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Welcome to the *NEW* Electrophysiology &

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Dear Researcher:

Warner Instruments is proud to introduce our new Electrophysiology & Cell Biology Catalog. This catalog contains many new products for cell imaging, biosensing, microinjection, and electrophysiology.

NEW Products Featured Include:

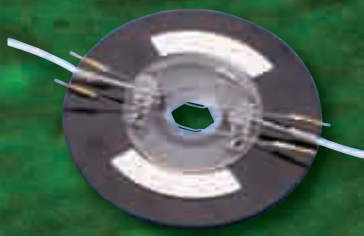
- **PLI-100A Picoliter Microinjector** - With three positive and two negative pressure capabilities, the versatile PLI-100A is capable of large injections into capillaries or small injections into mammalian nuclei.
- **BioStat Multi-channel Potentiostat** - The BioStat is a software-driven, multi-mode potentiostat that can be used for measurement of pH, reactive oxygen species, and nitric oxide.
- **Compact Motorized Micromanipulator** - Linear amplifiers, used to drive the stepper motors, eliminate stray electromagnetic radiation; reducing noise and resulting in improved patch clamp and electrophysiology performance.
- **PFC-1 Proflow Chamber** - Computer designed gaskets optimized for well-defined, well-controlled shear-flow.
- **RC-49FS Perfusion Chamber with Field Stimulation** - Uses popular 18 mm round coverslip. The low profile design allows for low entry angle patch electrodes.
- **CL-200 Dual Channel Bipolar Temperature Controller** - Single control temperature adjustment, built-in protection for Peltier devices, open thermistor fault protection.
- **New Zoom Stereo Microscopes** - Versatile, high performance, ergonomically designed microscopes, with multiple stand options.
- **ProgRes® Microscope Cameras** - These CMOS and CCD cameras are suitable for all contrast methods in light microscopy, C-Mount and USB2.0/FireWire interfaces. All ProgRes® cameras include CapturePro® image capture software.

Sincerely,

Ralph Abate
Business Manager, **Warner Instruments**

Cell Biology Research Catalog

NEW **CL-200 Dual Channel Bipolar Temperature Controller,** p. 111



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See more *NEW* products on our website: www.warneronline.com

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Perfusion/ Microfluidics

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Low Noise Temperature Controllers, In-Line Solution Heaters and Coolers, Objective and Syringe Warmers, Thermistors, Cables, and Accessories

Temperature Control

Micro-Incubation
Heated Culture Dish Platforms for 35 and 50 mm Dishes, Heated Platform for Chambered Slides, CO_2 Microscope Cage and Stage Incubators, Glass Bottom Cell Culture Dishes, Brain Slice Chamber System

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Biosensing

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Technical Support & Domestic Orders*

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e-mail	**bioscience@harvardapparatus.com**
website	**www.harvardapparatus.com**

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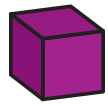

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If unsatisfied with a product purchased from Harvard Apparatus you may return the item for credit or replacement. You must contact us within thirty days of receipt of your shipment to obtain a Return Authorization Number and instructions to facilitate the return process. All returned products are subject to inspection and approval by Harvard Apparatus prior to issuing credit or replacement. Products must be in original manufacturer's packaging and include all instructions, manuals, and inserts. Products returned in new condition will be charged a 15% restocking fee or a minimum of $30.00. Products not in saleable condition will be returned to the customer or assessed a refurbishment fee.

Harvard Apparatus will provide full credit for the following:

1. **Items not supplied in accordance with your order.**
2. **Items that are defective at the time of receipt.**

Returns not acceptable for credit include:

1. **Items that have been customized**
2. **Items that are outdated, shelf-worn, damaged, or used and therefore unsuitable for return to stock for resale**
3. **Chemicals or sterile items that have been opened**
4. **Product(s) that have been exposed to harmful, toxic or hazardous substances**

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If your product is out of warranty but requires repair, you must contact Harvard Apparatus and obtain a Return Authorization Number and instructions to facilitate the return process. All repairs are subject to the following:

1. **Repair orders charged on a time and materials basis**
2. **$150 per hour for labor with a $150 minimum labor charge**
3. **All repairs are performed on a first in/first out basis, only after receipt of a valid purchase order**
4. **Estimates available upon request**
5. **Some older products may not be repairable due to component obsolescence**

Minimum Orders

We appreciate all orders and therefore have no minimum order requirement, however, a small handling fee of $10 will be added to orders below $75.

Note: *Products in this catalog are for Research Use Only. Not for use on humans unless proper investigational device regulations have been followed.*

All Prices subject to change without notice. Prices are quoted in US dollars only, and are for shipment and use within the US only. Prices listed do not include shipping charges. Shipping charges are prepaid and added to invoice at time of shipment.

Introduction to Microinjection

The use of Glass Needle (Fine Glass Microcapillary Pipette) based techniques for intracellular/extracellular microinjection and perfusion has become a popular procedure in numerous areas of experimental biology research (e.g. In vitro fertilization, transgenics, etc.). These techniques can best be described as micro surgical procedures that are conducted on a single cell using either a single or multiple barrel glass micropipette a precision positioning device (micromanipulator) and a microinjector or microperfusor. The micropipettes used in these procedures are formed using a Pipette Puller. The capillary glass tubing is heated to its softening point and 'pulled' to create the proper size tip diameter and taper for the desired application. The small tip diameters (as low as 0.2 µm) of these micropipettes combined with the high precision of the Micromanipulator and Microinjection/Perfusion Apparatus, allows for precise and accurate delivery. This precision allows for accurate and repeatable injections down to the sub-picoliter liter range into or around various types and sizes of cells with accuracy to 0.1 micron. The process of extruding substances through these micropipettes is accomplished through the use of either direct hydrostatic pressure (Pressure Injection) or by moving charged ions that are the result of an applied electric field (Iontophoresis) without the use of hydraulic flow.

Applications of microinjection range from assisted (In vitro) cell fertilization techniques to the transport of molecular and cellular elements. These substances are typically injected into the cell to manipulate and/or monitor the fundamental biochemistry of a specific living cell. Substance that can be injected include, cellular organelles, kinases, histochemical markers (such as horseradish peroxidase or lucifer yellow), proteins, metabolites, microbeads, ions, antibodies, genes, molecular biology mRNA and DNA, etc. The precise delivery (microperfusion) of small volumes (picoliter to milliliter) of various agents and drugs to a cell or group of cells for applications such as pharmacological drug testing can also be accomplished using these techniques.

In order for the researcher to conduct any of the above experiments and get meaningful results, the tools (equipment) used in these experiments must provide not only the specific functionality, but they also need to be of the highest quality and provide the necessary reliability, accuracy and repeatability to insure proper results. Harvard Apparatus, Inc. manufactures and sells the complete range of product that are needed to successfully microinject and/or microperfuse.

Warner and Harvard Apparatus Clark Capillary Glass, pages 324-330

Harvard Apparatus/Medical Systems Picoliter Injectors, pages 275 to 282

Harvard/Apparatus Medical Systems NeuroPhore, see pages 284 to 292

Pressure Injection Systems, pages 291 and 292

Pipette Pullers, pages 331 to 334

Micromanipulators, pages 295 to 304

NEW Model PLI-10

Low Cost Pico Injector

- Femtoliter to microliter injections
- Digital readouts for injection pressure, time, and count
- Reliable optically encoded circuit for injection time set
- Easy to use

The PLI-10 Pico-Injector reliably delivers ejections from femtoliters to nanoliters through micropipettes by applying a regulated pressure for a digitally set period of time.

Pressure to the pipette is controlled precisely through a multi-turn regulator, and is reported digitally for reproducibility. Injection time is set using an optically encoded circuit which permits fine and coarse settings from a single knob.

The system timer can be controlled in three ways, front panel push button, foot switch, and external trigger input BNC.

Typical applications are large volume injections, (large volume is considered to be in the 10-100 Pico liter range), extracellular sample delivery, and

Xenopus Oocyte injection because of their large size (1.0 mm).

Specifications

Input Gas Pressure	75 PSI Recommended, 105 PSI Maximum
Injection Pressure	0.2 to 60 PSI (413 KPa) regulated
Injection Time	0.01 to 99.99 Seconds
Injection Time Accuracy	±0.01% (Crystal Time Base)
Pressure Display	3½ Digits, 0.1 PSI or 1 KPa Resolution
Injection Count Display	0 to 9999 Injections
Trigger Mode	Front Panel, Footswitch, TTL (Gate In)
Pressure Monitor Output	BNC, Rear Panel, 10 mV/PSI or 1 mV/KPa
Power Input	External 9VDC @ 400mA (min) Power Supply universal input voltage 90 to 264 VAC
Weight	2.3 kg
Dimensions (HxWxD)	89 x 215 x 175 mm (3.5 x 8.5 x 6.9 in)
Warranty	One year, parts & labor

Order #	Model	Product
W4 64-1707	PLI-10	Pico-liter includes input hose, output hose, and foot switch
W4 64-1626	AO161.0	Acrylic pipette holder for 1.0 mm pipettes
W4 64-1627	AO161.2	Acrylic pipette holder for 1.2 mm pipettes
W4 64-1628	LPLI-PPH	Acrylic pipette holder for 1.5 mm pipettes
W4 64-1629	AO162.0	Acrylic pipette holder for 2.0 mm pipettes

PLI-100

Medical Systems Pico-Injector

A full featured workhourse microinjector

W4 65-0001 PLI-100 Pico-Injector

- 5 pressures: inject, balance, clear, fill and hold
- Reliable
- Femtoliter to microliter injections
- Reproducible performance
- Easy to use
- Popular applications:
  - Injection of mouse, frog, zebrafish and other oocytes
  - Extracellular brain injections
  - Injection of DNA, mRNA, microbeads, neurotransmitters, kinases and other proteins
- Most Published Injector

The PLI-100 Pico-Injector reliably delivers a wide range of volumes through micropipettes by applying a regulated pressure for a digitally set period of time. Compressed gas allows the user to deliver desired volumes from femtoliters to microliters while simultaneously holding a cell. Whether you need to do large injections into capillaries or very small injections into mammalian nuclei, the PLI-100 is well suited for your experiment.

The PLI-100 has become a favorite of prestigious national microinjection workshops like Cold Spring Harbor Laboratories and other researchers worldwide. Other companies have tried to design similar systems, but the PLI-100 remains unparalleled in terms of ease of use, durability, precision, and cost.

Researchers Say:

"The PLI-100 is very robust, in constant use in our lab."

"Most importantly, the PLI-100 valves prevent cytosol and yolk backflow into my pipette after oocyte injection."

"It's very easy to control."

"The PLI-100 is heavily used on a daily basis, and works great."

"I like the fact that I can use the PLI-100 with TTL pulses."

"It works great in conjunction with my imaging system."

"The balance pressure is a good option."

"My injection pipettes rarely clog."

Easy to Use

Inject with the touch of a button or a tap of the foot switch — it's as easy as that!

Reproducible

Pressure to the pipette is controlled precisely through a multi-turn regulator, and is reported digitally for easy repeat. Injection time is digitally controlled in 10 msec steps between 0.01 to 0.99 seconds (and in 1 second steps between 1 to 99 seconds). Pipette tip diameter, and hence delivered volume, are easy determinations once the timing and pressure are known.

Versatile

Deliver volumes from femtoliters to microliters with the same instrument, resulting in a wide range of applications.

Pressure Capabilities

The PLI-100 features two negative and three positive pressure pneumatic capabilities.

The negative, or vacuum functions allow the user to:

1. Fill micropipettes from their tips, reducing wastage of valuable injectables.
2. Provide a means to secure and manipulate a cell using a holding pipette.

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PLI-100

Medical Systems Pico-Injector (continued)

The positive pressures allow the user to:

1. Eject precise amounts of fluids.
2. Create a balance pressure which prevents backflow into the micropipette following an injection.
3. Clear a micropipette of material in it.

Unique Features

The PLI-100's important 'Balance', 'Hold' and 'Clear' functions are not found on other microinjection units.

Balance

In addition to the ejection pressure, the Pico-Injector offers a secondary balance pressure. This secondary balance maintains a positive pressure on the injection pipette before and after injections. This eliminates dilution caused by capillary action and aids in the prevention of clogging. Wasteful continuous injection, which often occurs when no separate balance pressure is offered by an injection device, is avoided.

Fill/Hold

There are two built-in vacuum generators to fill a micropipette from the tip and to hold suspended cells. Filling the pipette from the tip is easier than back filling. Suspended cells can be held with a second (holding) pipette. The holding vacuum's range accommodates most cell types.

Clear

A high-pressure pulse can be used for clearing a pipette, should it happen to clog. This is particularly useful when working with pipettes sized for smaller volumes.

Electrical Connectors

BNC type connectors are available at the front panel to ease integrating the Pico-Injector with other equipment. Synchronization of injections to other stimulations or recordings is therefore possible.

Selection Guidelines

The PLI-100 is available in three packages: Plus, Basic and Deluxe. The basic unit is supplied with an input hose, output hose, holding hose, power cord and instruction manual. The plus unit also includes a foot switch, pipette holder and input hose adapter. The deluxe unit includes all the previously mentioned accessories plus an additional foot switch and one pipette holder.

Accessories

Available accessories for the PLI-100 Injection Systems are located on page 281.

Specifications

Input Gas Pressure	70 to 105 p.s.i. (480 to 720 kPa)
Injection Pressure	0.2 to 60 p.s.i. (413 kPa), regulated, multi-turn control
Balance Pressure	0.1 to 3.5 p.s.i. (68.9 kPa), regulated, multi-turn control, other ranges available upon request
Fill Vacuum	Internally produced, -12.0 p.s.i. (-82 kPa), unregulated
Holding Vacuum	Internally produced, 0 to 3 in H_2O (0 to 0.75 kPa or 0 to 0.1 p.s.i.), regulated
Clearing Pressure	Input gas pressure, unregulated
Injection Timer Pulse Width	0.01 to 0.99 sec in 10 msec steps; 1 to 99 sec in 1 sec steps
Injection Count Display	Digital, 0 through 9999
Duration Mode	Internally timed or externally gated
Time Trigger	Front panel, foot switch, or external TTL pulse (BNC)
Pressure Units	p.s.i./kPa; switch selectable
Pressure Monitor	BNC connector, 10 mV/p.s.i.
Pressure Readout	Inject, balance, clear, output port
Line Voltage	100/110/220/240 VAC
Power Usage	220 W
Meter Accuracy	0.1% full scale
Foot Switches	Inject, fill, hold, and gated; provided in plus and deluxe pkgs.
Weight	6.8 kg (15 lb)
Dimensions, H x W x D	11 x 38 x 25.5 cm (5 x 15 x 10 in)
Accessories Supplied	Input, output and holding hoses

Order #	Model	Product
W4 65-0001	PLI-100	PLI-100 Basic Pico Injector with Injection, Balance, Clear, Filling and Holding Pressures; Comes with Input Hose, Output Hose, Holding Hose, Power Cord and Instruction Manual
W4 65-0002	PLI-100 Plus	PLI-100 Plus Pico Injector with Injection, Balance, Clear, Filling and Holding Pressures; Comes with Input Hose, Output Hose, Holding Hose, Power Cord, Instruction Manual, Foot Switch (W4 65-0029), Pipette Holder (W4 65-0013) and Input Hose Adapter
W4 65-0003	PLI-100 Deluxe	PLI-100 Deluxe Pico-Injector with Injection, Balance, Clear, Filling and Holding Pressures, Comes with Input Hose, Output Hose, Holding Hose, Power Cord, Instruction Manual, Two Foot Switches, Two Pipette Holders and Input Hose Adapter

PLI-100A

Pico-Injector

- Femtoliter to microliter injections
- Digital readouts for injection pressure, time, and count
- Reliable optically encoded circuit for injection time set
- 5 pressures: inject, balance, clear, fill and hold

The PLI-100A Pico-Injector reliably delivers ejections from femtoliters to nanoliters through micropipettes by applying a regulated pressure for a digitally set period of time.

Pressure to the pipette is controlled precisely through a multi-turn regulator, and is reported digitally for reproducibility. Injection time is set using an optically encoded circuit which permits fine and coarse settings from a single knob.

The system timer can be controlled in three ways, front panel push button, foot switch, and external trigger input BNC.

Whether you need to do large injections into capillaries or very small injections into mammalian nuclei, the PLI-100A is up for the task.

Pressure Capabilities

The PLI-100A features two negative and three positive pressure pneumatic capabilities. The negative or vacuum functions allow the user to:

1. Fill micropipettes from their tips, reducing waste of pipettes.

2. Provide a means to secure and manipulate a cell using holding pipette.

The positive pressures allow the user to:

- **Eject precise amounts of fluids**
- **Create a balance pressure which prevents backflow into the micropipette following an injection**
- **Clear a micropipette of material in it**

Unique Features

The PLI-100A's important 'Balance', 'Hold' and 'Clear' functions are features not found on other microinjection units.

Balance

In addition to the ejection pressure, the Pico-Injector offers a secondary balance pressure. This adjustable pressure keeps a positive pressure on the injection pipette before and after injections. This eliminates dilution caused by capillary action and aids in the prevention of clogging. Wasteful continuous injection, which often occurs when no separate balance pressure is offered by an injection device, is avoided.

Fill/Hold

There are two built-in vacuum generators to fill a micropipette from the tip and to hold suspended cells. Filling the pipette from the tip is easier than back filling. The PLI-100A features a Fill Vacuum adjustment on the front panel. Suspended cells can be held with a second (holding) pipette. The holding vacuum's range accommodates most cell types.

Clear

A high-pressure pulse can be used for clearing a pipette, should it happen to clog. This is particularly useful when working with pipettes sized for smaller volumes.

Electrical Connectors

BNC type connectors are available at the front panel to ease integrating the Pico-Injector with other equipment. Synchronization of injections to other stimulations or recordings is therefore possible.

Selection Guideline

The PLI-100A is available in three packages: **Basic, Plus, and Deluxe**. The **Basic** unit is supplied with an input hose, output hose, holding hose, and input hose adapter.

The **Plus** unit also includes a foot switch, pipette holder, and input hose adapter.

The **Deluxe** unit includes all the accessories included with the Plus and an additional foot switch and pipette holder.

PLI-100A

Pico-Injector (Continued)

Rear Panel


Output Hose


Holding hose with cell release bulb


Pipette Holder (W4 65-0013)

Specifications

Input Gas Pressure	75 PSI Recommended, 105 PSI Maximum
Injection Pressure	0.2 to 60 PSI (413 KPa), regulated
Balance Pressure	0.1 to 9.9 PSI (68.9 KPa) regulated, multi-turn control, other ranges available on request
Fill Vacuum	Internally produced 0 to -12 PSI (0 to-82 KPa), regulated
Holding Vacuum	Internally produced 0 to -0.1 PSI (0 to -0.75 KPa), regulated
Clearing Pressure	Input gas pressure, unregulated
Injection Time	0.01 to 99.99 Seconds
Injection Time Accuracy	±0.01% (Crystal Time Base)
Duration Mode	Internally timed or externally gated
Time Trigger	Front panel, foot switch, or external TTL pulse (BNC)
Pressure Units	PSI /KPa switch selectable
Pressure Monitor Output	BNC, Rear Panel, 10 mV/PSI or 1 mV/KPa
Pressure Readout	Inject, balance, clear, output port
Pressure Display Resolution	3½ Digits, 0.1 PSI or 1 KPa
Injection Count Display	0 to 9999 Injections
Power Input	External 9VDC @ 400mA (min) Power
	Supply universal input 90 to 264 VAC
Weight	5.44 kg (12 lb)
Dimensions (HxWxD)	89 x 432 x 250 mm (3.5 x 17 x 9.8 in) (H x W x D)
Warranty	One year, parts & labor

Order #	Model	Product
W4 64-1735	PLI-100A	PLI-100A Basic Pico Injector with Injection, Balance, Clear, Filling and Holding Pressures; Comes with Input Hose, Output Hose, Holding Hose, and Input Hose Adapter
W4 64-1736	PLI-100A Plus	PLI-100A Plus Pico Injector with Injection, Balance, Clear, Filling and Holding Pressures; Comes with Input Hose, Output Hose, Holding Hose, Foot Switch (65-0029), Pipette Holder (65-0013), and Input Hose Adapter
W4 64-1737	PLI-100ADeluxe	PLI-100A Deluxe Pico-Injector with Injection, Balance, Clear, Filling and Holding Pressures, Comes with Input Hose, Output Hose, Holding Hose, Two Foot Switches, Two Pipette Holders, and Input Hose Adapter

PLI-90

Medical Systems Pico-Injector

Precise and reproducible injection

W4 65-0004 PLI-90 Pico-Injector

- 3 pressures — inject, balance, and clearing
- Eliminates backflow into pipette after injection
- Reproducibly delivers femtoliters to microliters
- Easy to use
- Economical
- Precise

The PLI-90 Pico-Injector, like the reliable PLI-100 Pico-Injector, controls the precise and reproducible regulation of injection pressure and time.

Simplicity

Because the PLI-90 features only the injection, balance, and clearing pressures, it is a lower cost alternative to the PLI-100. This simplicity makes it even easier to use than the PLI-100.

Selection Guidelines

The PLI-90 is ideal for the user who does not require vacuum for filling pipette barrels or if using a holding pipette for holding cells is not essential to your application.

The PLI-90 is available in two packages: Basic and Plus. The basic model includes an input and output hose, handle, power cord and instruction manual. The plus model is supplied with all of the same parts as the basic model but also includes a Footswitch, Pipette Holder, and Input Hose Adapter.

Specifications

Input Gas Pressure	70 to 105 p.s.i. (480 to 720 kPa)
Injection Pressure	0.2 to 60 p.s.i. (413 kPa), regulated, multi-turn control
Balance Pressure	0.1 to 9.9 p.s.i. (68.9 kPa), regulated, multi-turn control, other ranges available upon request
Clearing Pressure	Input gas pressure, unregulated
Injection Time	0.01 to 0.99 sec in 10 msec steps; 1 to 99 sec in 1 sec steps
Pressure Display	Digital, three and a half digits
Duration Mode	Internally timed or externally triggered
Trigger Mode	Foot or panel switch
Pressure Readout	Inject, balance, clear, output port
Line Voltage	100/110/220/240 VAC
Power Usage	220 W
Foot Switch(es)	Optional inject and gating
Accessories Supplied	Input hose, output hose and power cord
Weight	6.8 kg (15 lb)
Dimensions, H x W x D	11 x 38 x 25.5 x cm (5 x 15 x 10 in)

Order #	Model	Product
W4 65-0004	PLI-90 BASIC	Pico-Injector with Injection, Balance and Clear Pressures; Includes Input Hose (PLI-IHN) and Output Hose (PLI-OHN), Handle, Power Cord and Instruction Manual. Applications: Basic setups that do not need suction.
W4 65-0005	PLI-90 PLUS	Pico-Injector Basic Model and Acces-sories (Shown Above), Plus One Each PLI-FS Foot Switch, PLI-PH1 Pipette Holder and PLI-IHA Input Hose Adapter

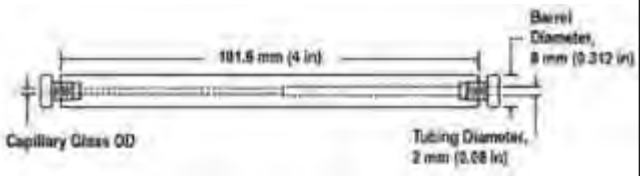
PLI-100 and PLI-90

PLI-100 and PLI-90 Accessories

Order #	Model	Product
Accessories		
W4 65-0029	PLI-FS	Footswitch for Inject, Hold, Fill or Gate (Order more than one if frequent use of footswitch is needed for more than one of these functions.)
W4 65-0030	PLI-RM	Frame to Mount PLI-90 or PLI-100 in 19-in. Wide Instrument Rack
Hosing		
W4 65-0006	PLI-IHA	Input Hose Adapter (¼ in Male W4T Pipe Thread) Gas Bottle Regulator Fitting; Connects with PLI-IHO/N
W4 65-0007	PLI-IHO	Gas Input Hose (Tygon Tubing), 9 ft x 0.250 in (6.35 mm) x 0.125 in (3.18 mm) x 0.062 in (1.57 mm) (L x OD x ID x Wall Thickness); Connects to PLI-IHA and PLI 90/100 Gas Input, Brass Screw Fitting Type - Old
W4 65-0008	PLI-IHN	Gas Input Hose (Tygon Tubing) 9 ft L x 0.250 in (6.35 mm) OD x 0.125 in (3.18 mm) ID x 0.062 in (1.57 mm) Wall Thickness; Connects to PLI-IHA and PLI 90/100 Gas Input, Quick Connect/Disconnect Type - New
W4 65-0009	PLI-OHO	Output Hose (Tygon Tubing) 9 ft L x 0.071 in (1.80 mm) OD x 0.039 in (1 mm) ID x 0.016 in (0.41 mm) Wall Thickness; Connects to MSC Pipette Holders, Brass Screw Fitting Type - Old
W4 65-0010	PLI-OHN	Output Hose (Tygon Tubing) 9 ft L x 0.071 in (1.80 mm) OD x 0.039 in (1 mm) ID x 0.016 in (0.41 mm) Wall Thickness; Connects to MSC Pipette Holders and PLI 90/100 Gas Output, Quick Connect/Disconnect Type - New
W4 65-0011	PLI-HHO	Holding Hose with Cell Release Bulb; 9 ft L x 0.071 in (1.80 mm) OD x 0.039 in (1 mm) ID x 0.016 in (0.41 mm) Wall Thickness; Connects to MSC Pipette Holders and PLI-100 Hold Output, Brass Screw Fitting Type - Old
W4 65-0012	PLI-HHN	Holding Hose with Cell Release Bulb; 9 ft L x 0.071 in (1.80 mm) OD x 0.039 in (1 mm) ID x 0.016 in (0.41 mm) Wall Thickness. Connects to MSC Pipette Holders and PLI-100 Hold Output, Quick Connect/Disconnect Type - New

Order #	Model	Product
Pipette Holder/Adapter/Parts		
W4 65-0013	PLI-PH1	Stainless Steel Pipette Holder, 130 mm L for 1 to 1.5 mm OD Glass Pipettes
W4 65-0014	PLI-PH1A	Stainless Steel Pipette Holder, 80 mm L for 1 to 1.5 mm OD Glass Pipettes
W4 65-0017	PLI-SRG	Silicone Rubber Gasket Replacement for use with PLI-PH1 and PLI-PH1A, 10.2 cm (12 in)
W4 65-0015	PLI-SRG1.5	Silicone Rubber Gasket Replacement for use with 1.5 mm Glass Pipettes
W4 65-0018	PLI-SSB	Stainless Steel Bushing Replacement for use with PLI-PH1 and PLI-PH1A Pipette Holders
W4 65-0019	PLI-PC	Stainless Steel Pipette Cap Replacement for use with PLI-PH1 and PLI-PH1A Pipette Holders
W4 65-0020	PLI-HN	Stainless Steel Hose Nut Replacement for use with PLI-PH1 and PLI-PH1A Pipette Holders
W4 65-0021	PLI-PH-KIT	Pipette Holder Hardware Replacement Kit for use with PLI-PH1 and PLI-PH1A Pipette Holders, Includes 1 each PLI-SSB, PLI-PC, PLI-HN and PLI-SRG
W4 65-0022	PLI-PHA	Stainless Steel Pipette Holder (PLI-PH series) Adapter for Eppendorf ECET FEMTOTIP

Optional "Easy Insert" Acrylic Pipette Holder



W4 64-1626	AO16 1.0	Acrylic Pipette Holder for 1.0 mm Pipettes
W4 64-1627	AO16 1.2	Acrylic Pipette Holder for 1.2 mm Pipettes
W4 64-1628	PLI-PPH	Acrylic Pipette Holder for 1.5 mm Pipettes
W4 64-1629	AO16 1.2	Acrylic Pipette Holder for 2 mm Pipettes

PLS-1

Pico Injection/Micromanipulator System

The PLS-1 Pico Injection/Micromanipulator System combines our popular PLI-100 pico injector, a motorized micromanipulator, and magnetic base in a single package.

The PLI-100 Pico-Injector delivers a wide range of volumes through micropipettes by applying a regulated pressure for a set period of time. The system features 5 pressures: inject, balance, clear, fill, and hold. The injector comes complete with input and output hoses, foot switch and pipette holder.

For precise and convenient movement of the electrode our three axes motorized micromanipulator and push button controller are included. This micromanipulator features hands free spatial resolution of 0.5 µm which enables positioning in the sub-micro range. Flexible motor coupling ensures no vibration of probe during movement.

The MB/B magnetic base provides a convenient position device for the micromanipulator.

Order #	Model	Product
W4 64-1608	PLS-1	Pico-Injector Micromanipulator System
W4 65-0002	PLI-100 Plus	Pico Injector
W4 60-0571		Right-handed motorized micromanipulator
W4 60-0577		Push button controller
W4 64-0060		MB/B Magnetic base

Model Air-1 Ultra Low Noise Air Compressor

- Suitable for installation directly at point of use
- Lowest noise and vibration level in the market 45dB(A) you won't even know it's on
- Complete compressed air package
- Ideal for use with our microinjection systems

When a reliable supply of clean and quiet compressed air is required, this oil-lubricated compressor is the perfect choice. The noise level is 45 dB(A) - far below the level of normal conversation. Quiet, vibration-free and reliable this compressors compact design easily allows mounting at the place of use.

The oil-lubricated piston compressor is supplied ready for use. The unique synthetic SJ-27 oil designed especially for AIR-1 optimizes the lubrication of the compressor.

Furthermore, the internal motor is mounted in a closed motor house, reducing the noise level even further. Due to the design of the motor, the oil is also used for cooling the motor.

The motor is mounted on springs inside the motor housing, which means that hardly any vibrations are imparted to the surroundings. Two noise reduction chambers on the intake side and two noise reduction chambers on the pressure side ensure absorption of the noise. The compressor is also supplied with rubber feet, preventing vibrations from imparting to the mounting bolts and foundation. The noise level of the oil-lubricated compressor is 45 dB (A) – below the noise level of a refrigerator.

The oil minimizes the wear and tear of the vital parts in the compressor, prolonging the lifetime and at the same time ensuring low maintenance costs.

Specifications

Input Voltage Range	120 or 230 VAC specify at time or order
Maximum Current	6.2A@ 120 VAC 2.9A@ 230 VAC
Motor	0.54 HP / 0.40kW
Displacement	60 l/min or 2.12 CFM
FAD @ 8 bar	32 l/min or 1.13 CFM
Max. Pressure	8 bar / 120 psi
Tank Size	4 liters / 1.1 gallon
Noise Level	45 dB(A)
Physical Dimensions:	
Size, H x W x D	382 x 300 x 334 mm (15 x 11.8 x 13.2 in)
Weight	23 kg (50.6 lb)
Warranty	One year, parts & labor

Order #	Model	Product
W4 64-1701	AIR-1 U	Ultra low noise 120VAC
W4 64-1702	AIR-2	Ultra low noise 230VAC

Harvard Neuro Phore BH-2 System

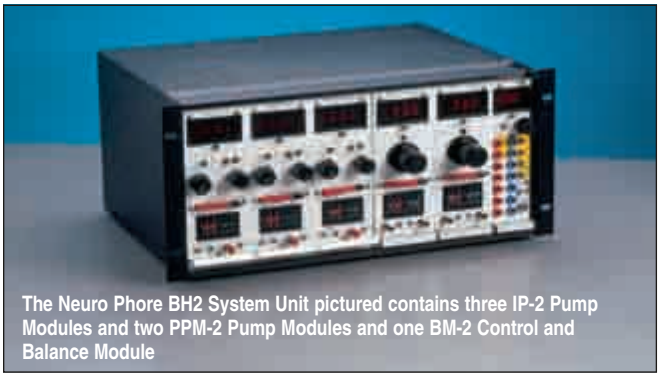
Micro-Iontophoresis and Micro Injection

Harvard Neuro Phore BH-2 System

In the past few decades, the application of drugs and other dissolved agents from multibarrel electrodes/pipettes has evolved into a practical method of testing their effects on cells or cellular systems. The versatile Neuro Phore BH-2 System is designed to facilitate controlled ejection of fluids from multibarrel micropipettes. Extracellular ejections of minute volumes can be delivered using up to five pumps in serial or parallel. The ejection schedule for each pump can be independently programmed for sequential or simultaneous output. Ejection cycles can be internally timed, triggered manually, or synchronized to external events.

This flexible system allows the use of iontophoretic pump modules, pneumatic pump modules, or a combination of both. By interchanging the IP-2 Iontophoresis Pump Module with a PPM-2 pneumatic pressure pump, the overall system capability can be expanded for simultaneous pressure and iontophoretic injection of drugs from a multibarrel pipette.

The Neuro Phore BH-2 System was developed under the guidance of active researchers with extensive experience in iontophoresis techniques. These researchers needed a system to provide precise stimulation and quantitative control for ejection of drugs in their pharmacological studies of drug evoked responses such as neurosynaptic discharges, contraction, and changes in chemical concentration. What emerged was a reliable, accurate, easy to use, Neuro Phore BH-2 system that is capable of accommodating high impedance multi-barreled micro-electrode pipettes.



The Neuro Phore BH2 System Unit pictured contains three IP-2 Pump Modules and two PPM-2 Pump Modules and one BM-2 Control and Balance Module

- Used by leading researchers for over 20 years
- Modular
- Minimal noise
- Up to 6 channels
- Digitally controlled eject and pause timing
- Mix and match pump types

Features

- Successfully utilized in key laboratories around the world for over 20 years, with many journal articles published as a result
- Modular design; buy what you need now and add additional modules later as your protocol evolves
- Accommodates 7 barrel micropipettes, supports the most complex and demanding injection and recording protocols
- Extremely low noise, ±105 volts compliance, allows rapid iontophoretic injection with even the smallest micropipette tips
- Automatic current neutralization for minimal electrical artifacts
- Digitally controlled eject and pause timing utilizes easy to read and set digital panel switches on each iontophoretic or pressure module/channel
- Unbalance and out of compliance indicators are a great aid in troubleshooting clogged pipettes and other problems
- External analog input control allows external programming of complex, or closed loop injection protocols
- Current and electrode resistance readout with large bright easy to read digital displays

System Configuration

The Neuro Phore BH-2 System is modular and is comprised of the following components (all ordered separately):

- One BH-2 Mainframe Chassis, W4 65-0600 that can accommodate 1 to 5 Iontophoretic Pump and/or Pressure Pump Modules; Mainframe Chassis can be rack mounted or set on table
- One BM-2 Control and Balance Module, W4 65-0602
- IP-2 Iontophoretic Pump Modules, W4 65-0603 and/or
- PPM-2 Pressure Pump Modules, W4 65-0604
- One low noise MS-2 Power Supply, W4 65-0601
- Blank Panel DP-1 Dummy Module, W4 65-0605 used to maintain timing if less than 5 Pump Modules are installed
- One Model OC-01 output cable, W4 65-0215
- One Model NL-952 lemo cable, W4 65-0285

Harvard Neuro Phore BH-2 System

Micro-Iontophoresis and Micro Injection (continued)

BH-2 Mainframe Chassis

The BH-2 Mainframe Chassis is pre-wired to accept one Control and Balance module and five Iontophoretic Pump Modules and/or Pneumatic Pump Modules. The selected modules are specified by the researcher and depend on applications. Although all components are ordered separately, the unit is assembled, calibrated, and balanced by Harvard Apparatus before shipping.

BM-2 Balance Module: Balance and More

In addition to providing current neutralization (automatic feedback and control of inverse sum of all pump currents), the balance module has independent capability of current pump settings with a working range of 0 to 500 nanoamperes. The Balance Module includes a digital display, time clock, provisions for electrical and manual cycle start/stop and single cycle/recycle switch, trigger, and gate input terminals to initiate externally controlled eject pumping action of respective modules. Analog input for balance or drive with override capability. Analog output for monitoring of unbalance currents.

**Brain Slice Chambers are available in a variety of formats. Please visit our website for more information.*

Order #	Product
W4 65-0600	BH-2 Mainframe Chassis (Does Not Include BM-2 Balance Module, see Below)
W4 65-0602	BM-2 Control and Balance Module with OC-01 and NL-952

Specifications

Neutralization (balance) Pump Range	Max. ±2500 nA automatically controlled
Current Pump	Compliance ±105 V linear constant current source; manually adjustable 0 to 500 nA by pump control; polarity selected +/OFF/- switch
Digital Meter Display	3 digits and sign
Unbalance Current/Current	Pump Switch:
Unbalance	Digital display reads unbalance (ground going) current in nA
Current Mode	In this mode, automatic current neutralization is provided
Current Pump Mode	Automatic balance feature is switched off; display reads amount of current in nanoamperes passed through balance barrel as adjusted by pump control
Single Cycle Mode	In single cycle mode, start switch or external trigger initiates each cycle
Recycle Mode	In recycle mode, once start switch or external trigger is actuated, repetitive cycles commence automatically
Time Unit Switch	Two basic time units can be selected, 10 msec or 1 sec. In 10 msec position, Eject and Pause time switches of IP-2 Modules can be set to cover time range from 10 to 990 msec with 10 msec resolution. In 1 sec position, time scale is expanded from 1 to 99 sec with 1 sec resolution.
Inputs	Cycle start, stop, trigger/gate #1 through #5; banana jacks terminals, floating input, optically coupled; input voltage ±5 to ±15 V TTL compatible
Analog Input	Lemo miniature receptacle, ground referenced 5 mV/nA; input impedance 100 kΩ
Analog Output	Lemo miniature receptacle, 5 mV/nA ground referenced
Sync Output	Lemo miniature receptacle, TTL pulse
Output Connector	7-pin miniature connector, mates with ultra flexible cable leading to micro-electrode holder
Dimensions, H x W x D	21 x 47 x 35 cm (8.75 x 19 x 14 in)
Weight	8.2 kg (18 lb)

Application Note: Working Unit:

One (1) each of BH-2 Main-Frame, MS-2 power supply, BM-2 Control & Balance module and any combination of one (1) to five (5) modules selected from IP-2 and/or PPM-2. If less than five (5), DP-1 module is required to fill the spaces.

MS-2 Power Supply

The AC power supply is self contained in a rack-mounted cabinet and provides all voltages required to operate the Neuro Phore System. The power supply interconnects with the mainframe via flexible cable. The supply works with 115 or 220 VAC, 50/60 Hz mains source.

Specifications

Outputs	±125 V at 0.1 A ±15 V at 0.5 A -5 V at 3 A Line operated 115 to 220 VAC, 50/60 Hz
Dimensions, H x W x D	13 x 47 x 35 cm (5-1/4 x 19 x 14 in)
Weight	11 kg (24 lb)

Order #	Product
W4 65-0601	MS-2 Power Supply with Power Cord

Harvard Neuro Phore BH-2 System

Micro-Iontophoresis and Micro Injection (continued)

Specifications

Cycle Start, Cycle Stop, Trigger/Gate Inputs	Push-button, and banana jack terminals; floating input, optically coupled
Input Voltage	±5 to ±15 V
Minimum Trigger Pulse Width	5 µsec at 5 V
Sync Out	Lemo miniature connector TTL pulse
Single Cycle Mode	In single cycle mode, start switch or external trigger initiates each cycle
Recycle Mode	In recycle mode, once start switch or and external trigger is actuated, repetitive cycles will continue until stopped
Time Unit Switch	Two basic time units can be selected: 10 msec or 1 sec. In 10 msec position, Eject and Pause time switches of PPM-2 Modules can be set to cover time range from 10 to 990 msec with 10 msec resolution. In 1 sec position, time scale is expanded to 1 to 99 sec with 1 sec resolution
Power	115 VAC, 50/60 Hz (100 or 220 VAC optional)
Dimensions, H x W x D	21 x 47 x 35 cm (8.75 x 19 x 14 in)
Weight	5.5 kg (12 lb) PPS-2 Mini-Frame System: mainframe, power supply and CM-1 Control Panel. PPM-2 Modules not included.

PPS-2 Mini-Frame

The rack mountable PPS-2 Mini-Frame was designed as a less expensive alternative to the BH-2 for those applications that require pressure injections only. The PPS-2 is a multichannel pneumatic pumping system, designed especially for short-term pressure ejection of small quantities of fluids through micropipettes. The system can operate with up to four PPM-2 Pump Modules. Each module can be programmed to its own schedule of ejection and pause times, coordinated with the other modules. Ejection and pause times cover a range of 10 to 990 milliseconds with 10 millisecond resolution and 1 to 99 seconds with 1 second resolution. Continuous and cyclical modes of operation are also available.

System Configuration

The PPS-2 system (Order # W4 65-0606) includes a Control Module and a power supply. It is pre-wired to accept up to four PPM-2 Pneumatic Pressure Modules (Order # W4 65-0604) which are ordered separately.

The Control Module CM-1 includes a time clock. Panel mounted push-buttons as well as TTL electrical inputs are provided to control the following functions: Cycle Start/Cycle Stop, Trigger (each PPM-2), and Gate (each PPM-2). In essence, the CM-1 Control Module provides all necessary signals to operate the sequential and single shot timing for the installed PPM-2 Pneumatic Pump Modules.

A Self Cycle mode control switch controls independent self timing action of each of the pneumatic pump modules. The self-timing action permits each PPM-2 Pump Module to eject and pause for a predetermined period. Actuating any of the self cycle control switches causes the respective PPM-2 Module to be engaged into the self timing mode. The push buttons at the corresponding trigger/gate terminals initiate the self cycle timing action.

Application Note:
Working Unit

Mini-Frame, Power Supply, and Control Panel plus four (4) modules selected from PPM-2 and DP-1

Order #	Product
W4 65-0606	PPS-2 Mini-Frame with Power Supply, Control Module and NL-952 Power Cord and Manual
W4 65-0604	PPM-2 Pneumatic Pump Module with OH-01 and IH-01, PPS-2 System Can Support 1 to 4 Modules
W4 65-0605	DP-1 Dummy Module (to Maintain Timing) PPS-2 System Can Support 1 to 4 Modules
W4 65-0210	Model SC-01, Tygon Flexible Hose Micropipette Interface Coupling for Pneumatic (PPM-2) Use
W4 65-0211	Model SC-02, Tygon Flexible Hose Micropipette Interface Coupling for Current (IP-2)/Pneumatic (PPM-2) Use
W4 65-0212	Model IH-01, Input Hose 2.7 m (9 ft) Coupling to PPM-2
W4 65-0213	Model OH-01, Output Hose 2.7 m (9 ft) Including SC-01 Coupling
W4 65-0214	Model OH-02, Output Hose 2.7 m (9 ft) Including SC-02 Coupling
W4 65-0215	Model OC-01, Output Cable 2.7 m (9 ft) with (7) Seven-Pin Lemo Connector
W4 65-0285	Model NL-952, Cable 2 m (6.5 ft) with Lemo Miniature Connector at One End and Tinned Leads at Other (Sync. Output or Analog Input/Output Cable)

Harvard Neuro Phore BH-2 System

Micro-Iontophoresis and Micro Injection (continued)

IP-2 Iontophoresis Pump Module

Each IP-2 Module includes controls for precise settings of current magnitude and polarity (retention 0 to 50 nanoamperes, ejection 0 to 500 nanoamperes). The actual current and polarity is continuously displayed digitally and can be externally monitored at the analog output terminal.

Operating Modes

Ejection Timing and Mode Switch

The mode switch provides five push-button controls which include operations such as cycle, trigger, gate, continuous, and termination.

Cycle Mode

In the cycle mode by virtue of selecting single or recycle operation on the BM-2 Module an incoming trigger or cycle start push-button will initiate the current ejection pumping action. In this mode each succeeding Pump Module is automatically triggered after the pause time of the preceding event has been completed. Both eject and pause times can be preset to cover a range from 10 to 990 milliseconds with a 10 millisecond resolution and 1 to 99 seconds with a 1 second resolution.

Trigger Mode

When the TRIG. switch is energized the eject time interval will be started by virtue of the incoming trigger pulse applied to the respective inputs on the BM-2 Balance Module. Eject timing interval can be preset covering a range from 10 to 990 milliseconds with a 10 millisecond resolution and 1 to 99 seconds with a 1 second resolution.

Gate Mode

When the GATE switch is energized the eject current will be started by virtue of a gate input signal applied to the respective trigger/gate terminals on the BM-2 Balance Module. The eject and pause time settings are not operative in this mode, since the eject time function is slaved to the duration of the gate input.

Continuous Mode

When the CONT. switch is energized the ejection pump current is continuously maintained.

Termination Mode

When the TERM. switch is energized the output is automatically diverted from the preparation into an internal 'dummy load' (100 MΩ). This function is particularly useful for testing of possible instability in the preparation pipette.

Analog Input

The analog input terminal is available to facilitate externally controlled current pumping action. An external voltage applied to the input will generate a pumping current at a ratio of 5 millivolts/nanoamperes. This current will be summated with any preset pump current governed by both the retention and ejection controls. The combined magnitude and sign of the summated pumping current is displayed on the digital display of each corresponding Pump Module. This input can be connected to a computer D/A converter when external programming is desired.

Analog Output

The analog output terminal provides a buffered voltage which is proportional in magnitude and polarity to the actual current passed from the current pump into the pipette. The conversion ratio is 5 mV/nA. This output can be polygraphically recorded to monitor progress of the experiment.

Sync Output

The sync output provides a TTL pulse that coincides with the eject time. This output is provided to trigger external devices such as a computer, event counter, etc.

Specifications

Current Pump	Compliance ±105 V, linear constant current source
Ejection Current	Pulsing controlled by Ejection Timing Mode Switch; amplitude adjustable by 10-turn ejection control and range switch from 0 to 50 or 0 to 500 nA; polarity is selected by polarity switch; accuracy of ±l nA
Ejection Indicator	Red LED lamp indicates Eject time period; green LED lamp indicates pause time period
Retention Current	Amplitude adjustable by front panel dial from 0 to 50 nA; polarity automatically set opposite to ejection current polarity, socket (x3)
Analog Input	Lemo miniature receptacle, ground referenced 5 mV/nA; input impedance 100 kΩ , socket (x3)
Analog Output	Lemo miniature receptacle, ground referenced 5 mV/nA, socket (x3)
Sync Output	Lemo miniature receptacle, TTL pulse time incident with eject pulse
Current and Resistance	Digital Meter Display 3 digits and sign Metering System
Resistance/Current Switch:	
Current Mode	Switch in center 'nA' position, digital display reads total current in nA passed through micro-electrode pipette (sum of retention and ejection current)
Resistance Mode	Switch in either (pos) or (neg) MΩ position, digital display reads actual electrode barrel resistance in MΩ derived by passing positive or negative constant current (50 nA) through electrode pipette
Compliance Exceeded Indicator	Digital display will flash whenever electrode barrel resistance exceeds working range of current pump (i.e., when electrode resistance times current exceeds compliance of ±105 V)
Voltage Readout Switch	Depressing switch will cause digital display to read voltage across pipette

Order #	Product
W4 65-0603	IP-2 Iontophoresis Pump Module

Harvard Neuro Phore BH-2 System

Micro-Iontophoresis and Micro Injection (continued)

PPM-2 Pneumatic Pump Module

Designed specifically for pressure injection of drugs in pharmacological studies of drug evoked responses (i.e. synaptic discharges, contraction, etc.) Emphasis has been given to pressure control and regulation (0 to 30 p.s.i.; optional 0 to 10 or 0 to 90 p.s.i.) as well as precise timing. The PPM-2 Module is comprised of a precise pressure regulator, digital display, transducer, and a timing mode switch. It connects to an external pressure source (such as a compressed bottle of N2) which can be set to provide continuous or periodic pressure pulses ranging from 0 to 30 p.s.i. Outputs include (0 to 1 volt) proportional to output pressure as well as a sync pulse coincident with pressure cycle.

Operating Modes

Ejection Timing and Mode Switch

The mode switch provides five push-button controls which include operations such as cycle, trigger, gate, continuous, and termination.

Cycle Mode

In the cycle mode, after selecting single or recycle operation, the start push-button will initiate the ejection pumping action. In this mode each succeeding pump module is automatically triggered after the pause time of the preceding event has been completed. Both eject and pause times can be preset to cover a range from 30 to 990 milliseconds with a 10 millisecond resolution and 1 to 99 seconds with a 1 second resolution.

Trigger Mode

When the TRIG. switch is energized the eject time interval will be started by virtue of an externally applied trigger pulse fed to the respective inputs on the CM-I control panel. Eject timing intervals can be preset to cover a range from 30 to 990 milliseconds with a 10 millisecond resolution and 1 to 99 seconds with a 1 second resolution.

Gate Mode

When the GATE switch is energized pumping action will be started by virtue of a gate input signal applied to the respective trigger/gate terminals on the CM-I control panel. The eject and pause time settings are not operative in this mode, since the eject time function is slaved to the duration of the gate input.

Continuous Mode

Eject pump action is continuously maintained when CONT. switch is energized.

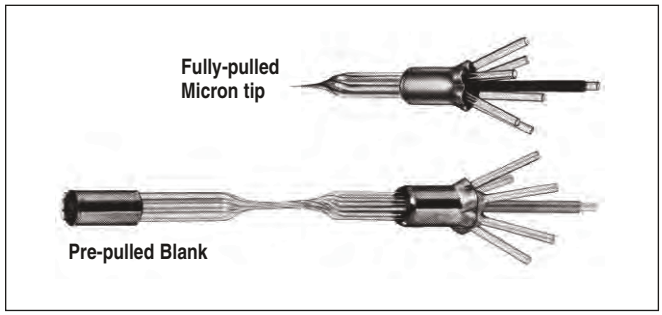
Termination Mode

When the TERM. switch is energized, the output pressure is automatically diverted from the preparation. This function is particularly useful for setting up the desired pressure range and timing while preventing ejection of any drug from the pipette.

Specifications

Source Gas	Air or Nitrogen recommended (no explosive or combustible gases)
Input Pressure	125 p.s.i.g. (7.8 kg/cm2) maximum
Input Filter	5 µm element
Output Pressure	0 to 99.9 p.s.i.g. (0 to 7 kg/ cm2), 30 p.s.i. standard
Output Pressure Display	Three decimal digits
Pressure Pulse Width:	
Minimum	30 msec
Maximum	99 sec (990 sec optional)
Gas Input and Output Couplings	Quick disconnect type
Analog Output	Lemo miniature connector, voltage proportional to output pressure, 0 to -999 mV full scale in p.s.i.g. setting; 0 to -700 mV full scale in kg/cm2 setting
Sync Output	Lemo miniature connector TTL pulse, time incident with output pressure pulse
Eject Time Indicator	Red LED
Pause Time Indicator	Green LED

Order #	Product
W4 65-0604	PPM-2 Pneumatic Pump Module with Input/Output Hose



- Easy filling
- Minimal tip resistance
- Minimal leakage
- Available pre-pulled or fully-pulled

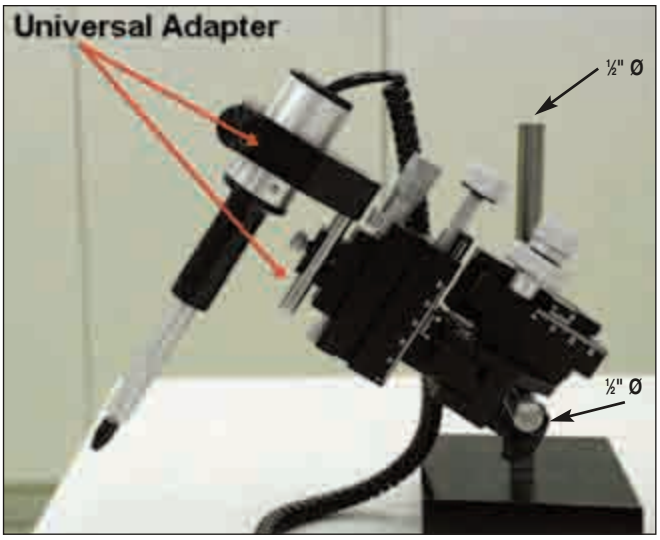
7-Barrel Iontophoresis Micropipette

The MS-7P Micropipette has been designed for iontophoretic use as well as pneumatic ejection of drugs. The standard blank consists of seven barrels, Pyrex Omegadot tubing, 1.5 mm outer diameter and 1.2 mm inner diameter, pre-pulled to 2 mm formation as shown. For complete details, see our Warner Instruments Cell Biology Catalog.

Order #	Model	Micropipettes
W4 65-0207	MS-7PB	Micropipette 7-Barrel, 1.5 mm OD Borosilicate Glass, Pre-Pulled Plank, 20 per box
W4 65-0208	MS-7MT	Micropipette 7-Barrel, 1.5 mm OD Borosilicate Glass, Fully-Pulled Approx. 20 µm Tip, 10 per box

Nanoject II

Auto Nanoliter Injector



Needs Micromanipulator to attach to Support Stand. Universal adapter now included for all NJ2's.

- Lower volume (2.3 nl) capability
- Positive displacement technology
- 2.3 to 69.0 nl range of volumes
- Minimal vibration
- New improved high torque motor
- Membrane key pad
- Improved micropipette holder
- Two speed injection/fill rates
- Auto 'Home' capability

The Nanoject II is the latest development in the Nanoject family of microinjectors. One unique features of the Nanoject II is the use of a high torque motor to provide smooth operation resulting in substantially reduced tip movement. A new collect configuration holds the micropipette more securely thereby reducing air infiltration and oil leakage. The two-speed fill/inject mode allows the user to fill and inject at half speed, facilitating the use of smaller micropipettes. The handling of more viscous samples is also improved. All of the above factors enhance the precise delivery of sample.

Volumes for the Nanoject II range from 2.3 nl to 69 nl. The smaller tips and smaller injection volumes of the Nanoject II allow users to perform injections into other specimens/applications that previously could not be performed.

Positive displacement technology and the use of precision micropipettes, eliminate the need for tedious calibration when the viscosity of the sample changes. Contaminants in the sample do not hinder or change the injection volume as with some other injectors. An optional universal mounting adapter provides easy mounting of the Nanoject II to a variety of micromanipulators and stereotaxic frames.

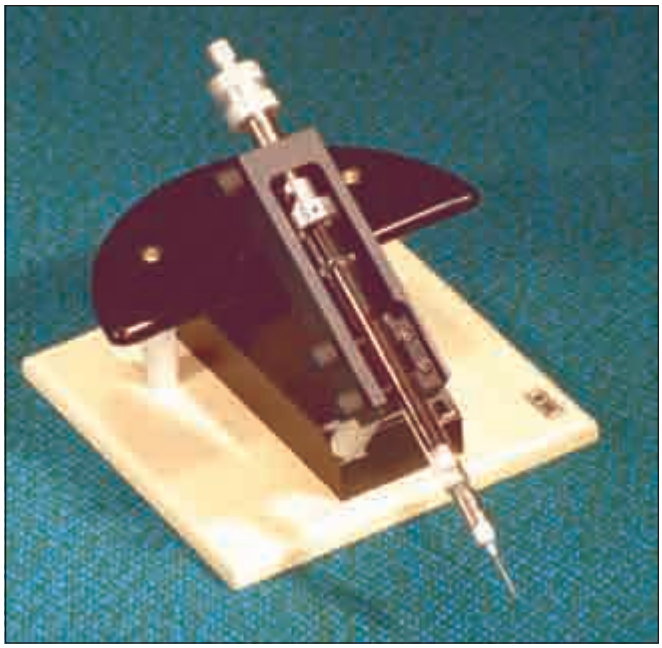
Specifications

Operation	Automatic
Glass Properties	Softening point 780°C
Glass Dimensions	1.14 x 0.053 mm (0.045 x 0.021 in) (OD x ID)
Injection Speed:	Fast: 46 nl/sec; Slow: 23 nl/sec
Fill Speed:	Fast: 46 nl/sec; Slow: 23 nl/sec
Empty Speed	92 nl/sec
Volume Range	2.3 nl to 69.0 nl
Change Volume	Dip switches #1 to #4
Change Inject Speed	Dip switch #5
Weight	99.2 g (3.5 oz)

Order #	Product
W4 69-0130*	Nanoject II Nanoliter Injector, 115 V, 60 Hz, US Plug
W4 69-0131*	Nanoject II Nanoliter Injector, 230 V, 50 Hz, European Plug
W4 69-0132*	Nanoject II Nanoliter Injector, 230 V, 50 Hz, UK Plug
Replacement Parts	
W4 69-0133	Replacement Glass, 88.9 x 1.14 x 0.053 mm (3.5 x 0.045 x 0.021 in) (L x OD x ID), Vial of 100
W4 69-0134	Replacement Glass, 177.8 x 1.14 x 0.053 mm (7 x 0.045 x 0.021 in) (L x OD x ID), Vial of 100
W4 69-0135	Flared Glass, 90 mm (3.5 in), Vial of 100
W4 69-0136	Standard O-Ring
W4 69-0137	Special Flared O-Ring
W4 69-0138	Replacement Wire Plunger
W4 69-0139	Needle, 30 ga x 51 mm (2 in)
W4 69-0142	Universal Mounting Adapter, see above photo
Accessories (Must be ordered separately)	
W4 69-0140	Footswitch
W4 69-0141	Support Base

**Universal adapter now included for all NJ2's*

Screw-Actuated Syringes



Screw-Actuated Air Syringes

- For air-assisted microinjection and microaspiration
- Uncomplicated and easy to use
- Accurate
- Sensitive control
- High suction/pressure

These air-assisted microinjection/microaspiration syringes provide the user with sensitive control and an extremely low dead-air volume. The capacity of the syringe is 10 ml. When required, the syringes can be used to generate high pressure or suction.

The Screw-Actuated Syringe is a small compact unit incorporated into a heavy circular base. Its convenient dimensions enable it to be ergonomically positioned next to the control lever of a micromanipulator to facilitate single-handed operation of both instruments.

The syringe is connected by hard polyethylene tubing to a micropipette, which in turn, may be fitted to a micromanipulator or positioning device. Suction/injection is obtained by turning the metal colored actuator screw-control on the top of the syringe. The syringe provides a solution to the problem of capillary action when working with small micropipettes. A small balance (equilibrating) pressure can be maintained to offset the effects of capillary action. A conveniently situated release-button on-top of the screw-control is provided to achieve equilibration.

Order #	Product
W4 69-0105	Screw-Actuated Air Syringe

Screw-Actuated Micrometer Driven Hamilton Syringe

- Ideal for oil-filled injection/aspiration
- Easy to use
- Hamilton syringe incorporated
- Accurate
- Sensitive control
- Low dead-air volume
- High suction/pressure
- Easy to exchange or replace the syringe

This screw actuated syringe is a micrometer-actuated syringe mechanism mounted on a small base. This syringe is for oil/air-assisted micro-injections and micro-aspirations. Its compact dimensions enable it to be ergonomically positioned next to the control lever of a micromanipulator to facilitate single-handed operation of both instruments.

Suction/injection is achieved by using the rotary-actuator with a fine micrometer-thread, which has a 15 mm movement range. A 1 ml gastight Hamilton glass syringe with a Luer-taper is incorporated. A Luer-taper hypodermic needle is mounted on the taper of the Hamilton syringe. The syringe is connected by hard polyethylene tubing to a micropipette, which in turn, may be fitted to a micromanipulator or similar instrument. The 1 ml Hamilton syringe can be easily exchanged for any other Hamilton 1700 syringe series including the 1000, 500, 200, 100 and 50 µl sizes, visit www.harvardapparatus.com for complete details.

Order #	Product
W4 69-0107	Screw-Actuated Micrometer Driven Hamilton Syringe

PM-8 and PM-4

8- and 4-Channel Pressure Injection Systems

W4 69-0153 8-Channel Pressure Injection System

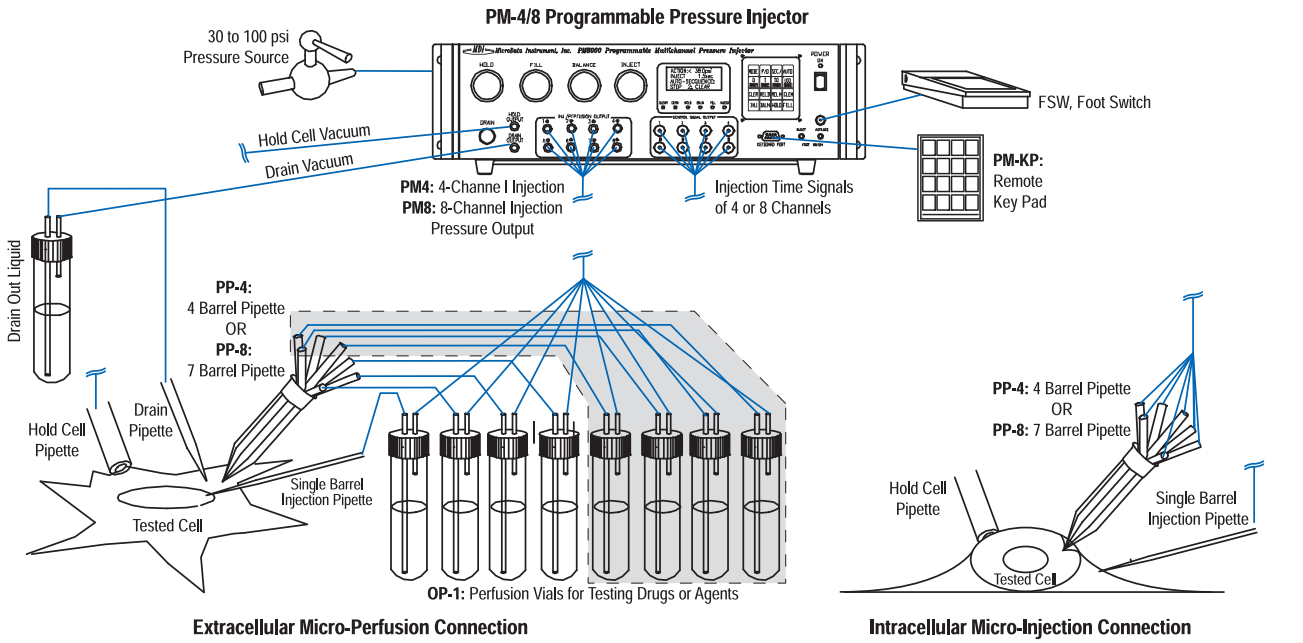
- Multiple function system for micro-injection and perfusion
- Up to 8 injection/perfusion outputs, one hold cell output, and one synchronized drain out channel
- Programmable timers, counters, and step sequences which can be stored for reuse
- Manual control or automatic sequential step cycle operation
- Front panel display for pressures and programming information

The PM-4 and PM-8 programmable 4 and 8-Channel Pressure Injector Systems are designed for one to eight channel intracellular injection and extracellular perfusion. These microinjection and perfusion engines are especially designed for pharmacological drug testing, molecular biological DNA, RNA transferring, intracytoplasmic sperm injection and cell electrophysiological applications.

Combining an advanced micro-controller with precision pneumatic components, these systems can simultaneously control up to eight injection micropipettes or eight perfusion vials, one cell holding pipette, and one drain pipette. The four (PM-4) or eight (PM-8) injection/perfusion output ports can be controlled separately or combined together to perform actions such as injection, capillary action balancing, suction or clear up. The cell holding output port can produce an adjusted gentle suction to hold a cell, eject a pressure to push a cell, or completely clear the holding pipette. Another drain output port can simultaneously produce an adjusted suction to drain and clear out liquid before the next channel micro-perfusion. The PM-4/8 can deliver different quantity agents and drugs from picoliters to continuous perfusion. All output pressures and vacuums can be regulated and can be displayed real-time on the front panel display. Previous pressure readings can also be recovered on the display for setting comparison.

Besides programmable timers and counters, there are 16 programmable and savable injection/perfusion sequences with 32 programmable steps in each sequence. Each sequence can be repeated continuously or triggered manually. The interval time between steps can be programmed for automatic sequential cycle or manual trigger. There are two foot switch connectors for sequential step trigger and injection trigger. A digital remote port can be connected to an optional remote key pad or be controlled by a computer. With exceptional versatility and extremely precise control, either the PM-4 or 8 is an ideal multi-channel injection/perfusion engine.

Connection Diagram for Extracellular Micro-Perfusion and Intracellular Micro-Injection Systems



PM-8 and PM-4

8- and 4-Channel Pressure Injection Systems (continued)

W4 69-0152 4-Channel Pressure Injection System

CE

Below are the components supplied with each of the **Pressure Injection Systems**.

Pressure Injection System		PM-4	PM-8
Order #	**Product**	**Qty.**	**Qty.**
W4 69-0154	IP1 Input Tubing with Connector	1	1
W4 69-0156	OP2 Output Tubing with Connector Only	6	10
W4 69-0157	FSW Foot Switch	1	1
W4 69-0164	PP-4 Pulled 4-Barrel Pipette	1	-
W4 69-0166	HOLD4 Holder for 4-Barrel Pipette	1	-
W4 69-0163	PP-7 Pulled 7-Barrel Pipette	-	1
W4 69-0167	HOLD7 Holder for 7-Barrel Pipette	-	1
-	Power Cord	1	1
-	User's Manual	1	1

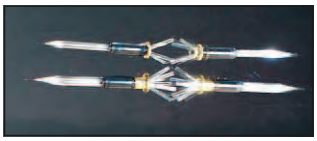
Specifications

Output Channels	Four (PM-4) or eight (PM-8) injection / perfusion outputs, one synchronized drain out and one cell hold channel
Input Gas Pressure	30 to 100 p.s.i.
Clearing Pressure	Same as input pressure
Clear Hold Pressure	0 to 3 p.s.i. (regulated)
Injection Pressure	0.05 to 60 p.s.i. (regulated)
Balance Pressure	0.05 to 10 p.s.i. (regulated)
Fill Vacuum	0 to 24 in Hg (regulated)
Hold Vacuum	0 to 30 in of water (regulated)
Drain Vacuum	0 to 30 in of water (regulated)
Repeatability	±0.02 p.s.i.
Display Accuracy	±0.05 p.s.i. for pressure, ±0.2 in for vacuum (< 2 in H_2O)
Timer Setting Range	10 msec to 327.67 sec (10 msec resolution for whole range)
Counter Setting Range	1 to 255
Savable Sequences	16 sequences
Programmable Steps	32 steps for each sequence
Remote Control Ports	DB9 connector for remote key pad, foot switch jack and BNC for negative TTL trigger, jack connector for injection foot switch
Signal Output Ports	Eight BNCs for injection signal on output port 1 to 4
Power Consumption	100, 120 or 220 VAC, 35 W

Order #	Model	Product
W4 69-0152	PM-4	4-Channel Pressure Injection System
W4 69-0153	PM-8	8-Channel Pressure Injection System
Options and Accessories		
W4 69-0154	IP-1	Input Tubing with Connector
W4 69-0155	OP-1	Output Tubing with Connector and 4.5 ml Vial
W4 69-0156	OP-2	Output Tubing with Connector only
W4 69-0157	FSW	Footswitch
W4 69-0158	PM-KP	Remote Key Pad
W4 69-0160	RK-2	Rack Mounting Kit with Handles for PM 4/8
W4 69-0163	PP-7	Pulled Seven Barrel Pipette (each)
W4 69-0164	PP-4	Pulled Four Barrel Pipette (each)
W4 69-0165	HOLD-1	Holder for Single-Barrel Pipette
W4 69-0166	HOLD-4	Holder for Four-Barrel Pipette
W4 69-0167	HOLD-7	Holder for Seven-Barrel Pipette

W4 69-0156 Output Tubing with Connector for use with:
W4 69-0152, see above
W4 69-0153, see above
W4 69-0150, see pages 332-333
W4 69-0151, see pages 332-333

W4 69-0154 Input Tubing with Connector for use with:
W4 69-0152, see above
W4 69-0153, see above
W4 69-0150, see pages 332-333
W4 69-0151, see pages 332-333



W4 69-0164 and **W4 69-0163** Pulled Pipettes for use with:
W4 69-0152, see above
W4 69-0153, see above

W4 69-0155 Output Tubing with Connector and 4.5 ml Vial for use with:
W4 69-0152, see above
W4 69-0153, see above
W4 69-0150, see pages 332-333
W4 69-0151, see pages 332-333

Micromanipulator Selection Guide

Manipulator Selection Guide Chart

	Ratio Adjustment	Coarse Movement Travel	Resolution	Fine Movement Travel	Resolution	Mounting	Features/ Options	Order #	Page
Mechanical Manipulators									
	–	X: 65 mm Y: 29 mm Z: 65 mm	X, Y, Z: 100 µm	Z fine: 2.2 mm	Z fine: 10 µm	Mounting Base 0.5 in Rod Clamp	Brass Construction Tiltable Arm	**W4 72-6030** **W4 72-6031** **W4 72-6032** **W4 72-6033**	296 296 296 296
	–	X: 37 mm max, Y, Z: 20 mm max	X, Y, Z: 100 µm	X: 10 mm max	X: 10 µm	10, 12 mm, 0.5 in Rod Clamp	Single Electrode	**W4 64-0056** **W4 64-0055**	295 295
	–	X: 37 mm max, Y, Z: 20 mm max	X, Y, Z: 100 µm	X: 10 mm max	X: 10 µm	10, 12 mm, 0.5 in Rod Clamp Tilting Base	Dual Tool/ Electrode Holder	**W4 60-0569** **W4 60-0570**	295 295
	1:15 to 1:150	X: 37 mm Y: 20 mm Z: 25 mm	–	Z fine: 3 mm	–	Mounting Base 0.5 in Rod Clamp	Joystick	**W4 60-0582** **W4 60-0583**	300 300
	–	–	–	X, Y, Z: 25 mm max	X, Y, Z: 5 µm	Integrated 25° Tilting Base	Large Spindle Knobs, High Mass for Stability	**W4 60-0594**	301

Micromanipulator Selection Guide

Manipulator Selection Guide Chart (continued)

	Ratio Adjustment	Coarse Movement Travel	Resolution	Fine Movement Travel	Resolution	Mounting	Features/ Options	Order #	Page
Motorized Manipulators									
	–	–	–	10 mm max	0.5 µm	7 mm Clamping Bolt Parallel to Working Axis	DC Motor-Controlled	**W4 73-0003**	303
	–	–	–	25 mm max	1 µm	12 mm Clamping Fitting, 10 mm Clamping Width	DC Motor-Controlled	**W4 73-0011**	303
	–	X: 37 mm max, Y, Z: 20 mm max	X, Y, Z: 100 µm	X, Y, Z: 100 µm	X, Y, Z: 0.5 µm	10, 12 mm, 0.5 in Rod Clamp Tilting Base	Can use either Joystick or Push-Button Controller	**W4 60-0571** **W4 60-0572** **W4 60-0574** **W4 60-0600** **W4 60-0601**	298 298 298 298 298
	–	–	–	X, Y: 25 mm max	X, Y: 1 µm*	Integrated 25° Tilting Base	Velocity of ≤36 mm/sec, 40,000 steps/µm revolution	**W4 60-0586** **W4 60-0588**	301 301
	–	–	–	X, Y, Z: 25 mm max	X, Y, Z: 1 µm*	Integrated 25° Tilting Base	Velocity of ≤36 mm/sec, 40,000 steps/µm revolution	**W4 60-0590** **W4 60-0592**	301
	–	–	–	X, Y, Z; 25 mm max	25 nm	–	Designed for Electrophysiology Applications	**W4 64-1731** **W4 64-1732** **W4 64-1733**	297 297 297

** In conjunction with MCL Controller 0.01 µm Resolution*

Standard Manual Control

Classic design at a reasonable price

Micromanipulators *are recognized as classic pieces of research equipment. How they work is precision engineering. How they 'feel' is art. These micromanipulators have set the standard worldwide for decades. They are the most popular and widely used. Selecting the correct micromanipulator for the application is important. If you are buying one instrument for general laboratory use, then select the Ultraprecise Micromanipulator, see page 301.*

Its rigidity and scope make it ideal for any application. For repetitive work, where a number of stations may be required, the Standard Manual Control Micromanipulator with its numerous options generally meets any requirement. To hold freely mobile cells or manipulate larger cells, the Micromanipulator with Mechanical Joystick, see page 300, is flexible yet stable.

W4 60-0570 Left-Handed Standard Manual Control Micromanipulator with 1 Tool/Electrode Holder, Micropipettes not included

Standard Manual Control Micromanipulator with 2 Tool/Electrode Holders, Micropipette not included

- 20 mm of travel in lateral (Y-axis) and vertical (Z-axis) graduated in 0.1 mm increments
- 37 mm of travel in probe direction (X-axis) graduated in 0.1 mm increments plus 10 mm of travel with fine positioning in 0.01 mm increments
- All three control knobs located in a single plane for one-handed operation and close positioning of several instruments side-by-side
- For use with microscope magnifications up to 250x

These micromanipulators have three stacked, stainless steel roller bearing raceways providing movement in the X, Y and Z axes. Rack and pinion drives minimize backlash and provide fast positioning and long life. The lateral (Y-axis) and vertical (Z-axis) planes each have 20 mm of travel graduated in 0.1 mm increments. The probe direction (X-axis) has 37 mm of travel. Two adjustments are provided. The coarse adjustment is graduated in 0.1 mm increments while the fine adjustment provides 10 mm of travel with precision positioning graduated in 0.01 mm increments.

A unique and valuable feature of these standard manual control micromanipulators is that the three control knobs are located in a single plane. This positioning permits one-handed control of a single instrument, without taking the operator's eyes from the microscope. It also allows several micromanipulators to be closely positioned side-by-side with all control knobs easily accessible. They are available for both right- and left-handed use.

Tool/Electrode Holder

Each micromanipulator is supplied complete with one or two tool/electrode holders. The second holder has two fine controls that allow movement of 8 mm in both the lateral (Y) and probe (X) direction independent of the micromanipulator. Two additional fine controls allow this second tool/electrode holder to be tilted and swiveled.

Tilt Base or Clamp Mounting

Each micromanipulator is offered with a choice of either a tilt base or a clamp to mount the micromanipulator on a 13 mm (½ in) OD vertical rod. Other clamps are available as accessories. For a selection of stands with 13 mm (½ in) OD rods, see the Stronghold Clamps, Stands and Lattices on the Harvard Apparatus website: www.harvardapparatus.com. The tilt base permits the micromanipulator to be tilted 80° from the vertical. The manipulators with clamp mount are supplied with a ½ in. to 10 mm bushing which permits mounting on a magnetic base, see page 304.

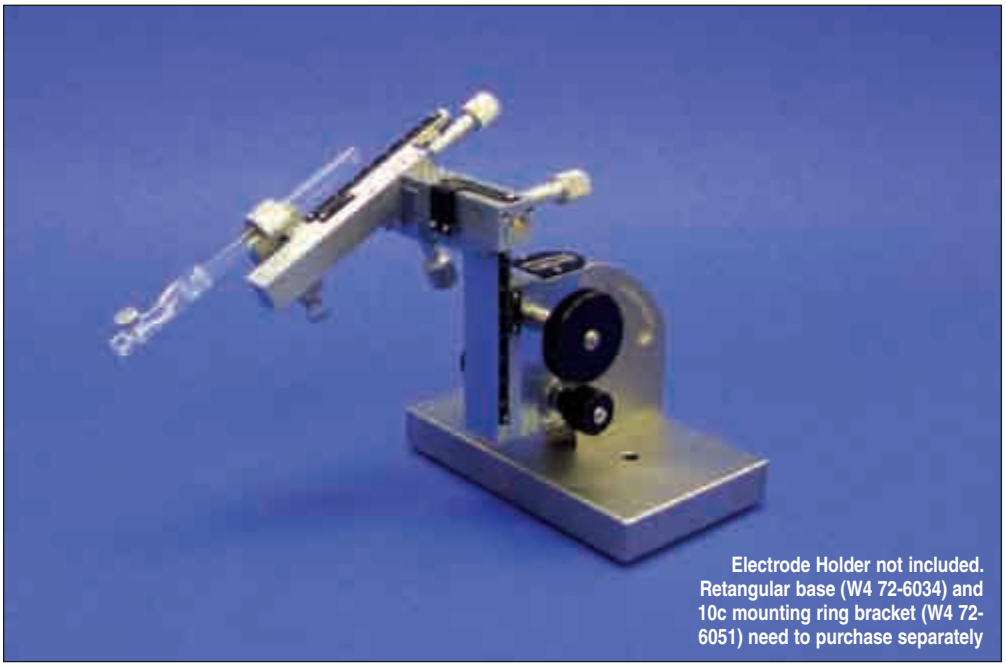
Standard Manual Control Micromanipulator

	One Holder	Two Holders
Right-Handed		
Clamp	**W4 64-0056**	**W4 60-0569**
Tilt Base	**W4 64-0058**	–
Left-Handed		
Clamp	**W4 64-0055**	**W4 60-0570**
Tilt Base	**W4 64-0057**	–

Order #	Product
W4 69-1066	10 mm Rod Clamp, for use with Magnetic Bases
W4 69-1067	12 mm Rod Clamp, for use with Magnetic Bases
W4 60-0604	Tool Holder, pkg. of 3
W4 64-1652	Rod Clamp, ½ in
W4 64-1652WB	Rod Clamp, ½ in with ½" to 10 mm bushing

Dovetail Slide Micromanipulators

For applications requiring a robust holder



Electrode Holder not included. Retangular base (W4 72-6034) and 10c mounting ring bracket (W4 72-6051) need to purchase separately

- Brass dovetail slide construction – strong and durable
- Available with fixed or tiltable X-axis arm
- Stable probe clamp allows for firm hold of 1/4 to 1/2 inch probe, rod or electrode
- Available for right- or left-handed use

Manufactured from brass, these Dovetail Slide Micromanipulators are significantly more durable, and hold greater weight without slippage or drift, than any ball bearing slide micromanipulator available. Micromanipulators are available with a fixed or a tiltable X axis arm. The fixed arm version has the X axis locked at precisely 90°. The tilt arm version can be rotated to any desired angle and securely locked.

The dovetail slides are driven by rack and pinion mechanisms for rapid positioning to a resolution of 0.1 mm on the coarse vertical (Z) and lateral (Y) drives. The probe direction (X) drive is also graduated in 0.1 mm increments, and has an anti-backlash worm drive for more precise control of movement.

The fine drive, graduated in 0.01 mm increments, is located on the base of the Z axis. This is especially useful where the specimen is in a Petri dish or microtiter tray. The probe holder allows mounting of any rod or pipette, even up to ½ inch diameter. These micromanipulators can be mounted directly on several bases via the most secure dovetail slide mount. Alternatively, a mounting ring bracket is available, which allows mounting onto any ½ inch rod.

The adjustable probe clamp allows firm hold of the widest range of probe and electrode diameters, providing absolutely steadfast grip of any probe, rod or electrode holder from ¼ to ½ inches.

Rectangular base and mounting ring bracket must be purchased separately.

Specifications

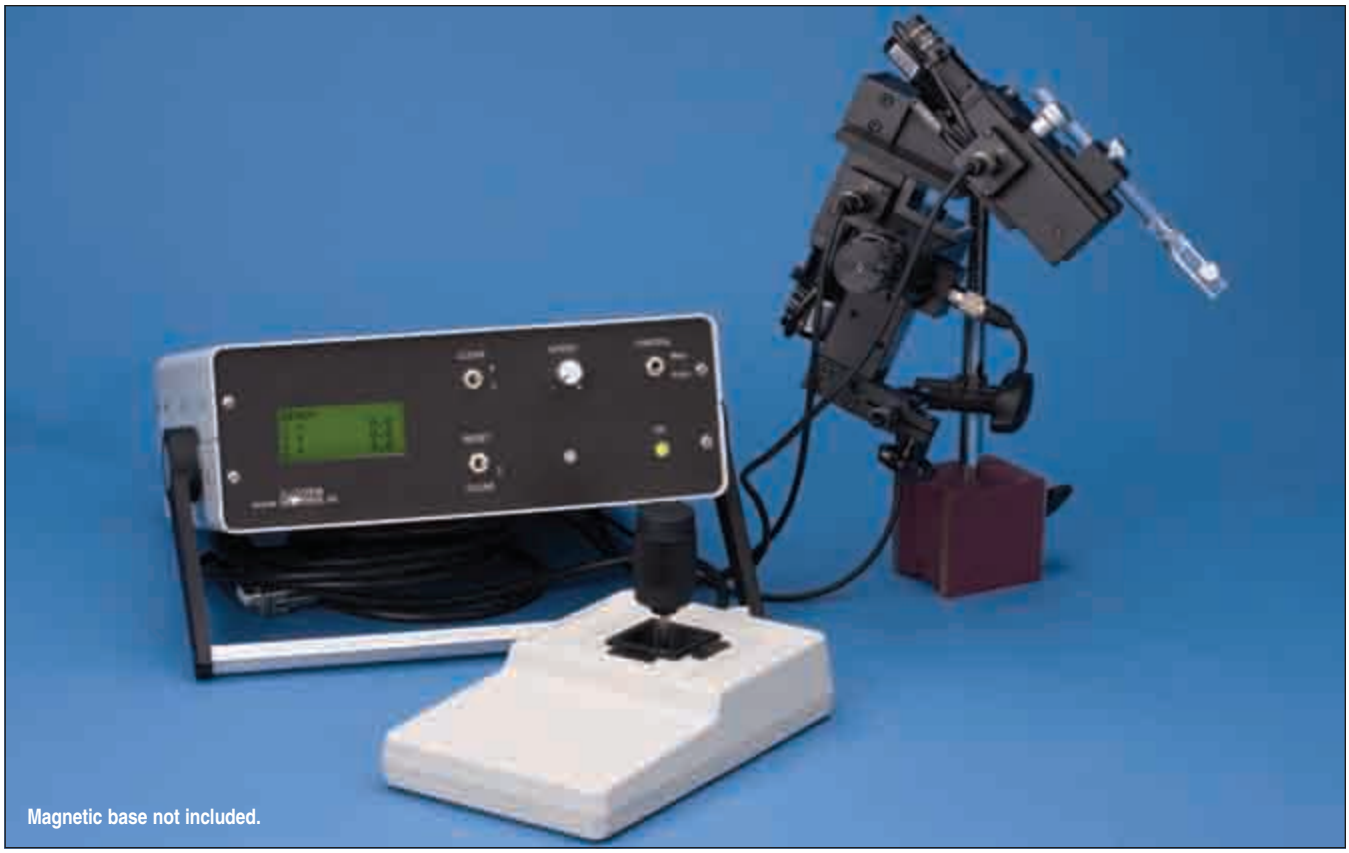
Axis	Range	Resolution
X	65 mm	0.1 mm
Y	29 mm	0.1 mm
Z	65 mm	0.1 mm
Z fine	2.2 mm	0.01 mm
Weight (without base)	1.25 kg	

Order #	Product
W4 72-6030	Right-Handed Fixed Axis
W4 72-6031	Right-Handed Tilt Arm
W4 72-6032	Left-Handed Fixed Axis
W4 72-6033	Left-Handed Tilt Arm
W4 72-6034	Rectangular Base
W4 72-6051	Mounting Bracket*

**Rectangular base not included*

NEW SM-3

High Resolution Motorized Micromanipulator



The SM-3 is a high-resolution, three axes motorized micromanipulator featuring a compact design, 25 nm resolution, and a low noise controller. Linear amplifiers, used to drive the stepper motors, eliminate stray electromagnetic radiation, a key feature for patch clamp and noise sensitive electrophysiology applications.

The mechanical design of the SM-3 manipulator is compact and is optimized for direct attachment to a microscope stage. The x-slide may be tilted by 90 degrees making precise positioning of the tool assembly simple and direct. Additionally, an integral swivel device allows the tool holder to tilt to one side permitting rapid exchange and easy cleaning of micro tools.

Stepper motors with 40,000 steps per revolution, and single steps of 25 nm, enable vibration-free operation with no backlash. Full travel range is 25 mm in all three axes, eliminating the need for a course manual adjustment.

The included controller features a 4 line display, and includes a front panel switch enabling stand-alone operation via joystick. The controller comes complete with user-friendly WinCommander software, a joystick, an RS-232 interface cable, and motor cables. The software can store up to 999 position coordinates for automated operation. For users wishing to write their own software, a complete set of function commands and a DLL library are included.

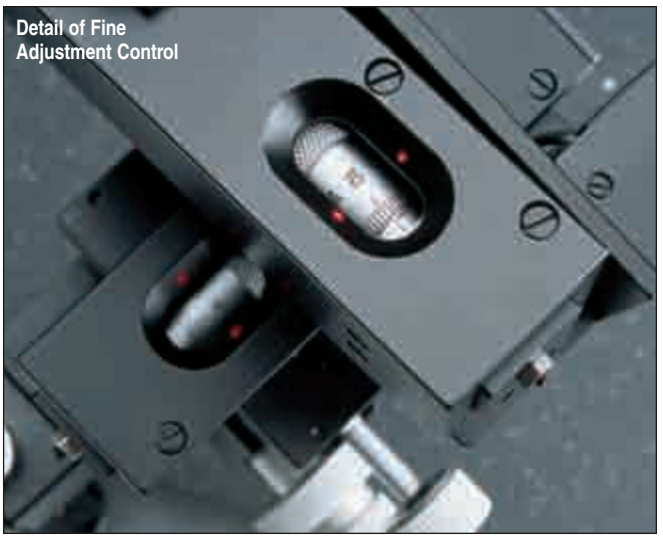
Specifications

Resolution	25 nm/step 40,000 steps/revolution
Travel range	25 mm each axis
Control method	Joystick, RS-232/software
Maximum speed	4 mm/sec
Power Input	120 to 260 VAC switch selectable
Weight Micromanipulator	1.400 Kg
Controller	3.1Kg
Dimensions Micromanipulator (H x W x D)	106 x 135 x 135 mm (4.1 x 5.3 x 5.3 in)
Controller (H x W x D)	89.9 x 25.4 x 228.5 mm (3.5 x 1 x 9 in)

Order #	Model	Description
W4 64-1731	SM-3	Compact high resolution three axis motorized micromanipulator with MCL3 controller
W4 64-1732	MCL3	Controller for SM-3 micromanipulator Includes RS-232 interface, cables, software, and joystick
W4 64-1733	SM-3MO	Compact high resolution three axis motorized micromanipulator without controller

Standard Motorized Control Micromanipulators

Hands-off control for fine positioning



- Requires one of two control units offered on the facing page.
- Available with choice of:
  - 1- or 2-tool/electrode holders
  - Tilt base or clamp mounting
  - Right- or left-handed use
- 20 mm of travel in lateral (Y-axis) and vertical (Z-axis) graduated in 0.1 mm increments
- 37 mm of travel in probe direction (x-axis) graduated in 0.1 mm increments
- All three control knobs located in single plane for ease of operation and close positioning of several instruments side-by-side
- For use with microscope magnifications up to 250x
- Positioning in sub-micron range is possible
- Smallest step size is 0.5 µm
- Micromanipulator does not have to be touched for fine adjustment
- Flexible motor coupling ensures zero vibration of probe during movement

This Standard Motorized Micromanipulator has the same manual coarse adjustment for each of the three axes graduated in 0.1 mm increments: X-axis 37 mm of travel; Y- and Z-axes 20 mm of travel each. On each of the three axes there is installed an additional fine adjustment slide with built-in miniature DC-motors rotating micrometer spindles. This motorized fine adjustment has 10 mm (2-1/2 in) of travel on each axis and the scales read to 0.01 mm. (Note: For operation, these motorized micromanipulators require one of the control units listed on the facing page.)

These micromanipulators provide 'hands off' control for fine adjustments. Each axis has a controller motor with a flexible coupling to the micrometer spindle which ensures that the probe can be moved with zero vibration.

They are available with one or two tool/electrode holders. The micromanipulator with two tool/electrode holders has a swing-in/swing-out platform. This feature permits the entire x-axis platform with tool holder to be swung out to the side for rapid and easy exchange and cleaning of tools, capillaries, electrodes, etc. After exchange/cleaning of tools, the platform swings back to the prior working position without losing time for readjustment. The micromanipulators with this X-axis tilt should always be mounted in the vertical position to make best use of the tilting fine control.

Standard Motorized Control Micromanipulator

	One Electrode Holder	*Two with X-Axis Platform Swing-Out
Right-Handed		
Clamp Base	**W4 60-0571**	**W4 60-0600**
Left-Handed		
Clamp Base (20 x 12 x 11 cm)	**W4 60-0572**	**W4 60-0601**
Tilt Base	**W4 60-0574**	–

Note: These Standard Motorized Control Micromanipulators require one of the control units described on page 299.

Control Units for Motorized Manipulators

Hands-off control for fine positioning

Choice of two control units with increasing complexity

- Push button control unit
- 3-direction joystick control unit

Push Button Control Unit

- For either 'step' or continuous motion
- Simple push button control

Movement, forward or back, in each of three axes is controlled by six push buttons. The amount of time the button is depressed determines the type of movement that occurs. By pressing a button for less than 1 second, a 'step' movement is provided. Pressing the button for more than 1 second activates continuous movement until the button is released.

This control unit has two control knobs: one for 'step' size and one for continuous motion speed. The 'Step' size knob ranges from 0.5 to 10 microns graduated in 0.5 micron increments. The continuous motion knob provides speeds up to 0.2 mm/sec. The 'step' size and speed are equal for all three axes. Backlash on reversing directions has been essentially eliminated with this control unit. At each reversal an additional current pulse compensates almost completely for gear/spindle slack. This is particularly important in the step mode as it eliminates 'dead steps' when the motor turns but the micromanipulator does not move. For use on either 115/230 VAC, 50/60 Hz.

Order #	Product
W4 60-0577	Push Button Control Unit

3-Direction Joystick Control Unit

- Provides simultaneous movement in three axes
- Permits easy placement of probe within accuracy of 2 or 3 µm

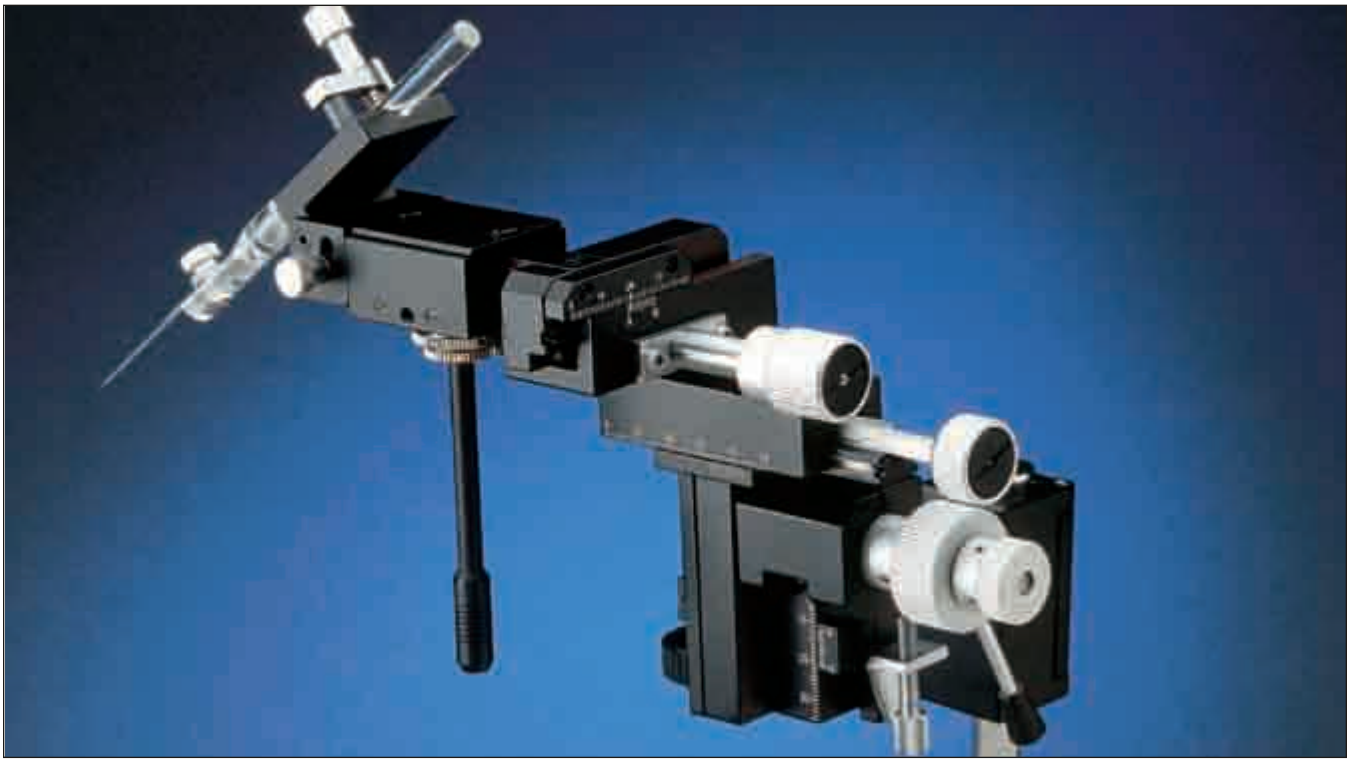
This control unit permits control of movement in three directions simultaneously. The speed and direction of forward or backward movement is regulated by the degree of displacement of the joystick from the central null position. The third axis of simultaneous movement is obtained by rotating the joystick handle. For use on either 115/230 VAC, 50/60 Hz. Supplied with a screened cable. Joystick requires W4 60-0577 for operation.

Order #	Product
W4 60-0581	3-Direction Joystick Control Unit
W4 60-0580	Replacement Screened Cable
W4 60-0604	Tool Holder, pkg. of 3
W4 69-1066	10 mm Rod Clamp, for use with Magnetic Bases
W4 69-1067	12 mm Rod Clamp, for use with Magnetic Bases

Joystick

Micromanipulator Joystick

Simple, multi-dimensional control



- Joystick reduction gear ratio from 1:15 to 1:150
- Fine positioning on Z-axis (vertical) gives 3 mm (0.12 in) of movement per revolution
- Lever tips the tool quickly for such actions as hanging a petri dish and the preset stop returns tool tip to focus plane
- Stop screw prevents damaging probe tip
- Probe holder tilts to 90°
- Available for right- or left-handed use

With this very sensitive mechanical joystick micromanipulator, motion, even in the micron range, is possible. This micromanipulator is so stable and strong that it can accommodate even piezo-steppers. Joystick micromanipulators provide movement of probes that are direct reductions of the speed and direction of the hand movement. Under the microscope, the probe appears to move directly with the hand.

Typical applications for the Joystick micromanipulator are positioning of holding pipettes, to grab and hold freely mobile cells, or the manipulation of larger cells. The joystick drives the probe in the X (probe) and Y (horizontal) directions. The reduction of the joystick travel relative to the hand may be adjusted from 1:15 to 1:150. The travel of the joystick ranges from 0.35 to 4 mm (0.014 to 0.16 in) depending on the reduction gear ratio being employed.

The Z-axis also has a fine movement with a reduction gear ratio of 1:10 relative to the coarse movement. This fine movement is operated by a further knob on the Z-axis providing 3 mm (0.12 in) of movement per revolution. The Z-axis has a lever on the coarse adjust which enables the operator to lift the tool tip quickly for such operations as changing a petri dish. A preset stop ensures that the tool tip will return to the previous focusing plane when again lowered. The stop screw prevents the probe from being inadvertently broken by being driven into the slide or dish. The stop screw also prevents downward drift of the micromanipulator so that the pipette or electrode may be left in a stable position over a long period of time. The probe holder may be tilted up to 90°.

This joystick micromanipulator is offered in right- or left-handed versions. It is also offered with a mounting clamp for a 13 mm (½ in) OD vertical rod or with a wide table clamp, when particularly stable mounting is required.

Joystick Micromanipulator Coarse Positioning

Axis	Travel
X (probe)	37 mm (1.45 in)
Y (horizontal)	20 mm (0.79 in)
Z (vertical)	25 mm (1 in)

Order #	Product
W4 60-0582	Right-Handed Joystick Micromanipulator with Mounting Clamp for 13 mm (0.5 in) Rod
W4 60-0583	Left-Handed Joystick Micromanipulator with Mounting Clamp for 13 mm (0.5 in) Rod
W4 60-0604	Tool Holder, pkg. of 3
W4 69-1066	10 mm Rod Clamp, for use with Magnetic Bases
W4 69-1067	12 mm Rod Clamp, for use with Magnetic Bases

Ultraprecise Micromanipulators

For accurate, reproducable, and precise positioning

These ultraprecise micromanipulators have the mass, 6 kg (13.2 lb), and solid workmanship to support the most precise movement with a minimum of hand-transmitted vibration, backlash or drift. The instrument can be used alone or can serve as an ideal mount for even more precise microdrives. For ultimate precision the ultraprecise micromanipulator is available with motorized control on either two or three axes for essentially vibration-free steps as small as 0.01 mm.

- Available with manual control or motorized control

Ultraprecise Motorized Control Micromanipulator

This ultraprecise motorized control micromanipulator is offered either with stepper motors on two axes or on all three axes. These motors are controlled by a precision controller that is supplied with the instrument. The same micrometers are used, as with the manual version, with a travel of 25 mm (1 in). The controller provides fast motor speed of 9 revolutions/sec which allows a maximum velocity of 36 mm/sec. Speed is infinitely variable to a slowest speed of 40,000 steps per revolution which corresponds to 0.01 µm per step. Only by these extremely small single steps can an operator be assured of essentially vibration-free movement. The controller works in a vector mode, that is, the target coordinates are approached directly in a straight line from the starting point. In all modes there are end stop switches.

The movement can be programmed on a thumb wheel switch and is started by a press button. Alternatively, advance and retraction may be controlled by manual operation of buttons. A return button causes the probe to be retracted to the zero position. The Motorized Controller is available with or without a display. The Controller with Display monitors the location of the probe on a six digit LED counter. A clear button resets the position to zero. Movement may also be made by joystick. These joystick movements are also monitored and may be both displayed on the controller and read via the RS-232 interface. The Controller may be used either alone or computer driven via the RS-232 interface. Power 115/230 VAC, 50/60 Hz.

W4 60-0594 Ultraprecise Manual Control Micromanipulator, Micropipette Not Included

Ultraprecise Motorized Control Micromanipulator

	With Stepper Motors	
Controller	**On 2 Axes**	**On 3 Axes**
With Display	**W4 60-0586**	**W4 60-0590**
Without Display	**W4 60-0588**	**W4 60-0592**

Ultraprecise Manual Control Micromanipulator

The base of the manual micromanipulator is in keeping with the mass and stability of the entire instrument. It is 14 x 14 cm (5-1/2 x 5-1/2 in), has a three point rest and is bored for four M6 bolts. The large diameter micrometer spindles on each axis have fine adjustment only with 25 mm (1 in) of travel that can be read direct to 5 µm and interpolated to a 1 µm positioning resolution.

The entire micromanipulator can be tilted forward up to 25° so that cells can be penetrated along the axis of one of the drives. The same locking screw that controls the tilt also provides coarse height adjustment. The probe holder has multiple locking swivels allowing it to be positioned at any angle relative to the X, Y or Z axes.

Order #	Product
W4 60-0594	Ultraprecise Manual Control Micromanipulator
W4 60-0604	Tool Holder, pkg. of 3
W4 69-1066	10 mm Rod Clamp, for use with Magnetic Bases
W4 69-1067	12 mm Rod Clamp, for use with Magnetic Bases

HSE-HA Microdrive Controller 864

Hands-off control for precise positioning

- Single-axis motorized micrometer drive controller
- Alternative to hydraulically-operated micro drive

The HSE-HA Microdrive Controller Type 864 is a single-axis control unit with microprocessor control for operating motorized micrometer drives (vernier controls) with DC motor. It has been specially developed to meet the requirements in physiological and pharmacological research. It is ideally suitable as control unit for the remote operation and vibration-free movement of microelectrodes or capillaries, e.g. in intracellular potential recording, patch clamp experiments or stereotaxic investigations in the brain. When used with either the micrometer drive HSE-HA 864/1 or 864/2, see page 303, the Microdrive Controller thus represents a complete alternative to hydraulic micro drives which have now become very expensive. Apart from its compact size, similar to a remote control for a TV set, a special feature is the combination of continuous and stepping linear operation. In the continuous mode the micrometer drive is operated by the joystick shift in the direction IN or OUT. The drive speed is proportional to the displacement of the joystick. In the switch mode the micrometer drive is moved by the joystick either IN or Out by a preset step. The size of the step can be adjusted continuously with the STEP BS4DTH potentiometer from ~0.5 µm to approx. 0.1 mm per step. This operating mode is particularly useful when advancing glass microelectrodes into the cell membrane for intracellular potential recording. In order to reduce interference emission to a minimum, e.g. in the input circuit of a microelectrode amplifier, special attention has been paid in the design of the instrument to good electrical de-coupling and screening. The system consists of the Microdrive Controller 864, mains adapter, ground cable, foil-screened connecting cable for micrometer drive and operating instructions.

Specifications

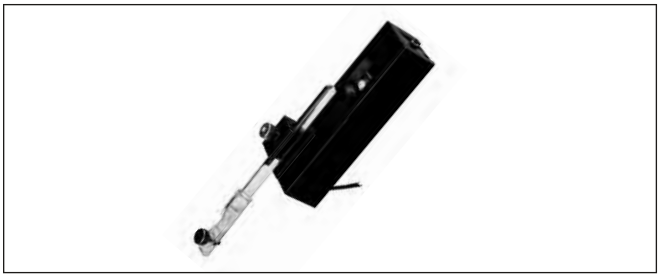
Operating Mode	Pulse width modulation under microprocessor control
Accuracy	Real information on resolution obtainable, positioning accuracy, compensation of play and min/max displacement speed cannot be provided for controller alone; these are affected largely by drive mechanics, loading, sliding and sticking friction in guides, operating position, and manufacturing tolerances
Motor Voltage	10 to 15 V DC (depending on mains supply unit used)
Motor Current	Nominally 100 mA
Overload Protection	Output current is monitored continuously to protect drive mechanics and motor; switch-off limit can be adapted by trimmer potentiometer to suit individual micrometer drive used
Continuous Operating Mode	Manual displacement proportional to movement of joystick in IN or OUT direction
Stepping Operating Mode	Step-wise displacement by amount set on STEP BS4DTH potentiometer
Fast Mode	Changes displacement speed for fast movement of micrometer drive
Backlash Compensation	Backlash in gearing is compensated by means of additional displacement pulse on change of direction; pulse length can be adjusted to individual mechanism
Monitor LEDs	Brightness-modulated indicating LED for IN and OUT directions to indicate control voltage produced
Beep	Short audible signal when triggering pulse in stepping mode or error message on over-current switch-off
Supply suit	230 V AC (115 V AC) through external mains adapter to local supply, or directly by 12-15 V DC or AC, 150 mA
Dimensions, W x H x L	45 x 130 x 70 mm (1.8 x 5.1 x 2.8 in)
Weight	250 g (8.8 oz)

Note: The motorized micrometer drive required for operation is not included with the controller and has to be ordered additionally, e.g. HSE Type 864/1 or Type 864/2.

Order #	Product
W4 73-0000	Microdrive Controller 864, 115 VAC, 60 Hz
W4 73-0001	Microdrive Controller 864, 220 VAC, 50 Hz

Microdrive 864/1 and 864/2

Hands-off control for precise positioning



HSE-HA Microdrive 864/1

• Resolution down to 2 µm

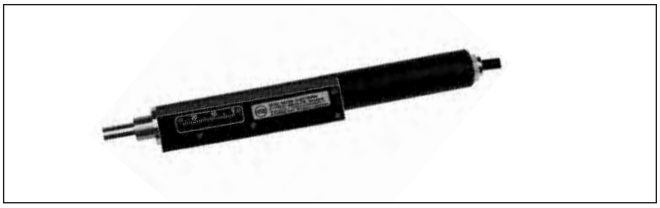
The motorized micrometer drive Type 864/1 is based on the motor X axis of the long-established micromanipulator DC-3K. Together with the HSE-HA Microdrive Controller Type 864 it permits remotely controlled displacement of microelectrodes or capillaries, e.g. in intracellular potential recording, patch clamp experiments or stereotaxic investigations in the brain. It thus represents a complete alternative to hydraulic micro drives which have now become very expensive. The mechanism is based on a conventional micrometer screw with a displacement of 10 mm. The micrometer scale is visible and permits reading to 10 µm. The drive is powered by a flange-mounted DC motor with gearbox. The micrometer drive slider moves on a precision crossed-roller guide.

The excellent rolling properties of the guide ensure absence of sticking and sliding friction, and therefore no stick-slip effect, so that this design is ideally suitable for precision displacement systems. The micrometer drive is mounted at its back through a 7 mm dia. mounting bolt parallel to the working axis. The drive can therefore be mounted e.g. on the non-remote-control micromanipulator MM-3 in place of the microelectrode holder.

Specifications

Spindle	Precision micrometer
Displacement Range	10 mm
Resolution	2 µm
Drive	DC motor (12 V, 100 mA nom. current)
Gearbox	Spur gearing; compensation of gearing backlash is through backlash correction setting of HSE Microdrive Controller Type 864
Connection Cable	Foil-screened cable with moulded Mini-DIN plug suitable for HSE Microdrive Controller Type 864 (approx. 1.60 m long)
Scale	According to displacement, 0 to 10 mm, reading accuracy 10 µm
Case	Rigid aluminium, black anodized
Mounting	On back, offset 7 mm clamping bolt parallel to working axis
Dimensions (H x W x D)	112 x 25 x 32 cm (4.4 x 1 x 1.3 in), sizes without fitted microelectrode holder and mounting bolt
Weight	320 g (11.3 oz)

Order #	Product
W4 73-0003	DC Microdrive Type 864/1



•HSE-HA Microdrive 864/2

Perfect for intracellular recording

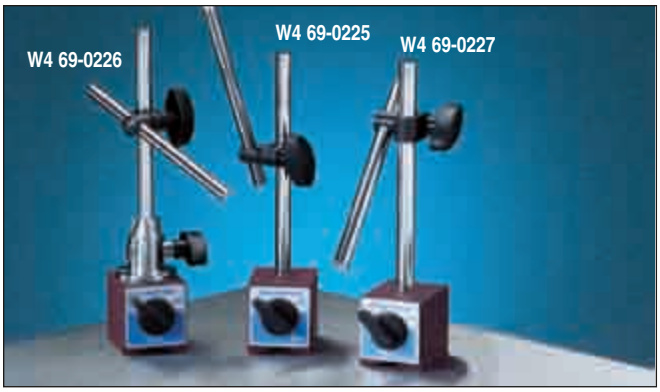
The motorized micrometer drive Type 864/2 offers excellent displacement characteristics, as required e.g. for inserting glass microelectrodes during intracellular measurement. Together with the control unit (HSE-HA Microdrive Controller Type 864) the Microdrive Type 864/2 represents a complete alternative to previous hydraulic micro controls for the remote operation and vibration-free insertion of the microelectrode into the cell membrane. In addition to the compact construction, a special feature is the backlash-free circulating-ball spindle and the limit switch built into the mechanism. The circulating-ball spindle requires no maintenance and operates virtually without friction, unlike a micrometer spindle with sliding bearing. Freedom from backlash is achieved through the use of factory-selected balls and is maintained through a very long operating life. Absence of sliding friction inside the circulating-ball spindle ensures freedom from the so-called stick-slip effect. As a result the mechanism accurately follows even the slightest displacement settings.

Specifications

Spindle Drive	Hardened and ground circulating-ball spindle, freedom from axial play through use of selected balls
Resolution	~1 µm
Maximum Loading	in both directions 50 N
Displacement Range	25 mm (50 and 75 mm options also available)
Bi-Directional Repeatability	±2 µm
Uni-Directional Repeatability	±0.1 µm
Drive	DC motor with flanged gearbox (12 V, 170 mA nom. current)
Gearbox	76:1, with backlash (optionally without backlash); backlash compensation normally through backlash correction adjustment of HSE Microdrive Controller Type 864
Connection Cable	Foil-screened cable with moulded Mini-DIN plug suitable for HSE Microdrive Controller Type 864 (approx. 1.60 m L)
Limit Switch	To protect drive unit, wired internally, with evaluation of displacement direction
Scale	To suit displacement, 0 to 25 mm
Case	Rigid aluminium, black anodized
Mounting	Clamping fitting 12 mm D and 10 mm clamping width
Dimensions	Length 196 mm, motor case D. 20 mm
Spindle Connection	M6 x 0.5 mm, 6 mm deep
Weight	360 g (12.7 oz)

Order #	Product
W4 73-0011	DC Microdrive Type 864/2

Magnetic Bases



- Holds with powerful magnetic force
- Perfect for use with micromanipulators
- Easy on-off control lever

Magnetic bases offer a convenient way to mount various tools such as micromanipulators in various positions near to your working site. The easy to use on-off control lever allows for easy placement of the magnetic base in the off position. When the control knob is moved to the on position the magnet is engaged and a powerful magnet field holds the magnetic base (and tool) securely in place.

A wide variety of models are available with varying rod sizes, mounting holes and magnetic base mounts to meet every need. When combined with our line of lightweight breadboards, see page 242, it provides a configurable platform for all of your positioning needs. Other configurations of bases are available, please call our Technical Sales Department for details.

Order #	Product
W4 69-0235	Sub Pole, 10 x 165 mm (D x L)
W4 69-0236	Sub Pole, 12 x 165 mm (D x L)
W4 69-1066	10 mm Rod Clamp
W4 69-1067	12 mm Rod Clamp

Magnetic Bases

	Base			Main Pole		1st Sub Pole		2nd Sub Pole		
Order #	**Width**	**Length**	**Height**	**Diameter**	**Length**	**Diameter**	**Length**	**Diameter**	**Length**	**Hold Force**
W4 69-0225	50 mm	58 mm	55 mm	12 mm	176 mm	10 mm	165 mm	–	–	800 N
W4 69-0226	50 mm	58 mm	55 mm	12 mm	194 mm	10 mm	165 mm	–	–	800 N
W4 69-0227	50 mm	58 mm	55 mm	14 mm	178 mm	12 mm	165 mm	–	–	800 N
W4 69-0229	50 mm	73 mm	55 mm	20 mm	178 mm	14 mm	165 mm	12 mm	130 mm	1000 N
W4 69-0230	50 mm	58 mm	55 mm	16 mm	315 mm, flex with holder for 8 mm rod					800 N

Magnetic Holders

	Holder			Tapped Hole			Mounting Screw Holes				
Order #	**Width**	**Length**	**Height**	**Diameter**	**Thread**	**Depth**	**Qty.**	**Diameter**	**Depth**	**Span**	**Hold Force**
W4 69-0231	50 mm	58 mm	55 mm	M8	1.25	7	–	–	–	–	800 N
W4 69-0232	45 mm	45 mm	20 mm	M8	1.25	6	4	M6	6	25	65 N
W4 69-0233	65 mm	65 mm	20 mm	M8	1.25	6	8	M4	6	25	200 N
W4 69-0234	90 mm	90 mm	20 mm	M8	1.25	6	8	M4	6	25	250 N
W4 69-0237	50 mm	73 mm	55 mm	M8	1.25	7	–	–	–	–	1000 N

E Series

E-Series Electrode Holders

Microelectrode holders for every application and manufacturer

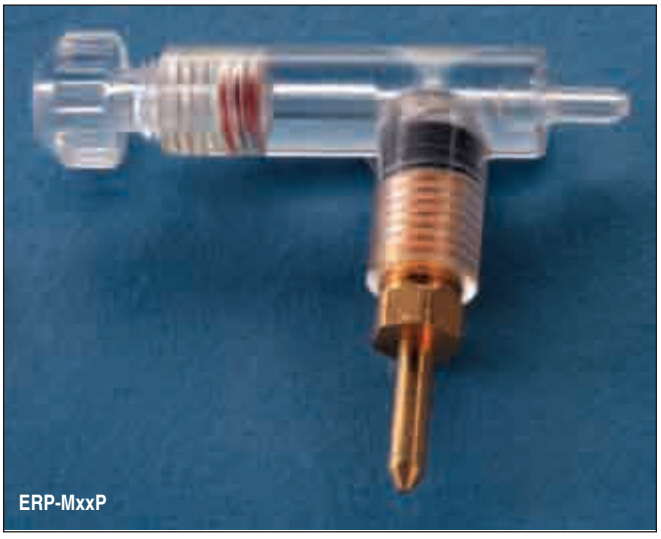

ESW-MxxP


ERW-FxxN


E45-MxxP


E45-FxxN


ESP-FxxN


ERP-MxxP

- Intracellular recording
- Extracellular recording
- Iontophoresis
- Ported or vented versions
- Compatible with MHH-25 holder

E Series

Applications include intracellular and extracellular recording, iontophoresis and ion specific measurements. They are available with choice of body style and electrical coupling and may be specified with or without a port or vent (see accompanying chart). The holders are used with microelectrode amplifiers that have either a 2 mm pin or 2 mm jack headstage connector. Amplifier headstages with the BNC connector will use a Q Series holder.

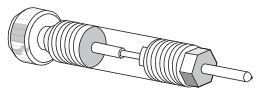
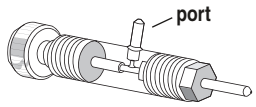
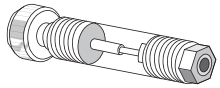
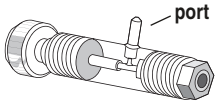
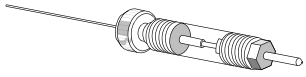
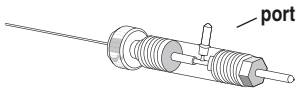
Specifications

Body Material	Acrylic, 6.3 mm diameter
Body Styles	Straight, 45°, and 90°
Connectors	2 mm Pin or 2 mm Jack
Coupling	Ag Wire or Ag-AgCl Pellet
Port	2 mm diameter Polycarbonate
Vent	0.8 mm diameter Hole
Standard Glass Sizes	1.0, 1.2, 1.5 and 2.0 mm

E Series

E Series Straight Body Holders

E-SERIES Straight Body Holders

Order #	Wire/Pellet	Connector	Port	Glass OD (mm)	Model	
W4 64-0992	Pellet	2 mm Pin	No	1.0	ESP-M10N	
W4 64-0993				1.2	ESP-M12N	
W4 64-0994				1.5	ESP-M15N	
W4 64-1260				2.0	ESP-M20N	
W4 64-0995			Yes	1.0	ESP-M10P	
W4 64-0996				1.2	ESP-M12P	
W4 64-0997				1.5	ESP-M15P	
W4 64-0998				2.0	ESP-M20P	
W4 64-0980		2 mm Jack	No	1.0	ESP-F10N	
W4 64-0981				1.2	ESP-F12N	
W4 64-0982				1.5	ESP-F15N	
W4 64-0983				2.0	ESP-F20N	
W4 64-0984			Yes	1.0	ESP-F10P	
W4 64-0985				1.2	ESP-F12P	
W4 64-0986				1.5	ESP-F15P	
W4 64-0987				2.0	ESP-F20P	
W4 64-1011	Wire	2 mm Pin	No	1.0	ESW-M10N	
W4 64-1012				1.2	ESW-M12N	
W4 64-1013				1.5	ESW-M15N	
W4 64-1014				2.0	ESW-M20N	
W4 64-1015			Yes	1.0	ESW-M10P	
W4 64-1016				1.2	ESW-M12P	
W4 64-1017				1.5	ESW-M15P	
W4 64-1018				2.0	ESW-M20P	

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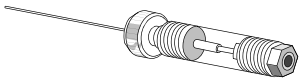
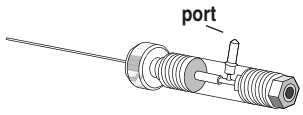
E Series

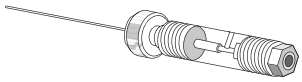
E Series Straight Body Holders (continued)

E SERIES-Straight Body Holders (continued)

Order #	Wire/Pellet	Connector	Port	Glass OD (mm)	Model
W4 64-0999	Wire	2 mm Jack	No	1.0	ESW-F10N
W4 64-1000				1.2	ESW-F12N
W4 64-1001				1.5	ESW-F15N
W4 64-1002				2.0	ESW-F20N
W4 64-1003			Yes	1.0	ESW-F10P
W4 64-1004				1.2	ESW-F12P
W4 64-1005				1.5	ESW-F15P
W4 64-1006				2.0	ESW-F20P
W4 64-1007			Vent*	1.0	ESW-F10V
W4 64-1008				1.2	ESW-F12V
W4 64-1009				1.5	ESW-F15V
W4 64-1703				1.7	ESW-F17V
W4 64-1010				2.0	ESW-F20V

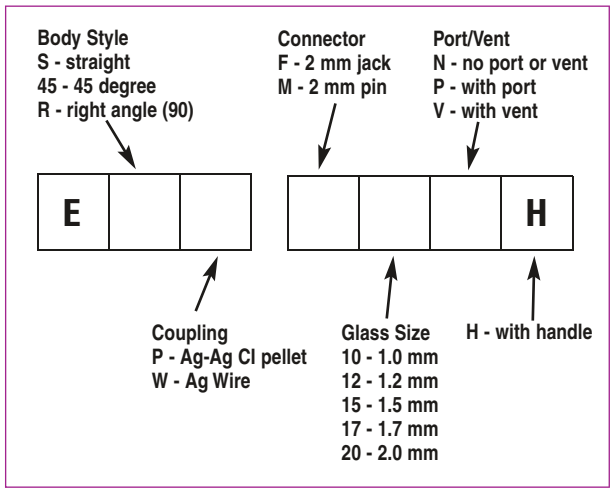






**Vented models are standard with the Warner OC-725 Oocyte Clamp.*

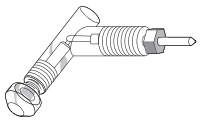
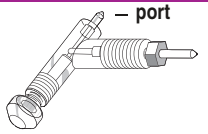
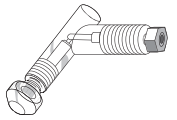
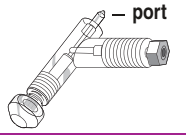
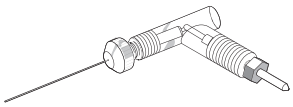
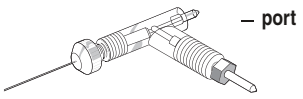
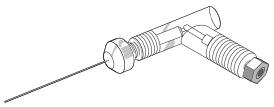
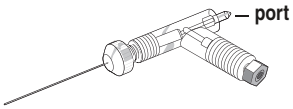
How to Decode E Series Model Numbers



E Series

E Series 45° Body Holders

E SERIES-45° Body Holders

Order #	Wire/Pellet	Connector	Port	Glass OD (mm)	Model	
W4 64-0908	Pellet	2 mm Pin	No	1.0	E45P-M10N	
W4 64-0909				1.2	E45P-M12N	
W4 64-0910				1.5	E45P-M15N	
W4 64-0911				2.0	E45P-M20N	
W4 64-0912			Yes	1.0	E45P-M10P	
W4 64-0913				1.2	E45P-M12P	
W4 64-0914				1.5	E45P-M15P	
W4 64-0915				2.0	E45P-M20P	
W4 64-0900		2 mm Jack	No	1.0	E45P-F10N	
W4 64-0901				1.2	E45P-F12N	
W4 64-0902				1.5	E45P-F15N	
W4 64-0903				2.0	E45P-F20N	
W4 64-0904			Yes	1.0	E45P-F10P	
W4 64-0905				1.2	E45P-F12P	
W4 64-0906				1.5	E45P-F15P	
W4 64-0907				2.0	E45P-F20P	
W4 64-0924	Wire	2 mm Pin	No	1.0	E45W-M10N	
W4 64-0925				1.2	E45W-M12N	
W4 64-0926				1.5	E45W-M15N	
W4 64-0927				2.0	E45W-M20N	
W4 64-0928			Yes	1.0	E45W-M10P	
W4 64-0929				1.2	E45W-M12P	
W4 64-0930				1.5	E45W-M15P	
W4 64-0931				2.0	E45W-M20P	
W4 64-0916	Wire	2 mm Jack	No	1.0	E45W-F10N	
W4 64-0917				1.2	E45W-F12N	
W4 64-0918				1.5	E45W-F15N	
W4 64-0919				2.0	E45W-F20N	
W4 64-0920			Yes	1.0	E45W-F10P	
W4 64-0921				1.2	E45W-F12P	
W4 64-0922				1.5	E45W-F15P	
W4 64-0923				2.0	E45W-F20P	

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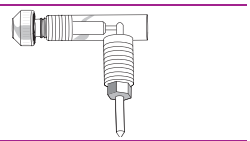
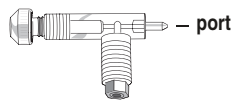
E Series

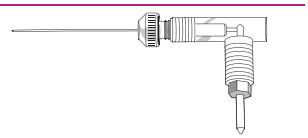
E Series 45° Body Holders

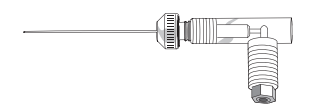
E SERIES-90° Body Holders

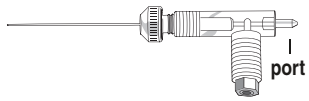
Order #	Wire/Pellet	Connector	Port	Glass OD (mm)	Model
W4 64-0940	Pellet	2 mm Pin	No	1.0	ERP-M10N
W4 64-0941				1.2	ERP-M12N
W4 64-0942				1.5	ERP-M15N
W4 64-0943				2.0	ERP-M20N
W4 64-0944			Yes	1.0	ERP-M10P
W4 64-0945				1.2	ERP-M12P
W4 64-0946				1.5	ERP-M15P
W4 64-0947				2.0	ERP-M20P
W4 64-0932		2 mm Jack	No	1.0	ERP-F10N
W4 64-0933				1.2	ERP-F12N
W4 64-0934				1.5	ERP-F15N
W4 64-0935				2.0	ERP-F20N
W4 64-0936			Yes	1.0	ERP-F10P
W4 64-0937				1.2	ERP-F12P
W4 64-0938				1.5	ERP-F15P
W4 64-0939				2.0	ERP-F20P
W4 64-0956	Wire	2 mm Pin	No	1.0	ERW-M10N
W4 64-0957				1.2	ERW-M12N
W4 64-0958				1.5	ERW-M15N
W4 64-0959				2.0	ERW-M20N
W4 64-0960			Yes	1.0	ERW-M10P
W4 64-0961				1.2	ERW-M12P
W4 64-0962				1.5	ERW-M15P
W4 64-0963				2.0	ERW-M20P
W4 64-0948		2 mm Jack	No	1.0	ERW-F10N
W4 64-0949				1.2	ERW-F12N
W4 64-0950				1.5	ERW-F15N
W4 64-0951				2.0	ERW-F20N
W4 64-0952			Yes	1.0	ERW-F10P
W4 64-0953				1.2	ERW-F12P
W4 64-0954				1.5	ERW-F15P
W4 64-0955				2.0	ERW-F20P











**Vented models are standard with the Warner OC-725 Oocyte Clamp.*

E Series

E Series Holders with Handle

Holders include a 6.3 mm diameter 6.3 cm long handle for mounting in a micropositioner. Handles are screwed together except for vented models which are joined by a pin and jack for easy removal from the handle.

E-SERIES with Handle

Order #	Wire/Pellet	Connector	Port	Glass OD (mm)	Model	
W4 64-1023	Pellet	2 mm Jack	No	1.0	E45P-F10NH	
W4 64-1024				1.2	E45P-F12NH	
W4 64-1025				1.5	E45P-F15NH	
W4 64-1033		2 mm Pin		1.5	E45P-M15NH	
W4 64-1026				2.0	E45P-F20NH	
W4 64-1039			Yes	1.0	E45P-F10PH	port
W4 64-1040				1.2	E45P-F12PH	
W4 64-1041				1.5	E45P-F15PH	
W4 64-1042				2.0	E45P-F20PH	
W4 64-1019	Wire	2 mm Jack	No	1.0	E45W-F10NH	
W4 64-1020				1.2	E45W-F12NH	
W4 64-1021				1.5	E45W-F15NH	
W4 64-1022				2.0	E45W-F20NH	
W4 64-1035			Yes	1.0	E45W-F10PH	port
W4 64-1036				1.2	E45W-F12PH	
W4 64-1037				1.5	E45W-F15PH	
W4 64-1038				2.0	E45W-F20PH	
W4 64-1051			Vent*	1.0	E45W-F10VH	
W4 64-1052				1.2	E45W-F12VH	
W4 64-1053				1.5	E45W-F15VH	
W4 64-1372				1.7	E45W-F17VH	
W4 64-1054				2.0	E45W-F20VH	

**Vented models are standard with the Warner OC-725 Oocyte Clamp.*

Q Series

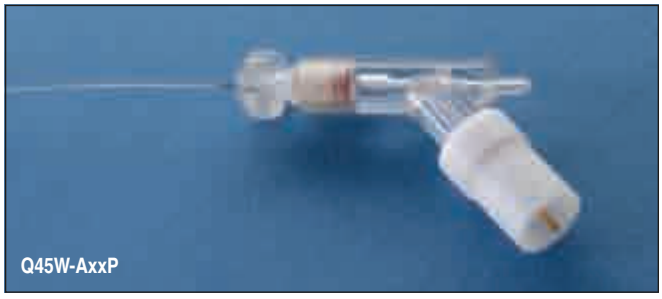
Q Series Electrode Holders

Microelectrode holders for every application and manufacturer


QSW-Bxxp


QSW-TxxP


QRW-AxxN


Q45W-AxxP

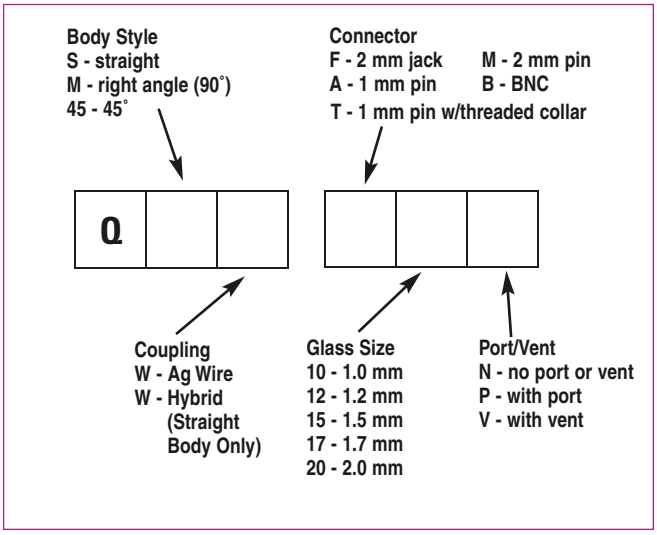

QSW-MxxP

- Patch Clamp Recording
- Intracellular Recording

Specifications

Body Material	Polycarbonate, 6.3 mm diameter
Body Styles	Straight, 45°, and 90°
Connectors	1 mm Pin, 1 mm Pin Threaded and BNC
Coupling	Ag Wire or Ag-AgCl Hybrid
Port	2 mm diameter Polycarbonate
Standard Glass Sizes	1.0, 1.2, 1.5, 1.7 and 2.0 mm

How to Decode Q Series Model Numbers



Connector and Amplifier Headstage Compatibility

Connector	Headstage
A (1 mm pin)	Warner PC-505A/B, PC-501A Axon Patch Clamps prior to 2/1/95
B (BNC)	List and Dagan
F (2 mm jack)	Warner PC-501 & Electrometers
M (2 mm pin)	Axon Axoclamp & Axoprobe prior to 2/1/95
T (1 mm pin/threaded	All Axon after 2/1/95

Q Series

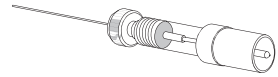
Q Series Electrode Holders with 1 mm Pin

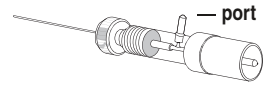
Compatible with Warner PC-501 and PC-505 Patch Clamps, and Axon Patch Clamps (prior to 2/1/95)

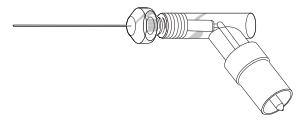
NOTE: Holders without ports are not suitable for patch clamp recording.

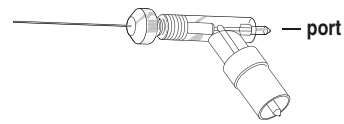
Q SERIES Holders with 1 mm Pin

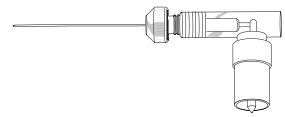
Order #	Wire/Pellet	Connector	Port	Glass OD (mm)	Model
W4 64-1105	Wire	Straight	No	1.0	QSW-A10N
W4 64-1106				1.2	QSW-A12N
W4 64-1107				1.5	QSW-A15N
W4 64-0745				1.7	QSW-A17N
W4 64-1108				2.0	QSW-A20N
W4 64-0821			Yes	1.0	QSW-A10P
W4 64-0822				1.2	QSW-A12P
W4 64-0823				1.5	QSW-A15P
W4 64-0978				1.7	QSW-A17P
W4 64-0824				2.0	QSW-A20P
W4 64-0841		45°	No	1.0	Q45W-A10N
W4 64-0842				1.2	Q45W-A12N
W4 64-0843				1.5	Q45W-A15N
W4 64-1098				1.7	Q45W-A17N
W4 64-0844				2.0	Q45W-A20N
W4 64-1055			Yes	1.0	Q45W-A10P
W4 64-1056				1.2	Q45W-A12P
W4 64-1057				1.5	Q45W-A15P
W4 64-0968				1.7	Q45W-A17P
W4 64-1058				2.0	Q45W-A20P
W4 64-0861		90°	No	1.0	QRW-A10N
W4 64-0862				1.2	QRW-A12N
W4 64-0863				1.5	QRW-A15N
W4 64-1103				1.7	QRW-A17N
W4 64-0864				2.0	QRW-A20N
W4 64-1075			Yes	1.0	QRW-A10P
W4 64-1076				1.2	QRW-A12P
W4 64-1077				1.5	QRW-A15P
W4 64-0973				1.7	QRW-A17P
W4 64-1078				2.0	QRW-A20P
W4 64-1351	Hybrid	Straight	No	1.5	QSH-A15N
W4 64-1352				1.7	QSH-A17N
W4 64-1353				2.0	QSH-A20N
W4 64-1354			Yes	1.5	QSH-A15P
W4 64-1355				1.7	QSH-A17P
W4 64-1356				2.0	QSH-A20P

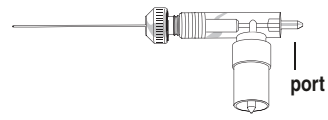


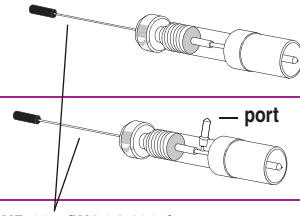












HP-205 (W4 64-1288) with Teflon™ Sleeve

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Q Series

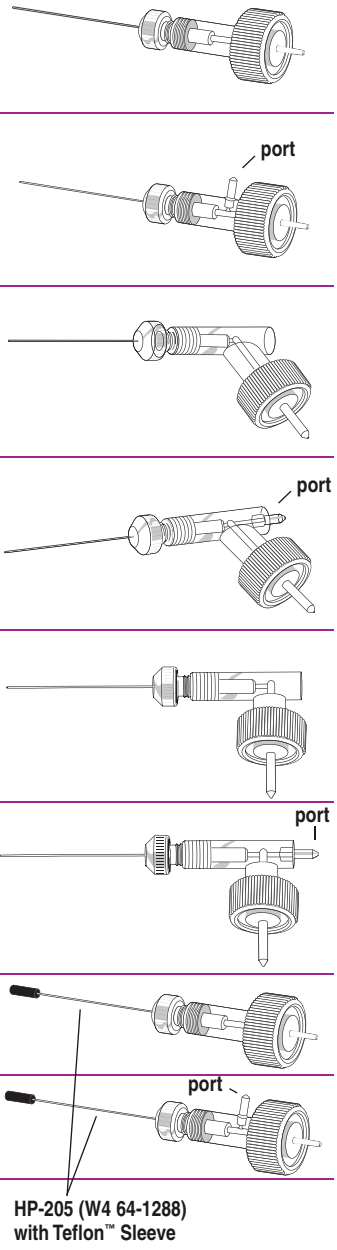
Q Series Holders with 1 mm Pin, Threaded Collar

Compatible with: Axon Patch Clamps and Microelectrode Amps post 2/1/95

NOTE: Holders without ports are not suitable for patch clamp recording.

Q SERIES Holders with 1 mm Pin, Threaded Collar

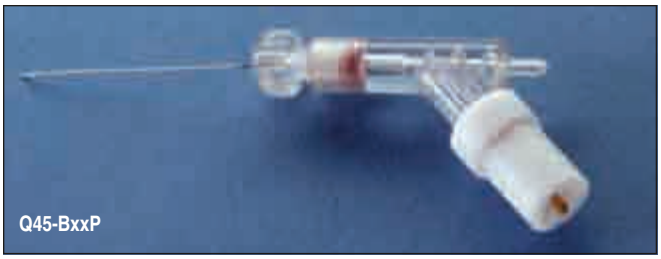
Order #	Wire/Pellet	Connector	Port	Glass OD (mm)	Model
W4 64-1121	Wire	Straight	No	1.0	QSW-T10N
W4 64-1122				1.2	QSW-T12N
W4 64-1123				1.5	QSW-T15N
W4 64-0749				1.7	QSW-T17N
W4 64-1124				2.0	QSW-T20N
W4 64-0837			Yes	1.0	QSW-T10P
W4 64-0838				1.2	QSW-T12P
W4 64-0839				1.5	QSW-T15P
W4 64-1097				1.7	QSW-T17P
W4 64-0840				2.0	QSW-T20P
W4 64-0857		45°	No	1.0	Q45W-T10N
W4 64-0858				1.2	Q45W-T12N
W4 64-0859				1.5	Q45W-T15N
W4 64-1102				1.7	Q45W-T17N
W4 64-0860				2.0	Q45W-T20N
W4 64-1071			Yes	1.0	Q45W-T10P
W4 64-1072				1.2	Q45W-T12P
W4 64-1073				1.5	Q45W-T15P
W4 64-0972				1.7	Q45W-T17P
W4 64-1074				2.0	Q45W-T20P
W4 64-0877		90°	No	1.0	QRW-T10N
W4 64-0878				1.2	QRW-T12N
W4 64-0879				1.5	QRW-T15N
W4 64-0744				1.7	QRW-T17N
W4 64-0880				2.0	QRW-T20N
W4 64-1091			Yes	1.0	QRW-T10P
W4 64-1092				1.2	QRW-T12P
W4 64-1093				1.5	QRW-T15P
W4 64-0977				1.7	QRW-T17P
W4 64-1094				2.0	QRW-T20P
W4 64-1363	Hybrid	Straight	No	1.5	QSH-T15N
W4 64-1364				1.7	QSH-T17N
W4 64-1365				2.0	QSH-T20N
W4 64-1366			Yes	1.5	QSH-T15P
W4 64-1367				1.7	QSH-T17P
W4 64-1368				2.0	QSH-T20P



HP-205 (W4 64-1288) with Teflon™ Sleeve

Q Series

Q Series Holders with BNC Connector

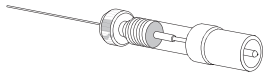


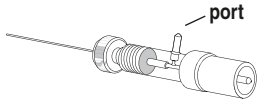
Compatible with: Heka, List and Dagan Patch Clamps

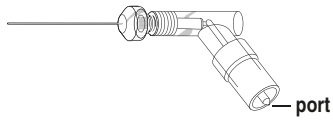
NOTE: Holders without ports are not suitable for patch clamp recording.

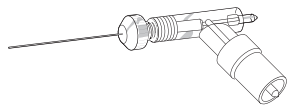
Q SERIES Holders with BNC Connector

Order #	Wire/Pellet	Connector	Port	Glass OD (mm)	Model
W4 64-1109	Wire	Straight	No	1.0	QSW-B10N
W4 64-1110				1.2	QSW-B12N
W4 64-1111				1.5	QSW-B15N
W4 64-0746				1.7	QSW-B17N
W4 64-1112				2.0	QSW-B20N
W4 64-0825			Yes	1.0	QSW-B10P
W4 64-0826				1.2	QSW-B12P
W4 64-0827				1.5	QSW-B15P
W4 64-0979				1.7	QSW-B17P
W4 64-0828				2.0	QSW-B20P
W4 64-0845		45°	No	1.0	Q45W-B10N
W4 64-0846				1.2	Q45W-B12N
W4 64-0847				1.5	Q45W-B15N
W4 64-1099				1.7	Q45W-B17N
W4 64-0848				2.0	Q45W-B20N
W4 64-1059			Yes	1.0	Q45W-B10P
W4 64-1060				1.2	Q45W-B12P
W4 64-1061				1.5	Q45W-B15P
W4 64-0969				1.7	Q45W-B17P
W4 64-1062				2.0	Q45W-B20P







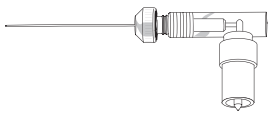


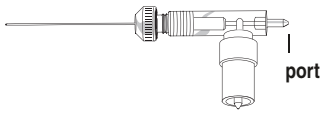
Q Series

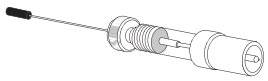
Q Series Holders with BNC Connector (continued)

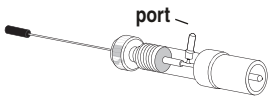
Q SERIES Holders with BNC Connector

Order #	Wire/Pellet	Connector	Port	Glass OD (mm)	Model
W4 64-0865		90°	No	1.0	QRW-B10N
W4 64-0866				1.2	QRW-B12N
W4 64-0867				1.5	QRW-B15N
W4 64-1104				1.7	QRW-B17N
W4 64-0868				2.0	QRW-B20N
W4 64-1079			Yes	1.0	QRW-B10P
W4 64-1080				1.2	QRW-B12P
W4 64-1081				1.5	QRW-B15P
W4 64-0974				1.7	QRW-B17P
W4 64-1082				2.0	QRW-B20P
W4 64-1357	Hybrid	Straight	No	1.5	QSH-B15N
W4 64-1358				1.7	QSH-B17N
W4 64-1359				2.0	QSH-B20N
W4 64-1360			Yes	1.5	QSH-B15P
W4 64-1361				1.7	QSH-B17P
W4 64-1362				2.0	QSH-B20P
W4 64-0833*		Straight	Yes	1.0	QSW-M10P
W4 64-0834*		Straight	Yes	1.2	QSW-M12P
W4 64-0835*		Straight	Yes	1.5	QSW-M15P
W4 64-0836*		Straight	Yes	2.0	QSW-M20P









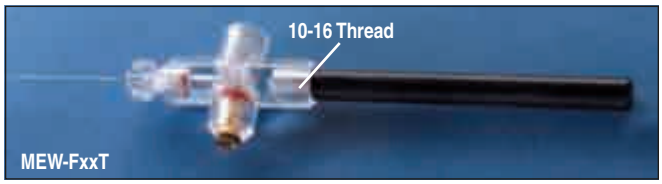
**Compatible with Axon.*

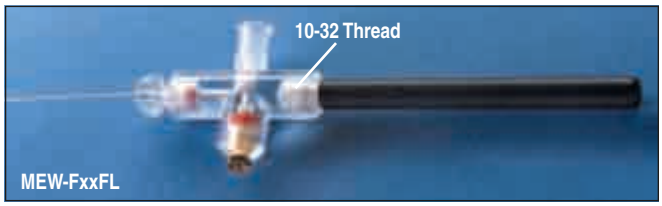
ME Series

ME Series Electrode Holders

Microelectrode holders for every application and manufacturer

- Intracellular and Extracellular Recording
- Microiontophoresis





Pressure Ports

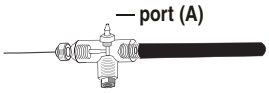
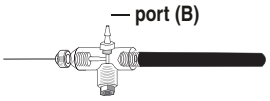
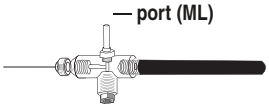
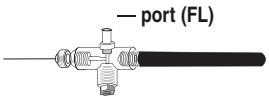
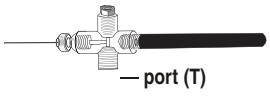
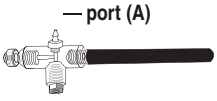
A	Accepts 1.5 mm (1/16") tubing
B	Accepts 2.4 mm (3/32") tubing
ML	Accepts female Luer fitting
FL	Accepts male Luer fitting
T*	Accepts ¼-28 male thread fitting

** Holders with the T port are compatible with the Picospritzer® system made by General Valve Corp.*

Specifications

Body Material	9.3 mm diameter acrylic
Body Style	Straight
Connector	2 mm jack
Coupling	Ag/AgCl pellet or Ag Wire
Standard Glass Sizes	1.0, 1.2, 1.5 and 2.0 mm
Handle	6.3 mm diameter x 6.3 cm long, threaded to attach to holder.

ME SERIES Holders

Order #	Wire/Pellet	Body Style	Port	Connector	Glass OD (mm)	Model	
W4 64-1220	Wire	2 mm Straight	Jack	1/16" barb	1.0	MEW-F10A	
W4 64-1221					1.2	MEW-F12A	
W4 64-1222					1.5	MEW-F15A	
W4 64-1223					2.0	MEW-F20A	
W4 64-1224				3/32" barb	1.0	MEW-F10B	
W4 64-1225					1.2	MEW-F12B	
W4 64-1226					1.5	MEW-F15B	
W4 64-1227					2.0	MEW-F20B	
W4 64-1232				male Luer	1.0	MEW-F10ML	
W4 64-1233					1.2	MEW-F12ML	
W4 64-1234					1.5	MEW-F15ML	
W4 64-1235					2.0	MEW-F20ML	
W4 64-1228				female Luer	1.0	MEW-F10FL	
W4 64-1229					1.2	MEW-F12FL	
W4 64-1230					1.5	MEW-F15FL	
W4 64-1231					2.0	MEW-F20FL	
W4 64-1236				threaded	1.0	MEW-F10T	
W4 64-1237				¼-28	1.2	MEW-F12T	
W4 64-1238					1.5	MEW-F15T	
W4 64-1239					2.0	MEW-F20T	
W4 64-1180	Pellet	2 mm Straight	Jack	1/16" barb	1.0	MEP-F10A	
W4 64-1181					1.2	MEP-F12A	
W4 64-1182					1.5	MEP-F15A	
W4 64-1183					2.0	MEP-F20A	

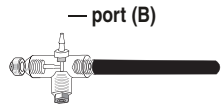
Warner Instruments • Phone (203) 776-0664 • Toll Free U.S. (800) 599-4203 • Fax (203) 776-1278 • **www.warneronline.com**

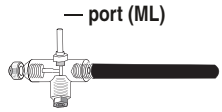
ME Series

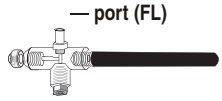
ME Series Electrode Holders (continued)

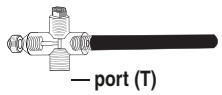
ME SERIES Holders

Order #	Wire/Pellet	Body Style	Port	Connector	Glass OD (mm)	Model
W4 64-1184				1/32" barb	1.0	MEP-F10B
W4 64-1185					1.2	MEP-F12B
W4 64-1186					1.5	MEP-F15B
W4 64-1187					2.0	MEP-F20B
W4 64-1192				male Luer	1.0	MEP-F10ML
W4 64-1193					1.2	MEP-F12ML
W4 64-1194					1.5	MEP-F15ML
W4 64-1195					2.0	MEP-F20ML
W4 64-1188				female Luer	1.0	MEP-F10FL
W4 64-1189					1.2	MEP-F12FL
W4 64-1190					1.5	MEP-F15FL
W4 64-1191					2.0	MEP-F20FL
W4 64-1196				threaded	1.0	MEP-F10T
W4 64-1197				1/4-28	1.2	MEP-F12T
W4 64-1198					1.5	MEP-F15T
W4 64-1199					2.0	MEP-F20T





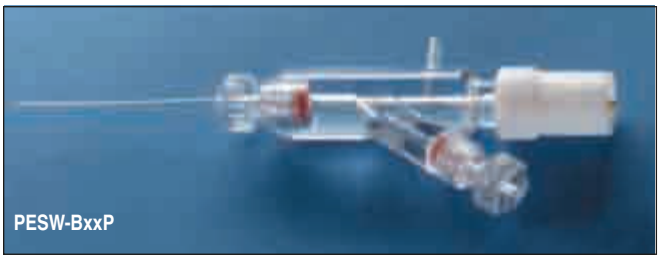


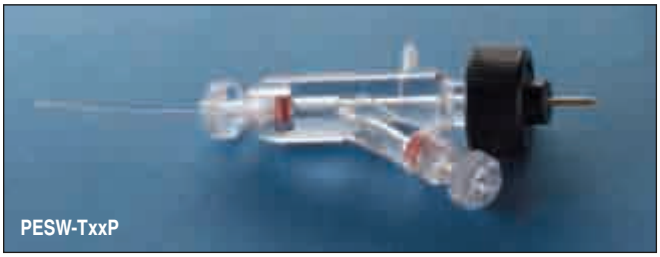


PE Series

PE Series Electrode Holders

Microelectrode holders for every application and manufacturer





- Microperfusion (perfusion at the pipette tip)*

For microperfusion inside the pipette

Perfusion at the electrode tip is possible with the **PE Series holders**. They include an additional port at 30° to the glass bore allowing for the insertion of micro-bore tubing into the pipette. This port includes a threaded cap and seal for up to 1 mm diameter tubing. See references below for information on the microperfusion technique.

Specifications

Body Material	Polycarbonate
Body Style	Straight
Connectors	1 mm Pin, 1 mm Pin Threaded and BNC
Coupling	Ag Wire
Port	2 mm diameter Polycarbonate
Perfusion Port	30° port accepts tubing up to 1 mm diameter
Standard Glass Sizes	1.0, 1.2, 1.5, 1.7 and 2.0 mm

Ø 9.5 mm, compatible with MHH-38

Patch Clamp Compatibility

Connector	For Use With
1 mm Pin	Warner Patch Clamp Models PC-501 & PC-505 Axon Patch Clamps prior to 2/1/95
BNC	List, Heka and Dagan Patch Clamps
1 mm Pin with threaded collar	Axon Patch Clamps and Microelectrode Amps prior to 2/1/95

***References:**

1) *Nehr, E. and Eckert, R.: Fast patch-pipette internal perfusion with minimum solution flow. Grinnel, A.D., Armstrong, D. and Jackson, M.B.: Calcium and Ion Channel Modulation, Plenum Press, N.Y.*

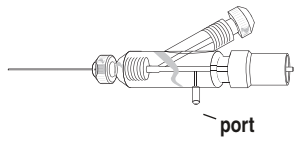
2) *Cull-Candy, S.G., Miledi, R. and Parker, I.: Single glutamate-activated channels recorded from locust muscle fibers with perfused patch clamp electrodes. J. Physiology 32-, 195-210.*

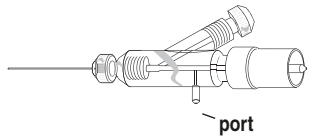
3) *Pusch, M. and Nehr, E. (1987) Kinetics of loading small cells with various compounds by use of patch pipettes. Pflugers Archives (Spring Meeting of the Physiol. Ges.).*

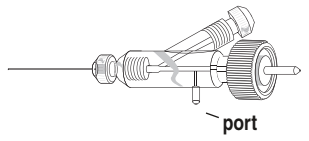
4) *Tang, J.M., Wang, J. and Eisenberg, R.S. (1992) Perfusing patch pipettes. Methods in Enzymol. 207, 176-181.*

PE SERIES Holders

Order #	Wire/Pellet	Body Style	Port	Connector	Glass OD (mm)	Model
W4 64-1144	Wire	Straight	Yes	1 mm Pin	1.0	PESW-A10P
W4 64-1145					1.2	PESW-A12P
W4 64-1146					1.5	PESW-A15P
W4 64-1371					1.7	PESW-A17P
W4 64-1147					2.0	PESW-A20P
W4 64-1148				BNC	1.0	PESW-B10P
W4 64-1149					1.2	PESW-B12P
W4 64-1150					1.5	PESW-B15P
W4 64-1369					1.7	PESW-B17P
W4 64-1151					2.0	PESW-B20P
W4 64-1160				1 mm pin	1.0	PESW-T10P
W4 64-1161				Threaded	1.2	PESW-T12P
W4 64-1162				Collar	1.5	PESW-T15P
W4 64-1373					1.7	PESW-T17P
W4 64-1163					2.0	PESW-T20P







NEW PE30W Series

PE30W Series Electrode Holders for Patch Perfusion

- Microperfusion (perfusion at the pipette tip)*

For microperfusion inside the pipette

Perfusion at the electrode tip is possible with the **PE Series holders**. They include an additional port in-line with the glass bore allowing for the insertion of microbore tubing into the pipette. This port includes a threaded cap and seal for up to 1 mm diameter tubing. See the reports referenced below for information on the microperfusion technique.

Specifications

Body Material: Polycarbonate

Body Style: 30

Connectors: 1 mm Pin, 1 mm Pin

Threaded and BNC

Coupling: Ag Wire

Port: 2 mm diameter

Polycarbonate

Perfusion Port: port accepts

tubing up to 1 mm diameter

Standard Glass Sizes: 1.0, 1.2,

1.5, 1.7 and 2.0 mm

Patch Clamp Compatibility

Connector	For use with
1 mm Pin	Warner Patch Clamp Models PC-501 & PC-505 Axon Patch Clamps prior to 2/1/95
BNC	List, Heka and Dagan Patch Clamps
1 mm Pin with threaded collar	Axon Patch Clamps and Microelectrode Amps prior to 2/1/95

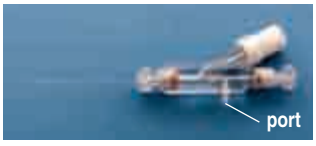
***References:**

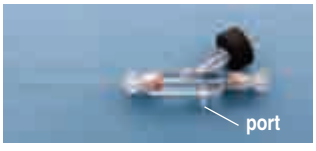
1) Nehr, E. and Eckert, R.: Fast patch-pipette internal perfusion with minimum solution flow. Grinnel, A.D., Armstrong, D. and Jackson, M.B.: Calcium and Ion Channel Modulation, Plenum Press, N.Y. Cull-Candy, S.G., Miledi, R. and Parker, I.: Single glutamate-activated channels recorded from locust muscle fibers with perfused patch clamp electrodes. J. Physiology 32-, 195-210.

2) Pusch, M. and Nehr, E. (1987) Kinetics of loading small cells with various compounds by use of patch pipettes. Pflugers Archives (Spring Meeting of the Physiol. Ges.). Tang, J.M., Wang, J. and Eisenberg, R.S. (1992) Perfusing patch pipettes. Methods in Enzymol. 207, 176-181.

PE30W SERIES Holders

Order #	Wire/Pellet	Body Style	Port	Connector	Glass OD (mm)	Model
W4 64-1761	Wire	Straight	Yes	1 mm Pin	1.0	PE30W-A10P
W4 64-1762					1.2	PE30W-A12P
W4 64-1763					1.5	PE30W-A15P
W4 64-1764					1.7	PE30W-A17P
W4 64-1765					2.0	PE30W-A20P
W4 64-1766				BNC	1.0	PE30W-B10P
W4 64-1767					1.2	PE30W-B12P
W4 64-1768					1.5	PE30W-B15P
W4 64-1769					1.7	PE30W-B17P
W4 64-1770					2.0	PE30W-B20P
W4 64-1771				1 mm pin	1.0	PE30W-T10P
W4 64-1772				Threaded	1.2	PE30W-T12P
W4 64-1773				Collar	1.5	PE30W-T15P
W4 64-1774					1.7	PE30W-T17
W4 64-1775					2.0	PE30W-T20P





MP Series

MP Series Electrode Holders

Microelectrode holders for every application and manufacturer

- Microinjection

Pressure Ports

A	Accepts 1.5 mm (1/16") tubing
B	Accepts 2.4 mm (3/32") tubing*
ML	Accepts female Luer fitting
FL	Accepts male Luer fitting
T*	Accepts 1/4-28 male thread fitting

Specifications

Body Material	Acrylic
Body Style	Straight
Port	1/16" barbed (1/16" tubing ID), 3/32" barbed (3/32" tubing ID), male Luer, female Luer and 1/4-28 female threaded
Glass Sizes	1.0, 1.2, 1.5 and 2.0 mm
Handle	6.3 mm diameter x 6.3 cm long, threaded to attach to holder.

MP SERIES Holders

Order #	Body Style	Port	Glass OD (mm)	Model	
W4 64-1261	Straight	1/16" barb	1.0	MP-S10A	
W4 64-1262			1.2	MP-S12A	
W4 64-1263			1.5	MP-S15A	
W4 64-1264			2.0	MP-S20A	
W4 64-1265		3/32" barb*	1.0	MP-S10B	
W4 64-1266			1.2	MP-S12B	
W4 64-1267			1.5	MP-S15B	
W4 64-1268			2.0	MP-S20B	
W4 64-1273		male Luer	1.0	MP-S10ML	
W4 64-1274			1.2	MP-S12ML	
W4 64-1275			1.5	MP-S15ML	
W4 64-1276			2.0	MP-S20ML	
W4 64-1269		female Luer	1.0	MP-S10FL	
W4 64-1270			1.2	MP-S12FL	
W4 64-1271			1.5	MP-S15FL	
W4 64-1272			2.0	MP-S20FL	
W4 64-1278		threaded	1.0	MP-S10T	
W4 64-1279		1/4*-28**	1.2	MP-S12T	
W4 64-1280			1.5	MP-S15T	
W4 64-1281			2.0	MP-S20T	

** Shaft Diameter*

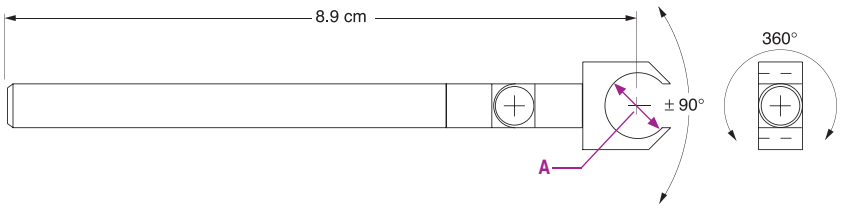
*** Threads/Inch*

MHH-25, MHH-38 and Theta Glass Holders

Microelectrode holders for every application and manufacturer

A Diameter

Model	Diameter
MHH-25	6.3 mm (¼")
MHH-38	9.5 mm (⅜")



Electrode/Manifold Holders MHH-25, MHH-38

Specifications

The MHH-25 and MHH-38 Holders permit convenient mounting of manifolds and electrode holders or other devices with 6.3 or 9.5 mm diameters. The holder head can be pivoted ±90° from the axial position and rotated 360° about the axis. Friction holds the head firmly in the set position. Holder head and coupler are made from Delrin®. The anodized aluminum handle is 6.3 mm diameter x 6.3 cm long and will fit most positioners.

Device Compatibility

Order #	Model	Description
W4 64-0218	MHH-25	E and Q Series Electrode Holders
W4 64-0219	MHH-38	PE Series and Theta Electrode Holders MP and MPP Series Manifolds

Theta Glass Holders

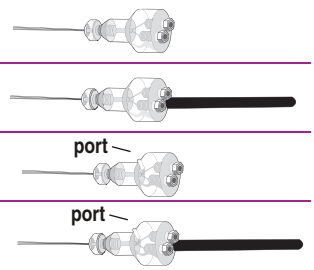
- Microinjection or microiontophoresis with theta glass

Specifications

Body Material	Acrylic
Body Style	Straight
Coupling	Ag wire (2)
Connector	2 mm jack
Port	2 mm diameter polycarbonate
Standard Glass Sizes	1.5 and 2.0 mm
Handle	6.3 mm diameter x 6.3 cm long, threaded to attach to holder.

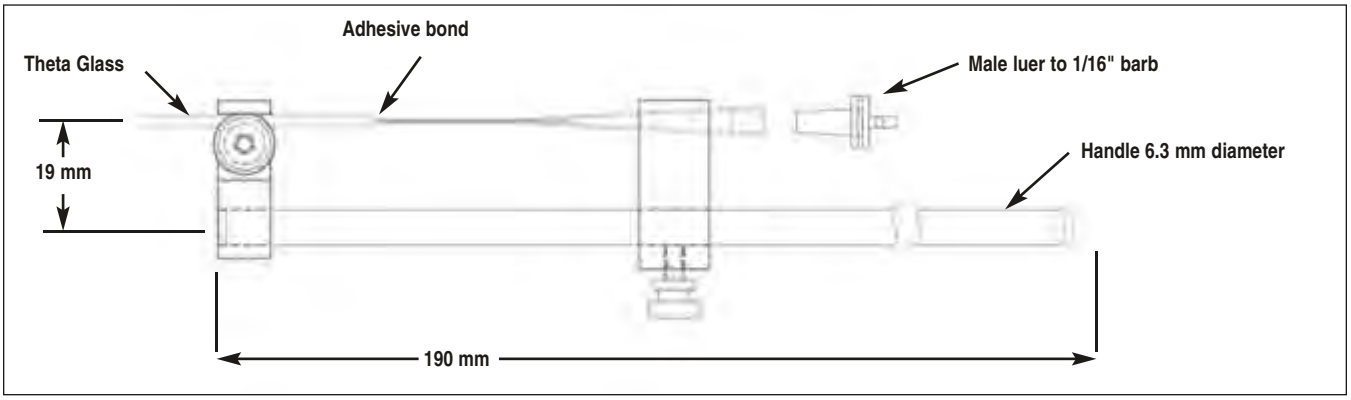
Theta Glass Electrode Holders

Order #	Port	Handle	Glass OD (mm)	Model
W4 64-1164	No	No	1.5	THS-F15
W4 64-1165			2.0	THS-F20
W4 64-1172		Yes	1.5	THS-F15H
W4 64-1173			2.0	THS-F20H
W4 64-1168	Yes	No	1.5	THS-F15P
W4 64-1169			2.0	THS-F20P
W4 64-1176		Yes	1.5	THS-F15PH
W4 64-1177			2.0	THS-F20PH



THP Pressurized Holder for Theta Glass

This holder allows quick and easy coupling of theta tubing to a pressurized source



- Allows microinjection using theta glass
- Kit includes everything needed
- Light weight acrylic electrode holder
- Easy coupling to pressure source
- Rated to 100 PSI

The new THP holder from Warner Instruments allows quick and easy coupling of theta tubing to a pressure source.

Complete kits are available for both 1.5 mm and 2.0 mm theta tubing. A drop of included hot glue adhesive bonds the theta to a flexible fill capillary tube. A barb fitting at the output permits coupling to the pressure source with 1/16" I.D. Tygon tubing. The light weight, fully adjustable holder makes assembly a breeze.

Order #	Model	Product
W4 64-1620	THP-15	Pressurized Holder Kit for 1.5 mm Theta Tubing
W4 64-1621	THP-20	Pressurized Holder Kit for 2.0 mm Theta Tubing
W4 64-1624	THP	Pressurized Holder Only
W4 64-1642	FTC-35	Flexible Fill Capillary Tubes 350 µm
W4 64-1643	FTC-45	Flexible Fill Capillary Tubes 450 µm
W4 64-0810	TG150-4	Theta Glass 1.5 mm OD
W4 64-0811	TG200-4	Theta Glass 2.0 mm OD
W4 64-1622		Barb Fittting 1/16" Male Luer (25)

Included with the THP-15:

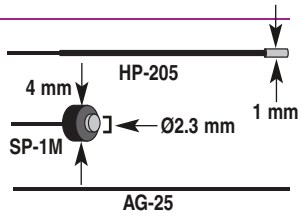
1	THP acrylic theta tubing holder with integrated handle
1	Package of 10 Flexible Fill Capillary Tubes 350µ O.D. O.D.Package of 10
50	Feet of 1/16" Tygon tubing
1	Hot Glue Gun
5	Hot Glue Sticks
1	Package of male luer to 1/16" barb fittings, (25 pcs/pkg.)
1	Package of 1.5 mm O.D. Theta glass, (100 pcs/pkg.)

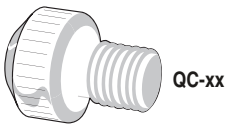
1	THP acrylic theta tubing holder with integrated handle
1	Package of 10 Flexible Fill Capillary Tubes 450µ O.D.Package of 10
50	Feet of 1/16" Tygon tubing
1	Hot Glue Gun
5	Hot Glue Sticks
1	Package of male luer to 1/16" barb fittings, (25 pcs/pkg.)
1	Package of 2.0 mm O.D. Theta glass, (100 pcs/pkg.)
1	Package of 10 Flexible Fill Capillary Tubes 350µ O.D. O.D.Package of 10

Electrode Holder Replacement Parts

Microelectrode Replacement Parts

Order #	Qty/Pkg	Model	Description
Coupling Elements			
W4 64-1297	3	SP-1M	Molded Ag-AgCl pellet assembly
W4 64-1282	10	AG25-10	Ag wire, 0.25 mm diameter x 70 mm long
W4 64-1319		AG10W	Ag wire, 0.25 mm diameter x 2 m (6'6")
W4 64-1288	1	HP-205	Hybrid Ag-AgCl pellet/Ag wire assembly with 40 mm teflon sleeve sealed at junction of pellet and silver wire
Pipette and Wire Seals			
W4 64-1289	10	PS-10	Pipette seal for 1.0 mm diameter glass
W4 64-1290	10	PS-12	Pipette seal for 1.2 mm diameter glass
W4 64-1291	10	PS-15	Pipette seal for 1.5 mm diameter glass
W4 64-1374	10	PS-17	Pipette seal for 1.7 mm diameter glass
W4 64-1292	10	PS-20	Pipette seal for 2.0 mm diameter glass
W4 64-1298	10	WS-1	Wire seal for E, ME, MP and theta holder
W4 64-1299	10	WS-2	Wire seal for Q and PE Series holders
W4 64-1300	10	WS-3	Wire seal for Q and PE Series holders with threaded "T" connector
Glass Seal Compression Caps			
W4 64-1293	2	QC-10	Compression cap for 1.0 mm glass holders
W4 64-1294	2	QC-12	Compression cap for 1.2 mm glass holders
W4 64-1295	2	QC-15	Compression cap for 1.5 mm glass holders
W4 64-1375	2	QC-17	Compression cap for 1.7 mm glass holders
W4 64-1296	2	QC-20	Compression cap for 2.0 mm glass holders
Connector Pins and Jacks			
W4 64-1283	3	HC-10M	1 mm pin for Q and PE holders with A or T connectors
W4 64-1284	3	HC-13M	1.3 mm pin for Q and PE holders with B (BNC) connector
W4 64-1285	3	HC-20M	2 mm threaded pin for E, ME and theta holders
W4 64-1286	3	HC-21F	2 mm jack assembly for all series holders
W4 64-1287	3	HC-22M	2 mm pin for Q and PE holders with M connector





Premium Capillary Glass

Warner capillary glass is known worldwide for its consistent high quality

- Ends are fire polished to prevent damage to the rubber gaskets when inserted into electrode holders
- Glass is cleaned with deionized water before being packed in dust-free containers

Warner capillary glass is known worldwide for its consistent high quality. The glass is precision drawn to insure reliability and consistency from batch to batch. The full line of glass capillaries listed here is stocked for fast shipment.

Standard Wall/Thin Wall

Tubing is available in two wall thickness, standard wall and thin wall. Additionally, a variety of diameters is offered to cover most needs of micropipette and microelectrode research.

Capillaries with Filament

A small diameter filament is fused to the glass inside diameter to facilitate rapid solution filling through capillary attraction. This is especially important for the very small diameter of sharp electrodes typically used for intracellular studies and microiontophoresis.

Premium Corning Type 7740 (Pyrex)

Corning 7740 Borosilicate is the most commonly used glass in electrode fabrication because of its mechanical strength, chemical durability, electrical resistivity, and its ability to withstand thermal stress. It is also easy to work with and suitable for a wide range of applications. Corning 7740 glass is offered in a choice of diameters, in standard or thin-walled format, and either with or without inner filament; they are additionally available in Theta style. Single barrel glass is available in 3 lengths: 75, 100 and150 mm. Theta glass is offered in 100 mm lengths only.

Specifications

Composition	81% SiO_2, 13% B_2O_3, 4% Na_2O, 2% Al_2O_3
Softening Temp.	821°C
Dielectric Constant	4.6

Premium Standard Wall Borosilicate

Order #	Model	OD mm	ID mm	Length mm	Qty/Pkg
W4 64-0765	G100-3	1.0	0.58	75	500
W4 64-0766	G100-4	1.0	0.58	100	500
W4 64-0770	G120-6	1.2	0.69	150	350
W4 64-0771	G150-3	1.5	0.86	75	225
W4 64-0772	G150-4	1.5	0.86	100	225
W4 64-0773	G150-6	1.5	0.86	150	225
W4 64-0774	G200-3	2.0	1.16	75	125

Premium Thin Wall Borosilicate

Order #	Model	OD mm	ID mm	Length mm	Qty/Pkg
W4 64-0778	G100T-4	1.0	0.78	100	500
W4 64-0780	G120T-3	1.2	0.94	75	350
W4 64-0781	G120T-4	1.2	0.94	100	350
W4 64-0783	G150T-3	1.5	1.17	75	225
W4 64-0784	G150T-4	1.5	1.17	100	225
W4 64-0785	G150T-6	1.5	1.17	150	225

Premium Standard Wall Borosilicate with Filament

Order #	Model	OD mm	ID mm	Length mm	Qty/Pkg
W4 64-0786	G100F-3	1.0	0.58	75	500
W4 64-0787	G100F-4	1.0	0.58	100	500
W4 64-0788	G100F-6	1.0	0.58	150	500
W4 64-0789	G120F-3	1.2	0.69	75	350
W4 64-0790	G120F-4	1.2	0.69	100	350
W4 64-0791	G120F-6	1.2	0.69	150	350
W4 64-0792	G150F-3	1.5	0.86	75	225
W4 64-0793	G150F-4	1.5	0.86	100	225
W4 64-0794	G150F-6	1.5	0.86	150	225
W4 64-0795	G200F-3	2.0	1.16	75	125
W4 64-0796	G200F-4	2.0	1.16	100	125

Premium Capillary Glass (continued)

Premium Thin Wall Borosilicate with Filament

Order #	Model	OD mm	ID mm	Length mm	Qty/Pkg
W4 64-0798	G100TF-3	1.0	0.78	75	500
W4 64-0799	G100TF-4	1.0	0.78	100	500
W4 64-0800	G100TF-6	1.0	0.78	150	500
W4 64-0801	G120TF-3	1.2	0.94	75	350
W4 64-0802	G120TF-4	1.2	0.94	100	350
W4 64-0804	G150TF-3	1.5	1.17	75	225
W4 64-0805	G150TF-4	1.5	1.17	100	225

Premium Theta Glass (100 pcs/pkg.)

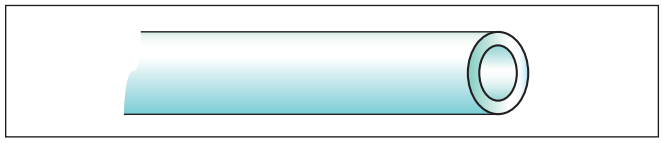
Order #	Model	OD mm	ID mm	Septum mm	Length mm
W4 64-0810	TG150-4	1.5	1.0	0.2	100
W4 64-0811	TG200-4	2.0	1.4	0.2	100

Patch Clamp Glass

Custom 8520 glass has been shown to be equal in noise performance to the discontinued Corning 7552

Choosing patch clamp glass is generally based on noise performance and the ability to form and maintain a seal. No single type of glass works best in all applications and some trial and error is usually required to find the type yielding optimum results in your experiment. Patch glass is manufactured without an inner filament. This glass is offered in both the standard and premium models. The premium glass has fire polished ends and is cleaned with deionized water before being packed in dust-free containers.

Custom 8520 Patch Glass



Now Available in Premium Line!

The custom patch glass from Clark was introduced in 1997 as a substitute for the Corning 7052 glass, a favorite amongst researchers performing patch clamping. Initial tests showed the 8520 glass to be equal to the 7052 in noise performance. More importantly, seals were formed faster and maintained for longer periods.

Specifications

Composition	>10% SiO_2, >10% B_2O_3, >1% Al_2O_3, >1% K_2O, <1% Na_2O, <1% Li_2O, <1% ZnO, <1% As_2O_3, <1% TiO_2, <1% ZrO_2
Softening Temperature	720°C
Dielectric Constant	4.6

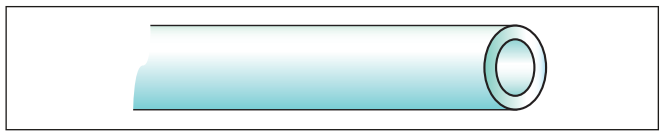
Premium Custom 8520 Patch Glass

Order #	Model	OD mm	ID mm	Length mm	Qty/Pkg
W4 64-0817	G85150T-3	1.50	1.16	75	225
W4 64-0818	G85150T-4	1.50	1.16	100	225
W4 64-0819	G85165T-3	1.65	1.28	75	190
W4 64-0820	G85165T-4	1.65	1.28	100	190

Clark Custom 8520 Patch Glass

Order #	OD mm	ID mm	Length mm	Qty.
W4 30-0091	1.2	0.93	75	350
W4 30-0089	1.2	0.93	100	350
W4 30-0090	1.2	0.93	150	350
W4 30-0094	1.5	1.16	75	225
W4 30-0092	1.5	1.16	100	225
W4 30-0093	1.5	1.16	150	225
W4 30-0097	1.65	1.28	75	190
W4 30-0095	1.65	1.28	100	190
W4 30-0096	1.65	1.28	150	190

Premium Corning 7056 (Alkali Barium Borosilicate) Patch Glass



Now Available in Premium Line!

Corning 7056 glass is now offered in place of the 7052 glass, last melted in 1992 and no longer available. The 7056 formula has also been discontinued by Corning (last melt in 1995) but stocks of this material are still available. The properties of the 7056 glass are similar to the 7052 as is its performance in patch experiments.

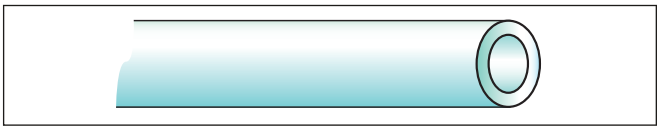
Specifications

Composition	68% SiO_2, 18% B_2O_3, 9% K_2O, 3% Al_2O_3, 1% Li_2O, 1% Na_2O
Softening Temperature	718°C
Dielectric Constant	5.7

Premium Corning 7056 Patch Glass

Order #	Model	OD mm	ID mm	Length mm	Qty.
W4 64-0813	G75150T-4	1.50	1.10	100	225
W4 64-0814	G75165T-4	1.65	1.20	100	190

Premium Corning 8161 (Potash Rubium Lead) Patch Glass



This glass pulls at a lower temperature and is easily shaped. It is recommended for low noise recordings. However, the lead content should be considered for the intended application.

Specifications

Composition	51% PbO, 39% SiO_2, 6% K_2O, 2% BaO
Softening Temperature	600°C
Dielectric Constant	8.3

Premium Corning 8161 (Potash Rubium Lead) Patch Glass

Order #	Model	OD mm	ID mm	Length mm	Qty.
W4 64-0815	G86150T-4	1.50	1.10	100	225
W4 64-0816	G86165T-4	1.65	1.20	100	190

Clark Capillary Glass

An old favorite

Borsilicate Capillaries

The properties of borosilicate glass make it the most popular material among researchers for the fabrication of electrodes and micro-pipettes. Its low softening temperature combined with its mechanical strength, chemical durability, high electrical resistivity, and its ability to withstand thermal stress, make these capillaries the most widely used in the world. Clark borosilicate capillaries are offered in a variety of diameters and wall thickness (standard or thin walled) with or without an inner filament. They are available in fused multi-barrel configurations, as well as in theta style. Single barrel glass is available in 75 mm (3 in), 100 mm (4 in) and 150 mm (6 in) lengths.

- High quality borosilicate glass
- Five outside diameters available
- Available with either thin or standard wall
- Ratio of outside to inside diameters preserved to tip
- Economical

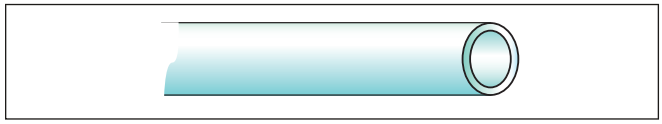
Discounts on Quantity Purchases:

Discount apply to only single part number quantities (no mixing).	
1 to 4	none
5 to 9	5%
10+	10%

Specifications

Composition	80.9% SiO_2 12.9% B_2O_3 4.4% Na_2O 1.8% Al_2O_3
Softening Temp.	815°C
Dielectric Constant	4.7

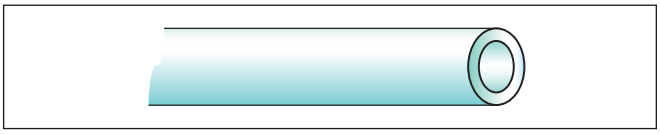
Borosilicate Thin Wall without Filament



Borosilicate Thin Wall without Filament

Order #	OD mm	ID mm	Length mm	Qty.
W4 30-0037	1.0	0.78	75	500
W4 30-0035	1.0	0.78	100	500
W4 30-0036	1.0	0.78	150	500
W4 30-0049	1.2	0.94	75	350
W4 30-0047	1.2	0.94	100	350
W4 30-0048	1.2	0.94	150	350
W4 30-0064	1.5	1.17	50	225
W4 30-0065	1.5	1.17	75	225
W4 30-0062	1.5	1.17	100	225
W4 30-0063	1.5	1.17	150	225

Borosilicate Standard Wall without Filament

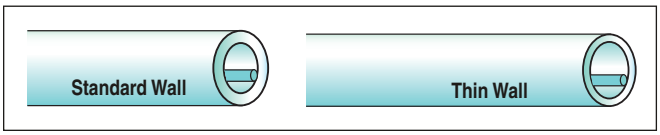


Borosilicate Standard Wall without Filament

Order #	OD mm	ID mm	Length mm	Wall	Qty.
W4 30-0018	1.0	0.58	75	0.21	500
W4 30-0016	1.0	0.58	100	0.21	500
W4 30-0017	1.0	0.58	150	0.21	500
W4 30-0043	1.2	0.69	75	0.25	350
W4 30-0042	1.2	0.69	100	0.25	350
W4 30-0041	1.2	0.69	150	0.25	350
W4 30-0056	1.5	0.86	75	0.32	225
W4 30-0054	1.5	0.86	110	0.32	225
W4 30-0053	1.5	0.86	100	0.32	225
W4 30-0055	1.5	0.86	150	0.32	225
W4 30-0073	2.0	1.16	75	0.42	125
W4 30-0070	2.0	1.16	100	0.42	125
W4 30-0071	2.0	1.16	150	0.42	125
W4 30-0127	3.0	1.62	75	0.69	55
W4 30-0080	3.0	1.62	100	0.69	55
W4 30-0081	3.0	1.62	150	0.69	55

Clark Capillary Glass (continued)

Borosilicate with Filament

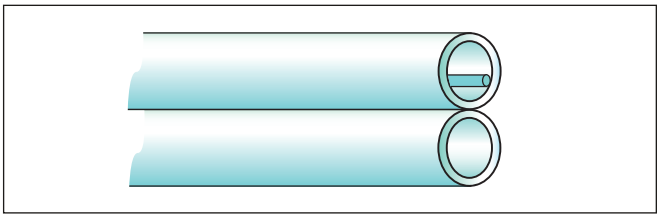


- Easy filling
- Available in standard or thin wall configurations with selection of three outside diameters
- Exceptionally low tip impedance (less than 50 MΩ)
- Good for patch clamp pipettes and microinjection needles

Borosilicate with Filament

Order #	OD mm	ID mm	Length mm	Qty.
Borosilicate Standard Wall with Filament				
W4 30-0034	1.0	0.50	75	500
W4 30-0032	1.0	0.50	100	500
W4 30-0033	1.0	0.50	150	500
W4 30-0021	1.0	0.58	75	500
W4 30-0019	1.0	0.58	100	500
W4 30-0020	1.0	0.58	150	500
W4 30-0046	1.2	0.69	75	350
W4 30-0044	1.2	0.69	100	350
W4 30-0045	1.2	0.69	150	350
W4 30-0060	1.5	0.86	75	225
W4 30-0057	1.5	0.86	100	225
W4 30-0058	1.5	0.86	150	225
W4 30-0076	2.0	1.16	75	125
W4 30-0074	2.0	1.16	100	125
W4 30-0075	2.0	1.16	150	125
W4 30-0084	3.0	1.62	75	55
W4 30-0082	3.0	1.62	100	55
W4 30-0083	3.0	1.62	150	55
Borosilicate Thin Wall with Filament				
W4 30-0040	1.0	0.78	75	500
W4 30-0038	1.0	0.78	100	500
W4 30-0039	1.0	0.78	150	500
W4 30-0052	1.2	0.94	75	350
W4 30-0050	1.2	0.94	100	350
W4 30-0051	1.2	0.94	150	350
W4 30-0068	1.5	1.17	75	225
W4 30-0066	1.5	1.17	100	225
W4 30-0067	1.5	1.17	150	225
W4 30-0128	2.0	1.56	75	125
W4 30-0077	2.0	1.56	100	125
W4 30-0078	2.0	1.56	150	125

Borosilicate Double and Triple Barrel Specials

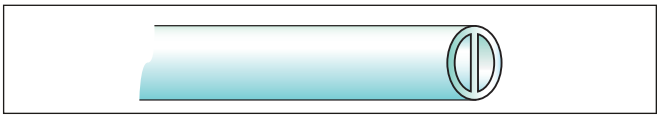


- High quality borosilicate glass
- Special two barrels - one barrel with filament, one without
- Ratio of outside to inside diameter preserved to tip during pull

Borosilicate Double and Triple Barrel Specials

Order #	OD mm	ID mm	Length mm	Qty.
Double Barrel				
W4 30-0004	1.5	0.86	75	100
W4 30-0005	1.5	0.86	100	100
W4 30-0006	1.5	0.86	150	100
Triple Barrel				
W4 30-0011	1.5	0.86	75	100
W4 30-0009	1.5	0.86	100	100
W4 30-0010	1.5	0.86	150	100

Borosilicate Theta Glass



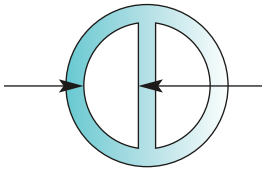
- Easy to fill
- Two channels in a single diameter

Borosilicate Theta Glass

	Order #	OD mm	ID mm	Septum mm	Length mm	Qty.
A	W4 30-0116	1.5	0.23	0.17	75	100
A	W4 30-0114	1.5	0.23	0.17	100	100
A	W4 30-0115	1.5	0.23	0.17	150	100
B	W4 30-0119	2.0	0.30	0.22	75	100
B	W4 30-0117	2.0	0.30	0.22	100	100
B	W4 30-0118	2.0	0.30	0.22	150	100

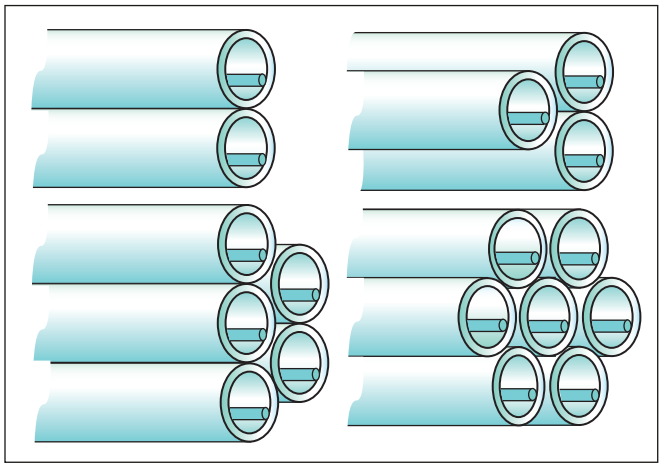
A: 0.435 mm
B: 0.59 mm

HRC = ½ (OD - 2 x Wall Sept)



Clark Capillary Glass (continued)

Borosilicate Multi-Barrel

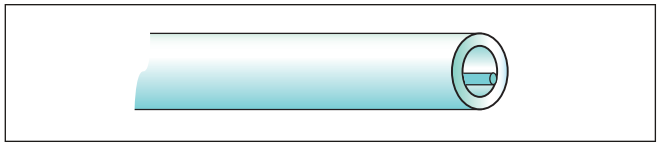


- High quality borosilicate glass
- Two, three, five and seven barrel configurations with filament
- Capillaries fused along their full length

Borosilicate Multi-Barrel

Order #	OD mm	Wall mm	# of Septum	Barrels	Qty.
W4 30-0003	1.5	0.86	75 mm	2	100
W4 30-0001	1.5	0.86	100 mm	2	100
W4 30-0002	1.5	0.86	150 mm	2	100
W4 30-0007	1.2	0.69	100 mm	3	100
W4 30-0008	1.2	0.69	150 mm	3	100
W4 30-0012	1.2	0.69	100 mm	5	65
W4 30-0013	1.2	0.69	150 mm	5	65
W4 30-0014	1.0	0.58	100 mm	7	60
W4 30-0015	1.0	0.58	150 mm	7	60

Aluminosilicate Capillaries with Filament



Aluminosilicate Capillaries with Filament

Order #	OD mm	ID mm	Length mm	Qty.
W4 30-0110	1.0	0.53	75	500
W4 30-0108	1.0	0.53	100	500
W4 30-0109	1.0	0.53	150	500

Specifications

Composition	51.9% SiO_2, 22.0% Al_2O_3, 7.8% P_2O_5, 7.7% MgO, 6.9% CaO, 2.1% B_2O_3, 1.4% BaO and 0.2% As_2O_3
Softening Temperature	950°C
Dielectric Constant	6.2

Aluminosilicate Capillaries

In recent years there has been a developing interest in fabricating micropipettes from aluminosilicate glass. Like silicon, aluminum combines with oxygen to form Tetrahedral Networks and the Al-O bonds are very strong. In comparison with borosilicate glass, **aluminosilicate** *provides increased hardness, improved chemical durability, reduced electrical conductivity and a lower coefficient of thermal expansion. Also, while the original ratio of a borosilicate capillary's inner to outer diameter will remain unchanged over its total taper length, aluminosilicate glass demonstrates a marked tendency to thin out as it is drawn to a tip. This behavior allows extremely fine tips to be formed.*

For more information, see:

1. Na/H Exchange, Vaughan-Jones, RD.; Grinstein Press, Ch.1 p.8;
2. Effects of intracellular and extracellular pH on contraction in isolated mammalian cardiac muscle, Bountra, C. & Vaughan-Jones, R.D.; Journal of Physiology Volume 418 (1989)

Borosilicate Glass Rod

- High quality borosilicate glass
- Available in two diameters

Borosilicate Glass Rod

Order #	OD mm	Length mm	Qty.
W4 30-0087	1.0	75	500
W4 30-0085	1.0	100	500
W4 30-0086	1.0	150	500

Pipette Sterilization and Micropipette

The Pipette storage container is both convenient and easy to use

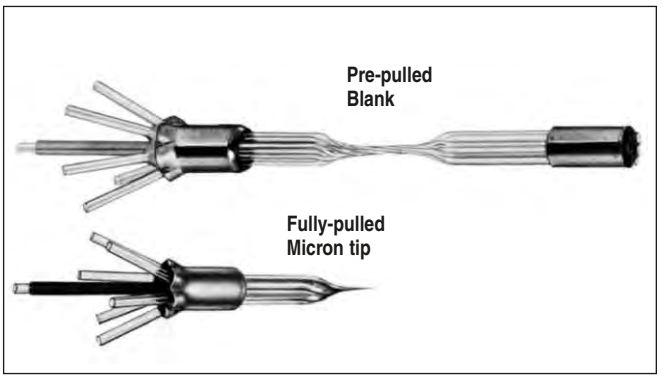
Pipette Sterilization and Storage Container

- Ideal for dry heat sterilization of pipettes
- Pyrex-type glass covers make contents easily visible
- Holds 21 pipettes
- Available for 1.0, 1.2, 1.5 and 2.0 mm diameter pipettes

This container is a convenient and easy to use pipette storage container. It is ideal for both storage and dry heat sterilization of micropipettes. In most application pipettes must be free from contamination at all times. By storing completed pipettes and partially made pipettes (between operations), the cleanliness of the micropipettes can be assured. Because the covers are made of Pyrex glass, the complete container with pipettes in-situ can be dry-heat sterilized, ensuring contamination-free pipettes. The base accepts 21 pipettes. Select from containers holding either 1.0, 1.2, 1.5 or 2.0 mm OD pipettes.

Order #	Product
W4 69-0114	Pipette Sterilization and Storage Container for 1.0 mm Pipettes
W4 69-0316	Pipette Sterilization and Storage Container for 1.2 mm Pipettes
W4 69-0317	Pipette Sterilization and Storage Container for 1.5 mm Pipettes
W4 69-0318	Pipette Sterilization and Storage Container for 2.0 mm Pipettes

Designed for iontophoretic applications and pneumatic ejection of drugs through up to seven barrels



7-Barrel Iontophoresis Micropipette

- Easy filling
- Minimal tip resistance
- Minimal leakage
- Available pre-pulled or fully-pulled

The MS-7P Micropipette has been designed for iontophoretic use as well as for pneumatic ejection of drugs. The standard blank consists of seven barrel, pyrex Omegadot tubing, 1.5 mm outer diameter and 1.2 mm inner diameter, pre-pulled to 2.0 mm formation as shown. The design of the micropipette readily lends itself to electrical connection by inserting Ag wire or to pressure tube attachment for pneumatic use. The overall length of the blank assembly is 10 centimeters. The micropipette is supplied as either pre-pulled blanks or fully-pulled to a micron tip as shown. The micron tip is not bumped and therefore can be finalized prior to use.

Features

- The orifice ratio of each barrel is 0.80 and thus is optimized for minimal tip resistance when pulled to micron size.
- Omegadot tubing permits easy filling.
- Fanned-out outer barrel assembly provides separation thus avoiding leakage due to spills and any cross-coupling between barrels.
- The 22 mm long twisted segment of the blank assembly assures singular tip formation during pulling action thus provides flexibility in a selection of a desired tip configuration.

Order #	Model	Micropipettes
W4 65-0207	MS-7PB	Micropipette 7-Barrel, 1.5 mm OD Borosilicate Glass, Pre-Pulled Blank, pkg. of 20
W4 65-0208	MS-7MT	Micropipette 7-Barrel, 1.5 mm OD Borosilicate Glass, Fully-Pulled, approx. 20 µm Tip, pkg. of 10

Pipette Pullers

A state of the art, microprocessor controlled horizontal pipette puller designed to simultaneously pull two identical, single barrel pipettes

Needle micropipette fabrication devices include instruments intended to pull, bevel, or forge various types and styles of glass micropipette needles for ICSI, IVF, transgenics, patch recording or other similar procedures involving the use of micropipettes in electrophysiological recording, microinjection, and microperfusion techniques.

The first step in the process involves the initial fabrication of the micropipette itself using either single or multibarrel capillary tubing. This tubing typically ranges in size from between 1 and 2 mm OD and is usually made from borosilicate glass although other materials such as aluminosilicate or quartz are also used in some applications. The capillary tubing is then placed in a micropipette puller where a point on the capillary tubing is brought to its softening point through the use of a heating device such as an electrical filament, laser or gas flame. Once the capillary tubing's softening point temperature is reached, a mechanical parallel pulling force is applied to each end of the capillary tube and it is 'pulled' to the desired tip diameter and profile. Depending on a number of preset variables such as capillary material type, temperature, filament type and pulling force, numerous types of tip profiles and tip diameters can be fabricated. Using this technique tip sizes as small as 0.02 µm can be achieved. Pipette pullers can range in complexity from a simplistic spring/counter weight mechanical puller to highly sophisticated programmable microprocessor controlled pullers.

To reshape the pipette or to fuse the tip into a different geometry, a microforge system is used. A microforge uses a heating element, microscope, illumination, micromanipulators and microtools to change the shape of or contact fuse other elements to the micropipette pipette by heating certain sections of the micropipette to either soften (for bending) or melting (fusing) the micropipette. Some types of microforges can also be fabricate metal and glass microtools.

Harvard Apparatus manufactures and sells a complete range of high quality equipment and supplies to fabricate micropipettes.

Pipette Pullers

Programmable Pipette Pullers

A state of the art, microprocessor controlled horizontal pipette puller for pulling single- or multi-barrel micropipettes

W4 69-0151

- Two models available:
  - Single-barrel
  - Multi-barrel
- Microprocessor controlled system performs programmable multiple step pulling sequences
- Produces micropipettes for patch clamping, intracellular electrodes, injection micropipettes, micro needles, etc.
- Consistent pulling force by utilizing pneumatic pressure instead of gravity or magnetic fields

The PMP-102 is a state of the art microprocessor controlled horizontal pipette puller that has been designed to pull two identical single barrel pipettes at the same time. The pipettes can be used as patch clamp electrodes, intracellular electrodes, injection micropipette or micro-needles.

The PMP-107 is similar to the PMP-102, but is designed to pull a single 4- or 7-barrel pipette. Under program control, the PMP-107 can automatically heat, twist and pull a multi-barrel pipette. There is no need for any manual rotation or any inconsistent timing interrupt control.

Exclusive Optical-Digital Taper Measurement

Instead of a mechanical tip length setting as on other pipette pullers, the PMP-102 and PMP-107 use an exclusive optical-digital ruler to perform precise taper length setting, real-time measuring and controlling. With this feature, a user can handle the taper pulling of pipette tips precisely and very easily. Equipped with a powerful computerized tip sensing function, the PMP-102 and PMP-107 can automatically finish the tip pulling.

Computerized Heater Control

The PMP-102 and PMP-107 use an advanced microcontroller design to perform real-time heater monitoring and pulling control. Thus, they will always provide precise heating power, despite multiple/consecutive pipette pullings or changes in thermal/electrical characteristics.

Programmable Sequences for Creation and Reproduction

There are 25 user programmable pulling sequences with 18 steps in each sequence. Users can start the pulling sequence by just pressing the Start button.

Factory Installed Preset Programs for Major Different Pipette Pulls

Every pipette puller is pre-installed with a number of different pipette pulling programs. With just a few modifications to these steps or parameters new programs can be configured.

Pneumatic Pulling Force

Both pullers use a precise controlled pneumatic pressure as the pulling force rather than gravity or magnetic fields used by other manufacturers. This technique provides more controlled, even, and consistent dragging characteristics allowing the units to pull an ideal injection tip or microelectrode tip. A precision micro-linear ball bearing rail, and advanced pneumatic components are used to provide no fault pulling movement.

Programming

A simple 4x4 keypad and full information display allows the user to easily control and read all pulling parameters. Programming functions include sequences, steps, time, timing, heater level, heater control, and tip length and actions.

These units are supplied with input tubing and connector, spare heater filament, tweezers, power cord and manual.

Pipette Pullers

Programmable Pipette Pullers (continued)

W4 69-0150

Specifications

Pulling Force	Pneumatic
Multi-Barrel Pipette	4- or 7-barrel (W4 69-0150 only)
Each Barrel Pipette	1 mm OD
Heater	Nichrome coil
Heater Control	Microcontroller
Heating	74 general heat levels (24 to 99), 54 auto heat levels (45 to 98)
Number of Sequences	25
Steps in Each Sequence	18
Taper Length Setting	0.5 to 20 mm
Pressure 1 Regulator	0.1 to 10 p.s.i.
Pressure 2 Regulator	0.1 to 60 p.s.i.
Pressure Gas Input	30 to 60 p.s.i.
Actions	Pull 1, pull 2, pull 2/cool, rotation (W4 69-0150 only), cool air, return
Display	20 x 4 LCD
Power Input	110/240 VAC
Power Consumption	Max. 150 W
Dimension, H x W x D	17.8 x 27.9 x 35.6 cm
Weight:	
W4 69-0150	6.8 kg (18 lbs)
W4 69-0151	5.9 kg (13 lbs)

Order #	Product
W4 69-0150	PMP-107 Programmable Multi-Barrel Pipette Puller
W4 69-0151	PMP-102 Programmable Single-Barrel Micropipette Puller
W4 69-0161	Unpulled 7-Barrel Pipette for W4 69-0150 Only
W4 69-0162	Unpulled 4-Barrel Pipette for W4 69-0150 Only

MF-5 and MG-5

Microforge-Grinding Center

Glass micropipette polishing, shaping, tipping. Bending, beveling, and grinding - all in one compact platform

- Glass micropipette tip polishing, shaping, tipping, bending, bevelling, and grinding all in one compact platform.
- Quick changeable platinum heater and microgrinder as center tools.
- Precise, convenient movement controls for heater/grinder, pipette locations, and optical focus.
- Universal pipette holder for one to seven barrel pipette holding and 0-180 degree bevelling.
- Up to 40x long working distance objective and 20x eyepiece optics combination, plus scale eyepiece for precision measurement.
- Adjustable precision power supply for variable grinder speed and heating level.
- Pressurized air for pipette tip clearing, expanding and cooling. Foot switch controllable.

The MFG-5 Microforge/Grinding Center is designed for precise and efficient modification of micropipette and multi-pipette tips. This unique apparatus combines a precision microforge with a full-function microgrinder in a compact platform.

The optical system of the MFG-5 is based on a high-power, horizontally mounted, binocular microscope. A precision focusing system, with a dual-axial pipette holder, can conveniently and precisely position single or multi-barrel pipettes. The pipette holder is capable of rotating through 180° to allow a multitude of beveling angles and pipette bending positions.

The MFG-5 uses high quality optical components which include 10x and 20x wide field eyepieces, and 4x, 10x/0.25, and 40x/0.6 long working distance plan achromatic objectives. The 10x wide field scale eyepiece can be used as an independent and accurate measurement tool. Two high intensity LED's provide a powerful light source.

An included foot switch, or a heat/speed adjustment dial, can be used to regulate the attached heater or grinder. In addition to the included heater/grinder foot switch, the MFG-5A has an second foot switch for the regulation of pressurized air. Air from an external source is connected to the Microforge/Grinding Center and, when the foot switch is activated, is directed to an output channel. Pressure air from this source can be used for clearing a pipette of dust after grinding, or for expanding or cooling a pipette during forging.

The MFG-5 can be purchased comprised of the microforge only, the microgrinder only, or comprised of both components. For the latter system, the microgrinder and the microforge mini-heater can be quickly and easily exchanged since both components use the same quick connector and temperature/speed control system. Finally, the MFG-5 can be combined with a PMP-102 or a PMP-107 micropipette/multipipette puller to assemble a complete micropipette production work station.

Specifications

Pipette Movement	Two-axial manipulator and coarse-fine focusing adjustment
Heater Movement	Three-dimensional adjustment
Pipette Holder	180 degree turnable for single or multipipette holding
Body	Horizontal Binocular microscope
Eyepiece	10x, 20xWF Optional 10x Scaled
Objective Lenses	4x, 10x/0.25, 40x Optional: 25x, 40x/0.6 Long Working Distance
Heater	Platinum wire
Light	Two super bright white LED's
Air In/Output	Optional air jet foot switch, in/output tubing and connector
Microgrinder	Optional changeable microgrinder One foot switch
Accessory	Extra foot switch
Power Supply	20W, 120/240VAC

Order #	Model	Product
W4 64-1610	MF-5	Microforge
W4 64-1611	MG-5	Microgrinder
W4 64-1612	MFG-5	Microforge-Grinding Center
W4 64-1613	MFG-5A	Microforge-Grinding Center w/ Air
W4 64-1614	MF-5E	Microforge 220/240VAC
W4 64-1615	MG-5E	Microgrinder 220/240VAC
W4 64-1616	MFG-5E	Microforge-Grinding Center 220/240VAC
W4 64-1617	MFG-5AE	Microforge-Grinding Center with Air 220/240VAC

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NEW Automatic Oscillating Tissue Slicer (OTS 5000)

Updates and Advantages of the OTS 5000 Series:

- Cutting window for automatic sectioning allows for faster and more reliable sectioning.
- Control pad with membrane buttons is now separated from the slicer module for improved ergonomics and protection of electronic components.
- 3-axis adjustable specimen mounting pedestal.
- Easy to release slicer head for safety and ease of specimen mounting.
- Slice thickness is now adjustable from 1-999 microns (in 1 micron increments).
- One touch "home" button to return the blade arm to a predetermined point near the specimen.
- The specimen tray is made from clear polycarbonate for improved viewing of the slice operation.
- The pivot pins which come as a standard on the pedestal as well as the vice holder allow changing of the angle of the pedestal relative to the blade. Easy sample orientation in all directions.
- The tray includes a lock-on feature for a more secure mount to the platform.
- The standard unit comes complete with our unique pivotal tissue pedestal (you can mount the specimen directly on the pedestal without the need for vices or blocks mounted in the sample tray).

Automatic Oscillating Tissue Slicer (OTS 5000)

The OTS-5000 Oscillating Tissue Slicer represents the most thoughtfully designed solution to sectioning either fixed or fresh tissue, and can prepare sections as thin as 5 microns. Embedding or freezing of the sample is not required, thus tissue preparation time is reduced dramatically. The risk of distortion and artifacts normally associated with these procedures are eliminated. The OTS-5000 meets the highest standards for precision and accuracy and it meets or exceeds the performance of units on the market costing twice as much.

The OTS 5000 now features a new innovative design of the slicer head which minimizes Z-Axis vibration. This improvement dramatically improves slice surface integrity and is especially beneficial in the use of fresh tissue where IR/DIC imaging methods are used. The unique blade holder has the ability to accept sapphire blades as well as razor blades.

To minimize the time between harvesting consecutive slices, the OTS-5000 features a user programmable travel window (cutting window). This allows the section-cutting range of the blade to be customized to the specimen sample. In conjunction with the "home button", the programmable window guarantees rapid sectioning of even the largest of specimens. As well, the OTS-5000 allows the sectioning of samples in two different modes. In the single-slice mode, the unit prepares one section at a time and the blade repositions itself and waits to perform the next slice upon triggering by the user. In the multiple-slice mode, the OTS-5000 will automatically perform multiple uniform slices.

The OTS-5000 control panel has been redesigned to allow for ambidextrous and ergonomical operation. The keypad has been sealed to avoid exposure from buffer spills. The tray is made from molded clear polycarbonate for improved viewing of the slicing operation. The tray is removable to facilitate specimen mounting and cleaning. Two white LED's are installed in the blade head, which provide constant cold-illumination of the specimen during the slicing process.

The OTS-5000 is engineered for maximum stability, allowing even the most delicate of tissue to be cut successfully every time. The knife holder allows the blade to be well-secured and the blade angle set from 10-20 degrees. The specimen mount is adjustable on the x, y, and z axis. Blade oscillation is adjustable from 50-5000 cycles/minute, the knife advance is continuously adjustable with a touch of the keypad from 0-5mm/s, and the section thickness is adjustable in 1 micron increments ranging from 1-999 microns. This precision slicer features automatic touch selection of section thickness, blade speed, advance, and a user-defined travel window so that consecutive sections may be cut easily and rapidly. Other OTS-5000 features include: Touch pad control of the blade height, slice counter / slice thickness, precise bar graph displays of blade oscillation and advance speeds.

The OTS-5000 is designed for easy operation and maintenance. The specimen collecting tray is removable and easy to clean. All controls may be set with one hand with options for multiple slicing modes.

The unit comes complete with gooseneck magnifying lens, media tray (2.5" wide) and pedestal, specimen vice holder, blocks, as well as a foot switch with 6' cable. A large tray (3.5" wide) is available as an option and comes complete with fixed stage and adjustable pedestals.

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