specialized tools for Electrophysiology & Cell Biology Research

Planar Lipid Bilayer

Perfusion/Microfluidics

Oocyte Clamps

Patch Clamps

Microinjectors

Microincubators

Micromanipulators

Ussing/Diffusion Systems

Live Cell Imaging Chambers

Temperature Control Systems

BTX® HARVARD APPARATUS Electroporation/Transfection

WARNER INSTRUMENTS
A Harvard Apparatus Company

Electro-physiology & Cell Biology Research

Call to receive other catalogs of interest

Animal, Organ & Cell Physiology

Behavioral Research

Harvard Apparatus Pumps

Electro-poration & Electrofusion

Molecular Sample Preparation

Welcome to the *NEW* Electrophysiology &

WARNER INSTRUMENTS

A Harvard Apparatus Company

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:

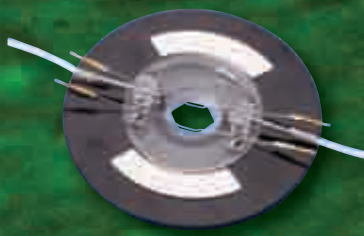
- **PLI-100A Picoliter Microinjector** - With three positive and two negative pressure capabilities, the versatile PLI-100A is capable of large injections into capillaries or small injections into mammalian nuclei.
- **BioStat Multi-channel Potentiostat** - The BioStat is a software-driven, multi-mode 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



NEW **RC-49FS Perfusion Chamber with Field Stimulation,** p. 54

NEW **PFC-1 Proflow Chamber,** p. 57

NEW **BioStat Multi-channel Potentiostat,** p. 372

NEW **Compact Motorized Micromanipulator,** p. 297

NEW **ProgRes® Microscope Cameras,** p. 344

NEW **PLI-100A Picoliter Microinjector**, p. 278

NEW **New Zoom Stereo Microscopes,** p. 338

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

Table of Contents

Table of Contents

Imaging and Recording Chambers
Chambers for live cell microscopy, Series 20, 30, 40, and 50. Culture Dish Inserts, Heated Platforms, Stage Adapters and Chamber Accessories

Chambers

Perfusion/Microfluidics
Syringe & Peristaltic Pumps, Valve Control Systems, Pressurized Perfusion, Fast-Step Perfusion Systems, Gas Controllers, Spill Detection Systems & Accessories

Perfusion/ Microfluidics

Temperature Control
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

Micro-Incubation

Electrophysiology Equipment
Patch Clamp Equipment, Bilayer Workstation, Oocyte Clamps, Amplifiers, Low Pass Filters, Neurolog™ System, Ussing/Diffusion, Stimulators

Electro-physiology

Cell Biology Tools
Microinjection, Micropositioning, Tissue Sampling, Microelectrode Holders, Capillary Glass, Pipette Pullers

Cell Biology

Microscopy
Stereo Zoom Microscopes, Microscope Cameras, Cold Light Sources, LED and Halogen, Fiber Optic Ring Lights and Light Guides, Laser Systems, Coverslips

Microscopy

Biosensing
Nitric Oxide Systems, Dissolved O2, Respirometry, Electrodes

Biosensing

Electroporation
BTX Electroporation, Electrofusion, Transfection, Transformation Solutions, Pulse Generators for In Vivo Electroporation Systems, High Throughput Electroporation, Monitoring Systems and Specialty Electrodes

Electroporation

Indexes
Warner Model Number Index
Ordering Number Index
Product Index

Indexes

Technical Support, Ordering, Payment, Delivery, Terms and Conditions

Technical Support & Domestic Orders*

Warner Instruments
1125 Dixwell Avenue
Hamden, CT 06514 USA

phone	**800.599.4203 (toll-free)** **203.776.0664**
fax	**203.776.1278**
e-mail	**support@warneronline.com**
website	**www.warneronline.com**

Domestic Orders*

Harvard Apparatus
84 October Hill Road
Holliston, MA 01746-1388 USA

phone	**800.272.2775 (toll-free)** **508.893.8999**
fax	**508.429.5732**
e-mail	**bioscience@harvardapparatus.com**
website	**www.harvardapparatus.com**

** See inside back cover for distributors outside of the United States.*

Payment Options

Purchase Order

Terms are net 30 for customers with pre-approved credit.

Credit Card

Visa, MasterCard, American Express and Discover are accepted.

Prepayment

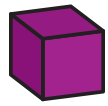
To prepay, send check or money order with your purchase order. Call Harvard Apparatus customer service in advance for exact shipping charges or include your UPS or FedEx account number. All checks should be made payable to Harvard Apparatus, in U.S. Dollars and drawn on a U.S. bank.

Delivery Options

Shipping

Shipping charges are added to your invoice. Orders ship UPS Ground service unless otherwise requested. FOB Hamden, CT 06514

Terms and Conditions



Return Policy

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**

Repairs

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:

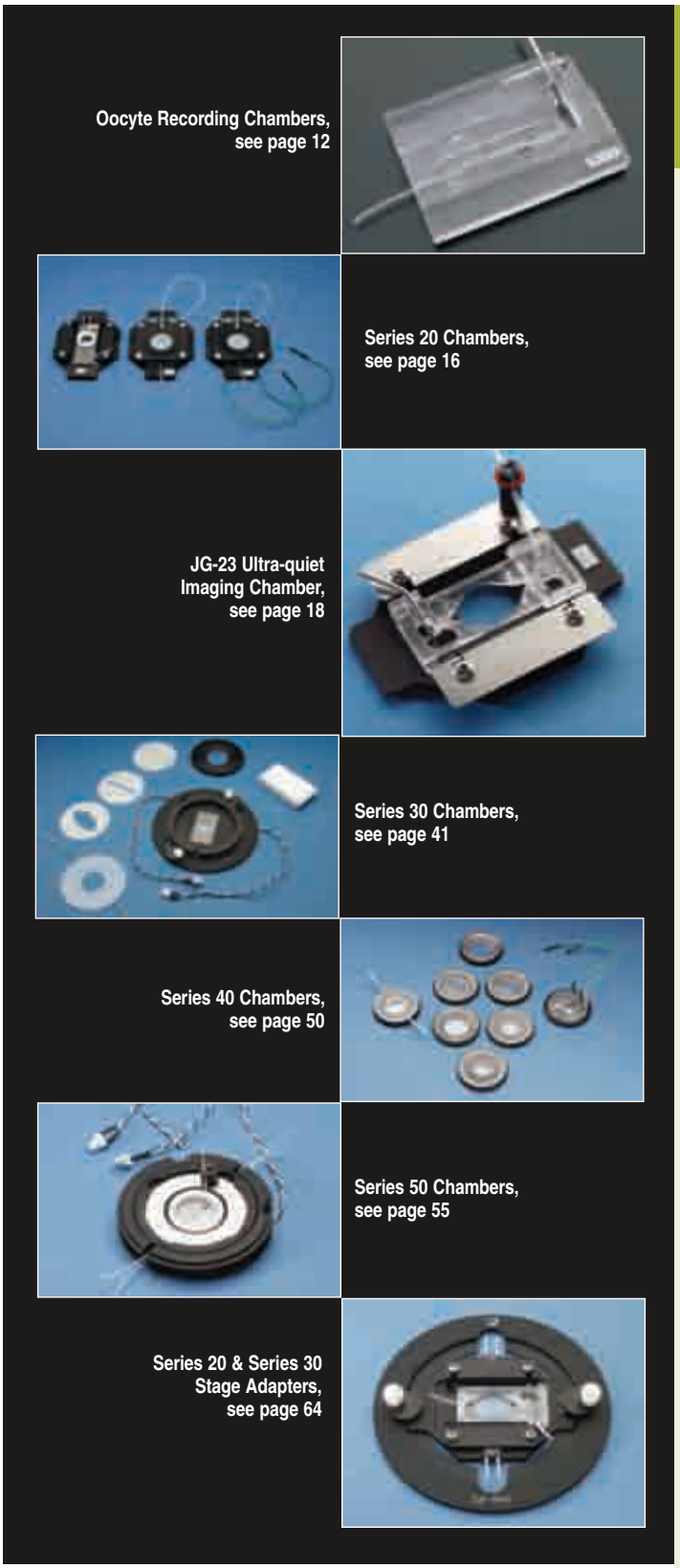
1. **Repair orders charged on a time and materials basis**
2. **$150 per hour for labor with a $150 minimum labor charge**
3. **All repairs are performed on a first in/first out basis, only after receipt of a valid purchase order**
4. **Estimates available upon request**
5. **Some older products may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

Minimum Orders

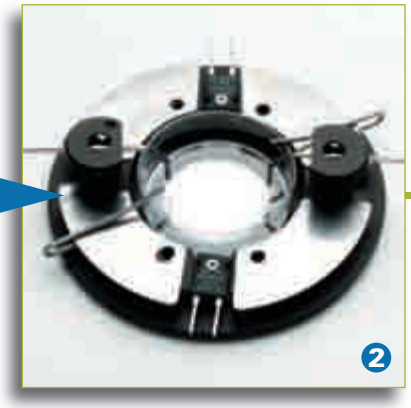
We appreciate all orders and therefore have no minimum order requirement, however, a small handling fee of $10 will be added to orders below $75.

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.



Chambers, Perfusion and Temperature Control for Live Cell Imaging



Imaging and Recording Chambers

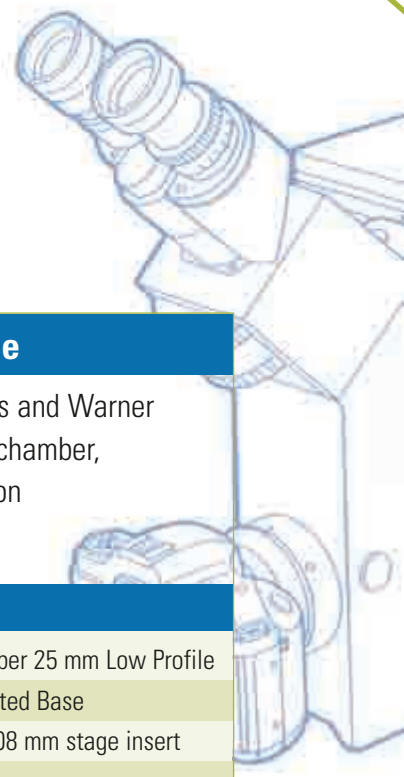
Series 40 imaging and recording chambers
page 50

Stage Adapters
page 64

Inline solution heater and coolers
page 117

Temperature Controller Cables
page 62

Temperature Controllers
page 108



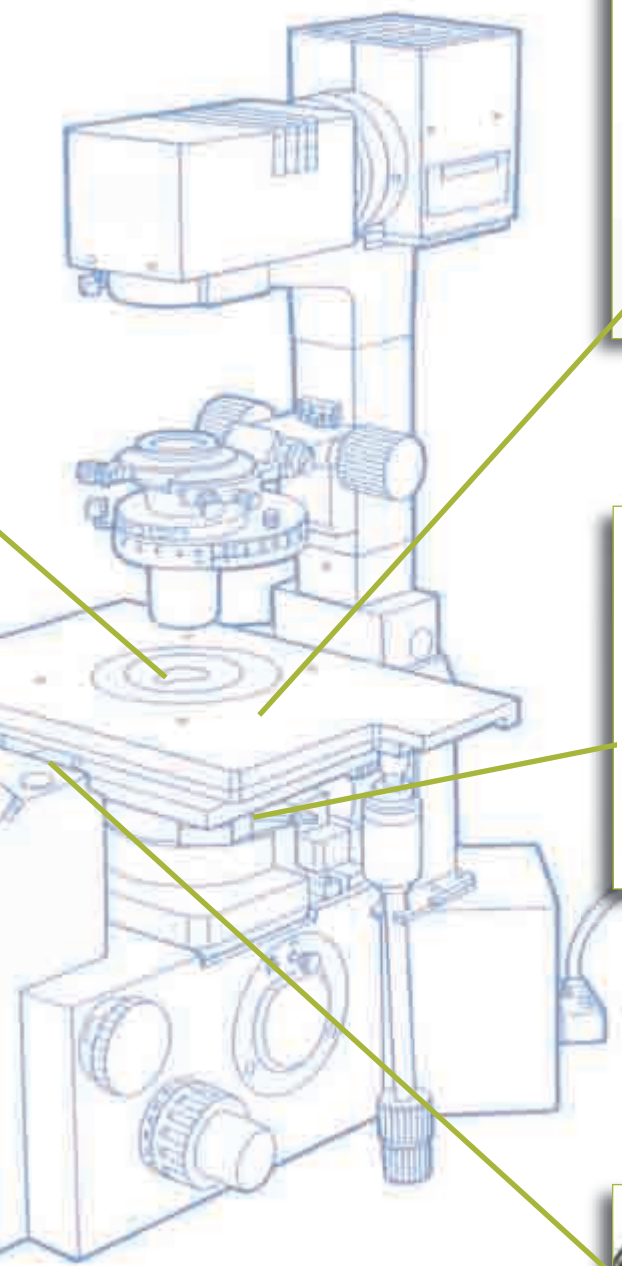
Typical, complete package

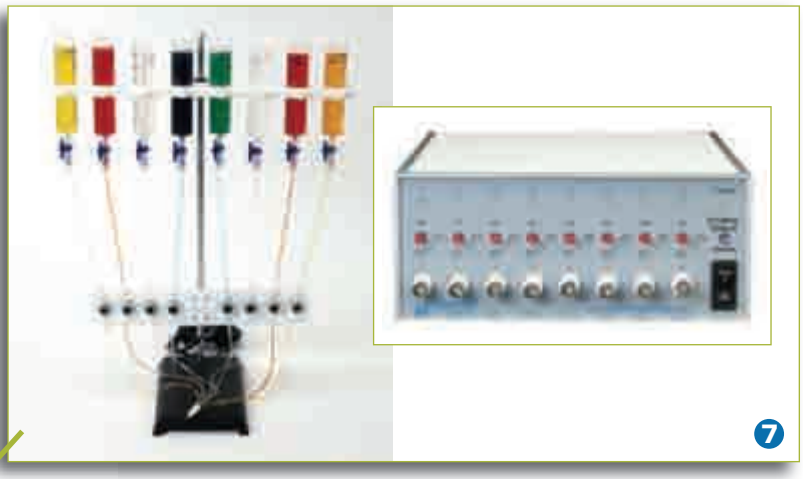
for use with 35 mm culture dishes and Warner quick change chambers includes chamber, temperature control, Inline solution heater and stage adapter

	Model	Product
1	RC-40LP	Quick Change Chamber 25 mm Low Profile
2	QE-1	Quick Exchange Heated Base
3	SA-NIK	Stage Adapter for 108 mm stage insert
4	SH-27B	Solution Heater
5	CC-28	Cable Assembly for Heater Platforms
6	TC-344B	Dual Channel Heater Controller
7	VC-8	Eight Channel Perfusion Valve Controller
8	OW Series TC-124	Objective Warmer Temperature Controller
9	Spill Sensor	Solution Leak Detector

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

systems approach





Perfusion Systems, *page 89*

Objective Warmers, *page 122*

Spill Sensors, *page 105*

perfusion/microfluidics

Pump 11 Elite

Advanced Syringe Pumps

Applications

- Controlled Flow
- Cellular Injections
- Oocyte Applications
- Microfluidics
- Drug/Nutritional Delivery
- Microdialysis
- Emulsification

Features

- Small Footprint
- Easy to use touch screen and icon interface
- Outstanding flow performance
- Easily run simple to complex methods without a PC
- Alphanumeric keypad for easy Method naming and recall
- Adjustable linear force up to 35 lbs
- Upgrade new versions of software remotely
- Legendary reliability – 2 year warranty

The Pump 11 Elite Series of syringe pumps expands its capabilities to satisfy your experimental requirements. These compact syringe pumps carry on the tradition as the premier workhorse infusion pump, offering unparalleled ease of use with a high resolution color touch screen with intuitive icon interface. The Pump 11 Elite Series allows you to create, save and run simple to complex methods without a PC.

Superior Performance

These syringe pumps have a new mechanism that includes a tight gripping, more secure syringe clamp for syringes ranging from 0.5ul to 60ml (single syringe) and 0.5µl to 10 ml (dual syringe). The Pump 11 Elite Series offers enhanced flow performance with high accuracy and smooth flow from 1.28 pl/min to 88.28 ml/min (25.99 ml/min for dual syringe rack).

The Pump 11 Elite Series is available in Infusion Only or Infusion/ Withdrawal Programmable Models with single or dual syringe racks. All Pump 11 Elite syringe pumps have a footswitch input and USB serial port for computer control. The Infusion/Withdrawal Programmable models also have RS-485 (or optional RJ-11) ports for daisy chaining pumps and Digital I/O for external control via an independent computer or device (see facing page for more information on connectivity).

Since 1901 Harvard Apparatus has been supporting bioresearch fluidics requirements with a key milestone being the introduction of the first commercial syringe pump for bioresearch in 1956. Since 1956, over 70,000 satisfied syringe pump users around the world have made Harvard Apparatus syringe pumps the worlds #1 choice.

The Pump 11 Elite Series is a family of accurate, low flow syringe pumps designed for use in applications including: controlled flow, cellular injections, oocyte applications and more.

Program Description

To operate the Pump 11 Elite, the user defines all the required parameters for infusing or withdrawing liquids through a Method.
This may be a Quick Start Method, Pre-Programmed or User-Defined Method. The basic operation is a simple 3-step procedure:

1. **Select a method**
2. **Enter operating parameters**
3. **Preview or Run your method**

Quick Start Methods are simple infusions, withdrawals or a combination (depending upon the model). Custom user-defined Methods can be created when more advanced programming is required. The setup for a custom Method is easy using the standard profiles found on all Infusion/ Withdrawal Programmable Elite Models. The list of available profiles is:

Constant Rate	Gradient (binary)
Ramp	Autofill

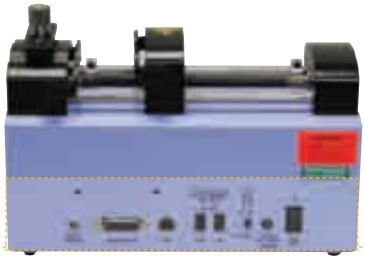
By programming custom (user-defined) Methods into the pump, multi-user errors are reduced. Easily transfer Methods to other pumps and/or download Methods from a PC. Forget having to duplicate Method-development efforts for each new pump added to your system.

Pump 11 Elite

Advanced Syringe Pumps (continued)

Advanced Connectivity

The infusion only Pump 11 Elite Syringe Pumps come standard with a Footswitch input and USB connector. The infusion/withdrawal programmable Pump 11 Elite Syringe Pumps include a Footswitch input, USB, RS-485 and I/O connectors. There is also an option for RJ-11 connectors on the programmable pumps. This option has to be ordered at the time the pump is ordered.



OPTIONAL RJ-11 CONNECTORS (for pump-to-pump communication)

FOOTSWITCH INPUT

USER I/O CONNECTOR

USB SERIAL INPUT (for communication from PC)

RS-485 CONNECTORS (for pump-to-pump communication)

UNIVERSAL POWER INPUT

Pump 11 Elite Specifications

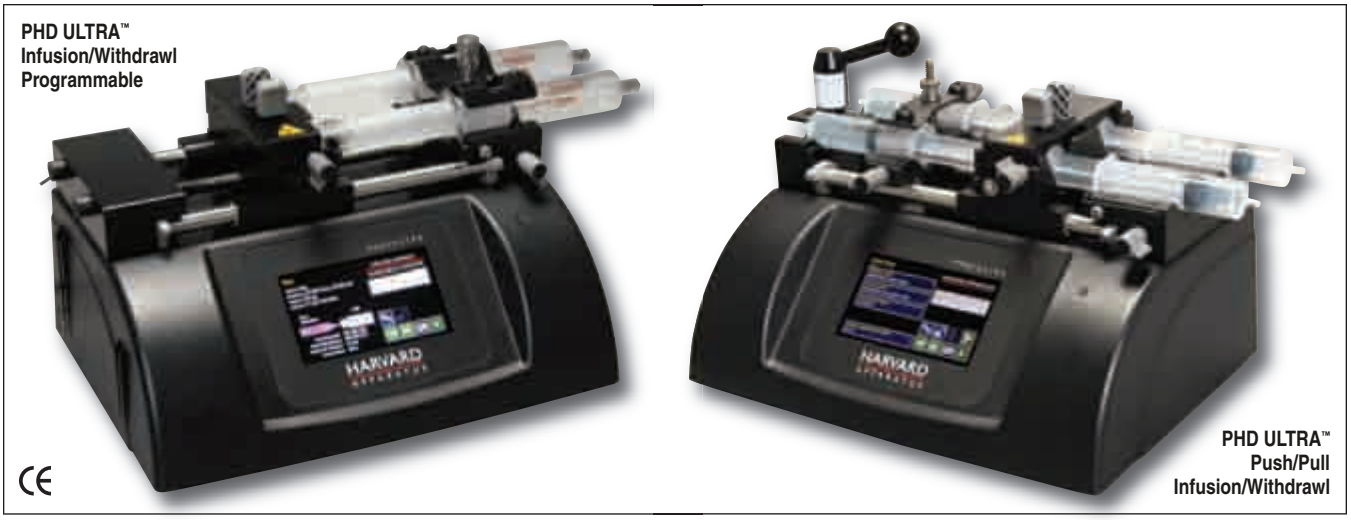
Type	Microprocessor single or dual syringe, infusion only or infusion/withdrawal programmable
Accuracy	±0.5%
Reproducibility	±0.05%
Syringe:	
Type	Plastic or glass
Size (single syringe)	0.5 µl to 50/60 ml
Size (dual syringe)	0.5 µl to 10 ml
Flow Rate:	
Single Syringe	1.28 pl/min to 88.28 ml/min
Dual Syringe	1.28 pl/min to 25.99 ml/min
Display	4.3" WQVGA TFT color display with touch screen
Connectors:	
RS-485	IEEE-1394, 6 position
USB	Type B
I/O & TTL	15 pin D-Sub connector
Footswitch	mini phono jack
Average linear force	16 kg (35 lbs) @ 100% Force Selection
Step Resolution	0.069 µm/µstep
Input Power	12-30 VDC
Input Power Connection	2.5 mm ID x 5.5 mm OD male plug
Power Supply	100-240 VAC, 50/60 Hz, 8 Watts Universal Power Supply, Use Only a Harvard Apparatus Approved Power Supply and Line Cord
Dimensions, H x W x D	22.6 x 17.78 x 15 cm (9 x 7 x 6 in)
Weight	2.1 kg (4.6 lbs)
Regulatory Certifications	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

FOOTSWITCH INPUT	Start and stop a pump
USB SERIAL INPUT	Control your pump with a computer
RS-485 CONNECTORS	Connect multiple pumps together (daisy chain up to 99 pumps)
	Connect satellite pumps to the Master pump for binary gradient system (% composition)
RJ-11 CONNECTORS (OPTION)	Connect multiple pumps together (daisy chain)
USER I/O CONNECTOR	
Direction Control Input	Set pump to infuse or withdraw
Trigger Input	Connect an external device to start and stop a pump or Method
Trigger 1 Ouput	Signal another device to start and stop a pump or Method
Run indicator	Connect an external LED or monitoring device to a pump

Order #	Product
W4 70-4500	Pump 11 Elite Infusion Only Single Syringe
W4 70-4501	Pump 11 Elite Infusion Only Dual Syringe
W4 70-4504	Pump 11 Elite Infusion/Withdrawal Programmable Single Syringe
W4 70-4505	Pump 11 Elite Infusion/Withdrawal Programmable Dual Syringe

PHD ULTRA™

Advanced Syringe Pumps



Applications

- Shear Stress Studies
- Long-term time lapse
- Continuous Flow
- Oocyte Applications
- Patch Clamping
- Microfluidics
- Feeding Cells
- Flow Programming

Features

- New patent pending drive mechanism for unmatched smooth flow, accuracy and precision
- For operation at pl/min to ml/min flow rates
- Easily program simple to complex methods without a PC
- Alphanumeric keypad for easy Method naming and recall
- Real and relative time clocks
- Intuitive touch screen and icon interface
- Vertical or horizontal orientation
- Adjustable linear force up to 75 lbs
- Multi-syringe racks for multi-channel operation or large capacity reservoir
- Legendary reliability– 2 year warranty

PHD ULTRA™

The PHD ULTRA™ syringe pump family has a new patent pending fluidics drive mechanism which assures ease of use and high performance, for the smoothest, most accurate flow rates of any syringe pump. Flow rates of 1.56 pl/min to 215.8 ml/min are accurate within 0.25% and reproducible within 0.05%. A microprocessor-controlled, small step angle stepper motor drives a lead screw and pusher block. Advanced micro-stepping techniques are employed to further reduce the step angle to eliminate flow pulsation.

The PHD ULTRA™ is the solution for your most demanding fluidics applications. This pump represents the latest technology in syringe pumps and was developed utilizing the feedback of the world's largest population of syringe pump users.

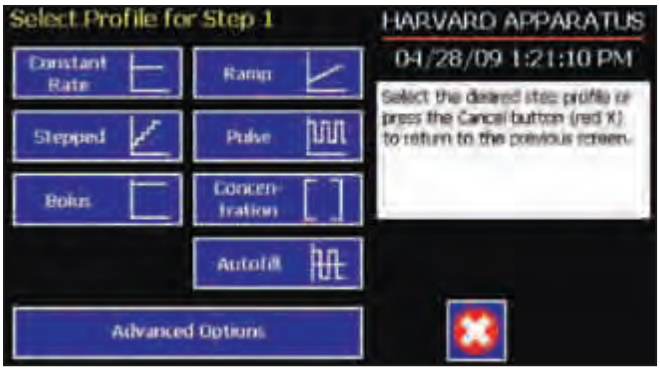
The PHD ULTRA™ will change the way you think about syringe pumps. There are three major reasons the PHD ULTRA™ is the new standard for syringe pumps:

1. **NEW Patent pending mechanical drive mechanism and syringe holding mechanics to achieve the highest performance of any syringe pump.**
2. **NEW EZ PRO Software and user interface allow easy programming of Methods from simple to complex, all without the use of a PC.**
   - *Preprogrammed Methods for simple to complex operations that allow you to be up and running with the touch of a button.*
   - *LCD, high resolution color touch screen for powerful functionality, yet very easy to use.*
3. **NEW Levels of Versatility**
   a. **Configurations:** *Standard, push-pull, remote, high pressure, multi-racks.*
   b. **Connectivity:** *For USB or RS-232 computer control; RS-485 or optional RJ-11 for daisy chain (control multiple pumps).*
   c. **Orientation:** *Horizontal or vertical orientation to optimize bench space or to minimize tubing.*

Since 1901 Harvard Apparatus has been supporting bioresearch fluidics requirements beginning with the introduction of the first commercial syringe pump for bioresearch in 1956. Since 1956, over 70,000 satisfied syringe pump users around the world have made Harvard Apparatus syringe pumps the world's #1 choice.

PHD ULTRA™

Advanced Syringe Pumps (continued)



Program Description

To operate the PHD ULTRA™, the user defines all the required parameters for infusing and/or withdrawing liquids through a Method. This may be a Quick Start, Pre-Programmed or User-Defined Method. The basic operation is a simple 3-step procedure:

1. **Select a Method**
2. **Enter operating parameters**
3. **Preview or Run your Method**

Quick Start Methods are for simple infusions, withdrawals or a combination (depending on the pump model). Custom user-defined Methods can be created when a more advanced Method is required. The setup for a custom Method is easy using the standard profiles found on all Infusion/Withdrawal and Infusion/Withdrawal Programmable PHD ULTRA's. The list of available profiles are:

Constant Rate	Bolus	Pulse
Ramp	Concentration	Autofill
Stepped	Gradient	

By programming and saving custom Methods in the pump, multi-user errors are reduced. Easily transfer complex methods to other pumps and/or download methods from a PC. Forget having to duplicate method-development efforts for each new pump added to your system.

In addition to the advanced pumping profiles listed above, the PHD ULTRA™ contains a variety of advanced options allowing the user to repeat steps, link methods, control valves, external triggers etc.

Advanced Programming Features

Flow Programming: *Change the flow with time, volume or a triggered event as many times as you like.*

Bolus: *Inject a large volume of drug (or drugs) at once. The bolus injection can be made in time or volume.*

Concentration Delivery: *Calibrate flow in concentration units of mg/kg easily so flow is calibrated to concentration of drug and animal weight.*

Gradients: *EZ PRO software allows you to easily program gradients, continuous or stepped.*

% Ratio: *Up to three solvents.*

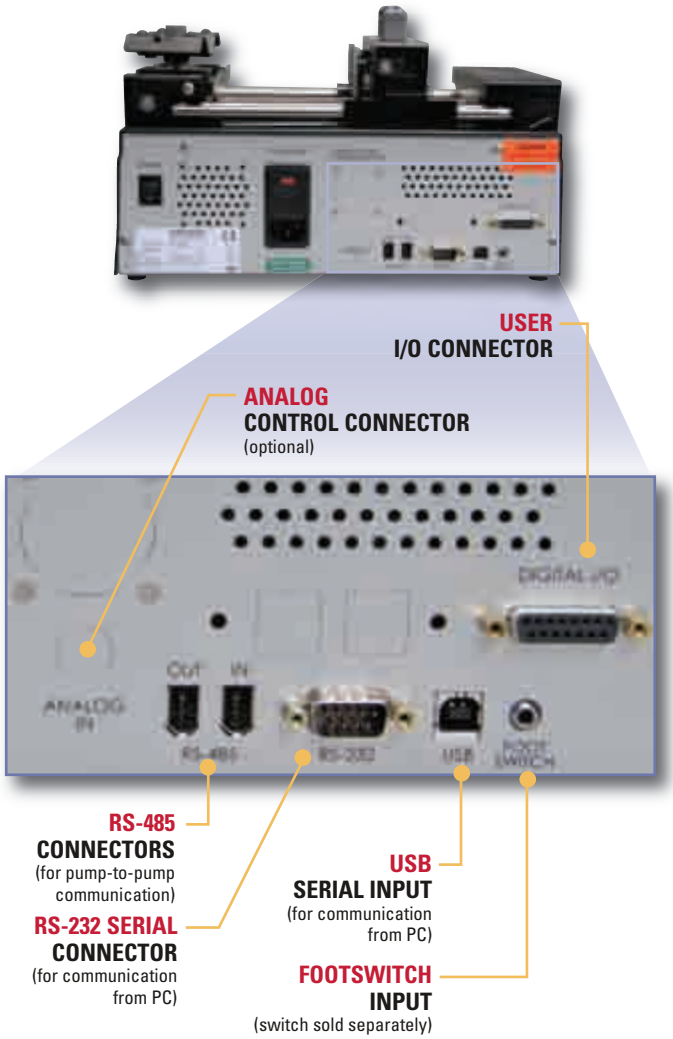
I/O: *Dedicated and user defined I/O.*

Pulsed Flow: *So you can program the pulse easily.*

Advanced Connectivity

All PHD ULTRA™ Syringe Pumps come standard with a footswitch, USB, RS-232, RS-485 and I/O connectors. There is also an option for RJ-11 connectors and analog control. These options have to be ordered at the time the pump is ordered.

FOOTSWITCH INPUT	Start and stop a pump
USB AND RS-232 SERIAL INPUTS	Control your pump with a computer
RS-485 CONNECTORS	Connect multiple pumps together (up to 99)
	Connect remote mechanism
	Connect satellite pumps to the Master pump for binary or ternary gradient system (% composition)
RJ-11 CONNECTORS (OPTION)	Connect multiple pumps together (daisy chain)
USER I/O CONNECTOR	
Direction Control input	Set pump to infuse or withdraw
Trigger Input	Connect and external device to start or stop a pump or Method
Footswitch Input	Start and stop a pump
Trigger 1 Ouput	Signal another device to start and stop a pump or Method
Trigger 2 Output	Signal another device to start and stop a pump or Method
Sync Output	Synchronize other devices
Valve Output	External valve control
Run Indicator	Connect an external LED or monitoring device to a pump
ANALOG CONTROL (OPTIONAL)	Analog control of the motor speed (0 to 10 v). This option must be ordered at the same time the pump is ordered.



PHD ULTRA™

Advanced Syringe Pumps (continued)

PHD ULTRA™ Specifications

Type	Microprocessor multiple syringe, infusion only, infusion/withdrawal or infusion/withdrawal programmable
Accuracy	±0.25%
Reproducibility	±0.05%
Syringes:	
Type	Plastic, glass or stainless steel
Size Minimum	0.5 µl
Size Maximum	140 ml
Flow Rate:	
Minimum	1.56 pl/min
Maximum	215.8 ml/min
Display	4.3" WQVGA TFT color display with touchscreen
Connectors:	
RS-232	9 pin D-Sub Connector
RS-485	6-position IEEE-1394
USB	Type B
I/O & TTL	15 pin D-Sub connector
Footswitch	Phono jack
Linear Force	34 kg (75 lbs) @ 100% force selection
Step Resolution	0.082 µm/step
Voltage Range	Universal input 100/240 VAC, 50/60 Hz
Dimensions, H x W x D	10.16 x 30.48 x 21.59 cm (4 x 12 x 8.5 in)
Weight	4.5 kg (10 lbs)
Regulatory Certifications	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Product	Order #	Order #	Order #	Order #
PHD ULTRA™ Standard	**Stand Alone**	**Remote**	**Satellite***	**Syringe Pump Module**
PHD ULTRA™ Infusion Only	**W4 70-3005**	**W4 70-3305**	–	–
PHD ULTRA™ Infusion/Withdrawal	**W4 70-3006**	**W4 70-3306**	**W4 70-3406**	**W4 70-3506**
PHD ULTRA™ Infusion/Withdrawal Programmable	**W4 70-3007**	**W4 70-3307**	–	–
PHD ULTRA™ Push/Pull	**Stand Alone**	**Remote**	**Satellite***	**Syringe Pump Module**
PHD ULTRA™ Push/Pull Infusion/Withdrawl	**W4 70-3008**	**W4 70-3308**	**W4 70-3408**	**W4 70-3508**
PHD ULTRA™ Push/Pull Infusion/Withdrawl Programmable	**W4 70-3009**	**W4 70-3309**	**W4 70-3410**	–
PHD ULTRA™ High Pressure	**Stand Alone**	**Remote**	**Satellite***	**Syringe Pump Module**
PHD ULTRA™ 4400 Pump I/W Programmable	**W4 70-3010**	**W4 70-3110**	**W4 70-3410**	**W4 70-3510**
PHD ULTRA™ Hpsi Remote Pump I/W Programmable	–	**W4 70-3111**	–	–
PHD ULTRA™ Hpsi Remote Pump I/W Programmable with 10 x 140 Rack	–	**W4 70-3112**	–	–

**Note: Gradient Systems are available. Contact technical support for more details.*

Order #	Product
PHD ULTRA™ Options	
W4 70-3030	RS-232 RJ-11 Connectors Option (daisy chain)
W4 70-3033	Analog Control Input Option (0-10V)[3]
W4 70-3031	Internal Pinch Valve Option[2]
W4 70-3032	Internal 3-Way Isolation Valve Option[2]
W4 70-3034	Internal Fan Option[4]
PHD ULTRA™ Upgrades	
W4 70-3020	6/10 Multi-Syringe Rack for PHD ULTRA™
W4 70-3021	4 x 140 Multi-Syringe Rack for PHD ULTRA™
W4 70-3022	Microliter Rack, for PHD ULTRA™ holds 4 syringes
W4 70-3023	Anti-Siphon Kit for PHD ULTRA™
W4 70-4010	Upgrade Infusion Only to I/W[1]
W4 70-4011	Upgrade Infusion Only to Programmable[1]
W4 70-4012	Upgrade I/W to Programmable[1]

1 Note: Requires Return to Factory
2 Note: Only for available for Infusion/Withdrawal or Programmable Models
3 Note: Only for Programmable Models. Not available on Satellite Boxes.
4 Note: Fan option is required if external operating ambient is expected to be >35˚C

Accessories

W4 70-4000	RS-485 Cable for Pump-to-Pump Communication, 0.5 m (1.6 ft)
W4 70-4001	RS-485 Cable for Pump-to-Pump Communication, 2 m (6.6 ft)
W4 70-4020	RS-485 Extension Cable, 9.1 m (30 ft)
W4 70-4002	USB Cable for PC-to-Pump Communication, 2 m (6.6 ft)
W4 70-4003	USB Cable for PC-to-Pump Communication, 5 m (16.4 ft)
W4 70-4004	RS-232 Cable for PC-to-Pump Communication, 9 pin D-sub, 2 m (6.6 ft)
W4 70-4005	Adapter, PHD Digital I/O
W4 70-4006	Adapter, D-sub 15 to Term. Blk
W4 72-8340	Adapter, USB to Serial
W4 70-2215	Footswitch (with Phono Plug)
W4 55-7002	Auto Fill Valve Box, Normal Pressure, 30 psi
W4 55-7004	Auto Fill Valve Box, High Pressure, 200 psi
W4 55-7760	Cable Assy, Daisy-chain, Legacy RS-232 RJ-11, 0.6 m (2 ft)
W4 72-2478	Cable Assy, Daisy-chain, Legacy RS-232 RJ-11, 2.1 m (7 ft)
W4 55-8000	Adapter for 25 ml, 50 ml, 100 ml Hamilton GasTight™ Syringes

PHD ULTRA™ Nanomite

Applications

- Cellular Injections
- Drug Delivery
- Microinjections
- Hand-Held Automated Delivery
- Chamber Dosing
- Regenerative Medicine

Features

- Light weight makes it ideal for hand-held or stereotaxic injection
- Easy-to-use LCD color touch screen with GUI interface
- Create and store >50 programs for
- High performance in a small package
- 1000 times better than manual syringes

The PHD ULTRA™ Nanomite is a single syringe infusion/withdrawal programmable syringe pump. This pump allows you to create, save and run simple to complex Methods without a PC. The flow rate range is 3.66 pl/min to 3.818 ml/min with 11 lbs of adjustable force across the entire flow rate range.

The PHD ULTRA™ Nanomite has a footswitch input, RS-232 and USB serial ports for computer control, RS-485 ports for daisy chaining pumps and Digital I/O for external control via an independent computer or device. There is also an option for daisy chaining pumps through the RS-232 (RJ-11) ports. This option must be ordered at the time the pump is ordered. See page 81 for more information on connectivity.

This pump consists of a control unit, an injection unit, a 6 foot cable to connect the two units and a footswitch.

For more information on the PHD ULTRA™ Nanomite including features and programming see the PHD ULTRA™ on page 80.

PHD ULTRA™ Nanomite Specifications

Type	Microprocessor single syringe Infusion/Withdrawal Programmable
Accuracy	±0.5%
Reproducibility	±0.05%
Syringes:	
Type	Glass or plastic
Size Minimum	0.5 µl
Size Maximum	1 ml
Flow Rate:	
Minimum	3.66 pl/min
Maximum	3.818 ml/min
Display	4.3" WQVGA TFT color display with touchscreen
Connectors:	
RS-232	9 pin D-Sub connector
RS-485	IEEE-1394, 6 position
USB	Type B
I/O & TTL	15 pin D-Sub connector
Footswitch	Mini phono jack
Average Linear Force	5 kg (11 lbs) @ 100% force selection
Step Resolution	0.198 µm/µstep
Voltage Range	100-240 VAC, 50/60 Hz, 75 W, 0.5 A fuse
Dimensions H x W x D:	
Control Box	30.5 x 21. 6 x 11.1 cm (12.0 x 8.5 x 4.38 in)
Injector Unit	6.35 x 5.08 x 19.05 cm (2.5 x 2.0 x 7.5 in)
Weight:	
Control Box	2.06 kg (4.55 lbs)
Injector Unit	0.458 kg (1.01 lbs)
Regulatory Certifications	CE, EU RoHS

Order #	Product
W4 70-3601	PHD ULTRA™ Nanomite Infusion/Withdrawal Programmable Single Syringe

Physio 22

Low RFI Syringe Pump for Physiological Experiments

Large volume, low noise pump for sensitive applications

Applications

- Patch Clamping
- Oocyte Applications
- Cellular Injections

Features

- Low electrical noise
- Pulse less flow
- High accuracy

The PHYSIO 22 Pump delivers high accuracy, pulseless flow with no electrical noise to interfere with the sensor signal while performing physiological analyses. This specialty pump is based on our legendary Syringe Pump 22, but with a special toroidal transformer designed for minimum RFI (Radio Frequency Interference). This new transformer cuts electrical noise so that it is almost non existent.

The electrical noise difference between our standard PUMP 22 and this new model is quite dramatic. Standard pumps generate a Magnetic field which will induce a current into the conductive media coming out of the syringe. This will create noise in the biological reading/recordings. With the new PHYSIO 22, even the most sensitive sensors will not show a noise spike. With the new toroidal transformer the noise disappears completely.

This pump features an LED display and numerical keypad for easy entry of syringe diameter data and flow rates. Flow rate units can be set in µl/hr, µl/min, ml/hr and ml/min. An optical encoder monitors leadscrew rotation to accurately maintain any flow rate. The run LED flashes when syringe plunger movement stops unexpectedly. A complete line of accessories for the PHYSIO 22 are available including a footswitch, audible alarm, reversing switch and serial cables, visit our website at www.harvardapparatus.com.

The PHYSIO 22 can be controlled using RS-232 (serial) commands. Multiple syringe pumps can be interconnected by daisy chaining pumps. Up to 100 pumps can be addressed independently using internal reference addresses from 0 to 99. A set of sample programs, using the Basic programming language, is included with each pump.

These types of applications are particularly sensitive to electrical noise and therefore would benefit tremendously by using our new PHYSIO 22 Syringe Pump.

This pump is currently available as infusion only with standard 2-syringe rack or infusion only with 6/10 syringe rack. An infuse/withdraw model is available by special order. Please call for details.

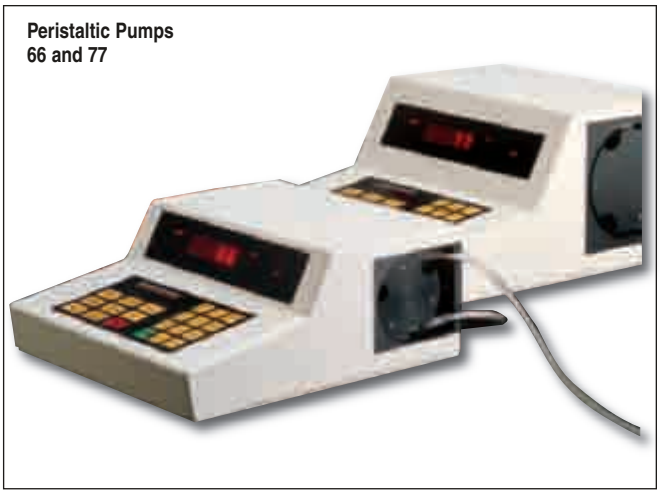
A spurious electromagnetic signal was recently found within the design of the PHYSIO 22 which allowed the introduction of a small 50/60 Hz signal into a shielded environment. In particular, a small transformer within the PHYSIO 22 generated an electromagnetic field which was sensed by an adjacent perfusion line. The problem was corrected by replacing the offending transformer with one incorporating toroidal architecture. This change in design successfully contains the stray electromagnetic field and renders the device electrically silent.

Specifications

Type	Microprocessor multiple syringe, infusion only
Accuracy	±0.35%
Reproducibility	±0.05%
Syringe:	
Type	Plastic, glass or stainless steel
Size Minimum	0.5 µl
Size Maximum	140 ml
Flow Rate:	
Minimum	0.002 µl/hr
Maximum	55.1 ml/min
Non Volatile Memory	Storage of all settings
RS-232	25-pin connector
TTL	Shared port with RS-232
Average Linear Force	47 lbs
Drive Motor	0.9° step angle motor
Motor Drive Control	1/4 microstepping
Motor Step per One Rev. of Leadscrew	3,200 steps
Step Resolution	0.33 µm/step
Step Rate:	
Minimum	6.8 sec/step
Maximum	416.7 µsec/step
Pusher Travel Rate:	
Minimum	2.9068 µm/min
Maximum	47.6 mm/min
Power	30 W, 0.5 A fuse
Voltage Range	95 to 130 VAC, 60 Hz; 220 to 260 VAC, 50 Hz, selectable
Dimensions, H x W x D	28 x 22.2 x 14 cm (11 x 8.75 x 5.5 in)
Weight	4.5 kg (10 lb)

Order #	Product
W4 70-2222	PHYSIO 22 Syringe Pump with Standard 2-Syringe Holder
W4 70-2223	PHYSIO 22 Syringe Pump with 6/10 Multi-Syringe Rack

Peristaltic Pump 66 and 77


Peristaltic Pumps
66 and 77

Features

- Highly accurate peristaltic pumps ±1%
- Unique ramped deceleration and 'slurp back'
- Continuous volume or batch mode operation
- Easy to use

Harvard Apparatus' 66 and 77 Peristaltic Pumps provide highly accurate and repeatable flow rates and are extremely easy to use.

High Accuracy

These pumps have the same high quality micro-stepping motor that creates the legendary accuracy of Harvard Apparatus' Syringe Pumps. Other peristaltic pumps have less accurate DC motors. No other peristaltic pump offers this quality of basic motor control. Additional accuracy features include ramped deceleration as the end-point is approached and a 'slurping' feature to prevent end of dispense dripping. As the end-point approaches, the pump slows to drop-by-drop delivery. As the last drop required is delivered, the pump immediately reverses one step and slurps back preventing unintended fluid delivery. Only these Harvard Apparatus innovations enable accuracy approaching that of a syringe pump from a peristaltic pump.

Fast and Easy

Routine work is made fast, easy and convenient with the 66 and 77 peristaltic pumps. Just enter the calibration factor of the tubing and the flow rate desired. The pump takes care of the rest. All settings are stored in non-volatile memory.

Flexibility

The 66 and 77 peristaltic pumps offer three pumping protocols for outstanding flexibility:

- **Continuous Flow** – set the flow rate desired and the pump will run continuously until you stop it.
- **Volume Mode** – enter the volume to be delivered and the pump will run until that volume is delivered.
- **Batch Mode** – simply enter the time interval between dispenses and the number of dispenses you want and the pump will take it from there. It couldn't be more simple.

Two Sizes Available

Harvard Apparatus' peristaltic pump is offered in two sizes. The only difference between the two pumps is the flow rates provided. The 66 accepts smaller diameter tubing and provides flow rates from 0.01 to 210 ml/minute. The larger size 77 pump accepts larger diameter tubing to provide flow rates from 0.01 to 750 ml/minute.

Calibration by Volume or Weight

For precise volumetric calibration, measure the actual volume pumped compared to what the pump thinks it has delivered. Enter the exact amount actually delivered into the pump and the pump will automatically recalibrate itself in microliters per pump head revolution. For precise gravimetric calibration, connect the pump to a Mettler, Ohaus or Sartorius scale with a feedback connector. The pump now operates by weight and will recalibrate itself in grams per pump head revolution.

RS-232C Interface and TTL Input/Output

This pump can be controlled remotely by any personal computer via an RS-232C interface. Up to 99 pumps can be daisy-chained using the daisy-chain connector and cables offered as accessories. A connector for TTL input/output permits remote control of all functions.

Peristaltic Pump 66 and 77 Specifications

Type	3 roller rotary peristaltic, single channel	
Accuracy	±1%	
Reproducibility	±1%	
RS-232C Interface	Chained dual bi-directional ports	
TTL Connector	9-pin connector	
Display	5 digits and 10 LED indicators	
Selectable Baud Rates	300, 600, 1200, 2400	
Step Rate:		
Minimum	27.3 sec/step	
Maximum	416.7 µsec/step	
Back Pressure	30 p.s.i. maximum	
Power	115/230 VAC, 50/60 Hz	
Voltage Range	95/130 VAC; 220/260 VAC	
Pump:	Small 66 Pump	Large 77 Pump
Tubing ID*	1.6 and 3.2 mm (0.0625 and 0.125 in)	3.2 and 6.4 mm (0.125 and 0.25 in)
Flow Rates	0.01 to 210 ml/min	0.01 to 750 ml/min
Dimensions, H x W x D	22.9 x 20.6 x 8.9 cm (9 x 8.125 x 3.5 in)	24.1 x 20.6 x 12.7 cm (9.5 x 8.125 x 5 in)
Weight	3.53 kg (7.85 lb)	5.1 kg (11.25 lb)

Order #	Product
W4 55-7766	Peristaltic Pump 66
W4 55-7777	Peristaltic Pump 77
W4 70-2022	RS-232 Connection Cable; Computer to Pump
W4 72-2478	Daisy Chain Cable; Pump to Pump, 1.8 m (7 ft)
W4 55-7760	Daisy Chain Cable; Pump to Pump, 0.6 m (2 ft)
W4 55-7757	Feedback Loop Connector for Mettler Scale
W4 55-7758	Feedback Loop Connector for Ohaus Scale
W4 55-7759	Feedback Loop Connector for Sartorius Scale

**Note: Tygon R-1000 or comparable tubing recommended, see page 87.*

Harvard MPII

Mini-Peristaltic Pump

Small, low cost 2-channel peristaltic pump for basic applications

W4 70-2027 Harvard MPII
Mini-Peristaltic Pump

- Continuous low flow rates ideal for:
  - Slow perfusion studies
  - Controlled animal feeding
- Pump can take one or two tubes simultaneously, 1/16 in. ID
- Control knob for pumping speed
- Toggle switches for direction and x1 or x2 speed range selection
- Low electrical and mechanical noise
- Small size

The Harvard MPII Mini-Peristaltic Pump takes only one size of tubing, 1.6 mm ID x 3.2 mm OD (1/16 x 1/8 in). It can be used with either a single tube or two tubes simultaneously. Two of the W4 55-4148 Pump Head Tubing Pieces are included with the pump. Additional Pump Head Tubing Pieces (W4 55-4148) may be purchased separately.

Two front panel controls provide flow rates from approximately 0.8 to 24.5 ml/min. The control knob provides variable adjustment from 0 to 100% of the selected flow rate range. The second control is a two position toggle switch marked x1, x2 which selects low or high flow rates, see table to right.

The easy-loading four-roller pump head is on top of the stout metal box. The back of the pump head effortlessly rotates into an 'open' position and either one or two tubes can be dropped into slots. The loaded section simply rotates back against spring loaded jaws and locks into place. The tubing is automatically in proper wiping contact with the pump head rollers. Each Pump is provided with a 12.5 mm (0.5 in) rod clamp on the back so that multiple pumps can be mounted vertically on a lattice rod.

MPII Flow Rates in ml/min

Switch Setting	With One Tube Min.	With One Tube Max.	With Two Tubes Min.	With Two Tubes Max.
x1	0.8 ml/min	7.00 ml/min	1.6 ml/min	14.00 ml/min
x2	1.5 ml/min	12.25 ml/min	3.0 ml/min	24.50 ml/min

Specifications

Output Pressure	In excess of 20 p.s.i.
Power	12 VDC 800 mA, 2.5 mm Connector, 115/230 VAC, 50/60 Hz, Universal power supply, 10 W
Dimensions, H x W x D	189 x 114 x 105 cm (3.5 x 4.5 x 4 in)
Weight	0.96 kg (2.1 lb)
Tubing ID	1/16 in

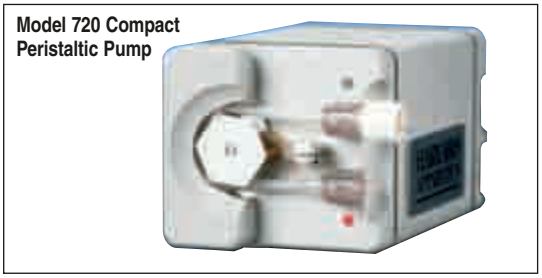
Order #	Product
W4 70-2027	MPII, 115/230 VAC, 50/60 Hz*
W4 55-4148	Pump Head Tubing Pieces. These Silicone Pump Head Tubing Pieces Have Connectors on Each End for 1/16 in ID Tubing 2.5 in, pkg. of 10

** Pump Head Tubing Pieces are necessary in order to use the Pump. They are not included, so they must be ordered separately.*

Model 720

Compact Peristaltic Pump

Small, low cost 1-channel peristaltic pump for basic applications



- Continuous infusion
- Battery back-up (30 hrs)
- Compact pump
- Minimal electromagnetic radiation
- Choose from low mid, or high flow

The Model 720 Compact Peristaltic pump is a stand-alone pump series with flow rates of 0.02 to 12 ml/hr (Low Flow), 0.2 to 145 ml/hr (Mid-Flow) and 2 to 1100 ml/hr (High Flow). It is an ideal pump for applications which require limited size or weight, low EMI interference, the versatility of single and dual tubes sets (see table below) and/or external analog control.

An internal 9V lithium battery (supplied with W4 61-0098 and W4 72-0002) will run the pump for up to 30 hours, protecting your experiments in the event of a power failure. Due to its power requirements, the high flow version is not available with battery backup.

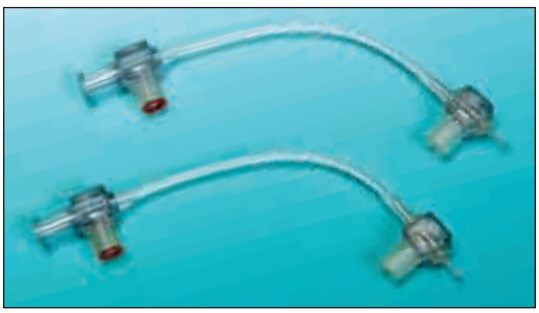
The pump is typically powered by a 1.25 V internal reference voltage. An external reference voltage can be used to regulate flow rate and direction (pump direction can only be reversed by analog control). Under external control the speed dials serve as voltage attenuators to limit the external voltage to ±1.25 volts.

Tube sets must be purchased separately. Frequently ordered tube sets are listed below. Other tube sets are available, please see our website or contact technical support. For use with saline and most drugs, use silicone tubing. For use with solutions containing fats, such as IV diets, use C-FLEX® tubing. For use with petroleum-based fluids, use VITON® tubing.

Universal power supply is included with each pump. Tube sets are not supplied and must be ordered separately. See below.

Specifications

Repeatability	±3%		
Flow Control Range	20:1		
Power Source	Wall-mounted 9 VDC adapter		
Dimensions, H x W x D	6.4 x 5.7 x 10.2 cm (2.5 x 2.3 x 4 in)		
Weight	375 g (1 lb)		
Voltage Range	Universal input 100/240 VAC; 50/60 Hz		
Flow Rate:	**High**	**Mid**	**Low**
Min. (0.015 in. tube)	2 ml/hr	0.2 ml/hr	0.02 ml/hr
Max. (0.093 in. tube)	1100 ml/hr	145 ml/hr	12 ml/hr
	W4 72-0001	**W4 61-0098**	**W4 72-0002**



Tube Sets

A wide variety of tube sizes, tube materials and connector types allows you to tailor your peristaltic pump to your particular application.

Tube sets typically last about one month under continuous operation. Dual channel tube sets place more stress on the pump than do single channel tube sets, which may shorten the life of your pump's motor.

Order #	Product
Silicone Tubing Set, pkg. of 5	
W4 61-0241	Silicone Tubing Set, 1-Ch, Female Luer to 22 ga, pkg. of 5
W4 61-0242	Silicone Tubing Set, 1-Ch, Female Luer to 20 ga, pkg. of 5
W4 61-0243	Silicone Tubing Set, 1-Ch, 0.062" ID Barbs, 0.8ml/hr, pkg. of 5
W4 61-0244	Silicone Tubing Set, 1-Ch, 0.062" ID Barbs, 5ml/hr, pkg. of 5
W4 61-0245	Silicone Tubing Set, 2-Ch, 0.062" ID Barbs, 3ml/hr, pkg. of 5

Frequently Ordered Tube Sets

Order #	Flow Rates with W4 72-0002*	Flow Rates with W4 61-0098*	Flow Rates with W4 72-0001*	Typical Application
W4 61-0241	0.02 to 0.45 ml/hr	0.2 to 5 ml/hr	2 to 43 ml/hr	IV infusion with 22 ga swivels (lab animals only)
W4 61-0242	0.04 to 0.95 ml/hr	0.3 to 11 ml/hr	4 to 90 ml/hr	IV infusion with 20 ga swivels (lab animals only)
W4 61-0243	0.08 to 1.8 ml/hr	0.8 to 21 ml/hr	9 to 170 ml/hr	General laboratory applications
W4 61-0244	0.9 to 12 ml/hr	7 to 145 ml/hr	90 to 1100 ml/hr	General laboratory applications
W4 61-0245	0.3 to 6.3 ml/hr	3 to 75 ml/hr	33 to 550 ml/hr	Dual channel laboratory applications

**Tube sets are no longer supplied with the pump. They must be purchased separately.*

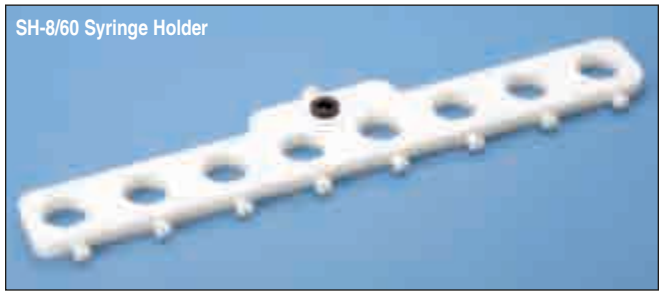
NEW Pressurized Perfusion Kits

Six and Eight Channel

Shown with optional syringe holder and stand.

VPP-1 Universal Reservoir Plug

SH-6/60 Syringe Holder



SH-8/60 Syringe Holder

- Upgrades any gravity-feed perfusion system to a pressurized system
- Universal reservoir plug fits 5, 10, and 20 ml syringes
- Dual regulators insure uniform fluid delivery

The latest accessory for Warner perfusion valve control systems is a simple, yet effective pressurization kit. The clever design of the universal reservoir plug allows for easy insertion into 5, 10, or 20 ml BD syringes.

Precise and accurate flow, even at low flow rates, is insured using dual regulator controls. House air or nitrogen is kept at constant 20 PSI using the first regulator and the second regulator is used to set the flow pressure at 0.1 PSI accuracy. Regulators include 5 µm filters and a large, easy to read pressure gauge on the output side. Universal reservoir plugs are designed to fit directly into a 60 cc syringe holder (SH6/60 or SH8/60).

The perfusion pressure kit for 8 channel valve controllers includes; 8-universal reservoir plugs pre-connected with tubing harness, dual pressure regulator/filter/gauges with rod mounting clamp, eight 10 ml BD syringes, eight stopcocks, and 25 feet of polyurethane tubing 4 mm I.D. x 6 mm O.D.

The kit for 6 channel valves includes everything listed above less two of the universal reservoir plugs, two 10 ml syringes, and two stopcocks.

Order #	Model	Product
W4 64-1711	VPP-6	Perfusion Pressure Kit Six Channel
W4 64-1712	VPP-8	Perfusion Pressure Kit Eight Channel
W4 64-1713	VPP-1	Universal Reservoir Plug
W4 64-1714	PPT-25	Tubing Polyurethane 4 mm I.D. x 6 mm O.D.
W4 64-0163	SH-6/60	Syringe Holder, 6 x 60 cc syringes
W4 64-0385	SH-8/60	Syringe Holder, 8 x 60 cc syringes
W4 64-1720	VPP-6-6	Perfusion Pressure Kit, 6 x 60 cc syringes
W4 64-1721	VPP-8-6	Prefusion Pressure Kit, 8 x 60 cc syringes

VC-8M, VC-8MLT, VC-8P, VC-8T

Valve Control Systems

An 8-channel multi-valve perfusion system for diverse applications

Model VC-8 Controller

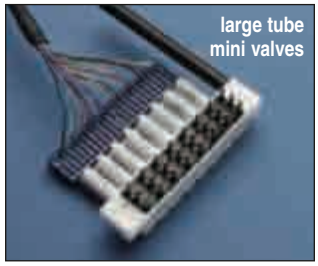
Pinch Valve System

Mini-Valve System

- Integrated spill sensor
- Choice of 3 valve types
- 8 channel system
- Manual and computer controllable

The VC-8 Valve Control System lies at the heart of a multi-valve perfusion system designed to automate and control the delivery of solutions to imaging and recording chambers. The flexible design of this system allows it to be used in diverse applications.

An exciting feature of the VC-8 system is the Spill Sensor Probe. This probe is used to detect the presence of an overflow condition on the microscope and, when activated, will automatically shut off all valves – protecting your valuable equipment.



The controller can independently regulate the function of up to eight valves. Individual valves are manipulated via a manual switch, an external analog signal or an external digital (TTL) signal. An event marker pulse, generated each time a valve is switched on, is provided at the rear of the instrument for recording into your acquisition system. Valve transitions (opened or closed) occur at full power to insure rapid response times and are then held in place at less than half power to prevent heat transfer to solutions.

While pinch valves are standard equipment, additional valve options include Teflon and Lee miniature types. The VC-8M is designed for slow flow perfusion systems where smaller diameter tubing is used. The VC-8MLT uses larger ports on a mini-valve platform to accommodate the PE-160 tubing used on most Warner chambers, this version will permit flow rates of up to 10 ml/min.

A complete VC-8 system includes a powered valve controller, a valve bracket with valves, connecting cable, C-Flex™ tubing, an MP Series manifold, support stand, eight 60 cc syringes, 25 feet of Tygon tubing and an assortment of tubing connectors.

Specifications

VC-8 Standard	12 V, 3-way pinch valves
VC-8 Teflon®	12 V, 2-way Teflon®
VC-8M Mini	12 V, 3-way solenoid valves
VC-8MLT Mini	12 V, 3-way solenoid valves
Typical Max. Flow Rates (with 60 cm head):	
VC-8P, VC-8T Systems	10 ml/min
VC-8M Systems	1 ml/min
VC-8MLT Systems	10 ml/min
VC-8 Valve Controller:	
Switching	Manual, TTL logic or Analog Signal
Event Marker	Logic level pulse
Spill Sensor	BNC Input for detecting an overflow
Power	100-130 or 200-250 VAC, 50/60 Hz, 50 VA
Size	8.9 x 20 x 25.4 cm (H x W x D)
Warranty	All systems carry 2-year warranty

Order #	Model	Product
W4 64-0186	VC-8M	Valve Control System 8 mini valves
W4 64-0186LT	VC-8MLT	Valve Control System 8 mini valves Large tubes for higher flow
W4 64-0185	VC-8P	VC-8P Valve Control System 8 pinch valves
W4 64-0187	VC-8T	Valve Control System 8 Teflon valves
W4 64-1523	MAT-2	Overflow Sensor Mats and Cable (4 Mats)

VC-6 and VC-6M

Valve Control Systems

4- or 6-channel multi-valve perfusion systems for diverse applications

Valve Controller

- Manual and computer control
- Basic or Complete systems
- Pinch valves, standard
- Teflon valves, optional

Perfusion Valve Control

Warner perfusion valve control systems are uncomplicated and easy to operate. The VC-6 Valve Controller is configured to control up to 6 valves. Each valve is individually manipulated by a manual switch or an external digital (TTL) signal. An event marker pulse, generated each time a valve is switched on, is provided for tape or chart recordings.

VC-6 Standard Pinch Valve Systems

Standard systems are supplied with tube pinch valves. They are the simplest to maintain as the solution never comes in contact with the valve and tubings are easily replaced. Valves are dual acting (3-way) with both normally open and closed sides. A "Y" connector at the valve input permits solution flow-to-waste with the valve off.

VC-6 Teflon® Valve Systems

Teflon® valves are also available and are for applications where resistance to chemicals is needed. The valves are 2-way (either on or off).

VC-6M Mini-Valve Systems

The VC-6M is designed for slow flow perfusion systems using smaller diameter tubing. Up to six valves mount directly to a compact Teflon® manifold. The 3-way valves allow for solution flow to waste if desired. The VC-6M system is ideally suited for use with the SF-77B perfusion stepper systems.

System Choices: Basic or Complete

The VC-6 Valve Perfusion Control System is available in two configurations with a choice of either a standard pinch valve or Teflon® valve.

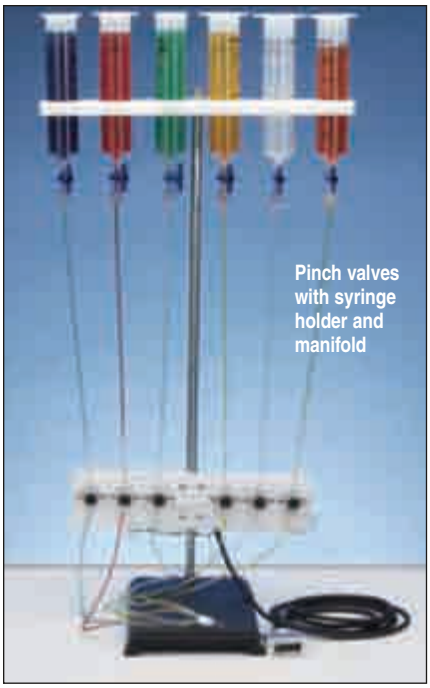
The Basic System includes the VC-6 Controller, valves, valve bracket with 8 ft cable and MP Series Manifold. Systems employing standard pinch valves are also supplied with C-Flex™ valve tubing.

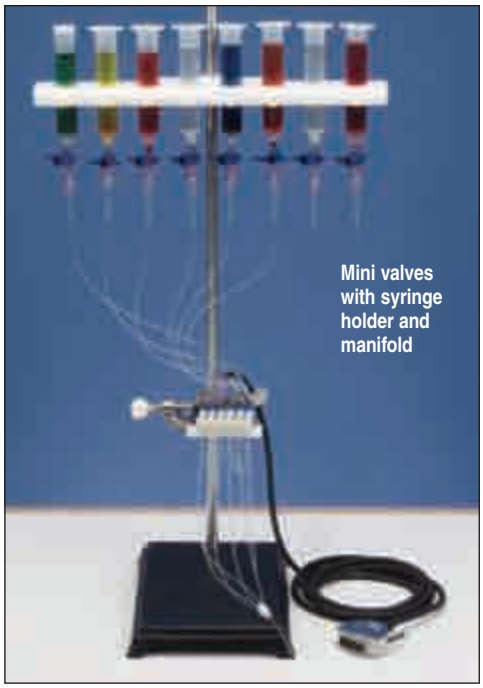
The Complete VC-6 Systems includes all of the components in the Basic Systems plus six 60 cc reservoirs, reservoir holder, support stand, stopcocks and tubing connectors. In addition, the systems employing standard pinch valves are supplied with Tygon™ tubing. Systems employing Teflon® valves include Teflon® tubing.

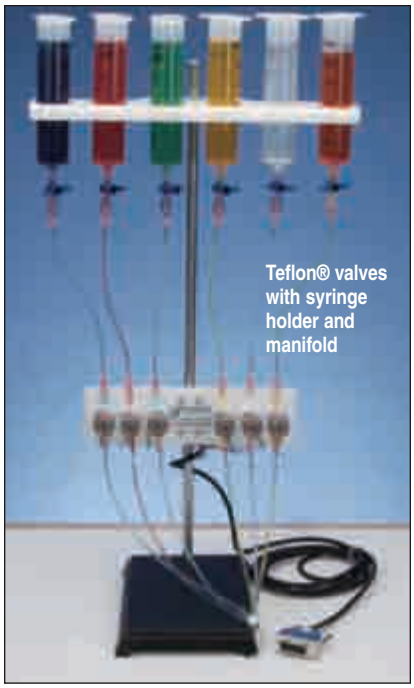
The VC-6M Mini-Valve Perfusion Control System is also available in two configurations. The Basic System includes the VC-6 controller, valves, valve manifold, 8 ft cable and ML Series manifold. The Complete System includes all of the components in the Basic Systems plus eight 10 cc reservoirs, reservoir holder, support stand, stopcocks, tubing connectors and two packages of PE-50 tubing (10 ft long).

VC-6 and VC-6M

Valve Control Systems (continued)







Comp - 6 channel system with larger tubes for higher flow

Specifications

Valves:	
VC-6 Standard	12 V, 3-way pinch valves
VC-6 Teflon®	12 V, 2-way Teflon®
VC-6M Mini	12 V, 3-way solenoid valves
Typical Max. Flow Rates (with 60 cm head):	
VC-6 Systems	10 ml/min
VC-6M Systems	1 ml/min
VC-6 Valve Controller:	
Switching	Manual or TTL logic
Event Marker	Logic level pulse
Power	110-130 or 200-250 VAC, 50/60 Hz, 50 VA
Size	8.9 x 20 x 25 cm (H x W x D)
Warranty	Two year

Order #	Model	Product
Basic Perfusion Systems		
W4 64-0171	VC-66MBB	Mini-Valve Controller System, 6 Valves
W4 64-0129	VC-66BB	Pinch Valve Controller System, 6 Valves
W4 64-0132	VC-66BBT	Teflon® Valve Controller System, 6 Valves
Complete Perfusion Systems		
W4 64-0174	VC-66MCS	Mini-Valve Controller System, 6 Valves
W4 64-0134	VC-64CS	Pinch Valve Controller System, 4 Valves
W4 64-0135	VC-66CS	Pinch Valve Controller System, 6 Valves
W4 64-0138	VC-66CST	Teflon® Valve Controller System, 6 Valves
W4 64-0174LT	VC-66MLTCS	Mini-Valve Controller System, 6 Valves for Large Tubes

Model VT-8 Valve Timer

- Add computer control to any Warner Instruments valve controller
- Low cost
- Easy to use
- Eight channel computer-controlled timer
- Plug and play connectivity via USB 2.0
- Two external trigger inputs
- Eight digital outputs
- Two analog outputs

The VT-8 Valve Timer is a microcontroller unit that communicates with Windows-based computers via the high speed USB 2.0 port. Designed with Warner's perfusion valve controllers in mind, the instrument also makes an excellent general purpose lab timer.

The VT-8 front panel has eight digital TTL outputs, two analog outputs, and two digital inputs. The two digital inputs can be used to trigger the VT-8. The VT-8 can drive TTL standard loads with 250ms time resolution, and can accept two TTL external trigger signals.

A user friendly, software-driven computer interface makes it easy to generate an automated protocol for valve opening and closing during any experiment.

The timer continuously communicates with the computer which facilitates instantaneous response to user-directed commands of the output TTL.

Programming is straightforward and is accomplished using a graphical interface and keyboard. A 'syringe configuration' feature ensures there is adequate solution volume to complete the experiment. An emergency cut-off feature is included and can be used to automatically close all valves simultaneously.

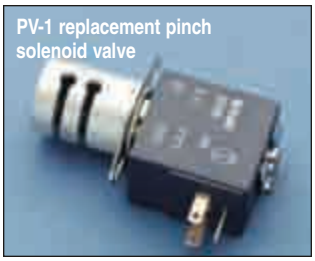
The VT-8 includes the control unit, USB cable (2 m), and software.

Specifications

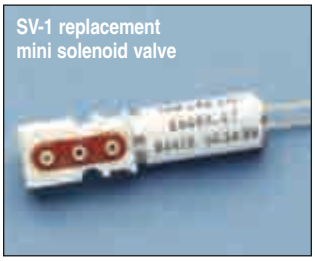
Digital Data Output	+5V TTL output, 20mA source, 20mA sink, 100Ω impedance.
Digital Data Input	+5V TTL input, 47KΩ impedance.
Analog Data Output	+10V buffered output.
Communication	USB 1.1, USB 2.0, 12Mbps
Firmware Update	Via supplied software
Data Generation	Via 54008 dedicated communication software included
Power Requirement	+5V, 300mA, supplied from USB bus
Operating Temperature	10° to 40° C
Physical Dimensions:	
Case Size	6.0 x 10.0 x 13.5 cm (H x W x D)
Shipping Weight	1 kg
Warranty	One year, parts & labor

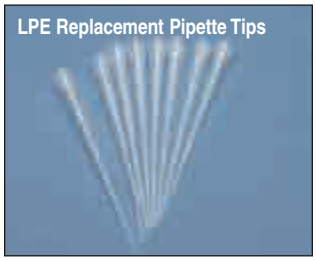
Order #	Model	Product
W4 64-1660	VT-8	Valve Timer
Accessories and Replacement Parts		
W4 64-1661	VT-ST	Set of 8 BNC Cables, (2 ft)
W4 64-0186	VC-8M	Valve Control System 8 Mini Valves
W4 64-0185	VC-8P	Valve Control System 8 Pinch Valves

Parts and Accessories


PV-1 replacement pinch solenoid valve


TV-2 replacement Teflon valve


SV-1 replacement mini solenoid valve


LPE Replacement Pipette Tips

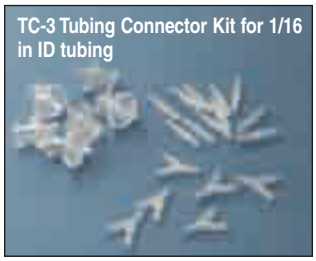

DC-6 Drip Chambers


SH6/60 Syringe Holder

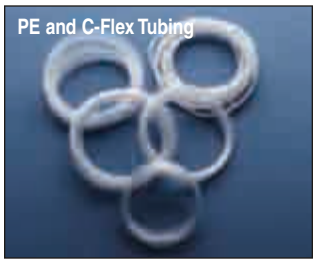

SH6/140 Syringe Holder


SH8/10 Syringe Holder


SH8/60 Syringe Holder


TC-3 Tubing Connector Kit for 1/16 in ID tubing


SL-6 Stopcocks


PE and C-Flex Tubing

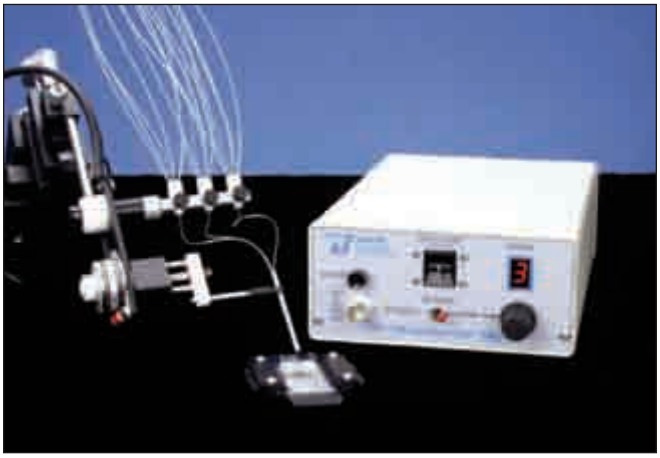

TY-50 Tygon Tubing

Order #	Model	Product
Replacement Valves for VC-6 Systems		
W4 64-0139	PV-1	Pinch Valve
W4 64-0140	TV-2	Teflon® Valve
W4 64-0175	SV-1	Mini Solenoid Valve
Accessories for VC-6 Systems		
W4 64-1428	LPE-10	Replacement Pipette Tips, pkg. of 10
W4 64-0162	RS-1	Support Stand
W4 64-0163	SH-6/60	Syringe Holder, six 60 cc syringes
W4 64-0144	SH-6/140	Syringe Holder, six 140 cc syringes
W4 64-0143	SH-8/10	Syringe Holder, eight 10 cc syringes
W4 64-0385	SH-8/60	Syringe Holder, eight 60 cc syringes
W4 64-0164	TC-3	Tubing Connectors (1/16 in ID), pkg. of 12 straight, 6 Y and 6 Luer Connectors
W4 64-0165	SL-6	Stopcock with Luer Connector, pkg. of 6
W4 64-1489	SN-18	Blunt End Needles 18 AWG, pkg. of 12
W4 64-1490	SN-23	Blunt End Needles 23 AWG, pkg. of 12
Tubing for VC-6 Systems		
W4 64-0166	CFL-6	C-Flex (1/32 in x 6 ft, ID x L)
W4 64-0168	TT-25	Teflon® (1/16 in x 25 ft, ID x L)
W4 64-0167	TY-50	Tygon (1/16 in x 50 ft, IDx L)
Tubing for VC-6M Mini Systems		
W4 64-0752	PE-50/10	PE-50 Polyethylene Tubing, 10 ft
W4 64-0753	PE-50/100	PE-50 Polyethylene Tubing, 100 ft
Additional PE Tubing		
W4 64-0754	PE-90/10	PE-90 Polyethylene Tubing, 10 ft
W4 64-0755	PE-160/10	PE-160 Polyethylene Tubing, 10 ft
W4 64-0756	PE-160/100	PE-160 Polyethylene Tubing, 100 ft
W4 64-0142	DC-6	Drip chamber, 6 pack

SF-77B, SF-77BLT and SF-77BST

Perfusion Fast-Step

A fast stepper combined with a mini-valve perfusion system



- Solution delivery for patch clamp and other electrophysiology studies
- Solution changes in milliseconds
- Minimal flow turbulence
- No switching through intervening solutions
- Manual or automatic step control (digital or analog)
- Modest cost and easy maintenance

The SF-77B is a fast solution delivery device for use in patch clamp and electrophysiology studies. Control and test solutions flow continuously through adjacent delivery tubes and a stepper mechanism selects which tube is directed at the preparation. The rapid response and nominal hysteresis of the stepper allows for very short switching times. Complete solution changes are typically achieved within 20 msec for a large, 700 µm step and times are significantly shortened as the step size is decreased.

Multiple Solution Studies

In the standard configuration, up to six different solutions are connected to a single input manifold, which in turn is connected to one of three square glass stimulus tubes. The three tube design is superior to a two-tube design in that complex solution exchange protocols can be brought to bear on the sample under study. Since the complete system is designed to accommodate three manifolds (one for each tube), and since each manifold can accommodate up to 6 feed lines, it is possible to immediately select between 18 different input solutions.

Manual or External Control

The stepper mechanism can be manually controlled via the front panel or externally directed from your data acquisition program. Manually, the system can be stepped to 8 positions in 7 equally spaced steps. These same 8 positions can also be directly selected by applying an analog signal to the external analog input BNC or by passing a 3 byte word to the TTL input on the instrument rear panel.

Square Glass Ports

The square glass tubes used for solution delivery significantly reduces mixing turbulence, allowing the SF-77B to be used for studies with both membrane patches and whole cells, even when the cells are not fixed to a substrate.

System Versatility

The design of the SF-77B permits the use of various size glass tubing for perfusion delivery.

SF-77B: Standard System (0.7 mm ID tubes)
The standard system is shipped with 3SG700-5 single-walled 3-barrel glass tubing which eliminates the need to glue individual barrels together. Spacing between barrels is 0.7 mm and step speed between adjacent barrels is typically 20 msec. Single barrel SG800-5 tubes (up to 5) can be used with the same holder.

SF-77BLT: Large Tube System (1.0 mm ID tubes)
Larger ports are required when using the SF-77B with larger cell structures such as the *Xenopus* oocyte. Solutions are delivered through 1.0 mm ID square tubes (SG1000-5) with barrel-to-barrel spacing of 1.4 mm.

SF-77B/5M: Standard System with Five Manifolds
The SF-77B/5M is the same system as the SF-77B except that it is provided with five perfusion manifolds.

SF-77BST: Fast Stepping with Theta Tubing
Very fast perfusion stepping is possible using 2-barrel Theta tubing. The technique requires close attention to detail with careful placing of the pipes and the excised patch. The tubing is pulled on a standard puller for a tip diameter of approximately 300 µm and a barrel spacing of approximately 100 µm. When using 100 µm steps, it is important to minimize any vibration produced by the stepper motor. This is accomplished by reducing the motor voltage via the control located on the instrument rear panel. The voltage is lowered until the vibration artifact is minimized. Any residual artifact may be removed by subtracting averaged null traces.*

Easy Set-Up

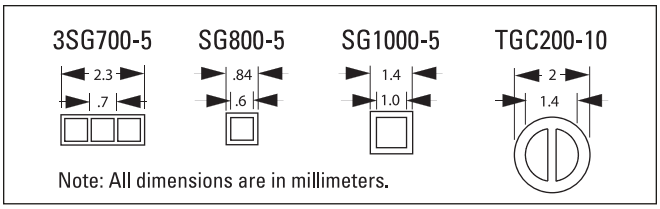
The stepper mechanism is compact, lightweight, and free of either mechanical or electrical noise. The mechanism connects to the control box with a 2 meter shielded cable and is provided with a mounting rod for attachment to a manipulator. Manifolds can support 2, 4 or 6 inputs depending on the experiment. Solutions flow from reservoirs to the manifold through PE-50 tubing and PE-10 tubing is used to connect the manifold outputs to the glass tubes.

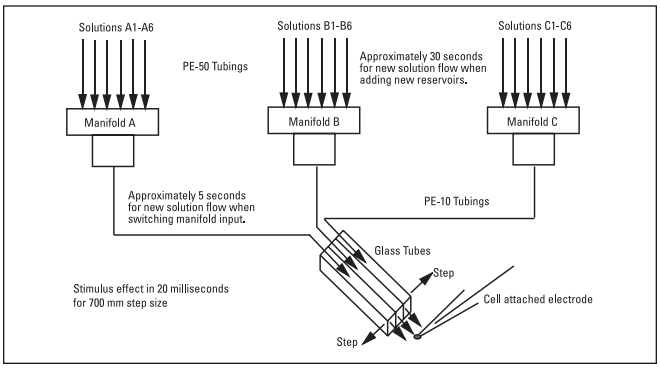
- Solution changes between tubes occur within milliseconds.
- Changes between solutions connected to individual ports occur within 5 seconds.
- Entirely new solutions can be added into any port with a waiting time of no more than 30 seconds.
- The cell is never required to pass through an intervening solution to get from control to test solution.

* Reference: Jie Zheng and Fred Sigworth, Selecting Changes during Activation of Mutant *Shaker* Potassium Channels, *J. General Physiology*, vol. 10 August 1997, 101-117, Rockefeller Univ. Press

SF-77B, SF-77BLT and SF-77BST

Perfusion Fast-Step (continued)





Specifications

Number of Steps	1 to 7 selectable
Step Size	Adjustable from 100 µm to 1.5 mm steps in 100 µm increments
Step Speed	Typically 20 msec for 700 µm step
Step Control:	
Manual	8 positions with POSITION selector
Analog Signal	8 positions with voltage levels 0-7 V, 1V/step
Digital Signal	8 positions with 3 byte TTL signal
Max. Stepper Range	12.0 mm
Mounting Handle	6.3 mm X 10 cm (D x L)
Stepper Weight	110.5 g (including handle)
Solution Manifolds:	Three manifolds supplied with each system; MM series for SF-77B and SF-77BST and ML series with SF-77 BLT
MM Series	Manifolds use PE-50 tubing at input and PE-10 tubing at output
ML Series	Manifolds use PE-50 tubing at both input and output
Solution Flow Rates:	Rates measured with solution reservoir height of approx. 60 cm (24 in)
With MM Series	100 µl/min
With ML Series	1 ml/min

Control Box:

Size (H x W x D)	6.3 x 14 x 23 cm
Power Requirements	100 – 130 or 220 – 250 VAC, 50/60 Hz, 10 VA
System Shipping Wt.	2.7 kg
Warranty	Two years, parts and labor

Order #	Model	Product
W4 64-0114	SF-77B	Standard System with MM Series Manifolds, 1 pkg. 3SG700-5 Glass, GH-1 Glass Holder, and 1 pkg. each PE-10 and PE-50 Tubing, 115 VAC
W4 64-1515	SF-77B	Standard System with MM Series Manifolds, 1 pkg. 3SG700-5 Glass, GH-1 Glass Holder, and 1 pkg. each PE-10 and PE-50 Tubing, 220/240 VAC
W4 64-0117	SF-77B/5M	Perfusion System with 5 manifolds, 115 VAC
W4 64-1518	SF-77B/5M	Perfusion System with 5 manifolds, 220/240 VAC
W4 64-0116	SF-77BLT	Large Tube System with ML Series Manifolds, 1 pkg. SG1000-5 Glass, GH-10 Glass Holder, and 2 pkg. of PE-50 Tubing, 115 VAC
W4 64-1517	SF-77BLT	Large Tube System with ML Series Manifolds, 1 pkg. SG1000-5 Glass, GH-10 Glass Holder, and 2 pkg. of PE-50 Tubing, 220/240 VAC
W4 64-0115	SF-77BST	Theta Glass System with MM Series Manifolds, 1 pkg. TGC-200-10 Glass, GH-2T Glass Holder, and 1 pkg. each PE-10 and PE-50 Tubing, 115 VAC
W4 64-1516	SF-77BST	Theta Glass System with MM Series Manifolds, 1 pkg. TGC-200-10 Glass, GH-2T Glass Holder, and 1 pkg. each PE-10 and PE-50 Tubing, 220/240 VAC

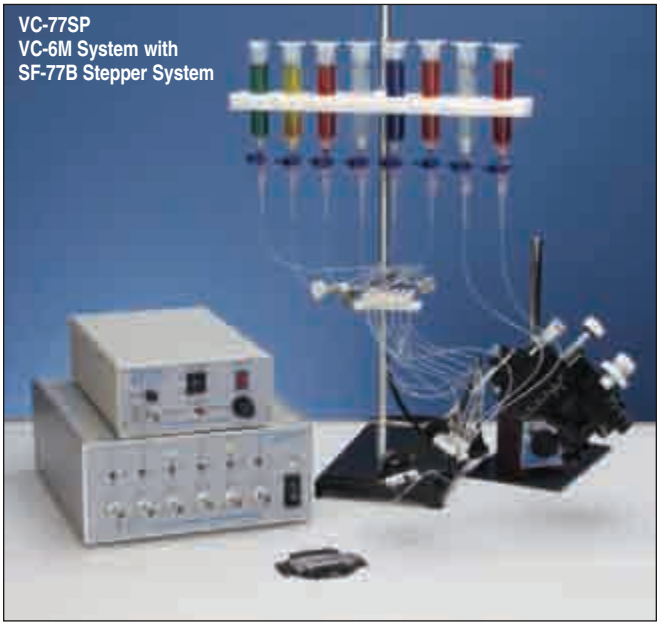
Accessories and replacement parts

W4 64-0119	3SG700-5	3-Barrel Square Glass Tubes, 0.6 mm x 5 cm (ID x L), pkg. of 10
W4 64-0120	3SG700-10	3-Barrel Square Glass Tubes, 0.6 mm x 10 cm (ID x L), pkg. of 10
W4 64-0121	SG-800-5	Single Barrel Square Glass Tubes, 0.6 mm x 5 cm (ID x L), pkg. of 25
W4 64-0122	SG-1000-5	Single Barrel Square Glass Tubes, 1 mm x 5 cm (ID x L), pkg. of 25
W4 64-0124	GH-1	Glass Holder for 3SG700-5, 3SG700-10 and SG800-5 Glass
W4 64-0125	GH-2T	Glass Holder for Theta Glass
W4 64-0126	GH-10	Glass Holder for SG1000-5 Glass
W4 64-0750	PE-10/10	Polyethylene Tubing 10 ft.
W4 64-0752	PE-50/10	Polyethylene Tubing 10 ft.
W4 64-0811	TG200-4	Theta Glass Tubes, 2.0 mm x 10 cm (OD x L), pkg. of 100

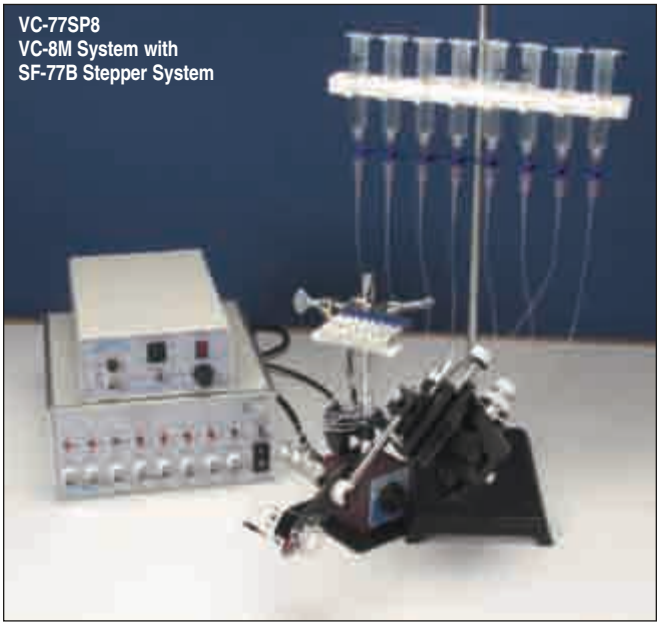
VC-77SP and VC-77SP8

Perfusion Fast-Step

A fast stepper combined with a mini-valve perfusion system



VC-77SP
VC-6M System with
SF-77B Stepper System



VC-77SP8
VC-8M System with
SF-77B Stepper System

- Allows computer control of multiple perfusion lines
- Six and eight channel systems available
- Solution changes in milliseconds

The VC-77SP perfusion system combines the VC-6M Perfusion Valve Control System and the SF-77B Fast Step Perfusion System into a single package. It allows computer control of multiple perfusion setups, saving time and effort.

The VC-77SP system includes:

W4 64-0174	VC-66MCS	Complete Mini-Valve System, 6-Channels
W4 64-0114	SF-77B	Perfusion Fast-Step System
W4 64-0056	MM-33R	Micromanipulator, Right Handed
W4 69-0225	MB-B	Magnetic Base

The **VC-77SP8** perfusion system combines the VC-8M Perfusion Valve Control Systems and the SF-77B Fast Step Perfusion System.

The VC-77SP8 system includes:

W4 64-0186	VC-8M	Complete Mini-Valve System, 8-Channels
W4 64-0114	SF-77B	Perfusion Fast-Step System
W4 64-0056	MM-33R	Micromanipulator, Right Handed
W4 69-0225	MB-B	Magnetic Base

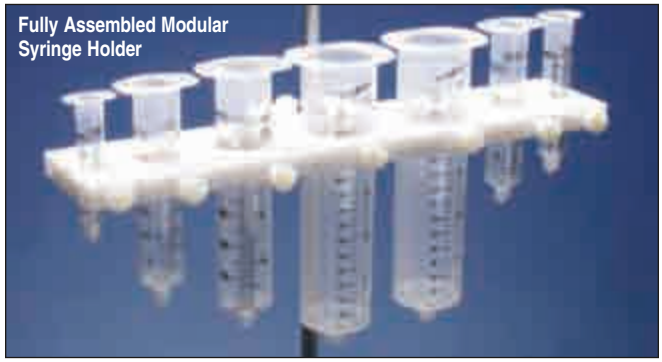
For complete details of the VC-6 and VC-8 Complete Mini-Valve Perfusion Systems, see pages 90 to 91. For complete details on other Perfusion Fast-Step System, see pages 94 and 95.

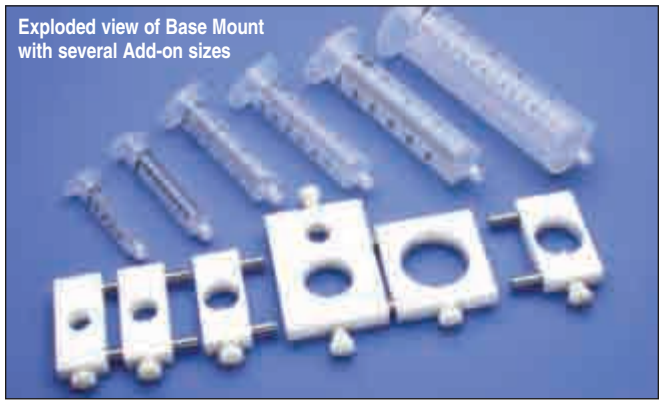
Order #	Model	Product
W4 64-0177	VC-77SP	Complete VC-6 Fast-Step Perfusion System with right-handed micromanipulator, 115 VAC
W4 64-1519	VC-77SP	Complete VC-6 Fast-Step Perfusion System with right-handed micromanipulator, 220/240 VAC
W4 64-0177L	VC-77SPL	Complete VC-6 Fast-Step Perfusion System with left-handed micromanipulator, 115 VAC
W4 64-0177LE	VC-77SPLE	Complete VC-6 Fast-Step Perfusion System with left-handed micromanipulator, 220 VAC
W4 64-1590	VC-77SP8	Complete VC-8 Fast-Step Perfusion System with right-handed micromanipulation, 115 VAC
W4 64-1590E	VC-77SP8E	Complete VC-8 Fast-Step Perfusion System with right-handed micromanipulation, 220 VAC
W4 64-1590L	VC-77SP8L	Complete VC-8 Fast Step Perfusion System with left-handed micromanipulator, 115 VAC
W4 64-1590EL	VC-77SP8EL	Complete VC-8 Fast Step Perfusion System with left-handed micromanipulator, 220/240 VAC

MSH and SH Series

Modular and Fixed Syringe Holders Series

A modular system designed to accept 5, 10, 20 , 30 , 60 , and 1400 cc syringes


Fully Assembled Modular Syringe Holder


Exploded view of Base Mount with several Add-on sizes


SH6/60 Fixed Syringe Holder


SH6/140 Fixed Syringe Holder


SH8/10 Fixed Syringe Holder


SH8/60 Fixed Syringe Holder

Syringe Holder Size Chart

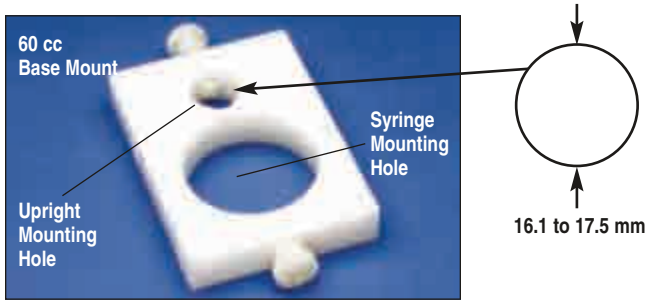
Syringe Holder	Maximum O.D. of syringe accepted	
	Inches	mm
5 cc	0.57	14.4
10 cc	0.655	16.6
20 cc	0.85	21.5
30 cc	0.95	24.1
60 cc	1.117	29.7
140 cc	1.63	41.4

MSH Series Holder System

The Modular Syringe Holder System offers users the ability to assemble a family of differently sized syringes into a single apparatus. Warner Instruments offers a full range of add-on holders to fit every application. Made from high quality Delrin and 316 stainless steel, this system assures excellent protection from most harmful chemicals.

The modular syringe holder system consists of a single syringe base mount that is coupled with add-on syringe holders. The base mount has a primary hole that holds the first syringe. A secondary hole permits the unit to mount onto an upright rod or support stand ranging in size from 3/8 to 5/8 inch. Both holes have thumbscrews that tighten so that the rod or syringe is securely held.

Additional add-on syringe holders can then mount on either side of the base mount by simply snapping the add-on onto the side of the base mount. Multiple add-on holders can used and sizes may be intermixed.



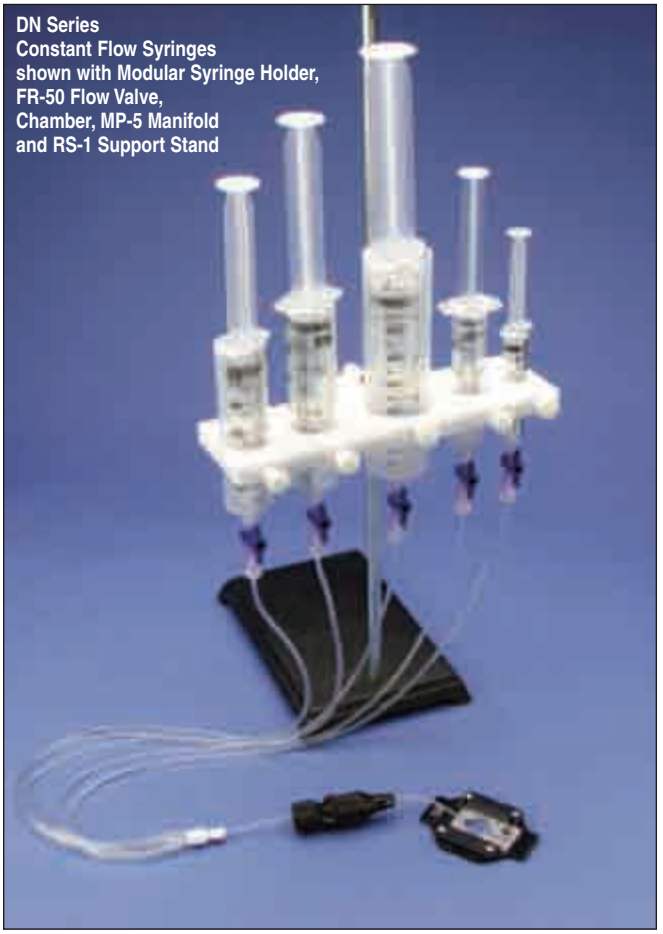
Order #	Model	Product
Base Mounts		
W4 64-0145	MSH/5M	Syringe Base Mount, 5 cc
W4 64-0146	MSH/10M	Syringe Base Mount, 10 cc
W4 64-0147	MSH/20M	Syringe Base Mount, 20 cc
W4 64-0148	MSH/30M	Syringe Base Mount, 30 cc
W4 64-0149	MSH/60M	Syringe Base Mount, 60 cc
W4 64-0150	MSH/140M	Syringe Base Mount, 140 cc
Add-on Units		
W4 64-0151	MSH/5	Syringe Add-On, 5 cc
W4 64-0152	MSH/10	Syringe Add-On, 10 cc
W4 64-0153	MSH/20	Syringe Add-On, 20 cc
W4 64-0154	MSH/30	Syringe Add-On, 30 cc
W4 64-0155	MSH/60	Syringe Add-On, 60 cc
W4 64-0156	MSH/140	Syringe Add-On, 140 cc
Fixed Syringe Holders		
W4 64-0143	SH-8/10	Syringe Holder, 8 x 10 cc Syringes
W4 64-0163	SH-6/60	Syringe Holder, 6 x 60 cc Syringes
W4 64-0385	SH-8/60	Syringe Holder, 8 x 60 cc Syringes
W4 64-0144	SH-6/140	Syringe Holder, 6 x 140 cc Syringes
Accessories and Replacement Parts		
W4 64-0165	SL-6	Stopcock with Luer Connector, pkg. of 6
W4 64-0162	RS-1	Support Stand

DN Series

Constant Flow Syringes

Eliminates changes in flow rate as the reservoir empties

DN Series
Constant
Flow Syringes



DN Series
Constant Flow Syringes
shown with Modular Syringe Holder,
FR-50 Flow Valve,
Chamber, MP-5 Manifold
and RS-1 Support Stand

When using a gravity-feed perfusion system, a common difficulty facing researchers is maintaining a constant flow as the reservoir empties. In general, since head pressure is a linear function of column height, the change in height of a 60 cc syringe as the solution reservoir drains can result in as much as a 20% decrease in flow rate.

Warner Instruments provides a simple and unique solution to this common problem. The DN Series Constant Flow Syringes eliminates changes in flow rate, normally to less than 1%. These reservoirs are designed to maintain a constant pressure on the syringe contents without resorting to complex or bulky apparatus (such as a pressure system or regulator).

When used in conjunction with Warner Instruments' FR-55S Solution Flow Valve, precise, sub-maximal flow control is easily achieved. Syringe reservoirs may be refilled without interrupting solution flow. They are available in 5 to 60 cc volumes and can be used with Warner's MSH Series Modular Syringe Holder System, see page 97.

If you want to use the DN Series Constant Flow Syringe with the MSH Modular Syringe Holder Series, you must order the next size up in the series. See the reference chart below for proper ordering information.

DN Series Constant Flow Syringes

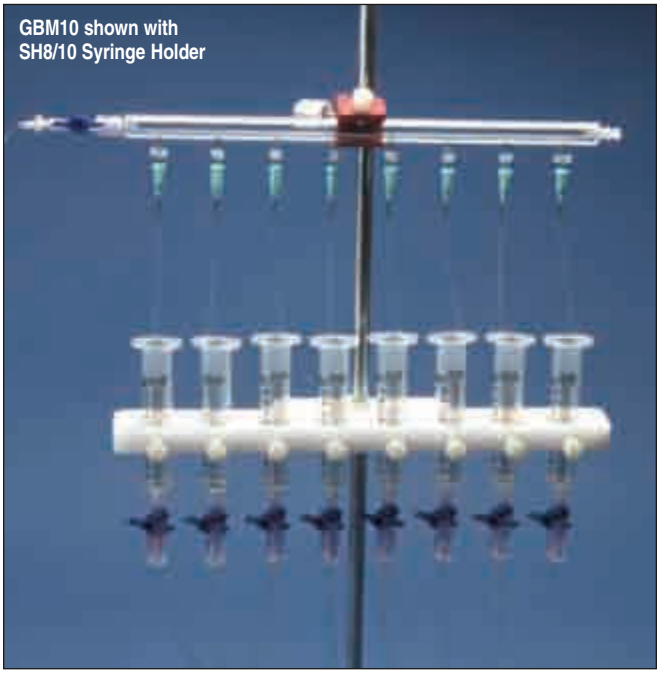
syringe size	mount/holder size	base mount	add-on holder
5 cc	10 cc	W4 64-0146	W4 64-0152
10 cc	20 cc	W4 64-0147	W4 64-0153
20 cc	60 cc	W4 64-0149	W4 64-0155
30 cc	60 cc	W4 64-0149	W4 64-0155
60 cc	140 cc	W4 64-0150	W4 64-0156

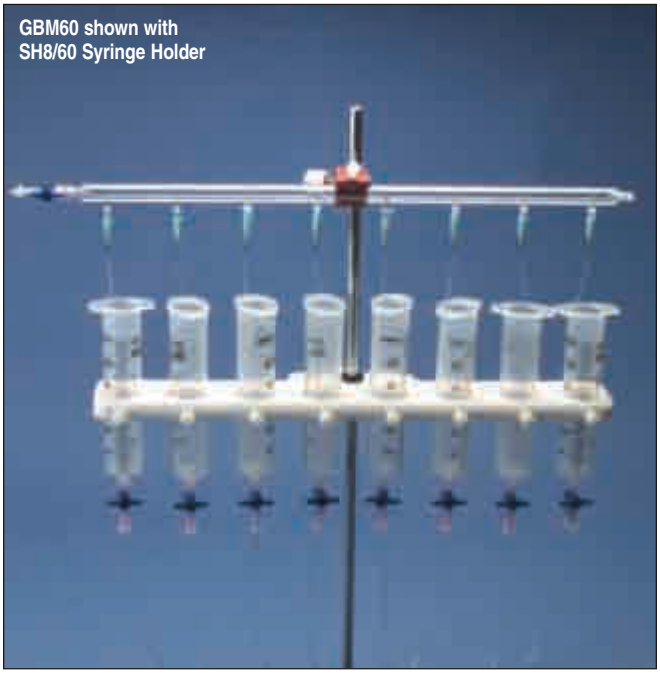
Order #	Model	Product
W4 64-0157	DN/5	Constant Flow Syringe, 5 cc, pkg. of 6
W4 64-0158	DN/10	Constant Flow Syringe, 10 cc, pkg. of 6
W4 64-0159	DN/20M	Constant Flow Syringe, 20 cc, pkg. of 6
W4 64-0160	DN/30M	Constant Flow Syringe, 30 cc, pkg. of 6
W4 64-0161	DN/60M	Constant Flow Syringe, 60 cc, pkg. of 6
Accessories and Replacement Parts		
W4 64-0220	FR-50	Flow Valve
W4 64-0221	FR-55S	Flow Valve with On-Off Switch
W4 64-0165	SL-6	Stopcock w/Luer Connector, pkg. of 6
W4 64-0162	RS-1	Support Stand
W4 64-0209	MP-5	5 to 1 Perfusion Manifold
W4 64-0755	PE-160/10	PE-160 Polyethylene Tubing, 10 ft
W4 64-0756	PE-160/100	PE-160 Polyethylene Tubing, 100 ft

GBM10 and GBM60

Gas Bubbler Manifold

Maintain gas tension in solution


GBM10 shown with SH8/10 Syringe Holder


GBM60 shown with SH8/60 Syringe Holder

These gas bubbler manifolds for 10 and 60 cc syringes are useful for delivering water soluble gases to syringe reservoirs mounted in Warner syringe holders. Luer fittings on all the inlet and outlet ports make these manifolds very easy to assemble. Constructed from clear polycarbonate for durability and easy cleaning.

Supplied with support stand clamp, Tygon tubing (1/16 x 1/8", ID x OD, 50 ft), PE-50 tubing (10 ft), 1 stopcock on the gas inlet port, and 9 luer plugs to block off any unused outlet ports.

Order #	Model	Product
W4 64-1587	GBM10	Gas Bubbler Manifold for 10 cc syringes
W4 64-1588	GBM60	Gas Bubbler Manifold for 60 cc syringes
W4 64-0752	PE-50/10	PE-50 Polyethylene Tubing, 10 ft
W4 64-0753	PE-50/100	PE-50 Polyethylene Tubing, 100 ft

Specifications

Physical Dimensions	
Body	(10 cc) 13 mm diameter x 267 mm long
Port Spacing	(10 cc) 33 mm center to center
Body	(60 cc) 13 mm diameter x 419 mm long
Port Spacing	(60 cc) 54 mm center to center

Tubing and Connector Kit, Syringe Needles

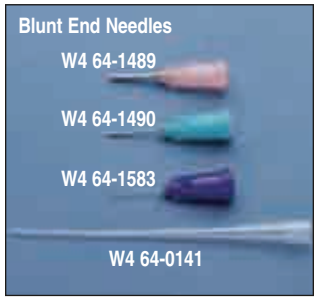
Parts and accessories

Warner Instruments offers a complete tubing and connector kit. This kit is ideal for use with Warner's Imaging and Recording Chambers. The kit is comprised of barbed and Luer fittings, blunt end needles, and an assortment of PE and C-Flex tubing. All barbed and Luer fittings are made from polypropylene and include tube to tube, reducing, Y-, T-, Luer-to-Luer, and Luer-to-barb adapters.

Comes in a convenient plastic storage box.

Order #	Model	Product
W4 64-1565	KIT-1	Fitting and Tubing Kit

Components listed at right are included in the tubing and connector kit. Components also sold separately.

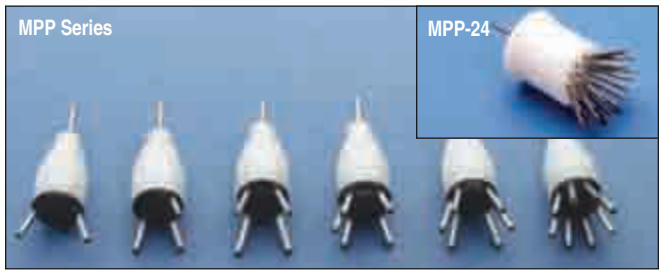


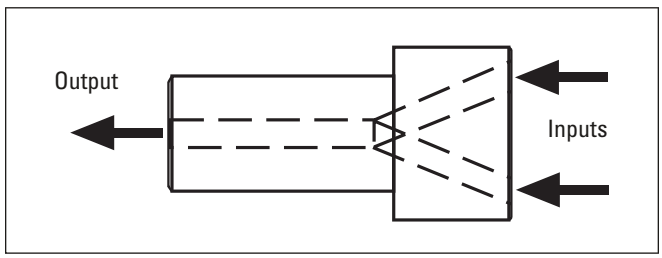
Order #	Product
W4 64-1566	Tube Fitting Barb ⅛" to 1⁄16", pkg. of 10
W4 64-1567	Tube Fitting Barb 1⁄16" to 1⁄16", pkg. of 10
W4 64-1568	Tube Fitting Barb ⅛" to ⅛" in, pkg. of 10
W4 64-1569	Tube Fitting Tee Barb 1⁄16", pkg. of 10
W4 64-1570	Tube Fitting Tee Barb ⅛", pkg. of 10
W4 64-1571	Tube Fitting Y Barb 1⁄16", pkg. of 10
W4 64-1572	Tube Fitting Y Barb ⅛", pkg. of 10
W4 64-1573	Tube Fitting Barb 1⁄16" to Luer Male, pkg. of 10
W4 64-1574	Tube Fitting Barb ⅛" to Luer Male, pkg. of 10
W4 64-1575	Tube Fitting Barb 1⁄16" to Luer Female, pkg. of 10
W4 64-1576	Tube Fitting Barb ⅛" to Luer Female, pkg. of 10
W4 64-1577	Tube Fitting Luer Male to Luer Female, pkg. of 10
W4 64-1578	Tube Fitting Luer Tee Female, pkg. of 10
W4 64-1579	Tube Fitting Luer Male to Luer Male, pkg. of 10
W4 64-1580	Tube Fitting Luer Female to Luer Female, pkg. of 10
W4 64-1581	Tube Fitting Luer Female Plug, pkg. of 10
W4 64-1582	Tube Fitting Luer Male Plug, pkg. of 10
W4 64-0141	LPE-50, Luer to PE-50 tubing adapter, pkg. of 8
W4 64-0166	CFL-6, C-Flex tubing (1⁄32" ID x 6 ft) 3⁄32 OD mm, 6 ft
Blunt Needle Plastic Hub	
W4 64-1489	SN-18, 18G, 0.5", pkg. of 12
W4 64-1490	SN-23, 23G, 0.5", pkg. of 12
W4 64-1583	SN-30, 30G, 0.5", pkg. of 12
Polyethylene Tubing	
W4 64-0750	PE-10/10, 0.28 ID x 0.61 OD mm, 10 ft
W4 64-0752	PE-50/10, 0.58 ID x 0.97 OD mm, 10 ft
W4 64-0754	PE-90/10, 0.86 ID x 1.27 OD mm, 10 ft
W4 64-0755	PE-160/10, 1.14 ID x 1.57 OD mm, 10 ft

ML, MM, MP and MPP Series

Manifolds and Flow Control Hardware

Multi-in or multi-out manifolds for fluid management





	ML Series	MM Series	MP Series	MPP Series
Material	Delrin™	Delrin™	Teflon®	Delrin™
Large Diameter	8.0 mm	8.0 mm	9.4 mm	9.4 mm
Small Diameter	4.7 mm	4.7 mm	6.3 mm	4.7 mm
Body Length	18 mm	18 mm	22 mm	21 mm
Input Tubing	PE-50	PE-50	PE-160	PE-160
Output Tubing	PE-50	PE-10	PE-160	PE-160

Warner perfusion manifolds can be used in any application where from 2 to 8 perfusion lines are required to be connected to a chamber or other device. Manifold inputs converge to the common output with minimum dead space. Designed for use with polyethylene (PE) tubing, manifolds can be used with any other tubing of similar dimensions. When connected to a chamber via a short length of tubing, very rapid solution changes are possible.

ML and MM Series

Designed to be part of the SF-77 Perfusion Fast-Step systems, these miniature manifolds are useful for applications involving small volumes or slow flow rates. Small diameter tubing is used with these models; PE-50 tubing for the input ports, and PE-10 or PE-50 tubing for the MM or ML series output ports, respectively.

MP Series

MP series manifolds are recommended for gravity fed perfusion systems. Input and output tubing are inserted with a friction fit. Manifolds should be ordered with inputs to match the number of solutions to be connected. Pin plugs to block unused inputs are also supplied. MP series manifolds are used with PE-160 tubing.

MPP Series

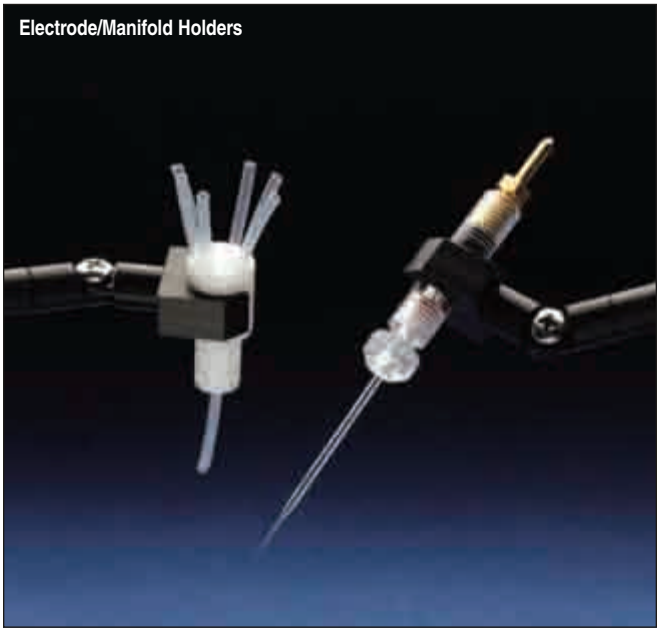
These manifolds are suitable for systems in which solutions are pumped or at pressures greater than those generated in gravity fed systems. Input and output ports are 18 gauge stainless steel hypodermic tubing. PE-160 tubing slides over these ports to make a snug fit.

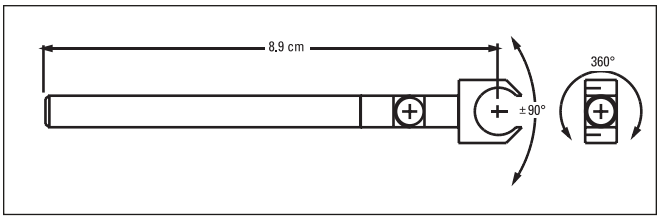
Order #	Model	Product
W4 64-0200	ML-2	Miniature Manifold, 2 ports
W4 64-0201	ML-4	Miniature Manifold, 4 ports
W4 64-0202	ML-6	Miniature Manifold, 6 ports
W4 64-0199	ML-8	Miniature Manifold, 8 ports
W4 64-0203	MM-2	Miniature Manifold, 2 ports
W4 64-0204	MM-4	Miniature Manifold, 4 ports
W4 64-0205	MM-6	Miniature Manifold, 6 ports
W4 64-0206	MP-2	MP Manifold, 2 ports
W4 64-0207	MP-3	MP Manifold, 3 ports
W4 64-0208	MP-4	MP Manifold, 4 ports
W4 64-0209	MP-5	MP Manifold, 5 ports
W4 64-0210	MP-6	MP Manifold, 6 ports
W4 64-0211	MP-8	MP Manifold, 8 ports
W4 64-0212	MPP-2	MPP Manifold, 2 ports
W4 64-0213	MPP-3	MPP Manifold, 3 ports
W4 64-0214	MPP-4	MPP Manifold, 4 ports
W4 64-0215	MPP-5	MPP Manifold, 5 ports
W4 64-0216	MPP-6	MPP Manifold, 6 ports
W4 64-0217	MPP-8	MPP Manifold, 8 ports
W4 64-0339	MPP-24	MPP Manifold, 24 ports

MHH-25/MHH-38 and FR-50/FR-55S

Manifolds and Flow Valves

Tools for fluid management





Electrode/Manifold Holders

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. The MHH-25 electrode/manifold holder is compatible with E and Q Series Electrode Holders, and the MHH-38 with PE Series and Theta Electrode Holders, as well as the MP and MPP Series Manifold.

Order #	Model	Product
W4 64-0218	MHH-25	Holder for 6.3 mm (1/4 in) Devices
W4 64-0219	MHH-38	Holder for 9.5 mm (3/8 in) Devices

Vacuum/Solution Flow Valves

FR-50 and FR-55S flow valves are used for fine control of solutions in a gravity fed perfusion system or for vacuum used to evacuate a chamber. When used for chamber evacuation, the FR-50 provides the fine control critical to a properly operating system. Solution flow rate is adjustable from zero to a maximum of 10 ml/min., (measured with a solution head of 30 cm). Model FR-55S includes a convenient on-off switch for interrupting the flow without disturbing the flow rate setting.

Specifications

Materials	Teflon® and Delrin® plastics
Input/Output	Stainless steel tubing compatible with PE-160 tubing

Order #	Model	Product
W4 64-0220	FR-50	Flow Valve
W4 64-0221	FR-55S	Flow Valve with On-Off Switch

Harvard CO_2 Gas/pH Controller

Precise solution pH control using CO_2 gas

- CO_2 flow regulation from 0 to 2 liters per minute
- Microminiature combination pH glass electrode included with system
- Easy setup
- Analog recorder output
- 12 V DC powered

This compact, stand-alone controller is designed to precisely regulate the pH of biological solutions. It can be used in a number of experiments requiring regulated pH, such as isolated organs (heart, lung, kidney, etc.) or isolated tissues.

Maintaining pH is accomplished by either "bubbling" CO_2 through the solution or flowing gas over the surface of the medium. CO_2 is supplied via an external source, such as a bottle.

To maintain pH, the "set-point" of the controller is adjusted to the desired level. When the pH exceeds the programmed set point, the flow of acidifying CO_2 is started. Adjusting the controller's flow rate regulator determines the rate of pH drop; the higher the flow rate the faster the drop in pH. The controller's flow regulator allows the user to adjust the CO_2 flow between 0 to 2.0 liters per minute. Once the pH reaches the set point, gas flow automatically stops.

A three-position (manual override) switch on the front panel provides several ways to control CO_2 gas delivery.

By-Pass Mode: the flow of CO_2 is continuous and the flow rate is controlled by adjustment of the regulator.
Momentary Mode: CO_2 flows as long as the switch is depressed. The switch is spring loaded and the regulator will return to the Auto Mode when released.

Auto Mode: the controller uses the set-point to regulate the flow of CO_2 automatically.

When used with the Harvard Apparatus series of heating/cooling micro-incubators, this controller provides a complete pH/temperature controlled environment ideal for long term cell or tissue studies. The pH controller has a 4-digit LCD display capable of displaying the full pH range from 0 to 14 pH. The supplied microminiature combination pH electrode is ideal for applications involving placement of the pH electrode in a small area. The system is also compatible with any standard combination pH electrode.

A BNC connector on the rear of the unit provides an output (0 to 5 V) signal proportional to the pH. This connection can be used to continuously log the pH values to a chart recorder, data acquisition system, or other recording device. The unit is powered by 12 VDC universal power supply for benchtop use. The pH controller is shipped with a controller, power supply, AC/DC adaptor, combination pH electrode and quick disconnect fittings matching front panel connectors for input and output hoses.

Specifications

Range	0 to 14 pH
Resolution	0.01 pH
Accuracy	±0.02 pH
Input Resistance	10^{12} Ω
Calibration:	
Offset	±2 pH units through offset trimmer
Slope	80 to 110% through slope trimmer
CO_2 Flowmeter	2 L per min
Gas Input/Output	Quick disconnect fittings
pH Analog Output	BNC connector 4-20 mA, isolated
Electrode Response Time	~0 sec
Electrode Slope	55 mV/pH in pH range of 1 to 14
Electrode Impedance	200 MΩ
Electrode Stability	0.05 pH/day
Electrode Dimensions	1.5 x 0.03 in (38.1 x 0.75 mm), L x D
System Power 50/60 Hz adapter)	12 VDC (Universal 90/240 VAC,
Dimensions (H x W x D)	12.2 x 15.2 x 12.7 cm (4.8 x 6 x 5 in)
Weight	0.8 kg (1.75 lb)

Order #	Model	Product
W4 70-2116		Harvard CO_2 Gas/pH Controller
Accessories and Replacement Parts		
W4 69-0494		Replacement pH Electrode
W4 65-0105		Input/Output Connector Fitting, pkg. of 5
W4 72-1015	R-3603	Tygon Tubing, ⅛ x ⅛ in (OD x ID x 50 ft)

Oxystreamer®

Dual Stream O_2 and CO_2 Controller

Simultaneous control of both gas and liquid phases, useful for live cell microscopy

- Provides two identical streams of any mix of O_2 and CO_2 gas
- Full range, real-time control of both gases
- Easily switch from one gas concentration to another
- Eliminates the inflexibility and high cost of premixed gas, and inaccuracies due to gas stratification in premixed gas tanks
- Vertical footprint saves bench space

The Oxystreamer® has two output streams that can be used to simultaneously condition (1) the atmosphere in a microscope stage mount cell culture incubator/chamber and (2) the dissolved oxygen and carbon dioxide levels in a media or perfusate. The following is a list of the major benefits derived from replacing pre-mixed gas cylinders:

- Precise, variable, selection of oxygen and carbon dioxide gas concentrations (ratios)
- Substantial cost savings by using standard, low cost cylinders of oxygen, carbon dioxide and nitrogen gas
- Eliminates the stratification induced concentration errors that are inherence in premixed gas cylinders
- By independently monitoring and controlling oxygen and carbon dioxide concentrations of the streams, the OxyStreamer® can monitor and proportionally mix (blend) oxygen, carbon dioxide and nitrogen gases into any concentration combination in real time

The OxyStreamer® is easy to use. After calibrating the oxygen and carbon dioxide sensors, the desired concentrations are simply entered into their respective controllers using the digital display and up/down control buttons. The closed-loop dynamic gas control system then automatically monitors and adjusts the output gas stream to the pre-programmed ratios in the controllers. This technique maintains the output (mixed) gas concentration to within 0.2% of the selected set-point levels.

The flow rate for each stream is independently controlled for efficiency and provides a method for setting a reproducible rate at which the gas is delivered to the cell culture chamber and/or diffused into the cell culture media or perfusate. Inlet ports on the back of the unit are 1/4 inch hose barb fittings and will take standard 1/4 inch ID tubing. Output ports are quick-disconnect fittings using 1/16 inch or 1/8 inch ID tubing.

Options include a Windows® based software package that provides trend plotting, data logging, and remote operation via RS-232 connection to your PC. Multiple Oxystreamer® models can be daisy-chained via an optional RS-485 interface.

Specifications

$O_2/CO_2/N_2$ Inlet Gas Supply Connectors	1/4 in hose barb
Outlet Gas Stream Connectors	Plastic quick disconnects for 1/16 in and 1/8 in ID tubing
Independent Channel Flow Control	0 to 100 ml/min, 0 to 50 ml/min
O_2 Range	0.1% to 99.9%
CO_2 Range	0.1% to 20.0%
Accuracy	±5% of reading; 2% full scale
O_2 Sensor	Fuel Cell
CO_2 Sensor	Infrared
Serial Comm.	RS-232/RS-485
O_2 Analog Output	0 to 100 mV DC linear
CO_2 Analog Output	0 to 1 V DC linear
Dimensions (H x W x D)	36.1 x 23.6 x 33.0 cm (14.2 x 9.3 x 13.0 in)
Power	12 V DC Universal Wall Adapter
Weight	4.54 kg (10 lbs)

Order #	Model	Product
W4 64-0383	SL_2CO	Oxystreamer – 0 to 10 ml/min max

OS-250

Overflow Sensor System

Because microscopes and liquides don't mix

Control Unit

As little as 3 drops of liquid will cause the OS-250 to respond

JC-1
Jumper cable used to connect two overflow sensor mats

- Prevent costly downtime
- Easy to install
- Compatible with upright and inverted microscopes
- Visible and audible alarms
- Switched power output on alarm

Warner Instruments is pleased to provide a product designed to detect solution leaks on your microscope before they cause a problem. As little as 3 drops of liquid will cause the OS-250 to react.

The system consists of a fluid sensing mat, a material specifically developed for detecting liquid spills, which simply connects to the OS-250. Once assembled, an alarm condition sounds an audible alert, flashes an LED, and turns the power off to any device plugged into the internal single outlet, solid-state power controller. The switched power outlet can control up to 8 amps and will easily handle syringe pumps or valve controllers.

The OS-250 is supplied with four reusable 30 x 30 cm mats that can be cut to any size with sharp scissors or knife. Additionally, the OS-250 is supplied with a mat connecting cable (1.5 m) and an IEC 60320 detachable power connector system.

Specifications

Power Requirements	92-240 VAC, 50/60 Hz, 0.5 VA
Operating Humidity	10% to 75%
Switched Outlet Current	8 A
Enclosure Dimensions	4.6 x 8.2 x 18 cm (H x W x D)
Shipping Weight	1.4 kg
Warranty	one year

Order #	Model	Product
W4 64-1520	OS-250	Overflow Sensor System
Accessories and Replacement Parts		
W4 64-1522	MAT-1	Overflow Sensor Replacement Mats, set of 4
W4 64-1523	MAT-2	Overflow Sensor Mats and Cable (4 Mats)
W4 64-1589	JC-1	Jumper Cable Used to Connect Two Overflow Sensor Mats

Battery Powered Spill Sensor System

Because microscopes and liquids don't mix

- Protect your microscope
- Audible alarm
- TTL cutoff circuitry
- Compatible with upright and inverted microscopes
- Easy set up and installation
- Complete system

Warner Instruments is pleased to provide a system to detect solution leaks before they cause a problem. This system is ideal for all environments where leak detection is critical such as on a microscope or in a chemical cabinet.

The heart of the system is comprised of a special moisture sensitive mat that has been specifically developed for detecting the presence of fluids. As little 3 drops of liquid are sufficient to trigger the system.

A simple connection between the moisture sensitive mats and the spill sensor controller arms the system. When as little as three drops of liquid come in contact with the moisture sensitive mat an audible alarm is sounded. In addition, an alarm condition switches the state of a regulated TTL output on the Spill Sensor allowing you to dynamically control attached devices.

The Spill Sensor System is supplied with four 30 x 30 cm mats that can be cut to any size or shape using sharp scissors or a straight edge.

Specifications

Power Requirements	9 V (internal battery)
Operating Humidity	10 to 75%
TTL Output	User settable; alarm = TTL high or TTL low
Enclosure	6.6 x 12.1 x 2.1 cm (W x H x D)

Order #	Model	Product
W4 64-1546		Spill Sensor System, Battery Powered
Accessories and Replacement Parts		
W4 64-1522	MAT-1	Overflow Sensor Replacement Mats, set of 4
W4 64-1523	MAT-2	Overflow Sensor Mats and Cable (4 Mats)
W4 64-1589	JC-1	Jumper Cable Used to Connect Two Overflow Sensor Mats

Sales Subsidiaries & Authorized Distributors

Subsidiaries

CANADA
Harvard Apparatus Canada
Attn: Sales Department
6010 Vanden Abeele
Saint-Laurent, Quebec H4S 1R9, Canada
phone **514.335.0792, 800.361.1905** (CAN only)
fax **514.335.3482**
e-mail **sales@harvardapparatus.ca**
website **www.harvardapparatus.ca**

FRANCE
Harvard Apparatus, S.A.R.L.
Attn: Sales Department
6 Avenue des Andes, Miniparc – Bat. 8
91952 Les Ulis Cedex, France
phone **33.1.64.46.00.85** fax **33.1.64.46.94.38**
e-mail **info@harvardapparatus.fr**
website **www.harvardapparatus.fr**

GERMANY
Hugo Sachs Elektronik
Harvard Apparatus, GmbH
Gruenstrasse 1
D-79232 March-Hugstetten, Germany
phone **49.7665.92000** fax **49.7665.920090**
e-mail **info@hugo-sachs.de**
website **www.hugo-sachs.de**

SPAIN
Panlab, S.L., Harvard Apparatus Spain
C/Energia, 112
08940 Cornellà, Barcelona, Spain
phone **34.934.750.697 (Intl. Sales)**
phone **934.190.709 (Sales in Spain)**
fax **34.934.750.699**
e-mail **info@panlab.com**
website **www.panlab.com**

UNITED KINGDOM
Harvard Apparatus, Ltd.
Attn: Sales Department, Fircroft Way,
Edenbridge, Kent TN8 6HE, United Kingdom
phone **44.1732.864001** fax **44.1732.863356**
e-mail **sales@harvardapparatus.co.uk**
website **www.harvardapparatus.co.uk**

UNITED STATES
Coulbourn Instruments
Attn: Sales Department
5583 Roosevelt Street
Whitehall, Pennsylvania 18052, USA
phone **610.395.3771** fax **610.395.1333**
e-mail **sales@coulbourn.com**
website **www.coulbourn.com**

Authorized Distributors

*The following **Distributors** are available to serve customers outside of the US. They can provide technical assistance, catalog information and quotations (including shipping and importation costs) and after sales service.*

ARGENTINA
ETC Internacional S.A.
Allende 3274, (C1417BMV) Ciudad
Autónoma de Buenos Aires, Argentina
phone **(+54 11) 4639 3488**
fax **(+54 11) 4639 6771**
e-mail **etcventa@etcint.com.ar**
danielr@etcint.com.ar
página web **www.etcint.com.ar**

AUSTRALIA
SDR Clinical Technology
213 Eastern Valley Way,
Middle Cove, NSW 2068, Australia
phone **61.02.9958.2688** fax **61.02.9958.2655**
e-mail **sdr@sdr.com.au**
website **www.sdr.com.au**

BELGIUM / FRENCH SWITZERLAND
Harvard Apparatus, S.A.R.L.
6 Ave des Andes, Miniparc - Bat 8
91952 Les Ulies Cedex
phone **(33) 1 64 46 00 85**
fax **(33) 1 64 46 94 38**
e-mail **info@harcardapparatus.fr**

BRAZIL
Sellex, Inc.
R. Cardoso de Almedia 788-114/S-1
05013-001 São Paulo – SP Brazil
phone **55.11.3872.2015**
fax **55.11.3872.1024**
e-mail **vendas@sellex.com**
website **www.sellex.com**

CHILE
Del Carpio Analisisy Asesorias Ltda
Avda Sucre #2596 Nunoa Santiago, Chile
phone **56.2.269.1348** fax **56.2.341.5397**
e-mail **cgarcia@delcarpio.cl**
website **www.delcarpio.cl**

CHINA (BEIJING)
DL Instruments, Inc.
A59-2-126 West 4th Ring Middle Road, Beijing
phone **(010) 6818 9642** fax **(010) 6822 2702**
e-mail **azou@dongeonline.com**
website **www.dongleonline.com,**
www.dongleonline.com.cn

CHINA (GUANGZHOU)
Bioprobes Ltd. (Guangzhou office)
Room 116, JinXia Bldg., No.15 Shi You Xin
Er Heng Road, Wu Yang Xin Cheng,
Guangzhou, China
phone **20-87357072, 20-87357737**
fax **20-87357072**
e-mail **info@bioprobeschina.com**
website **www.bioprobeschina.com**

DL Instruments, Inc.(Guangzhou office)
4 Siyou New Road
Great Wall Building, Rm 612, Guangshou
phone **(020) 8765 6735, (020) 8765 6736**
fax **(020) 8765 6737**
e-mail **azou@dongeonline.com**
website **www.dongleonline.com,**
www.dongleonline.com.cn

CHINA (WUHAN)
DL Instruments, Inc.
288 Zhenxing Road, Room 301-1-302, Wuhan
phone **(027) 8356 9708** fax **(027) 8356 9700**
e-mail **azou@dongeonline.com**
website **www.dongleonline.com,**
www.dongleonline.com.cn

DENMARK
Scandidact Biogimaterie
Oldenvej 45
3490 Kvistgaard, DK-3490, Denmark
phone **(+45) 49 13 93 33**
fax **(+45) 49 13 83 85**
email **admin@scandidact.dk**

HONG KONG
Bioprobes Ltd. (Hong Kong office)
14/F. Highgrade Building
117 Chatham Road South
Tsimshatsui, Kowloon, Hong Kong
phone **852.2723.9888** fax **852.2724.2633**
e-mail **info@bioprobes.imsbiz.com.hk**
website **www.bioprobeshk.com**

INDIA
Marsap Services Pvt. Ltd.
29/31 Ujagar Ind. Estate, WTP Marg Rd.
Deonar, Mumbai, India 400 088
phone **91.22.2551.6908**
fax **91.22.2556.3356**
e-mail **info@marsap.com**

ISRAEL
New Biotechnology Ltd.
P.O. Box 8662, Jerusalem, 91086, Israel
phone **972.2.6732001**
fax **972.2.6731611**
e-mail **nbtsales@nbtltd.com**
website **www.nbtltd.com**

ITALY
Crisel Instruments Srl
Crisel Instruments Srl
Via Mattia Battistini, 177
00167 Roma, Italy
phone **39.06.35402933**
fax **39.06.35402879**
e-mail **becattini@crisel-instruments.it**
website **www.crisel-instruments.it**

JAPAN
Take-In Incorporated
Kyosu Building 3-31-11 Amanuma
Suginami, Tokyo 167-0032, Japan
phone **81.3.3597.1911**
fax **81.3.5833.5596**
e-mail **take-in@labtak.com**
website **www.ha-j.com**

MEXICO
Intecs Instrumentación S.A de C.V.
Prolongacion de la 15 Poniente #3123
Colonia La Paz
Puebla, Puebla 72160, Mexico
phone **52-222-756-2900**
fax **52-222-231-5166**
e-mail **ventas@intecssa.com.mx**
website **marcop@intecssa.com.mx**

NEW ZEALAND
Alphatech Systems Limited
P O Box 62613, Kalmia St
Auckland 1544, New Zealand
phone **+64 9 580 1959**
fax **+64 9 580 2044**
e-mail **sales@alphatech.co.nz**
website **www.alphatech.co.nz**

PAKISTAN
Meditech Private Limited
Meditech House, 114 G/1 M. A. Johar Town
Lahore, Pakistan
phone **+92 42 5302643 thru 46 (4 lines)**
fax **+92 42 5302640 & 41 (2 lines)**
e-mail **info@meditech.com.pk**

PORTUGAL/ SPAIN
Izasa S.A.
C/ Aragon 90, 0815 Barcelona, Spain
phone **34.902.20.30.80**
fax **34.902.20.30.81**
e-mail **dac2@izasa.es**
website **www.izasa.es**

RUSSIA
Science Pribor
23/15 Avtozavodskaya str
Moscow, Russia, 115280
email **orders@sciencepribor.ru**
website **www.sciencepribor.ru**

SINGAPORE
Prime Bioscience Pte Ltd
Blk 431, Clementi Avenue 3, #01-358
Singapore 120431
phone **65-6364-0391**
fax **65-6269-0745**
e-mail **info@primebioscience.com**

SOUTH KOREA
Sang Chung Commercial Co., Ltd.
Dae Kyung Bldg 3F
839-15 Yuksam-Dong
Kangnam-Ku, Seoul Korea
35-935, CPO Box 1072
phone **82-2-564-8766**
fax **82-2-561-1603**
e-mail **info@sang-chung.co.kr**
website **www.sang-chung.co.kr**

Scitech Korea
Room 302, Kangbuk Union Building
Beon 3-dong, Kangbuk-Gu,
Seoul, 142-706, Korea
phone **82 2 986 4419**
fax **82 2 986 4429**
e-mail **scitech00@scitechkorea.co.kr**

GERMAN SWITZERLAND
Hugo Sachs Eletronik-Harvard Apparatus, GmbH
Gruenstrasse 1, D-79232 March-Hugstetten
phone **(49) 7665 92000**
fax **(49) 7665 920090**
e-mail **info@hugo-sachs.de**

TAIWAN
Major Instruments Co. Ltd.
9th Floor No. 69-3
Chung-Cheng E. Rd., Sec. 2
Tan-Shui, Taipei, Taiwan, ROC
phone **(02) 2808-1452**
fax **(02) 2808-2354**
e-mail **majortw@ms6.hinet.net**
website **major@major.com.tw**

TURKEY
Commat
Cetin Emec Blv 74.Sk No 4/9 Ovecler
Ankara, 6460, Turkey
phone **+90 312 472 74 17**
fax **+90 312 472 74 18**
e-mail **info@commat.com.fr**

Harvard Apparatus
84 October Hill Road
Holliston, MA 01746-1388 USA

Address Service Requested

Presorted
Bound Printed Matter
U.S. Postage
PAID
Harvard Apparatus

specialized tools for Electrophysiology & Cell Biology Research

WARNER INSTRUMENTS
A Harvard Apparatus Company

1125 Dixwell Avenue
Hamden, CT 06514 USA
Phone: 800.599.4203 (toll-free)
203.776-0664
Fax: 203.776.1278
Email: support@warneronline.com

HARVARD APPARATUS

84 October Hill Road
Holliston, MA 01746-1388 USA
Phone: 800.272.2775 (toll-free)
508.893.8999
Fax: 508.429.5732
Email: bioscience@harvardapparatus.com

www.warneronline.com
www.harvardapparatus.com

Publication W4