our knowledge to their particular research.

The **P-30** is our lowest cost and least sophisticated puller, based upon an NIH design from the 1950's. As a vertical puller, it offers all of the basic requisites for a pipette pulling device and provides a few additional features. It is intended for basic micropipette fabrication and is suitable for sharp electrode and microinjection work.

Evolution of the Flaming/Brown puller has led to the **P-97**. The **P-97** offers: microprocessor controlled programmability, constant current power supply, a self-contained precision air delivery system, and a patented velocity sensing system. Utilizing a velocity sensing scheme allows a means of selecting a precise glass temperature as the point at

which a hard pull is activated. This design feature has led to a significant improvement in pipette reproducibility when compared to other micropipette pullers. In addition, the **P-97** offers an environmental chamber to minimize the effects of humidity variation on tip formation.

The current state-of-the-art in micropipette puller technology is the **P-2000**. It incorporates the mechanical design and programmability of the Flaming/Brown pullers, but uses a CO_2 laser as the heat source. With the addition of the laser, quartz tubing can now be pulled in addition to other lower melting point glass compositions. Quartz pipettes have helped eliminate some technical barriers in electrophysiological studies and have enhanced microinjection procedures as well as near field scanning microscopy (NSOM) and nanospray mass spectroscopy.

The **BV-10** micropipette beveler was the company's first product and to date remains the state-of-the-art in micropipette beveling technology. For precision beveling of pipette tip diameters from fractions of a micron, to tens of microns, it is the system of choice.

P-2000 LASER BASED MICROPIPETTE PULLER

A significant advance in the technology of fabrication of micropipettes, optical fiber probes, and nanospray tips, is offered with the **P-2000** micropipette puller. The **P-2000** integrates a CO_2 laser-based heat source with the technology derived from our extensive experience with conventional pullers. This system offers capabilities unmatched by other pullers.

While the **P-2000** is suitable for working with most conventional glasses, its primary advantage is the ability to work with quartz glass (fused silica). Quartz offers superior material properties for a variety of research applications. Quartz is stronger than other glasses and can facilitate penetration through tough tissues which would normally break conventional pipettes[1] . For applications requiring a low noise glass, users will find that quartz is the lowest noise glass available[2,4]. Quartz contains none of the metals used in conventional glasses[3]. Optically, quartz is virtually free from fluorescence when illuminated.

A CO_2 laser was selected as the heat source for the **P-2000** for several reasons. 1) The nominal emission wavelength of the laser approximates the resonant frequency of the SiO_2 lattice in glass. Thus, quartz and other conventional glasses can be melted when the appropriate laser power is supplied. 2) Laser heat is clean and leaves no metal residue on the pipette as do conventional heating filaments. 3) Laser heat can be turned off instantly,

leaving no residual filament heat. 4) The user can program the amount and distribution of heat supplied to the glass.

The **P-2000** can store up to 100 separate programs, with each program consisting of up to 8 command lines. Programmable parameters include; laser power level, scan width, trip velocity, delay/ laser on time, and hard pull strength.

One important consideration for the use of the **P-2000** is the diameter of the glass used. The optical design produces even heating on glass up to 1.2 mm in outside diameter. Larger diameter glasses can be used with the **P-2000** (up to 1.5 mm quartz and 1.8 mm conventional glasses), but the performance is best with glass that is 1.2 mm diameter or less.

The **P-2000** works well with small diameter glasses such as optical fibers, and with small diameter fused silica capillary commonly used for the manufacture of nanospray tips. Smaller diameter glass with an outer diameter in the range of 0.125 mm to 0.6 mm, require special puller bars as well as an optical alignment optimized for the smaller diameter material. **These modified components will be installed, if requested, at the time of purchase**.

FEATURES > P-2000

Capable of pulling quartz, borosilicate and aluminosilicate glass.

Fully programmable — including heating filament characteristics.

The laser has no melting point limit as with conventional metal filaments; and therefore, cannot be burned out.

Pulls electrodes with tip diameters that are less than 0.03um.

Optimized velocity sensing circuit for maximized sensitivity and reproducibility.*

Operating life of the CO_2 laser is expected to be in excess of ten years with normal use, after which the laser can be refurbished by the Sutter Instrument Company for a nominal charge.

Individual programs can be write-protected in order to secure them from inadverent changes.

The total time that the heat is on during the pull is displayed for improved program development and troubleshooting.

A date and time stamp is displayed to show the last time that a program has been changed.

Preprogrammed sample programs for intra-cellular and patch pipettes. Special programming upon request.

**Patent No.4,600,424*

As with larger diameter glass, a wide range of tip sizes and taper geometries can be produced with this modified **P-2000** and small diameter glass. We have drawn optical fiber tips ranging from less than 10nm to more than 5um. Please consult our technical staff for further information.

SPECIFICATIONS > P-2000

Dimensions
37in x 19in x 19in
94cm x 48cm x 48cm

Weight
80lbs
36kg

Electrical
115/230 Volts
50/60 Hertz power line

CLASS I LASER PRODUCT

CE

PHONE: 1-888-883-0128 | FAX: 1-888-883-0900
INTL PHONE : 1-415-883-0128 | INTL FAX : 1-415-883-0572
EMAIL: INFO@SUTTER.COM | WEB: WWW.SUTTER.COM

US PRICES > P-2000

P-2000/G
Laser-based puller, outfitted for use with glass GREATER than 0.6mm outer diameter. **$ 12,750**

P-2000/F
Laser-based puller, outfitted for use with glass LESS than 0.6mm outer diameter. **$ 12,750**

(Pullers include box of Q100-70-7.5 sample glass)

REFERENCES > P-2000

1. Munoz, J.L. and Coles, J. *Quartz micropipettes for intracellular voltage microelectrodes and ion selective microelectrodes*. Journal of Neuroscience Methods: 22:57-64, 1987.

2. Rae, J.L. and Levis, R. A. *A method for exceptionally low noise single channel recordings*. European Journal of Physiology - Pflügers Archiv: 420:618-620, 1992.

3. Zuazaga, C. and Steinacker, A. *Patch-clamp recording of ion channels: Interfering effects of patch pipette glass.* News in Physiological Science: 5:155-159, 1990.

4. Levis, R. A. and Rae, J. L. *The use of quartz patch pipettes for low noise single channel recording*. Biophysical Journal: 65:1666-1677, 1993.

P-97 FLAMING/BROWN MICROPIPETTE PULLER

The Model **P-97** micropipette puller is the latest generation of the Flaming/Brown type puller for fabrication of micropipettes, patch pipettes and microinjection needles. While retaining many of the features on the Model **P-87**, the **P-97** offers improvements in mechanical, electronic and software design. The result is better control of the pulling process and a higher degree of reproducibility. The **P-97** combines a proven mechanical system with a sophisticated, programmable microprocessor controller. This programmable control of the pulling parameters allows the investigator to design application specific pipettes from a wide range of glass compositions and sizes.

A number of new features have been incorporated in the design of the **P-97**. One of the most apparent is the environmental chamber which houses the area surrounding the heating filament. The environmental chamber is designed to minimize the effect of changing humidity on the reproducibility of pulled pipettes. A 25% increase in power over the previous version allows for the use of larger heating filaments, larger diameter glass and multi-barreled glass. The metal jaws that clamp the heating filament have also been redesigned to minimize heat retention. A gas delivery mode switch provides for extended cooling for large diameter and multi-barreled glass. A spring-loaded clamping mechanism has been added for easier loading of glass. A vacuum fluorescent display has been added that allows easy viewing from any direction.

New software improvements on the **P-97** include a display of the total time that the heat is on to assist in program development and troubleshooting. Up to 100 programs can now be written and stored in memory, which makes the **P-97** suitable for multiple users. These programs can now be write-protected, adding security to prevent programs from being changed or altered inadvertently. When a program is written and saved, it includes the date it was written or edited. In addition, the air pressure is included as a programmable item.

The **P-97** contains a ramp test to overcome the difficulties of program adjustment when a new filament is installed or to help characterize a new glass and filament combination. This test allows for the rapid adjustment of heat values in established programs and provides estimates for establishing heat settings when using new sizes or compositions of glass capillaries. As with all Sutter instruments, the electronics have been carefully designed to maximize noise rejection.

** Patent No. 4,600,424*

FEATURES > P-97

- Environmental chamber.
- Programmable air pressure.
- Memory storage for up to 100 programs.
- Write protection lock and date stamp.
- Two symmetrical pipettes with each pull.
- Preprogrammed sample programs for intracellular and patch pipettes. Special programming on request.
- Ramp test—self test for establishing program heat settings when a new filament or glass is introduced.
- Vacuum fluorescent display.
- Internal memory test.
- Constant current power supply for filament and pull solenoid.
- Looping pull cycle for fabrication of patch type micropipettes.
- Self-contained air supply with filtration system and humidity control.
- Consistent and reliable electrodes with tip diameters less than 0.1um.
- Control over the time and pressure at which the air is delivered.
- Optimized velocity sensing circuit for maximized sensitivity and reproducibility.
- Quality control, SEM photograph of a tip pulled with each puller; criterion is tip measurement less than 0.1um and typically is ~0.06um.

SPECIFICATIONS > P-97

Dimensions
21in x 14in x 12in
53cm x 36cm x 30cm

Weight
62lbs
29kg

Electrical
115/230 Volts
50/60 Hertz power line

REFERENCES > P-97

These references describe the Flaming/Brown series of pullers and contain valuable information applicable to the **P-97**.

1. Brown, K.T. and Flaming, D.G. *Neurosciences Journal*: 2:813-827, 1977.

2. Flaming, D.G. and Brown, K.T., *Journal of Neuroscience Methods*: 6:91-102, 1982.

3. Brown, K.T. and Flaming, D.G., *Advanced Micropipette Techniques for Cell Physiology*. John Wiley and Sons. Great Britain, 1986.

US PRICES
> P-97

P-97 Flaming/Brown type micropipette puller **$ 6,700**

Pullers come with an assortment of 4 filaments and a sample box of BF100-50-10 glass.

UPGRADES

87-97 P-87 to P-97 upgrade **$ 2,000**

UP-97 All other pullers except PC-84 & P-30 to P-97 **$ 4,950**

P-30 VERTICAL MICROPIPETTE PULLER

The Model **P-30** vertical micropipette puller is designed for the fabrication of basic micropipettes and patch-type pipettes. It will pull micropipettes with tip diameters as small as 0.3um and moderate taper lengths (10 to 15mm). By using an included patching attachment, the **P-30** will pull the standard double pull patch-type pipette. Used with thin wall glass capillaries, it will generate pipettes or needles suitable for microinjection studies. The **P-30** is ideal for student laboratories and other situations which call for an economical, reliable pipette pulling device.

The **P-30** is available with either a platinum/iridium or a Nichrome filament. The Nichrome filament is suitable for many applications and is not

SPECIFICATIONS > P-30

Dimensions
18in x 10in x 9in
46cm x 25cm x 23cm

Weight
35lbs
16kg

Electrical
115/230 volts
50/60 hertz power line

CE

prone to damage.The Platinum filament is more efficient at heating and cooling, and, although is more prone to damage than the Nichrome filament, the platinum filament is recommended for thick wall and aluminosilicate glass and applications requiring shorter taper lengths.

US PRICES
> P-30

P-30/P Vertical micropipette puller with platinum/iridium filament		**$ 2,995**
P-30/N Vertical micropipette puller with Nichrome filament		**$ 2,995**

ACCESSORIES

P-30-NFL/M	Nichrome filament block assembly	**$ 200**
P-30-PFL/M	Platinum/iridium filament block assembly	**$ 200**

FEATURES
> P-30

Pulls electrodes with tip diameters down to 0.3um consistently and reliably.

A micrometer allows precision reproducibility of trip point settings in producing fine microelectrodes.

Full three digit digital controls for accurate setting of heat and pull values.

Constant current power supplies for filament and pull solenoid.

Enclosed front to reduce variability caused by drafts.

Dual (manually) switched heat settings for patch pulling or two different types of micropipettes.

All working parts are made from corrosion resistant material.

Two heating assemblies available; platinum/iridium (recommended) or Nichrome coil.

Built in RFI filter and dual voltage/ dual frequency operation.

Rubber padded jaws to minimize breakage of capillary tubing.

Designed to take up a minimum of bench space.

Slope of the front panel aids in preventing glass from entering cabinet/solenoid mechanism.

PULLER FILAMENTS

Minimum purchase of filaments is 2.

Appropriate filament selection depends on your research application, but a general guideline for filaments is as follows:

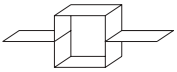
Box Filaments are recommended for large diameter, double barreled, or aluminosilicate glass. Box filaments are particularly suitable for slice preparations where long, parallel walls would aid penetration. If using a box filament, the size of the square box should be approximately 1.0mm to 1.5mm larger than the outside diameter of the glass that you will be using.

For IVF and ICSI applications, a 2.5mm x 4.5mm box filament is recommended. For pronuclear injection work, we recommend a 2.5mm x 2.5mm box filament. Call for more specific advice or to request a combination of settings, filaments, and glass for your application.

Trough Filaments are an excellent general purpose filaments and are recommended for patch pipettes produced from either standard or thin wall glass.

Sutter pre-programs the P-97 with a trough filament unless a box filament is requested.

For either type of filament, increasing the filament width tends to increase the length of the pipette taper. If there are specific questions as to the sizes needed please call and our technical support staff will guide you in your choice.



BOX FILAMENTS

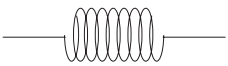
P-97, P-87, P80PC, P80C, PC-84, P-77B

FB215B	2.0mm square box filament, 1.5mm wide	**$ 12.50**
FB220B	2.0mm square box filament, 2.0mm wide.	**$ 12.50**
FB230B	2.0mm square box filament, 3.0mm wide	**$ 12.50**
FB255B	2.5mm square box filament, 2.5mm wide	**$ 12.50**
FB245B	2.5mm square box filament, 4.5mm wide	**$ 12.50**
FB315B	3.0mm square box filament, 1.5mm wide	**$ 12.50**
FB320B	3.0mm square box filament, 2.0mm wide	**$ 12.50**
FB330B	3.0mm square box filament, 3.0mm wide	**$ 12.50**

TROUGH FILAMENTS

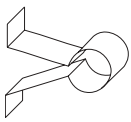
P-97, P-87, P80PC, P80C, PC-84, P-77B

FT315B	1.5mm wide trough filament	**$ 12.50**
FT320B	2.0mm wide trough filament.	**$ 12.50**
FT330B	3.0mm wide trough filament	**$ 12.50**
FT345B	4.5mm wide trough filament	**$ 12.50**



P-30 FILAMENTS

P30T15	1.5mm wide trough filament	**$ 12.50**
P30T20	2.0mm wide trough filament	**$ 12.50**
P30T30	3.0mm wide trough filament	**$ 12.50**
P30N	Nichrome filament	**$ 10.00**



P-77A LOOP FILAMENTS

(Serial number 160 and above)

FL315A	3.0mm loop filament, 1.5mm wide	**$ 12.50**
FL320A	3.0mm loop filament, 2.0mm wide	**$ 12.50**
FL325A	3.0mm loop filament, 2.5mm wide	**$ 12.50**

(Serial number below 160)

FL315X	3.0mm loop filament, 1.5mm wide	**$ 12.50**
FL320X	3.0mm loop filament, 2.0mm wide	**$ 12.50**
FL325X	3.0mm loop filament, 2.5mm wide	**$ 12.50**

ACCESSORIES

FILAMENT	Custom platinum/iridium filament	**$ 18**
FPS	Fire polishing spacer for P97, P87, and P2000 pullers.	**$ 25**
FS1875	Platinum/iridim sheet, 18mm x 75mm x 0.05mm (0.002in)	**$ 90**
IMOXAB	Instruction manual	**$ 15**
NTOXAB	Nitrogen tank (full)	**$ 130**

BV-10 MICROELECTRODE BEVELER

(BV-10-D with optional 80X stereo microscope)

Elegant and simple to use, the **BV-10** offers precision beveling of micropipette tips between 0.1 and 50um. The unique abrasive plate drive system is vibration free for greater control of the beveling process. Beveling can be accomplished very rapidly and produces consistent tip diameters using the techniques as described by Brown and Flaming, *Science*, August 1974, Vol. 185.

Intracellular recording electrodes can benefit from beveling because of 1) a reduction in the tip diameter by creation of the sharp point on the electrode and 2) a lowered electrical resistance of the electrode due to the larger cross sectional area of the lumen. This greatly facilitates penetrating and holding very small or difficult cells. Microinjection needles also benefit from beveling by promoting entry into cells with minimal damage while at the same time enhancing the flow of material through the needle.

The basic beveling system consists of a stationary pedestal, optically flat to a half wave (250nm), surface mounted on a heavy baseplate. This serves as a bearing for an abrasive coated glass grinding plate, which is also flat to half a wave. The flat abrasive plate is coupled to a low vibration, slow-speed motor by means of magnetic fields to provide a wobble-free flat grinding surface. The abrasive plates are fabricated with a proprietary process which insures a consistent abrasive coating.

A 2-stage micromanipulator holds the pipette to be beveled and permits controlled advancement onto the abrasive surface. The bevel angle and speed of advancement are adjustable. A halogen lamp with a gooseneck enhances the beveling operation by providing sharp illumination of the abrasive plate and pipette.

The basic system is completed with two abrasive plates of your choice, a wick with holder (for wet beveling), pedestal oil, degreasing fluid, and manual.

Two **options** are available for monitoring the beveling process, an 80X, stereo microscope and an electrode impedance meter. Depending on your research application, one or both of these options may be desirable. For all micropipette applications, the swing mounted microscope enhances your control of pipette advancement onto the abrasive plate and allows for viewing of the beveling operation (scope resolution is not sufficient for viewing the actual bevel except in the case of very large tips). For microelectrode applications, the impedance meter is used to monitor the tip resistance during the beveling operation. The meter is an analog design, offering three resistance ranges (0-10, 0-100, 0-500 MOhm). Measurements are made at 12 Hz to minimize capacitive contributions to the impedance measured and provide a near-true DC resistance value. A rapid roll-off is used to reduce 50/60 Hz interference, allowing operation in a laboratory environment without screening.

FEATURES
> BV-10

Vibration-free, magnetically coupled beveling surface.

Abrasive surface optically flat to a half wave (250nm).

Finest abrasive surface commercially available.

Synchronous clock motor insures stable rotation rate.

7lb steel baseplate adds additional dampening.

Integrated halogen lamp.

Robust micromanipulator controls bevel angle and advancement.

SPECIFICATIONS > BV-10

Beveling Range
0.1um through 50um finished electrodes depending on abrasive plate used

Grinding Surface Variation
less than 1.0um

Grinding Speed
60 RPM

Beveling Angle Range
5-90 degrees - adjustable

Micromanipulator
course drive:
0.075in / dial revolution
fine drive:
0.0004in / dial revolution

Dimensions
19in x 9in x 8in
48cm x 22cm x 20cm

Weight
Approx. 45lbs/20kg

Electrical
120 volts - 50/60 Hz power line (220 volt option requires special modification, please see price list)

OPTIONS

80X stereo microscope.

Impedance meter for real-time measurement of tip impedence.

US PRICES
> BV-10

SYSTEMS

BV-10-B	Micropipette beveler basic system [1]	**$ 2,750**
BV-10-C	BV-10-B with electrode impedance meter	**$ 3,250**
BV-10-D	BV-10-B with 80X stereo microscope	**$ 3,250**
BV-10-E	BV-10-B with impedance meter and 80X stereo microscope	**$ 3,750**

1) Includes micromanipulator, reference wick, reference wick holder, pedestal oil, degreaser, manual, and two abrasive plates of your choice.

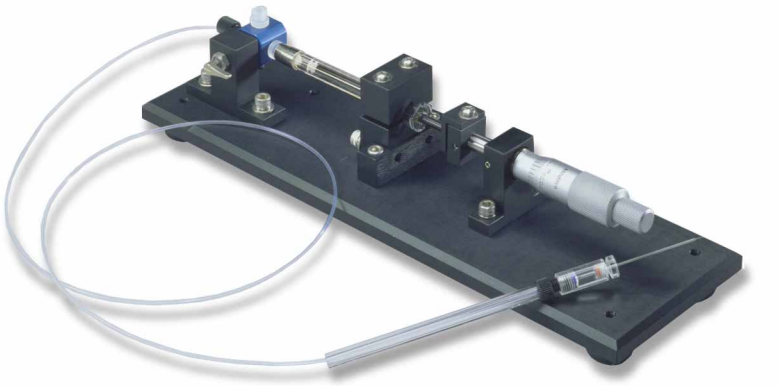
ACCESSORIES

BV-10M	Electrode impedance meter with active and reference lead	**$ 695**
BV-10S	80X stereo microscope	**$ 695**
104C	Diamond abrasive plate - coarse (5.0 µ to 50 µ tip sizes)	**$ 150**
104D	Diamond abrasive plate - fine (2.0 µ to 20 µ tip sizes)	**$ 150**
104F	Diamond abrasive plate - extra fine (0.5 µ to 5.0 µ tip sizes)	**$ 150**
005	Alumina abrasive plate - 0.05 microns (0.1 µ to 0.3 µ tip sizes)	**$ 150**
006	Alumina abrasive plate - 0.30 microns (0.3 µ to 1.0 µ tip sizes)	**$ 150**
007	Degreaser (bottle)	**$ 4**
008	Beveler pedestal oil	**$ 3**
220V-MOD	Modification to 220 volts	**$ 200**

REPLACEMENT PARTS

101	6-inch reference lead (body to meter)	**$ 7**
102	2-inch active lead (platinum to pipette)	**$ 7**
003	Reference wick	**$ 2**
003A	Reference wick holder	**$ 30**
105	Halogen bulb	**$ 12**
106	Drive belt	**$ 15**

MANUAL MICROINJECTOR



The **Manual Injector** is a manual syringe driver for pneumatic or hydraulic control of injection needles or holding pipettes. It is suitable for injecting volumes in the nanoliter to microliter range. It is also widely used as a fluid control device for IVF applications requiring sensitive manual control of the displacement of microneedle contents. The system is constructed from the highest quality parts. The base assembly is black anodized aluminum. A non-rotating Mitutoyo micrometer provides the drive to the gas-tight syringe[1]. A precision 3-way valve provides a convenient method for filling the fluid line and clearing air bubbles from the line. Teflon tubing, chromatography connectors and a pipette holder[2] complete the system.

SYRINGE VOLUME	VOLUME PER REVOLUTION	VOLUME PER DIVISION
10µl	106nl	4.2nl
25µl	267nl	10.6nl
50µl	529nl	21.2nl
100µl	1.06µl	42.3nl
250µl	2.65µl	105.8nl
500µl	5.29µl	211.7nl
1000µl	10.58µl	423.4nl

US PRICES
> MANUAL MICROINJECTOR

MANUAL Manual injector with non-rotating micrometer, 3-way valve, precision 50ul gas-tight syringe, teflon tubing, connectors and MI-10010 pipette holder assembly for 1.0mm capillary tubing.* **$ 950**

ACCESSORIES

MI-10010 Pipette holder assembly (specify 1.0mm, 1.2mm, or 1.5mm OD glass) includes holder and mounting rod. **$ 55**

V200050	Teflon tubing	**$3 per ft.**
V001180	10ul gas-tight syringe	**$105.00**
V001180	25ul gas-tight syringe	**$105.00**
V001180	50ul gas-tight syringe	**$105.00**
V001180	100ul gas-tight syringe	**$105.00**
V001180	500ul gas-tight syringe	**$105.00**
V001180	1000ul gas-tight syringe	**$105.00**

** Other syringe volumes, and pipette holder sizes are available upon request.*

The injection resolution is dependent on the volume of the syringe that is installed, as outlined in the table on the previous page. For example, with a 25ul syringe installed, one complete rotation of the micrometer (25 divisions) yields a displacement equivalent to a volume of 267nl and turning the micrometer one division (0.001in) yields 10.6nl.

1 *Please specify the syringe volume that you will be using. For IVF applications, 500ul and 1000ul syringes are commonly used.*

2 *Unless specified otherwise, a pipette holder for 1mm outside diameter glass will be supplied. The diameter of the pipette holder is 0.25 inches (6.4mm). For micromanipulators that cannot accept this size holder, an adapter is optionally available. Please contact us for further information.*

MICROPIPETTE TECHNIQUES
ADVANCED MICROPIPETTE TECHNIQUES FOR CELL PHYSIOLOGY

KENNETH T. BROWN

University of California at San Francisco

DALE FLAMING

Sutter Instrument Company, Novato, CA.

Fine glass micropipettes are extensively used in intra- and extracellular physiology as a means of recording electrical activity in cells and as channels for injecting a variety of substances for experimental purposes. In 1973, the authors began a course of systematic studies designed to help them improve the capabilities and efficiency of intracellular research using the micropipette technique. Here, they present for the first time their theory of how micropipette tips are formed, their methods of reducing tip size, and the implications of their work for research on small cells of all kinds, especially cells within the central nervous system. This text not only incorporates this new work, but reviews and analyzes existing publications on micropipette methodology, including patch-clamping, in order to present as complete an account as possible of how micropipettes can be used efficiently and effectively in a wide variety of experimental situations. The information presented here should prove helpful to anyone performing research with micropipettes, from a graduate student conducting a first project to the most experienced investigator.

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The Flaming/Brown Micropipette Puller: Its Background, Design and Underlying Principles

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Evaluation of Flaming/Brown Micropipette Puller

A Theory of Micropipette Tip Formation: Quantitative Prediction and Validation of the Effects of Capillary Wall Thickness Upon Tip Size

Effects of a Fused Internal Fiber (Omega Dot) Upon Micropipette Tips

Minimizing Tip Size With Borosilicate Tubing

Beveling Micropipette Tips: Techniques and Applications

Filling Micropipettes: Techniques and Solutions

Advancing Micropipettes Through Tissues and Into Cells

Ancillary Techniques for Conducting Intracellular Research

Evaluation of Improved Intracellular Recording Techniques in Vertebrate Photoreceptors

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Dual-Channel Micropipettes

The Burgeoning Field of Patch Clamping

Extension of the Flaming/Brown Micropipette Puller to Patch Clamping and Conveniently Handling Aluminosilicate Glass

References

Appendices

GLASS

Sutter Instrument Company, in addition to the finest micropipette pullers available, offers a wide selection of high quality glasses in various sizes and materials. Though there are many types and sizes of glass available, we have carefully selected only those that pass our criteria. Our expertise in micropipette technology assures you of precision and high quality.

We offer capillary tubing in three different compositions; quartz, borosilicate and aluminosilicate. Each composition has its own unique properties and the selection will be determined by your application and your puller's capabilities.

FIRE POLISHING

As of November 1, 2004 all borosilicate and aluminosilicate capillary glass offered by Sutter Instrument will have fire-polished ends. This process eliminates any sharp edges, making it easier to insert into holders, and does not affect the electrical or mechanical properties of the glass.

CUSTOM PIPETTES

Sutter Instrument Company can make custom pipettes and microtools not commonly available from other pipette manufacturers. The custom pipettes are considered non-sterile and are manufactured for research applications and non-human use. Please contact Sutter Instrument for further details.

BOROSILICATE (SCHOTT 8340)

The most commonly used glass is borosilicate. Sutter Instrument offers only TYPE I-CLASS A borosilicate as described by ASTM Standard 3.1.2[1] . This glass softens at 825 degrees Celsius and, as it is pulled, maintains its ratio of inside diameter to outside diameter over the total taper length. Borosilicate softens at a lower temperature than our other glasses and has a wider working range. These unique properties allow for a greater variety of shapes used in microelectrodes, patch pipettes, microinjection needles and, in the case of solid rod, chromosome dissection tools.

ALUMINOSILICATE (CORNING 1724 OR SCHOTT 8252)

Aluminosilicate softens at a higher temperature (935 degrees Celsius) than borosilicate and is workable over a much narrower range. It has a tendency to continuously thin out as it is drawn which allows extremely fine tips with very short tapers. For example, we have pulled aluminosilicate tips in the 200-300 Angstrom range with taper lengths of 5-6mm. Its resistivity is several orders of magnitude higher than borosilicate, thus reducing leakage currents when used in ion-selective micropipettes. Aluminosilicate is harder than borosilicate which results in a pipette that is more suitable for penetrating tough tissues.

QUARTZ (HERAEUS HSQ300)

The finest and purest glass available is quartz. It is superior to all other glasses in its mechanical, electrical and optical qualities. It has the lowest dielectric constant, the lowest loss factor and the highest volume resistivity making it ideal for patch clamp recording. Its chemical purity virtually eliminates leakage of ions[2] and by using quartz in single channel patch clamp recordings the lowest background noise levels have been achieved[3]. Due to its high melting point, it cannot be pulled on conventional pullers, but can be easily pulled with the Sutter CO_2 laser-based P-2000.

SIZES

Sutter Instrument capillary tubing is available in a broad range of wall thicknesses which allow you to select the size necessary for your application. The ratios of inside diameter to outside diameter typically run between 0.5 mm and 0.75mm with the lower end being referred to as thick wall tubing and the top of the range as thin wall tubing. All other factors being equal, the thicker wall capillaries produce pipettes with longer tapers and smaller tips which make it more suitable for intracellular microelectrodes. These thicker wall pipettes tend to reduce the noise contributions due to capacitance, which makes them more suitable for patch clamp pipettes. Thinner wall tubing allows for larger pore openings which makes it ideal for microinjection needles and low resistance microelectrodes.

[1] ASTM Designation E438-90 - April 1990.

[2] Zuazaga C., Steinacker A. Patch-clamp recording of ion channels: Interfering effects of patch pipette glass. News in Physiological Sciences: International Union of Physiological Sciences and the American Physiological Society: 5:155-158, August 1990.

[3] Rae, James L., Levis Richard A. A Method for exceptionally low noise single channel recordings. Pflügers Archive; European Journal of Physiology:420:618-620, Springer-Verlag 1992.

STANDARD WALL BOROSILICATE TUBING

WITH FILAMENT

catalog number	outside diameter	inside diameter	overall length	pieces per package	price
BF100-50-10	1.00mm	0.50mm	10cm	225	**$29**
BF100-50-15	1.00mm	0.50mm	15cm	225	**$43**
BF100-58-10	1.00mm	0.58mm	10cm	250	**$29**
BF100-58-15	1.00mm	0.58mm	15cm	250	**$40**
BF120-60-10	1.20mm	0.60mm	10cm	225	**$36**
BF120-69-10	1.20mm	0.69mm	10cm	250	**$32**
BF120-69-15	1.20mm	0.69mm	15cm	250	**$26**
BF150-75-10	1.50mm	0.75mm	10cm	225	**$36**
BF150-86-10	1.50mm	0.86mm	10cm	250	**$33**
BF150-86-15	1.50mm	0.86mm	15cm	250	**$74**
BF200-100-10	2.00mm	1.00mm	10cm	225	**$74**
BF200-116-10	2.00mm	1.16mm	10cm	250	**$85**
BF200-116-15	2.00mm	1.16mm	15cm	250	**$90**

WITHOUT FILAMENT

Catalog number	outside diameter	inside diameter	overall length	pieces per package	price
B100-50-10	1.00mm	0.50mm	10cm	225	**$30**
B100-50-15	1.00mm	0.50mm	15cm	225	**$69**
B100-58-10	1.00mm	0.58mm	10cm	250	**$26**
B100-58-15	1.00mm	0.58mm	15cm	250	**$37**
B120-69-10	1.20mm	0.69mm	10cm	250	**$35**
B120-69-15	1.20mm	0.69mm	15cm	250	**$25**
B150-86-10	1.50mm	0.86mm	10cm	250	**$35**
B150-86-15	1.50mm	0.86mm	15cm	250	**$67**
B200-116-10	2.00mm	1.16mm	10cm	250	**$55**
B200-116-15	2.00mm	1.16mm	15cm	250	**$65**

THIN WALL BOROSILICATE TUBING

WITH FILAMENT

catalog number	outside diameter	inside diameter	overall length	pieces per package	price
BF100-78-10	1.00mm	0.78mm	10cm	250	**$26**
BF100-78-15	1.00mm	0.78mm	15cm	250	**$42**
BF120-94-10	1.20mm	0.94mm	10cm	250	**$32**
BF120-94-15	1.20mm	0.94mm	15cm	250	**$45**
BF150-110-10	1.50mm	1.10mm	10cm	225	**$32**
BF150-117-10	1.50mm	1.17mm	10cm	250	**$28**
BF150-117-15	1.50mm	1.17mm	15cm	100	**$31**
BF200-156-10	2.00mm	1.56mm	10cm	250	**$35**
BF200-156-15	2.00mm	1.56mm	15cm	100	**$37**

WITHOUT FILAMENT

Catalog number	outside diameter	inside diameter	overall length	pieces per package	price
B100-75-10	1.00mm	0.75mm	10cm	225	**$22**
B100-75-15	1.00mm	0.75mm	15cm	225	**$37**
B120-90-10	1.20mm	0.90mm	10cm	225	**$25**
B150-110-10	1.50mm	1.10mm	10cm	225	**$27**

MULTIBARREL BOROSILICATE*

WITH FILAMENT

catalog number	outside diameter	inside diameter	overall length	pieces per package	price
2BF100-50-10	2 barrels	1.00/0.50	10cm	75	**$42**
2BF100-75-10	2 barrels	1.00/0.75	10cm	75	**$40**
2BF150-86-10	2 barrels	1.50/0.86	10cm	100	**$47**
2BF150-86-15	2 barrels	1.50/0.86	15cm	100	**$61**
3BF100-50-10	3 barrels	1.00/0.50	10cm	75	**$37**
3BF100-75-10	3 barrels	1.00/0.75	10cm	75	**$39**
3BF120-69-10	3 barrels	1.20/0.69	10cm	100	**$42**
3BF120-69-15	3 barrels	1.20/0.69	15cm	100	**$61**

** Multibarrel borosilicate requires a custom filament.*
Please contact Sutter Instrument for more information when ordering.

QUARTZ TUBING

WITH FILAMENT

catalog number	outside diameter	inside diameter	overall length	pieces per package	price
QF100-50-7.5	1.00mm	0.50mm	7.5cm	100	**$103**
QF100-50-10	1.00mm	0.50mm	10cm	100	**$150**
QF100-60-7.5	1.00mm	0.60mm	7.5cm	100	**$95**
QF100-60-10	1.00mm	0.60mm	10cm	100	**$145**
QF100-70-7.5	1.00mm	0.70mm	7.5cm	100	**$120**
QF100-70-10	1.00mm	0.70mm	10cm	100	**$145**
QF100-70-15	1.00mm	0.70mm	15cm	100	**$215**
QF120-60-7.5	1.20mm	0.60mm	7.5cm	100	**$150**
QF150-75-7.5	1.50mm	0.75mm	7.5cm	100	**$107**

WITHOUT FILAMENT

catalog number	outside diameter	inside diameter	overall length	pieces per package	price
Q100-30-7.5	1.00mm	0.30mm	7.5cm	100	**$108**
Q100-50-7.5	1.00mm	0.50mm	7.5cm	100	**$103**
Q100-50-10	1.00mm	0.50mm	10cm	100	**$140**
Q100-70-7.5	1.00mm	0.70mm	7.5cm	100	**$97**
Q100-70-10	1.00mm	0.70mm	10cm	100	**$140**
Q120-40-7.5	1.20mm	0.40mm	7.5cm	100	**$166**
Q120-60-7.5	1.20mm	0.60mm	7.5cm	100	**$145**
Q120-90-7.5	1.20mm	0.90mm	7.5cm	100	**$120**
Q120-90-10	1.20mm	0.90mm	10cm	100	**$160**
Q150-50-7.5	1.50mm	0.50mm	7.5cm	100	**$150**
Q150-75-7.5	1.50mm	0.75mm	7.5cm	100	**$95**
Q150-75-10	1.50mm	0.75mm	10cm	100	**$107**
Q150-110-10	1.50mm	1.10mm	10cm	100	**$170**
Q165-115-10	1.65mm	1.15mm	10cm	100	**$141**

SOLID QUARTZ ROD

catalog number	outside diameter	inside diameter	overall length	pieces per package	price
QR-100-7.5	solid	1.00 mm	7.5cm	100	**$63**
QR-100-10	solid	1.00 mm	10cm	100	**$63**
QR-100-15	solid	1.00 mm	15cm	100	**$63**

QUARTZ WITH STAINLESS STEEL CORE

catalog number	outside diameter	overall length	pieces per package	price
QS200-10	0.20 mm	10cm	100	**$125**
QS125-10	0.125mm	10cm	100	**$125**
QS80-10	0.08 mm	10cm	100	**$125**

QUARTZ THETA TUBING

catalog number	O.D./I.D.	septum thickness	overall length	pieces per package	price
QT120-90-7.5	1.20/0.9mm	0.15mm	7.5cm	50	**$68**

MULTIBARREL QUARTZ

catalog number	number of barrels	OD/ID in mm	overall length	pieces per package	price
7Q033-16-10	7 barrel	1.00/[.33/.16ea]	10cm	100	**$229**

THIN WALL ALUMINOSILICATE TUBING

WITH FILAMENT

catalog number	outside diameter	inside diameter	overall length	pieces per package	price
AF100-68-10	1.00mm	0.68mm	10cm	100	**$35**
AF120-85-10	1.20mm	0.85mm	10cm	100	**$37**
AF150-100-10	1.50mm	1.00mm	10cm	100	**$36**

WITHOUT FILAMENT

catalog number	outside diameter	inside diameter	overall length	pieces per package	price
A100-68-10	1.00mm	0.68mm	10cm	100	**$34**
A120-85-10	1.20mm	0.85mm	10cm	100	**$39**
A150-100-10	1.50mm	1.00mm	10cm	100	**$41**

BOROSILICATE THETA TUBING

catalog number	O.D./I.D.	septum thickness	overall length	pieces per package	price
BT-150-10	1.50/1.17mm	0.165mm	10cm	100	**$76**

SOLID BOROSILICATE ROD

catalog number	style	inside diameter	overall length	pieces per package	price
BR-100-15	solid	1.00mm	15cm	250	**$32**

MICROMANIPULATION

Precise movement. Just what you require in a micromanipulator. Sutter Instrument, the same company that refined the movements necessary to repeatedly pull micropipettes with sub-micron tips, has also harnessed the technologies necessary to easily move those same tips with sub-micron accuracy.

Micromanipulator design at Sutter Instrument began in 1985 with the **MP-85**, a refined and extended Huxley-style micromanipulator. Continuing from that time Sutter Instrument has shown a desire to provide manipulator mechanisms with smooth, ergonometric micro-movements that are also adaptable to many different experimental designs and platforms. This design process includes two motorized manipulators, the industry standard **MP-285** and its new sibling, the **MP-225**. Both couple the smooth mechanical micromotion and microprocessor-based, stepper-motor drive mechanisms users have come to expect in Sutter products.

As time has shown, much of what makes a scientific apparatus popular is how easy it can be incorporated into existing equipment. In the case of micromanipulators, this process has involved designing manipulator platforms that bolt directly to the frames of the most popular microscopes. Alternatively, we also offer rock-steady, free-standing platforms

that support our manipulators by clamping to the table beside the microscope. Our original stands, the **MT-70** and **MT-75**, originally designed to support the fifteen- pound Huxley with zero sag, also double as free-standing platforms for the **MP-225** and **MP-285**. The motorized manipulators are also supported by a number of microscope-specific stands that bolt directly to the bodies of the most popular Leica, Nikon, Olympus, and Zeiss inverted microscopes. These platforms lend themselves to the absolutely drift-free recording configuration required when using the **MP-225** and **MP-285** for positioning patch-electrodes onto attached cells in culture.

A task specific platform for manipulators is the **MT-1000** translation system. When coupled with **MP-285**s or **MP-225**s, the system forms a slice-patch workstation. The **MT-1000** was born out of the technique now common in slice recording that moves the optical pathway while keeping the slice and recording electrodes fixed. The translation system allows the user to move to multiple locations on the tissue at high resolution without disturbing recording electrodes. The **MT-1000** workstation encompasses: an X-Y translator designed to move a microscope smoothly and accurately; two **MT-75** gantry-type stands for positioning manipulators on one or both sides of the microscope; and a third gantry stand that becomes the fixed stage for the microscope. The newly introduced **MT-2000** uses a motorized X-Y translator. In this design, stepper-motor driven lead screws provide smooth movement of the microscope.

Rounding out our line of manipulators are the **MM-33** micromanipulator and the **MM-1** and **MM-3** micropositioners. The MM-33 is a low-cost, micromanipulator of sufficient resolution and control for impaling xenopus oocytes and other medium-fine manipulation tasks. The **MM-1** and the **MM-3** are suitable for positioning perfusion tubes, moving a preparation, or for positioning reference electrodes in a bath.

MP-285
MOTORIZED MICROMANIPULATOR

(Shown with ROE input device)

The flagship in our line of precision micromanipulators, the motorized **MP-285** is affordable yet offers advanced features found in manipulators costing thousands more. Custom engineered stepping motors, precision cross-roller bearing slides and proprietary worm gear capstan drives form the basis of the watch-like mechanical system. The controller provides power to the stage motors with a quiet linear power supply to minimize electrical noise radiation in your setup. Pipette holders and headstages are securely mounted to the **MP-285** with one of our several unique and rigid mounting systems.

The **MP-285** was designed to meet a wide variety of positioning needs for the scientific community, and is suitable for patch clamp experiments, extracellular recording, microinjection, intra-cellular recording and precision robotic positioning applications. An outstanding feature of this system is the unique definable 4th axis for diagonal advancement of the pipette. You select the angle, then activate the 4th axis. As with the other three axes, you may move with adjustable coarse or ultrafine resolution, select the movement speed, and move continuously or in single step increments. To quickly reposition the pipette, simply select the Home function. Axes positions are continuously shown in relative and absolute scales, and are easily readable on the vacuum fluorescent display.

The extremely low backlash of the **MP-285** removes traditional drawbacks of "open loop" technology and eliminates drift. This allows submicron resolution down to 0.2 microns in the coarse range and down to 40 nano-meters in the fine range. With over 1 inch of motorized travel on all three axes, and a user designated 4th axis, the **MP-285** allows tremendous range of motion while maximizing resolution.

Available with a table-top or rack mounted controller, our manipulator fits in seamlessly with your other components while the compact design and assignable axes of the **MP-285** allows you to easily integrate it into your setup at any orientation. To add to its practicality, your choice of one of two manual controls: joystick or rotary optical encoder (ROE), assures a comfortable experimentation environment, customized to the scientist.

For users who require repeatable motion sequences, the **MP-285** features easily programmed robotic control from the keypad, or via a remote computer. The system can store up to 500 position instructions, including pauses, and will execute the instruction set once, continuously, or in reverse.

FEATURES
> MP-285

- Highly stable for experiments intolerant of pipette drift.
- Submicron resolution and integrated coarse positioning.
- 1 inch of motorized travel on all three axes.
- 4th axis with user-selected angle for axial drive.
- Adjustable speed and resolution allows optimization for your experimental setup.
- Programmable robotics for complex motion sequences.
- Continuous display (in microns) of axes positions.
- Switch between continuous or single step movement.
- Absolute and relative origins.
- Convenient **Home** function allows pipettes to be quickly repositioned.
- Assignable axes permit any orientation of the manipulator.
- Easy to read vacuum fluorescent display.
- Remote computer control via serial interface.
- Compact design easily adaptable to your setup.
- Universal mounting system for headstage or pipette holder.
- Optional mounting adapters (see price list).

As always, our technical support team is available to address your concerns and answer all questions before, and after your purchase.

CHOOSE ONE OF TWO INPUT DEVICE OPTIONS

1) Rotary Optical Encoder (ROE). Turning one of three 2-inch knobs produces a movement along one axis proportional to the amount and speed of the turn. Buttons allow the activation of "4th axis", change of movement resolution, "home" return function, and toggle between continuous pulse movements.

2) Joystick. Our joystick is a modified three-axis game controller. The degree of handle deflection determines the velocity of movement of each axis. In pulse mode, a button commands the manipulator to take a single step in the axis selected by joystick deflection.

SPECIFICATIONS > MP-285

Travel
1 inch on all three axes

Resolution
Low: 0.2um/step
High: 0.04um/step

Maximum Speed
2.9mm/sec

Long Term Stability
<10nm/hour at 24deg C.

Drive Mechanism
Precision worm gear capstandrive

Serial Interface
RS-232, 9600 baud
(1 start bit, 8 data bits, 1 stop bit)

Dimensions
Mechanical: 4.5in x 6in x 6.25in
11cm x 15cm x 16cm

Controller: 4in x 16in x 12.25in
10cm x 40.5cm x 31cm

Weight
Manipulator: 3.85lb/1.7kg
Controller: 10lb 11oz/4.5kg

Electrical
115/230 Volts
50/60 Hertz power line

CE

US PRICES
> MP-285

MP-285/R Includes manipulator, rack mount controller unit, cables, rod holder, 4in dovetail headstage adapter, mounting adapter plate, choice of input device, power cord, and manual **$ 7,900**

MP-285/T Includes manipulator, table top controller unit, cables, rod holder, 4in dovetail, headstage adapter plate, mounting adapter plate, choice of input device, power cord, and manual **$ 7,900**

When ordering the MP-285, the following items must be specified. Please list as seperate items with no cost.

Choice of one input device	
Rotary Optical Encoder	**285ROE**
Joystick	**285JOY**
The handedness of the manipulator	
Right handed setup	**RIGHT**
Left handed setup	**LEFT**

If you have any questions regarding the part numbering system, please contact Sutter Instrument Company directly.

ACCESSORIES

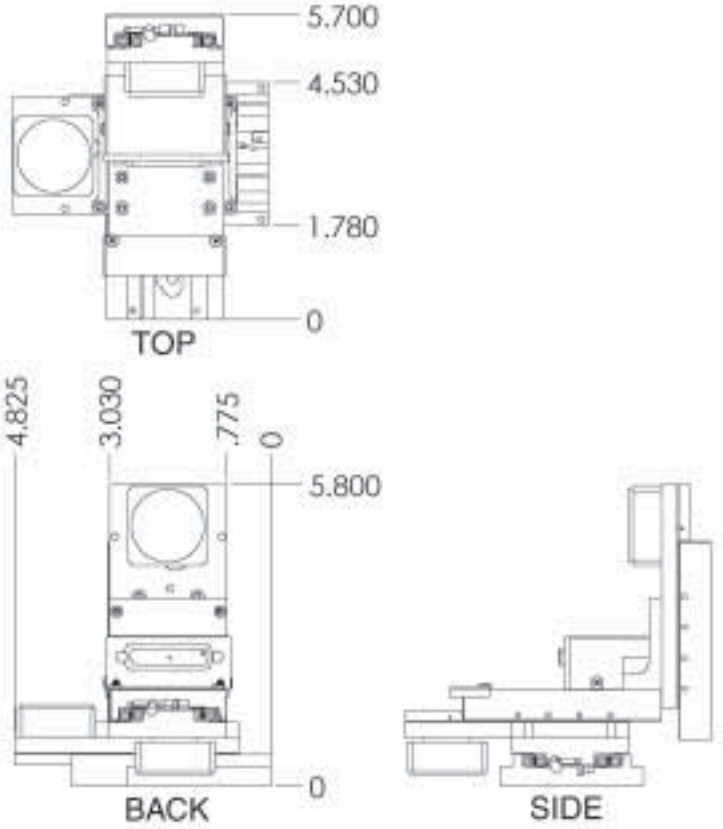
X285204	4in dovetail extension	**$ 35**
X285210*	Mounting adapter plate	**$ 45**
285RBI	Rotating base	**$ 300**
X285300	Right angle adapter	**$ 45**
X285305	Z-axis vertical extension	**$ 45**
X285310	Z-axis horizontal extension	**$ 45**
285HEA	Hinged headstage mount	**$ 200**

For detailed information on mounting our micromanipulators, refer to the Mounting Systems section or phone for assistance.

** For use with MT and MD series stands and platforms, or any surface with 1 inch centered holes.*

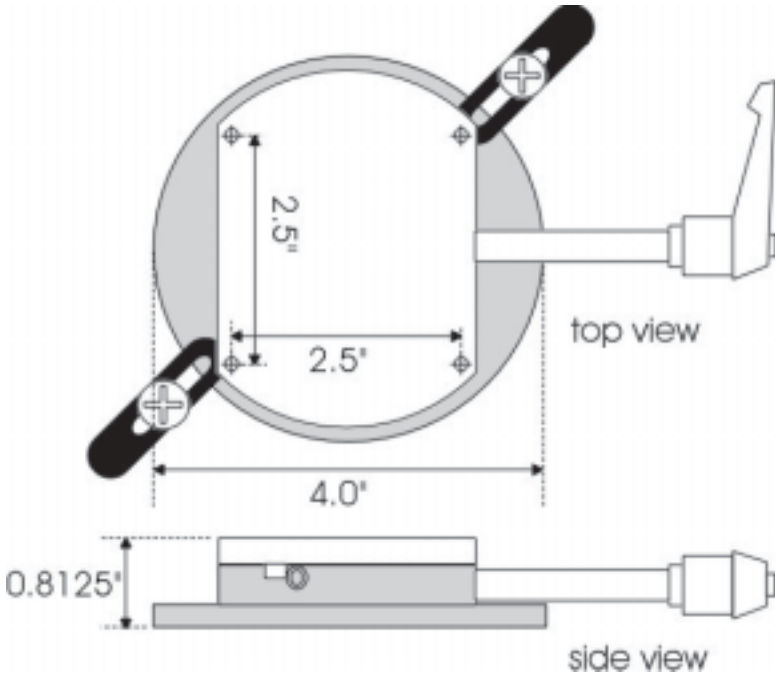
MECHANICAL DRAWINGS MP-285

(All measurements in inches)



MECHANICAL DRAWINGS MP-285 ROTATING BASE

(All measurements in inches)



MP-225
MOTORIZED MICROMANIPULATOR

The **MP-225** is the newest member in the Sutter Instrument Company micromanipulator line. Production and design changes have allowed us to produce a motorized manipulator that is a more affordable alternative to the industry standard **MP-285**. While the **MP-225** feature set is less comprehensive than the **MP-285**, it includes the most popular features with a user interface that is simpler to use. The mechanical design utilizes a miniature stepper motor and integral anti-backlash gear head. Preloaded ball bearing slides provide smooth movement throughout the 25mm of travel. The controller uses low-noise, linear-drive output circuitry identical to that found in the **MP-285**. The methodology for mounting pipette holders and headstages used with the **MP-285** has been maintained in the **MP-225** to allow for cross compatibility.

The **MP-225** is designed primarily for positioning patch and intracellular recording pipettes. We have retained and refined the features most desired for this type of work. An extended version of the popular rotary optical encoder (ROE) is the sole input device available with the **MP-225**. Like the **MP-285**, the manipulator has a synthetic 4th axis for diagonal advancement of the pipette; 16 different angles are selectable via DIP switches. Speed and resolution of movement are easily selected with a multiple position thumbwheel, allowing fast/course movement and slow/ultra-fine movement in 10 incre-

ments. Two commonly used robotic movements have been incorporated for user convenience. A single button press can initiate a move to a Home position for pipette exchange or to a user defined Work position for quick location of the pipette near the recording location. A display on the ROE gives position location. As all controls are located on the ROE, the controller can be moved to a less accessible area of your setup and does not need to occupy prime space in an equipment rack.

As always, our technical support team is available to address your particular needs and answer all questions before and after your purchase.

FEATURES > MP-225

Highly stable for experiments intolerant of pipette drift.

Submicron (62.5nm) minimal resolution for fine movement.

Convenient thumbwheel selects resolution/speed of movement.

25mm of motorized travel on all three axes.

4th axis for coaxial movement of pipette, angle selected by DIP switches on ROE.

ROE button press actuates move to Home position for pipette exchange.

ROE button press actuates move to Work position near recording location.

Continuous display (in microns) of axes positions located on ROE.

DIP switches on ROE select direction of movement produced by turn of ROE knob.

Modularized, compact design easily adaptable to your setup.

Universal mounting system for headstage or pipette holder.

Mounting adapters included with manipulator.

SPECIFICATIONS > MP-225

Travel
25mm on all three axes

Resolution
Six microstep sizes selectable (um/ustep): 0.0625, 0.125, 0.25, 0.5, 1.0 and 2.0
Finer movement settings use the 62.5nm microstep size but fewer microsteps are commanded per encoder knob turn

Maximum Speed
2.0mm/sec

Long Term Stability
1-2 um/hour maximum

Drive Mechanism
Integral miniature stepper motor anti-backlash gearhead

Dimensions
Mechanical: 4in x5.5in x 6in
10cm x 15cm x 15.5cm

Controller: 4in x 16in x 12.25in
10cm x 40.5cm x 31cm

Weight
Manipulator: 2.95lbs /1.3kg
Controller: 10lb 11oz/4.5kg

Electrical
115/230 Volts
50/60 Hertz power line

CE

US PRICES
> MP-225

U.S. PRICES

Motorized Micromanipulator

MP-225 Includes manipulator, table top controller unit, extended ROE, cables, rod holder, 4in dovetail extension, mounting adapter plate, hinged headstage mount, screws, hex wrench, power cord and manual* **$ 6,500**

For detailed information on mounting our micromanipulators, refer to the Mounting Systems section or phone for assistance.

** Indicate right- or left-handed set-up when ordering.*

ACCESSORIES

X285204	4in dovetail extension	**$ 35**
285RBI	Rotating base	**$ 300**
X285300	Right angle adapter	**$ 45**
X285305	Z-axis vertical extension	**$ 45**
X285310	Z-axis horizontal extension	**$ 45**

MP-85
HUXLEY-WALL TYPE MICROMANIPULATOR

(Shown with optional spacer, wedge and magnetic feet)

The classic micromanipulator developed by Sir Huxley many years ago is still considered by many investigators to be the finest manual micromanipulator available. The **MP-85** offers the advantage of a very large range of movement with its built-in coarse manipulator and precise submicron movement with the fine controls. Coarse positioning is achieved with a three axis manipulator mounted on top. The ultrafine positioning is accomplished with the large micrometers mounted on the base. These micrometers provide smooth, precise movement through a 10:1 reduction mechanism.

The brass and stainless steel construction of the **MP-85** makes for a very heavy and solid micromanipulator with excellent damping properties. This exceptionally stable design is ideal for patch clamp recording, intracellular recording, or any other application that is intolerant of drift.

The **MP-85** is chrome-plated and anodized to prevent corrosion. The J.R. Wall designed rotating base is machined from solid stainless steel with a brass spindle; a thin Teflon washer provides for the bearing surface.

Please contact Sutter Instrument for any additional information on the suitability and use of the **MP-85** micromanipulator for your specific application.

FEATURES > MP-85

Dual springing of the moment arms to insure zero backlash and zero torsion.

The micromanipulator is mounted on a precision rotating base featuring a positive stop and lock.

The coarse movement is an all cross-roller bearing design consisting of coarse X, Y, and Z with an additional fine X motion.

The micromanipulator can be ordered in either a right or left handed version.

OPTIONS > MP-85

Fifteen degree stackable wedges for tilting the manipulator.

A set of three magnetic feet for increased stability.

One inch thick, chrome plated, solid brass riser blocks.

SPECIFICATIONS
> MP-85

Coarse X-axis tilt
0 to 45 degrees
in 15 degree increments

Coarse resolution
0.1mm on all axes

Fine X resolution
0.01mm

Ultrafine (Huxley) resolution
0.2um

Huxley excursion
~2mm maximum in each axis

Dimensions
10in x 10in x 12in
25cm x 25cm x 28cm

Weight
15lbs
7kg

US PRICES
> MP-85

MICROMANIPULATOR

MP-85/R -Right handed- Includes manipulator, coarse movement MM-33 micromanipulator, and rotating base **$ 3,495**

MP-85/L -Left handed- Includes manipulator, coarse movement MM-33 micromanipulator, and rotating base **$ 3,495**

ACCESSORIES

Holder/MP85	Universal headstage adapter	**$ 135**
RBI	Rotating base only	**$ 425**
T363410	Magnetic feet (set of 3)	**$ 30**
X040073	MP-85 Axiopatch 200 adapter	**$ 70**
X850600	15 degree (each)	**$ 60**
X850700	1 inch increment spacer *(No more than three recommended)*	**$ 60**

MM-33
MICROMANIPULATOR

(Shown: MM-33A)

Successfully used in conjunction with our other micromanipulators, the **MM-33** is available separately for those wishing a small, practical instrument in applications not requiring submicron accuracy.

The **MM-33** is the right choice for tight environments which require maximum versatility within a small space. The optional rotating base and tiltable X-axis provide even further flexibility.

Stainless steel cross-loaded roller bearings are designed to offer low friction and smooth linear motion with a minimum of side play. The preloaded rollers are set at 90 degrees to the hardened steel guides ensuring constant contact and accuracy. This precise rack and pinion drive gives stable, drift free movement with minimal backlash. The controls are placed one above the other which makes for less hand movement and easier positioning. The scales for all axes are calibrated in 0.10mm increments and the fine micrometer adjustment for the X-axis thrust is calibrated at 0.01mm with estimates to 5um.

The optional rotating base extends the utility of the **MM-33** by providing two additional rotating planes. The rotation in the horizontal plane (approximately 120 degrees) has a positive stop, quick release mechanism for fast insertion and removal of pipettes. The second rotating axis allows the **MM-33** to be tilted in a vertical plane from 0 to 70 degrees.

The optional tiltable X-axis allows the fine axis to be tilted up to 45 degrees. An optional vertical lock is also available for locking the position of the vertical axis. These options should be ordered at the time of purchase since the modifications are factory installed.

INDIVIDUAL EXCURSIONS ARE AS FOLLOWS:

X-axis coarse movement: 37mm

X-axis fine movement: 10mm

Y-axis horizontal movement: 20mm

Z-axis vertical movement: 20mm

FEATURES > MM-33	OPTIONS > MM-33
Compact design allows use in tight environments.	Rotating base allows horizontal rotation and vertical tilting.
Cross-loaded roller bearings for smooth, low friction movement.	Fine x-axis tilt mechanism.
Rack and pinion drive gives stable movement with minimal backlash.	Vertical axis lock.

US PRICES
> MM-33

MICROMANIPULATOR

MM-33/R Right handed micromanipulator (with 1/2" rod clamps*). **$ 745**

MM-33/L Left handed micromanipulator (with 1/2" rod clamps*). **$ 745**

MM-33A/R Right handed micromanipulator with tilting mount for fine X-axis, vertical lock, rotating base, and two base clamps **$ 1,295**

MM-33A/L Left handed micromanipulator with tilting mount for fine X-axis, vertical lock, rotating base, and two base clamps **$ 1,295**

(*12mm rod clamps available upon request)

ACCESSORIES

MM-33000[1]	Right-handed tilting mount for fine x-axis	**$ 130**
MM-33001[1]	Left-handed tilting mount for fine x-axis	**$ 130**
MM-33002	Rotating base with two base clamps	**$ 350**
X850445[1]	Vertical lock	**$ 130**
X330105	Base clamps (2) for clamping rotating base	**$ 30**
X330103[1]	Stationary mounting base	**$ 99**

[1] *Must be ordered with the MM-33 since this option is factory installed only.*

MM-1 & MM-3
MICROPOSITIONERS

These unique micropositioners are precision instruments designed to eliminate many research and design problems at a justifiable cost, especially in the case of space limitations. The **MM-3** is roughly 1 3/4 inches (4.4cm) in height and less than 1 inch (2.5cm) in width and depth. The **MM-1** is even smaller at a height of only 1 inch (2.5cm).

The black anodized aluminum body is made with a one-piece base and three piece construction. The spring-loaded stages move on stainless steel tracks for smooth motion and precision; maximum wobble and straightness on the **MM-1** and **MM-3** is less than 1um and 2um, respectively. Both models are available in single, double, or triple stages for X, Y, and Z axes; adding stages is an easy job and requires no special tools or adaptors. The travel of the stages is 1/2" (3mm) for the **MM-1** and 1/2" (13mm) for the **MM-3**. The base is easily adapted to most surfaces.

SPECIFICATIONS > MM-1

Dimensions
0.20in x 0.44in x 1.03in
5mm x 11mm x 26mm

Travel
1/8in
3mm

Straightness
less than 1um

Wobble
less than 1um

Screw adjustments
64 TPI

Thermal stability
60deg F to 165deg F

SPECIFICATIONS > MM-3

Dimensions
0.28in x 0.66in x 1.75in
7mm x 17mm x 44mm

Travel
1/2in
13mm

Straightness
less than 2um

Wobble
less than 2um

Screw adjustments
40 TPI

Thermal stability
60deg F to 165deg F

MM-1 X	Single stage	**$ 105**
MM-1 XY	Double stage	**$ 220**
MM-1 XYZ	Triple stage	**$ 370**

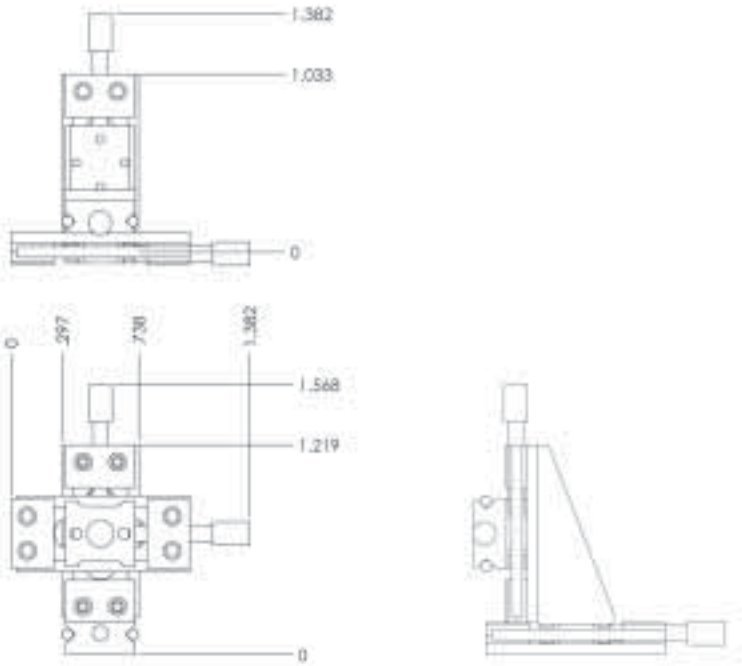
US PRICES > MM-3

MM-3 X	Single stage	**$ 115**
MM-3 XY	Double stage	**$ 250**
MM-3 XYZ	Triple stage	**$ 395**

MECHANICAL DRAWINGS MM1

(All measurements in inches)

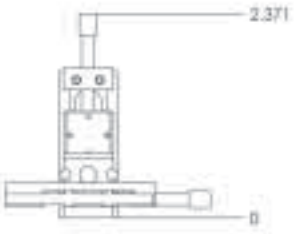
MM-1 TRIPLE STAGE

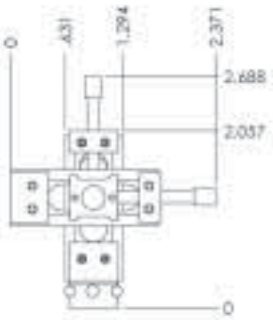


MECHANICAL DRAWINGS MM-3

(All measurements in inches)

MM-3 TRIPLE STAGE





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MT-2000

MOTORIZED X-Y TRANSLATOR/SYSTEM FOR FIXED-STAGE MICROSCOPES

The **MT-2000** is a motorized microscope translator system including fixed-stage and manipulator supports. The modular design of the **MT-2000** features free-standing columns that provide rock solid mounting for the tissue recording chamber and multiple micromanipulators. A two-axis rotary optical encoder (ROE) accepts user input to the motorized translator and can be placed in any convenient location in your setup.

The core of the **MT-2000** system is the **MT-800** stepper-motor driven X-Y translation table. The motors are powered by a two-axis version of the popular **MP-285** manipulator controller. As in the **MP-285**, the controller and ROE give the user smooth, high-resolution control of motion. In addition, the **MT-800/2000** controller gives the user robotic control of movement and a serial computer interface.

MT-800 motorized translators are currently available for the Olympus BX-51WI, Nikon E600FN, Zeiss Axioskop 2 FS and the Leica DMLFS.

In the complete system, **MT-2000**, the recording chamber and micromanipulators are mounted on independent columns firmly affixed to the users vibration isolation table. The chamber column options are also available.

SPECIFICATIONS
> MT-2000 X-Y TRANSLATOR

Baseplate Dimensions
8in x 15.25in x 2.25in
200mm x 375mm x 55mm

Maximum Travel
22-23mm

Resolution
0.250µm course/0.050µm fine

Maximum Load
110lbs /50kg

Weight
35 lbs/16kg

Mechanical controller
11 lbs/4.5Kg

US PRICES
> MT-1000

MT-2000/Y51*	Complete system for the Olympus BX51WI includes: Motorized X-Y translator, chamber column, two micromanipulator columns	**$ 9,900**
MT-2000/Z25*	Complete system for the Zeiss Axioskop 2 FS includes: Motorized X-Y translator, chamber column, two micromanipulator columns	**$ 9,900**
MT-2000/N60*	Complete system for the Nikon E600FN includes: Motorized X-Y translator, chamber column, two micromanipulator columns	**$ 9,900**
MT-2000/L30*	Complete system for the Leica DMLFS includes: Motorized X-Y translator, chamber column, two micromanipulator columns	**$ 9,900**

**Please specify chamber type when ordering.*

TRANSLATORS

MT-800/Y51	Motorized X-Y translator for Olympus BX51WI	**$ 7,900**
MT-800/Z25	Motorized X-Y translator for Zeiss Axioskop 2 FS	**$ 7,900**
MT-800/N60	Motorized X-Y translator for Nikon E600FN	**$ 7,900**
MT-800/L30	Motorized X-Y translator for Leica DMLFS	**$ 7,900**

CHAMBER COLUMN

MT-150/W20	Chamber column for Warner Instruments Series 20 recording chamber	**$ 695**
MT-150/CUST	Chamber column for non-standard recording chamber	**$ 795**

MANIPULATOR COLUMNS

MT-75	Tall gantry micromanipulator stand	**$ 695**
MT-75S	Short gantry micromanipulator stand	**$ 695**

MT- 1000
X-Y TRANSLATION SYSTEM FOR FIXED-STAGE UPRIGHT MICROSCOPES

The **MT-1000** is a microscope translator, fixed-stage and manipulator platform for moving optical pathway electrophysiology. The modular design of the **MT-1000** features free-standing columns that provide rock solid mounting for the tissue recording chamber and multiple micromanipulators, such as the **MP-285** or **MP-225**. The columns are positioned around a movable table that provides X-Y translation of the optical pathway in order to view multiple locations within the chamber at high resolution.

The column-mounted recording chamber is relatively compact and serves as an alternative to bulky stages. The modular columns allow easy access to the microscope and provide a very flexible design platform for customizing your rig.

At the core of the system is the X-Y translation table. It is designed to allow movement of a microscope's optics with respect to the fixed stage. Such an arrangement is currently in use by electrophysiologists recording from tissue slice preparations. The translator allows visualization and/or imaging of multiple tissue locations while maintaining multiple stable recordings from the preparation. Such a system is also useful for experiments on cells in culture where one wishes to monitor several cells not in the same field of view, e.g. recording from pre and post synaptic neurons in culture and/or imaging one cell while recording from or stimulating another.

Translators are available for the Olympus BX-51WI, Nikon E600FN, Zeiss Axioskop 2 FS and the Leica DMLFS as well as older fixed stage models. A generic rectangular table (295mm x 340mm) which can accommodate most standard, upright microscopes as well as a number of inverted microscopes is also available.

The recording chamber and micromanipulators are mounted on independent columns firmly affixed to the user's vibration isolation table. The manipulator columns are identical to the popular **MT-75** gantry style stands. The recording chamber fits into a dovetail slide on a similar column. While the chamber column shown conforms to a Warner Instruments Series 20 design, other chambers can be accommodated. A dovetail slide with a generic opening is available for users who wish to develop custom chambers.

SPECIFICATIONS > MT-500 X-Y TRANSLATOR

Baseplate Dimensions
8in x 15.25in x 2.25in
200mm x 375mm x 55mm

Maximum Travel
1in
25mm

Resolution
0.0002in
5um

Maximum Load
110lbs
50kg

Weight
35 lbs
16kg

US PRICES
> MT-1000

MT-1000/Y50* Complete system for the Olympus BX50WI includes: X-Y translator, chamber column, two micromanipulator columns. **$ 5,900**

MT-1000/Y51* Complete system for the Olympus BX51 includes: X-Y translator, chamber column, two micromanipulator columns **$ 5,900**

MT-1000/N60* Complete system for the Nikon E600FN includes: X-Y translator, chamber column, two micromanipulator columns. **$ 5,900**

MT-1000/L30* Complete system for the Leica DMLFS includes: X-Y translator, chamber column, two micromanipulator columns **$ 5,900**

MT-1000/Z20* Complete system for the Zeiss Axioskop FS includes: X-Y translator, chamber column, two micromanipulator columns **$ 5,900**

MT-1000/Z25* Complete system for the Zeiss Axioskop 2 FS includes: X-Y translator, chamber column, two micromanipulator columns **$ 5,900**

**Please specify chamber type when ordering.*

COMPONENTS

Translators

MT-500/Y50	X-Y translator for Olympus BX50WI	**$ 3,900**
MT-500/Y51	X-Y translator for Olympus BX51	**$ 3,900**
MT-500/N60	X-Y translator for Nikon E600FN	**$ 3,900**
MT-500/L30	X-Y translator for Leica DMLFS	**$ 3,900**
MT-500/Z20	X-Y translator for Zeiss Axioskop FS	**$ 3,900**
MT-500/Z25	X-Y translator for Zeiss Axioskop 2 FS	**$ 3,900**

Chamber Column

MT-150/W20	Chamber column for Warner Instruments Series recording chamber	**$ 695**
MT-150/CUST	Chamber column for non-standard recording chamber	**$ 795**

Manipulator Columns

MT-75	Tall gantry micromanipulator stand	**$ 695**
MT-75S	Short gantry micromanipulator stand	**$ 695**

MT-70 SERIES
MICROMANIPULATOR STANDS

The **MT-70** series of stands are sturdy, stable, and extremely versatile for mounting components for a variety of research applications. They were designed for placing our heavy Huxley-style micromanipulators adjacent to any microscope. We found them to be so useful and adaptable that we also use them for mounting other items such as optical components.

The stands are based on a rigid extruded aluminum tower which is available in 3 inch increments up to 12 inches. The tower is mounted on a sturdy 3/4in thick aluminum baseplate and then fitted with a 5/16in thick aluminum mounting platform. These systems are configurable as fixed height stands or, in the **MT-71** series, have an adjustable height cantilevered side platform for added versatility. The tower can be center or edge mounted to the baseplate for accommodating various spatial layouts. Rows of 1 inch and 25mm centered clearance holes are provided in the baseplate for attachment to tables. The mounting platforms have tapped 1/4-20 mounting holes on 1 inch centers.

The stands are available in sets or you can order individual components separately to meet your specific requirements. Custom heights can be made to order for an additional fee. To securely fasten our **MP-85** Huxley style manipulator to the mounting

plates, please order the manipulator adapter plate at the time of purchase. Larger baseplates or mounting plates are available upon special order.

SPECIFICATIONS > MT-70 SERIES

Dimensions of Baseplate
6in x 6in x 3/4in
153mm x 153mm x 19mm

Dimensions of Mounting Plate
5in x 5in x 5/16in
128mm x 128mm x 8mm

Total Stand Height
4 1/16in to 13 1/16in
104mm to 333mm
depending on configuration

Weight
3lb 11oz to 8lb 5oz
1.7kg to 3.8kg
depending on configuration

US PRICES
> MICROMANIPULATOR STANDS

MT-70 SERIES

MT-70-3	3in tower, baseplate, mounting platform and fastening hardware	**$ 265**
MT-70-6	Same as above with 6in tower	**$ 295**
MT-70-9	Same as above with 9in tower	**$ 325**
MT-70-12	Same as above with 12in tower	**$ 350**

(Custom tower lengths available: $10 per inch, $25 per cut)

MT-71 SERIES

MT-71-3	3in tower, baseplate, cantilever assembly with mounting platform,tower endcap and fastening hardware	**$ 325**
MT-71-6	Same as above with 6in tower	**$ 355**
MT-71-9	Same as above with 9in tower	**$ 380**
MT-71-12	Same as above with 12in tower	**$ 405**

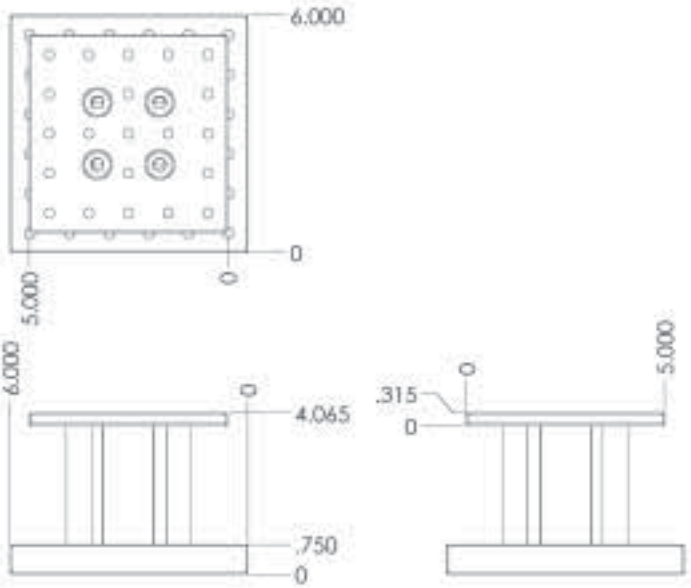
(Custom tower lengths available: $10 per inch, $25 per cut)

ACCESSORIES

MT-7001	Cantilever mounting assembly	**$ 140**
T363400	Magnetic feet (set of 4)	**$ 40**
X700100	Baseplate—6in x 6in x 3/4in thick	**$ 105**
X700102	Mounting plate—5in x 5in x 5/16in thick	**$ 75**
X700115	MP-85 adapter plate	**$ 35**

MECHANICAL DRAWINGS MT-70 SERIES

(All measurements in inches)



MT-75 SERIES
GANTRY STYLE MICROMANIPULATOR STAND

For ultimate flexibility in positioning micromanipulators or other devices adjacent to your microscope, look to the **MT-75** series stands. These unique gantry systems offer adjustable vertical and horizontal axes and up to 360 degrees of rotation. Your manipulator or other device will mount to the 3/4in thick aluminum cantilever which is dovetailed for secure positioning. The cantilever assembly is mounted on a heavy 2in diameter stainless steel post. The post is supported within the same extruded aluminum tower used in our **MT-70** stands. The tower can be center mounted or edge mounted to the base-plate for an additional degree of positioning freedom.

Vertical positioning is achieved with an aluminum collar which securely locks onto the steel post to fix the height of the system. The **MT-75** is suitable for use with most inverted microscopes, and can be adjusted from a minimum height of 8 5/8in to a maximum height of 12 1/2in. The **MT-75S** is suitable for most upright scopes, and can be adjusted from 6 5/8in to 9 1/2in. These systems are very stiff, deflecting approximately 2um per 25mm rise with a 1.5 kg load at the end of the cantilever.

A quick lock mechanism allows easy unlocking and rotation of the post/cantilever assembly up to 320 degrees, then rotation back to the same positive stop position and locking in place (e.g., insertion and removal of

microelectrodes from headstages). Remove the positive stop and you have a full 360 degree rotation. A Teflon washer contributes to the smooth rotation of the system.

The solid aluminum baseplate has through-holes on 1in (25mm) centers for mounting onto tables. The cantilever has eighteen 1in spaced 10-32 holes along the edges.

SPECIFICATIONS > MT-75 SERIES

Dimensions of Baseplate
6in x 6in x 3/4in
153mm x153mm x 19mm

Dimensions of Cantilever
2 1/2in x 8in x 3/4in
64mm x 204 x 19mm

Total Stand Height

MT-75
Adjustable 8 5/8in to 12 1/2in
220mm to 319mm
MT-75S
Adjustable 6 5/8in to 9 1/2in
169mm to 242mm

Weight

MT-75 11lb 7oz
(5.2kg)
MT-75S 9lb 14oz
(4.5kg)

US PRICES > MT-75 SERIES

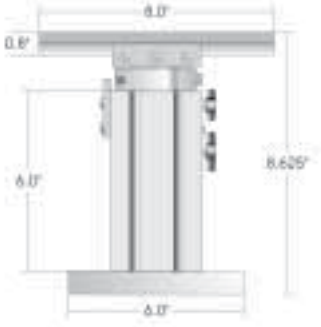
MT-75	Tall gantry micromanipulator stand	**$ 695**
MT-75S*	Short gantry micromanipulator stand	**$ 695**

**Useful for most upright scopes and the Axiovert 25 inverted scope with low stage plate.*

MECHANICAL DRAWINGS MT-75

(All measurements in inches)

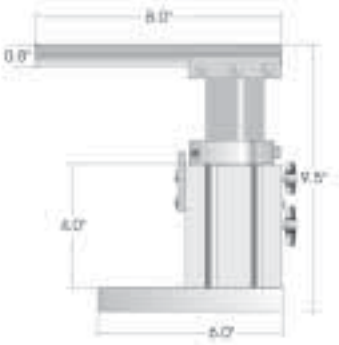
MT-75

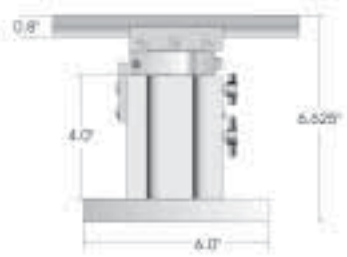


MECHANICAL DRAWINGS MT-75S

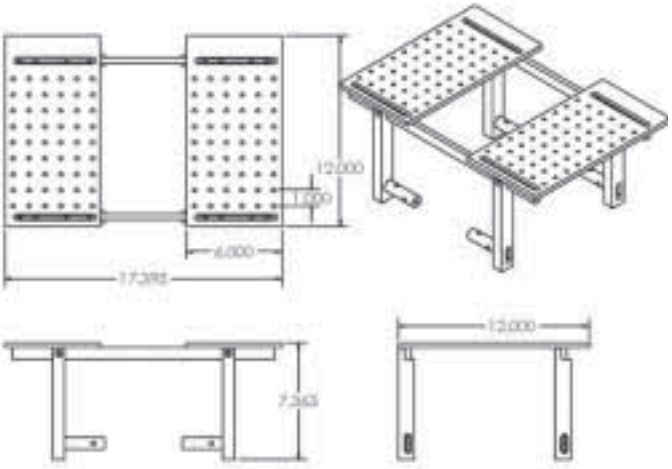
(All measurements in inches)

MT-75S





MD SERIES
MICROMANIPULATOR STANDS



For users who wish to use the **MP-285** or **MP-225** manipulator in conjunction with an inverted microscope, Sutter Instrument has designed a series of Microscope Dependent (MD) stands. The typical MD stand is a manipulator platform that bolts directly to the frame of an inverted microscope. Stands are available in either single-sided or double-sided versions for the most common inverted microscopes made by Nikon, Olympus, Leica, and Zeiss. These platforms lend themselves to the absolutely drift-free recording configuration required when using the manipulators to position patch-electrodes to record from attached cells in culture. To mount the **MP-285** to an MD stand you also need either the 285210 mounting adapter plate (for orthogonal mounting) or the 285RBI rotating base that allows for non-orthogonal mounting and rotation of the entire manipulator (note: the 285210 mounting plate is included with each **MP-285** and **MP-225**). New mounting options and adapters for new microscopes are being added frequently. Please see our web site for new additions, current mechanical drawings, and dimensions.

US PRICES
> MD-SERIES

Series Microscope Model	Part Number	Price
Nikon		
MD-50 series		
Nikon Diaphot 200/300	**MD-50-1**	**$ 435**
and Nikon TE 200/300	**MD-50-2**	**$ 870**
Nikon TMD	**MD-51-1**	**$ 435**
	MD-51-2	**$ 870**
Nikon TE-2000	**MD-52-1**	**$ 435**
	MD-52-2	**$ 870**
Nikon TS-100	**MD-53-1**	**$ 435**
	MD-53-2	**$ 870**
Leica		
MD-60 series		
Leica DMIRB*	**MD-60-1/L**	**$ 435**
	MD-60-1/R	**$ 435**
	MD-60-2	**$ 870**
Leica DMIL	**MD-61-1**	**$ 435**
	MD-61-2	**$ 870**
Olympus		
MD-80 series		
Olympus IX 50/70	**MD-80-1/L**	**$ 435**
	MD-80-1/R	**$ 435**
	MD-80-2	**$ 870**
Olympus IX 51/71/81	**MD-81-1**	**$ 435**
	MD-81-2	**$ 870**
Zeiss		
MD-90 series		
Axiovert 100/135	**MD-90-1**	**$ 435**
	MD-90-2	**$ 870**
Axiovert 200	**MD-91-1**	**$ 435**
	MD-91-2	**$ 870**
Axiovert 25	**MD-92-1**	**$ 435**
	MD-92-2	**$ 870**

Works with 3 plate stage #561040 DOES NOT work with fixed stage #521507 or 96 well plate stage #521508. For these stages we recommend the MT-75 tall gantry stand.

OPTICAL PRODUCTS

Precise mechanical movement and well engineered electronics have always been hallmarks of Sutter Instrument Company products. Ten 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 10-2** controller allows for the use of a second filter wheel without the expense of an additional controller. The **Lambda 10-C** has also been added as a lower cost alternative for those who do not require all the features of the **Lambda 10-2**. 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 inte-

grated 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 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 Company developed an RS 485 serial bus to allow up to 16 controllers to share a single serial port on a host computer. Sutter Instrument Company 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
ULTRA HIGH SPEED WAVELENGTH SWITCHER

The **Lambda DG-4** offers unprecedented speed and versatility for experiments requiring rapid light wavelength switching. It offers all the advantages of interference filter-based systems, yet eliminates the temporal constraints imposed by filter switching devices. Switching between any two wavelengths is achieved in less than the 1.2msec vertical retrace period of a video signal, allowing you to perform real-time video imaging. For dual wavelength ratio imaging studies, the **Lambda DG-4** enhances your ability to follow fast changes in ion concentrations by acquiring a ratio pair in two consecutive video frames.

Narrow bandpass systems, such as single cavity interference filters, grating monochromators, and A.O. modulators, will, by their nature, pass harmonics of the desired wavelength. 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**, have integral blocking characteristics 1000 times better than typical monochromator systems. In addition, it is difficult to adjust the intensity of one wavelength relative to another in a traditional system with a single optical path and a variable wavelength device. The dual galvanometer design of the **Lambda DG-4** eliminates this problem.

HOW IT WORKS:

This unique optical design of the **Lambda DG-4**, is based on dual scanning galvanometers. The wavelength selection is done by interference filters.

The standard version of the instrument, the **Lambda DG-4**, can host up to four 25mm interference filters. A five filter version (two 25mm and three 18mm), **Lambda DG-5** is also available.

The light coming from the 175W xenon arc lamp is focused on the first galvanometer mirror. The light is then directed, via a parabolic mirror, through one of the optical channels that may contain an interference filter. The light passing through the filter is collected by another parabolic mirror and sent to a second scanning mirror that directs it to a liquid light guide.

The light guide can be coupled to the illumination port of an instrument (e.g. epi-illumination port of a microscope). The intensity of the output can be modulated by controlling the relative orientation of the two scanning mirrors. Thus this system can provide narrow band excitation at selected wavelengths over a range of intensities or can rapidly turn off the light source. Dwell time at any wavelength is arbitrarily set by the user. Transitions are achieved in less than 1.2msec.

SPECIFICATIONS > LAMBDA DG-4

Output Range
330nm to 700nm - Ozone free
300nm to 700nm - Full spectrum

Lamp Type
175 Watt ozone free xenon arc bulb, pre-aligned (standard) (175W full spectrum also available)

Lamp Lifetime
1,000 hours
(All bulbs warrantied for 500 hours. Longer life depends on your application. Expected lifetime is 1000 hours.)

Power Consumption
350 Watts

Filter Diameter
DG-4: Four, 1in (25mm)
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

FEATURES
> LAMBDA DG-4

Complete system for wavelength switching

A built-in 175 Watt ozone-free xenon arc lamp makes the **Lambda DG-4** 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, with an additional standard neutral density filter inserted in the common path of the light.

The light guide output from the **Lambda DG-4** provides uniform spacial illumination, as well as vibration isolation from your microscope.

Integral shuttering and filtering

The **Lambda DG-4** provides a high speed shutter function with open/close times of 500µs. The shutter can be enabled between filter transitions to prevent light transmission through intermediate filters.

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 pipe, the output still has excellent uniformity.

Direct insertion of neutral density optical filters is also acceptable in the filter holders at any of the four optical channels. A final neutral density optical filter can also 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** 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 downloaded 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** is achieved in this mode using only a video sync input.

Video Sync with Strobe Low
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

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.

$ 16,900

DG-4/FS Same as DG-4, but with full spectrum 175W bulb.

$ 16,900

DG-5/OF Same as DG-4/OF, but with additional flat wrench and 5 filters. Three filters are 18mm and two filters are 25mm. **$ 16,900**

DG-5/FS Same as DG-4/FS, but with additional flat wrench and 5 filters. Three filters are 18mm and two filters are 25mm. **$ 16,900**

ACCESSORIES

O661176	Ozone free 175 Watt xenon bulb (attenuated output below 340nm)	**$ 630**
O661175	Full spectrum 175 Watt xenon bulb	**$ 630**
DG-IF	Interference filter holder (25mm)	**$ 50**
DG-IF/18	Interference filter holder (18mm)	**$ 50**
DG-ND	Neutral density filter holder	**$ 50**
O724025	UV light enhanced (visable reduced) galvo mirror**	**$ 350**
X100160	Retaining ring	**$ 10**
X100150	Filter spacer	**$ 4**
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.

** Non-shuttered 25mm wheel purchased separately.*
*** Must order two for a complete set.*

LAMBDA 10-2
OPTICAL FILTER CHANGER

The **Lambda 10-2** is a microprocessor controlled, high speed filter wheel. Its impressive speed coupled with exceptionally smooth operation make the **Lambda 10-2** ideal for research applications involving fluorescence microscopy, ratio imaging, spectrophotometry, visual physiology, or any application requiring rapid and accurate aperture positioning.

The **Lambda 10-2** controller which has both serial and parallel interfaces will drive up to two filter wheels and two shutters. Each wheel 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 microstep-ping technology and intelligent acceleration and deceleration algorithms assures the fastest possible moves for a given inertial load, while minimizing vibrations. The controller also has an error detection and correction circuit in the event that a position error occurs.

The controller system is designed around three embedded controllers; 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** 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.

For applications requiring absolute vibration isolation, and/or spatial uniformity independent of wavelength, an optional liquid light guide output is available for the **Lambda 10-2** wheel. 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.

SPECIFICATIONS
> LAMBDA 10-2

Filter Diameter
1in
25mm

Dimensions

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

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

Weight
25lbs
11kg

Electrical
115/230 Volts
50/60 Hertz power line

CE

FEATURES > LAMBDA 10-2

55msec between adjacent filters.

Parallel and serial interfaces.

Simultaneous control of two wheels.

Dual integral shutter drivers.

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 10-2/32**, 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.

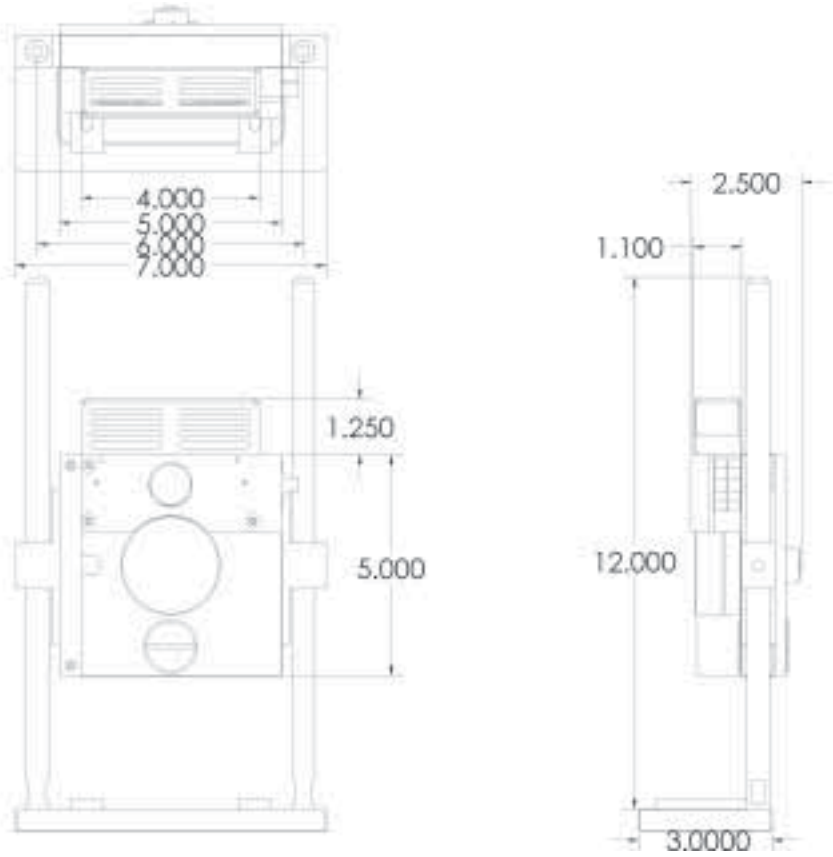
OEM wheels available

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 10-2

(All measurements in inches)

LAMBDA 10-2



(Shown with optional shutter)

US PRICES
> LAMBDA 10-2

SYSTEMS

LB10-2 Includes one 25mm filter wheel without shutter, support base with mounting rods, rack mount[1] 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 **$ 4,900**

LB10-2S Same as above—with shutter assembly and two slide-in filter holders. **$ 5,650**

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

LB10-232S Same as LB10-232 except with shutter (no drop-in or slide-in filters)and modified 10-Z 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 **$ 300**

1) Tabletop controller box available on request.

US PRICES (CONTINUED)
> LAMBDA 10-2

WHEELS

LB10-W	Additional 25mm filter wheel **without** shutter	**$ 2,500**
LB10-WS	Additional 25mm filter wheel **with** shutter	**$ 3,250**
LB10-W32	32mm filter wheel **without** shutter	**$ 3,000**
LB10-W32S	32mm filter wheel **with** shutter	**$ 4,025**
LB10-W50	50mm, 5 position wheel **without** shutter	**$ 3,500**

ACCESSORIES

SLIDE-IN[2]	Slide-in filter holder for 25mm wheel	**$ 50**
DROP-IN[3]	Drop-in filter holder for 25mm wheel	**$ 30**
LLG	Liquid light guide and coupling adapter	**$ 1,400**
SHUTTER	25mm replacement shutter (not an upgrade)	**$ 350**
CMAC	Serial cable for Macintosh	**$ 100**
CLAM10	25 pin breakout to BNC cable	**$ 100**
CSHUTTER	Shutter breakout cable	**$ 100**
X100111	35mm replacement 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.Please contact sutter for information on shutter upgrades

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-C
OPTICAL FILTER CHANGER

The **Lambda 10-C** system features the same masterfully designed stepper-motor driven wheel used in our **Lambda 10-2** system but in a more economical package. The direct drive system means no belts to slip, and no backlash. Only the controller has been changed to provide a lower cost package for low to medium frame-rate imaging applications requiring only a single wheel. All wheel components and shutters are interchangeable with the **Lambda 10-2**.

Switching speed between adjacent filter positions is maximally achieved in less than 90msec with two filters installed. The user can select between one of eight speeds allowing the speed to be adjusted in accordance with the loading of the wheel. An optional shutter which can be installed on the wheel has opening and closing times of 11 msec and 15 msec respectively.

Filter selection is easy with the microprocessor-based control unit. The desired filter can be selected from the keypad, or through the simple interface. The controller determines the direction and distance to move and performs an acceleration and deceleration sequence to make the move with minimal vibration. 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**. An integral shutter driver is also included for users who select to have the optional shutter.

A serial and an 8 bit parallel input port are provided to allow complete and easy control from a remote computer or other source of logic level signals. The serial port accepts RS232 level signals through a DB-9 connector. Parallel input is made through a DB-25 connector and can be directly connected to a PC type parallel printer port. Both serial and parallel communication is command compatible with our **Lambda 10-2**. The **Lambda 10-C** draws less than 75 Watts of power. Line voltage may be either 120 or 240 volts, 50 or 60Hz. A switch is provided on the rear of the unit for selection of the line voltage.

As with the **Lambda 10-2**, for applications requiring absolute vibration isolation, and/ or spatial uniformity independent of wavelength, an optional liquid lightguide output is available for the wheel.

SPECIFICATIONS > LAMBDA 10-C

Filter Diameter
1in
25mm

Dimensions of Control Box
5.125in x 8.5in x 4.875in
13.5cm x 21.5cm x 12.5cm

Dimensions of Filter Wheel
5in x 5in x 2.25in
13cm x 13cm x 6cm

Weight
20lbs
11kg

Electrical
115/230 Volts
50/60 Hertz power line

FEATURES > LAMBDA 10-C

90msec between adjacent filters.

Parallel and serial interfaces.

Controls one wheel and one optional shutter.

Adjustable support stand for wheel.

Command set compatable with the Lambda 10-2.

Low cost.

OPTIONS

Slide-in filter holders.

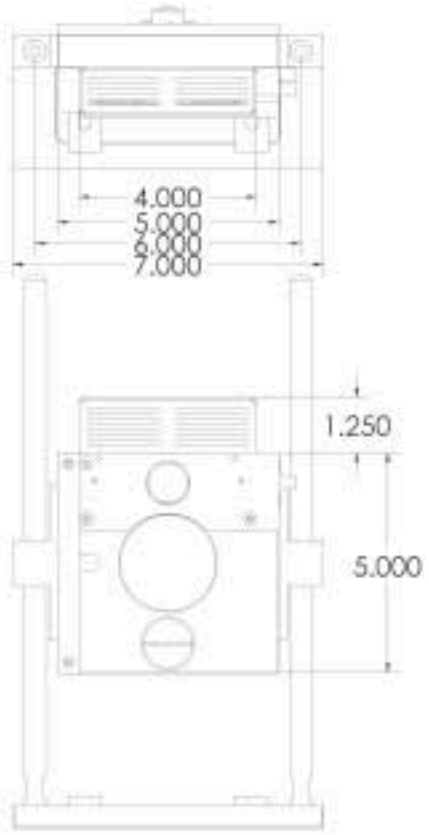
Microscope mounting adapters.

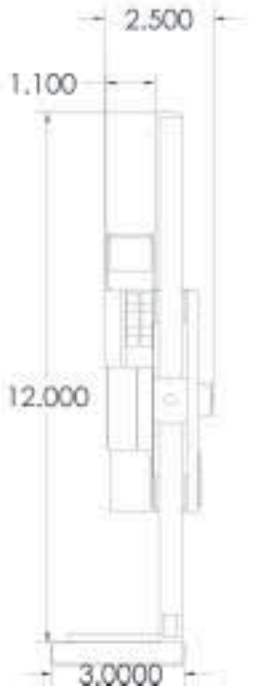
Liquid light guide.

MECHANICAL DRAWINGS LAMBDA 10-C

(All measurements in inches)

LAMBDA 10-C





(Shown with optional shutter)

US PRICES
> LAMBDA 10-C

BASIC SYSTEM

LB10-C Includes one 25mm filter wheel without shutter, support base with mounting rods, 2 individual filter holders with handles, controller unit, spanner wrench, mounting hardware, serial and parallel cables, power cable and manual. **$ 3,950**

LB10-CS Same as above—with shutter assembly and two slide-in filter holders. **$ 4,700**

ACCESSORIES

SLIDE-IN[1]	Slide-in filter holder for 25mm wheel	**$ 50**
DROP-IN[2]	Drop-in filter holder for 25mm wheel	**$ 30**
LLG	Liquid light guide and coupling adapter	**$ 1,400**
SHUTTER	Adds a shutter to an unshuttered 25mm filter wheel	**$ 350**
CSHUTTER	Shutter breakout cable	**$ 100**
CMAC	Serial cable for Macintosh	**$ 100**
CLAM10	25 pin breakout to BNC cable	**$ 100**

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

LAMBDA LS

STAND-ALONE XENON ARC LAMP AND POWER SUPPLY

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 175W xenon bulb is pre-aligned using a parabolic mirror and does not require alignment, focussing or collimation. In the standard configuration, the Lambda LS bulb is capable of producing light output from 340nm to a cut-off 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 Watt xenon (pre-aligned to produce collimated output)

Radiant Output
25 Watts (175W lamp) (broadband, full beam)

Lamp Life
1000 hours (Bulb warrantied 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

175W xenon lamps provide light levels which exceed those of standard microscope fluorescence lamps.

Equipped with a cold mirror to eliminate IR heating of down stream 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.

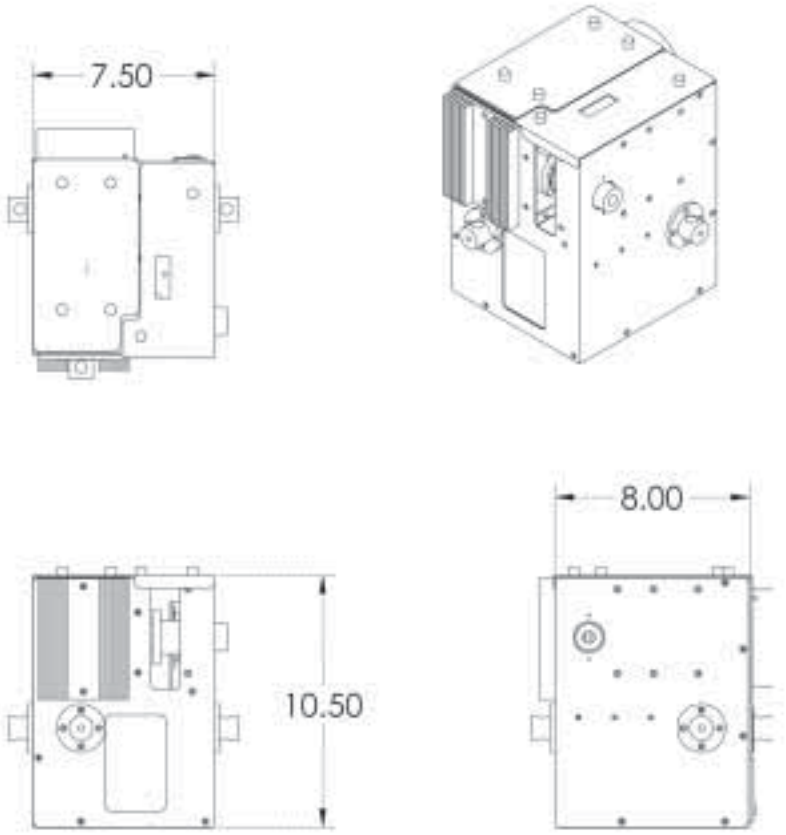
Modular construction allows use of optional liquid light guide for flexible direction of light output.

Easily accomodates Sutter Instrument filter wheels, Lambda 10-2 and Lambda 10-C, 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.

MECHANICAL DRAWINGS LAMBDA LS

(All measurements in inches)

LAMBDA LS



(Additional depth with second filterwheel attached)

US PRICES
> LAMBDA LS

BASIC SYSTEM

LB-LS/FS17 Includes 175Watt **full spectrum** lamp, cold mirror, power supply and lamp housing, support base with mounting rods and manual **$ 4,450**

LB-LS/OF17 Includes 175Watt **ozone free** lamp, cold mirror, power supply and lamp housing, support base with mounting rods and manual **$ 4,450**

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**

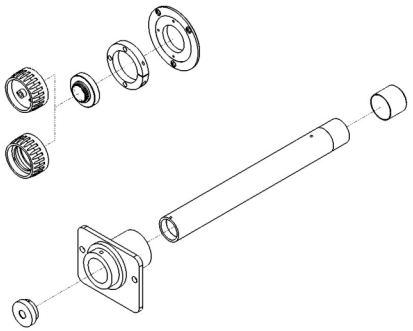
*Please note that the above bulbs do not include the outer blue housing. If you need or want an extra housing, please contact Sutter by phone, fax or email.

ACCESSORIES

LLG	Liquid light guide and coupling adaptor (2 meters, 3mm dia.)	**$ 1,400**

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 (10-2 & 10-C)

Excitation adapters (suffix EC) include all components necessary for mounting the **Lambda 10-2** and **Lambda 10-C** wheels between the lamp housing and excitation port.

When the **LLG** (Liquid Light Guide) is ordered for the **Lambda 10-2** and **Lambda 10-C** you will need the light guide adapter (prefix LG) and the lamp housing adapter (suffix LH).

Lambda DG-4

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

Lambda LS

The **Lambda LS** when used with the **LLG** (Liquid Light Guide) will only require a light guide adapter (prefix LG).

MICROSCOPE ADAPTERS

Scope/ Model	Type of adapter	Catalog number	List price
OLYMPUS			
IMT-2 (Y20)			
	EMISSION	10-Y20-EM	**$ 500**
	EXCITATION	10-Y20-EC	**$ 300**
	LAMP HOUSING	10-Y20-LH	**$ 150**
	LIGHT GUIDE (your scope must have the vertical illuminator)	LG-Y20	**$ 500**
BH-2 (Y25)			
	EXCITATION	10-Y25-EC	**$ 500**
	EMISSION	10-Y25-EM	**$ 300**
BX-50 / BX-51 (Y50)			
	EXCITATION	10-Y50-EC	**$ 350**
	EMISSION	10-Y50-EM	**$ 500**
	LAMP HOUSING	10-Y50-LH	**$ 175**
	LIGHT GUIDE	LG-Y50	**$ 500**
BX-60 / BX-61 (Y60)			
	EXCITATION	10-Y60-EC	**$ 350**
	LAMP HOUSING	10-Y60-LH	**$ 175**
	LIGHT GUIDE	LG-Y60	**$ 400**
	LS to SCOPE	LS-Y60	**$ 175**
IX-70 / IX-50 (Y70)			
	EXCITATION	10-Y70-EC	**$ 300**
	EMISSION (side port of scope needs modification at Sutter)	10-Y70-EM	**$ 500**
	LAMP HOUSING	10-Y70-LH	**$ 150**
	LIGHT GUIDE	LG-Y70	**$ 500**
IX-51 / IX71 / IX-81 (Y70)			
	EXCITATION	10-Y71-EC	**$ 300**
	EMISSION	10-Y71-EM	**$ 500**
	LAMP HOUSING	10-Y71-LH	**$ 150**
	LIGHT GUIDE	LG-Y71	**$ 500**
AX-70 (Y75)			
	EXCITATION	10-Y75-EC	**$ 350**
	LIGHT GUIDE	LG-Y75	**$ 500**

MICROSCOPE ADAPTERS

Scope/ Model	Type of adapter	Catalog number	List price
NIKON			
TMD (N10)			
	EXCITATION	10-N10-EC	**$ 300**
	EMISSION (needs 1x relay lens)	10-N10-EM	**$ 350**
	LAMP HOUSING	10-N10-LH	**$ 150**
	LIGHTGUIDE (dichroic housing needs modification at Sutter)	LG-N10	**$ 500**
DIAPHOT 200/300 (N20)			
	EXCITATION	10-N20-EC	**$ 300**
	EXCITATION - BIG ADAPTER	10-N20-ECB	**$ 1,500**
	EMISSION (needs 1x relay lens)	10-N20-EM	**$ 350**
	LAMP HOUSING	10-N20-LH	**$ 150**
	LIGHT GUIDE	LG-N20	**$ 700**
TE200/300 (N25)			
	EMISSION (needs 1x relay lens)	10-N25-EM	**$ 350**
	EXCITATION	10-N25-EC	**$ 300**
	EXCITATION-32mm	32-N25-EC	**$ 300**
	LAMP HOUSING	10-N25-LH	**$ 150**
	BOTTOM (QUANTUM)	10-N25-QB	**$ 350**
	LIGHT GUIDE	LG-N25	**$ 700**
TE2000 (N27)			
	EMISSION	10-N27-EM	**$ 350**
	EXCITATION	10-N27-EC	**$ 300**
	EXCITATION-32mm	32-N27-EC	**$ 300**
	EMISSION	10-N27-EM	**$ 350**
	LAMP HOUSING	10-N27-LH	**$ 150**
	LIGHT GUIDE	LG-N27	**$ 700**
OPTIPHOT (N30)			
	EXCITATION	10-N30-EC	**$ 300**
	EXCITATION (WITH QUADFLUOR)	10-N30-QF	**$ 300**
	EMISSION	10-N30-EM	**$ 350**
	LAMP HOUSING	10-N30-LH	**$ 150**
	LIGHT GUIDE	LG-N30	**$ 500**
MICROPHOT (N35)			
	EXCITATION	10-N35-EC	**$ 300**
	EMISSION	10-N35-EM	**$ 500**
	LAMP HOUSING	10-N35-LH	**$ 150**
	LIGHT GUIDE	LG-N35	**$ 500**
E400 & E600 (N40)			
	EXCITATION	10-N40-EC	**$ 500**
	EXCITATION-32mm	32-N40-EC	**$ 300**
	LIGHT GUIDE	LG-N40	**$ 500**

MICROSCOPE ADAPTERS

Scope/ Model	Type of adapter	Catalog number	List price
NIKON (CONTINUED)			
	LIGHTGUIDE-INTERNAL	LG-N40-I	**$ 700**
E800 & E1000 (N80)			
	EXCITATION	10-N80-EC	**$ 300**
	EXCITATION-32 MM	32-N80-EC	**$ 300**
	EMISSION	10-N80-EM	**$ 350**
	EMISSION-32mm	32-N80-EM	**$ 350**
	LAMP HOUSING	10-N80-LH	**$ 150**
	LIGHT GUIDE	LG-N80	**$ 500**
ZEISS			
IM-35 (Z10)			
	EXCITATION	10-Z10-EC	**$ 200**
	TRINOCULAR HEAD	10-Z10-TH	**$ 500**
	LIGHT GUIDE	LG-Z10	**$ 500**
AXIOSKOP (Z20) (also axioplan)			
	EXCITATION	10-Z20-EC	**$ 200**
	EMISSION	10-Z20-EM	**$ 400**
	LAMP HOUSING	10-Z20-LH	**$ 100**
	LIGHT GUIDE	LG-Z20	**$ 600**
AXIOSKOP 2 & 2 FS (Z25)			
	EXCITATION	10-Z25-EC	**$ 200**
	EMISSION	10-Z25-EM	**$ 400**
	LAMP HOUSING	10-Z25-LH	**$ 100**
	LIGHT GUIDE	LG-Z25	**$ 500**
	LIGHTGUIDE-INTERNAL	LG-Z25-I	**$ 700**
AXIOVERT 35 and 100 series (Z30)			
	EXCITATION	10-Z30-EC	**$ 200**
	LAMP HOUSING	10-Z30-LH	**$ 100**
	LIGHT GUIDE (replaces epi-illuminator)	LG-Z30	**$ 500**
	KELLER PORT	10-Z30-KP	**$ 350**
	KELLER PORT (100M SCOPE)	10-Z30-KP-M	**$ 350**
	SIDE PORT	10-Z30-SP	**$ 400**
	TRINOCULAR HEAD	10-Z30-TH	**$ 400**
AXIOPLAN 2 (Z50)			
	LIGHTGUIDE-INTERNAL	LG-Z50-I	**$ 700**

(ZEISS CONTINUED ON NEXT PAGE)

MICROSCOPE ADAPTERS

Scope/ Model	Type of adapter	Catalog number	List price
ZEISS **(CONTINUED FROM PAGE 97)**			
AXIOVERT 200 (Z35)			
	EXCITATION	10-Z35-EC	**$ 200**
	LAMP HOUSING	10-Z35-LH	**$ 100**
	EXCITATION – 32mm	32-Z35-EC	**$ 300**
	EMISSION (side port on left)	10-Z35-EM	**$ 600**
	200M – EMISSION (side port on left)	10-Z35-EM-M	**$ 600**
	KELLER PORT	10-Z35-KP	**$ 500**
	LIGHT GUIDE (replaces epi-illuminator)	LG-Z35	**$ 500**
LEICA			
DMR (L10)			
	EXCITATION	10-L10-EC	**$ 300**
	EXCITATION - 32 mm	32-L10-EC	**$ 300**
	EMISSION	10-L10-EM	**$ 500**
	LAMP HOUSING	10-L10-LH	**$ 150**
	LIGHT GUIDE	LG-L10	**$ 500**
DMIRB & DMIRE2 (L20)			
	EXCITATION	10-L20-EC	**$ 300**
	EXCITATION - 32mm	32-L20-EC	**$ 300**
	EMISSION*	10-L20-EM	**$ 500**
	LAMP HOUSING	10-L20-LH	**$ 150**
	LIGHT GUIDE	LG-L20	**$ 500**
	** please phone Sutter for assistance*		
OTHER ADAPTERS			
CARV (J20)			
	EXCITATION	10-J20-EC	**$ 500**
	EMISSION	10-J20-EM	**$ 1000**
	LIGHT GUIDE	LG-J20	**$ 700**

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