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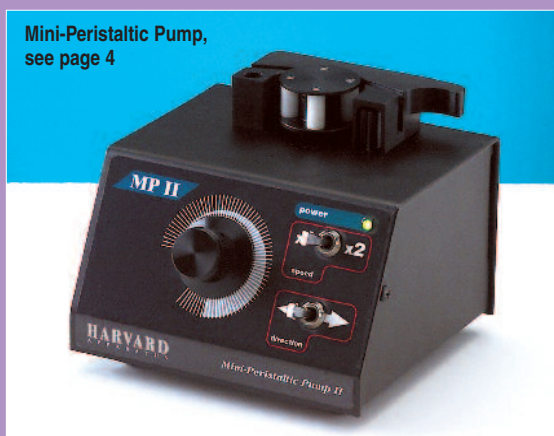
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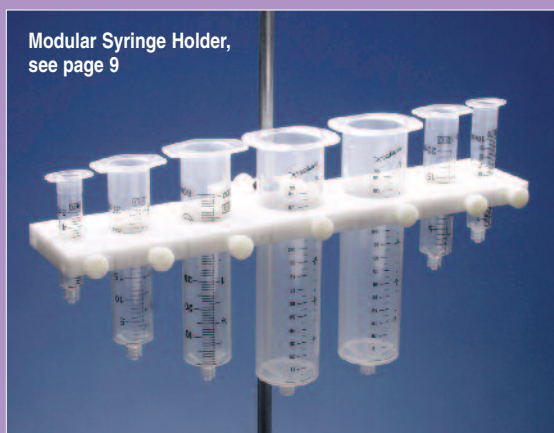
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Physio 22

Low RFI Syringe Pump for Physiological Experiments



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)

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 Pump 22 are available including a footswitch, audible alarm, reversing switch and serial cables, see Pumps page 30.

The pump 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.

Order # Product

EC1 70-2222	PHYSIO 22 Syringe Pump with Standard 2-Syringe Holder
EC1 70-2223	PHYSIO 22 Syringe Pump with 6/10 Multi-Syringe Rack

Nanomite Syringe Pump



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EC1 70-2217 Nanomite Syringe Pump



Applications

- Space limited
- Micro reactor delivery
- High pressure
- Cellular injection
- Chamber dosing
- Micro-dispensing
- Stereotaxic devices

Features

- 11 pounds of pumping force
- Bright blue LED run indicator
- Remote pump head
- Legendary reliability- 2 year warranty

The Nanomite is an exceptionally small syringe pump ideal for space limited applications. The Nanomite consists of a control unit, an injection unit, a 6 foot cable to connect the two units and a footswitch.

Bright Display and Easy-To-Use Interface

A two-line 16 character vacuum fluorescent display along with six membrane keys make this a most attractive but powerful, easy-to-use syringe pump. Only two entries required to start pumping; syringe Inside Diameter (mm) and pumping flow rates. The flow rate can be changed while the pump is running.

Two Modes of Operation, Constant Flow Rate & Volume Dispense

The Nanomite will operate continuously in RATE mode or accurately dispense a specific amount of fluid in VOLUME mode.

Audible alarm when target volume is reached.

Smooth Flow

Enhanced micro-stepping pump profiles deliver very smooth and consistent flow, that is virtually pulse free.

Nonvolatile Memory

The pump remembers its last syringe size, flow rate used and configuration settings.

Power Fail Mode

In a power failure the pump can either RESUME or STOP pumping when power is returned.

CE Mark Approved

The Nanomite meets all relevant European EMC and Safety requirements for laboratory equipment.

Specifications

Type	Microprocessor single syringe, infuse/withdraw
Accuracy	±0.5%
Reproducibility	±0.1%
Syringe:	
Type	Glass
Size Minimum	0.5 µl
Size Maximum	1 ml
Flow Rate:	
Minimum	3.3 nl/hr
Maximum	1901 µl/min
Non Volatile Memory	Stores diameter, rate and configuration settings
RS-232	Yes
TTL	Footswitch control
Average Linear Force	11 to 12 lbs
Drive Motor	1.8° step angle motor
Motor Drive Control	1/4 microstepping
Motor Step per One Rev. of Leadscrew	1,600 steps
Step Resolution	0.7933 µm/step
Step Rate:	
Minimum	1 pulse in 27.6 sec
Maximum	200 steps/sec
Pusher Travel Rate:	
Minimum	7.0 µm/min
Maximum	114 mm/min
Input Power	12 VDC 1.5 Amps
Voltage Range (Power Supply)	Universal input 100/240 VAC, 50/60 Hz, 18 watts (Use only a Harvard Apparatus approved supply and line cord)
Dimensions, H x W x D:	
Control Unit	8.9 x 22.9 x 11.4 cm (3-1/2 x 9 x 4-1/2 in)
Injector Unit	1.0 x 18.5 x 5.0 cm (2-1/2 x 7-1/4 x 2 in)
Weight:	
Control Unit	1.7 kg (3.80 lb)
Injector Unit	0.36 kg (0.80 lb)

Order # Product

EC1 70-2217 Nanomite Syringe Pump



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Harvard MPII Mini-Peristaltic Pump

EC1 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 EC1 55-4148 Pump Head Tubing Pieces are included with the pump. Additional Pump Head Tubing Pieces (EC1 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		With Two Tubes	
	Min.	Max.	Min.	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

EC1 70-2027	MPII, 115/230 VAC, 50/60 Hz
EC1 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

peristaltic pumps



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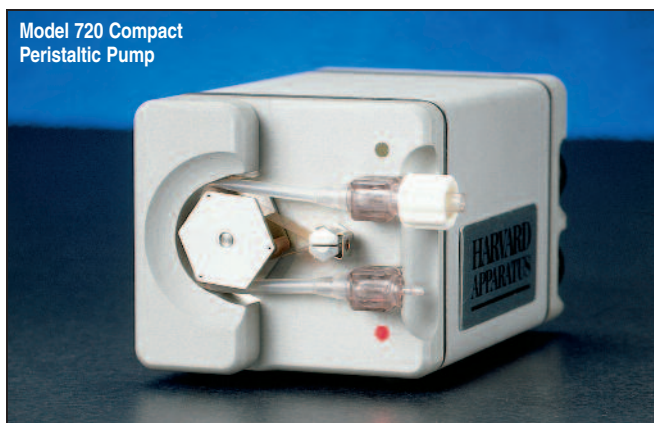
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Model 720

Compact Peristaltic Pump



- 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 EC1 61-0098 and EC1 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.

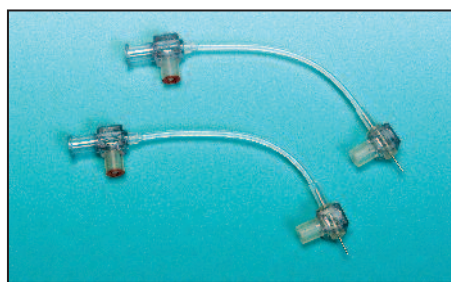
Frequently Ordered Tube Sets

Order #	Flow Rates with 72-0002 Pump	Flow Rates with 61-0098 or 61-0239 Pumps	Flow Rates with 72-0001 or 72-0008 Pumps	Typical Application
EC1 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)
EC1 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)
EC1 61-0243	0.08 to 1.8 ml/hr	0.8 to 21 ml/hr	9 to 170 ml/hr	General laboratory applications
EC1 61-0244	0.9 to 12 ml/hr	7 to 145 ml/hr	90 to 1100 ml/hr	General laboratory applications
EC1 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.

Specifications

Repeatability	$\pm 3\%$		
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
	EC1 72-0001	EC1 61-0098	EC1 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

EC1 61-0241	Silicone Tubing Set, 1-Ch, Female Luer to 22 ga, pkg. of 5
EC1 61-0242	Silicone Tubing Set, 1-Ch, Female Luer to 20 ga, pkg. of 5
EC1 61-0243	Silicone Tubing Set, 1-Ch, 0.062" ID Barbs, 0.8ml/hr, pkg. of 5
EC1 61-0244	Silicone Tubing Set, 1-Ch, 0.062" ID Barbs, 5ml/hr, pkg. of 5
EC1 61-0245	Silicone Tubing Set, 2-Ch, 0.062" ID Barbs, 3ml/hr, pkg. of 5



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VC-6 and VC-6M

Valve Control Systems

A multi-valve perfusion system – flexible design 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 Systems include 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).



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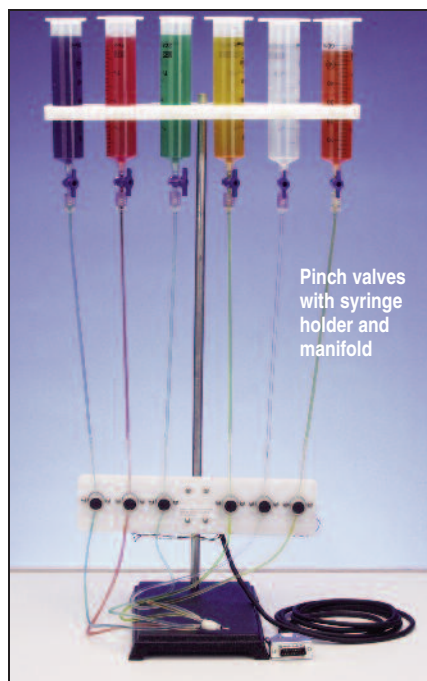
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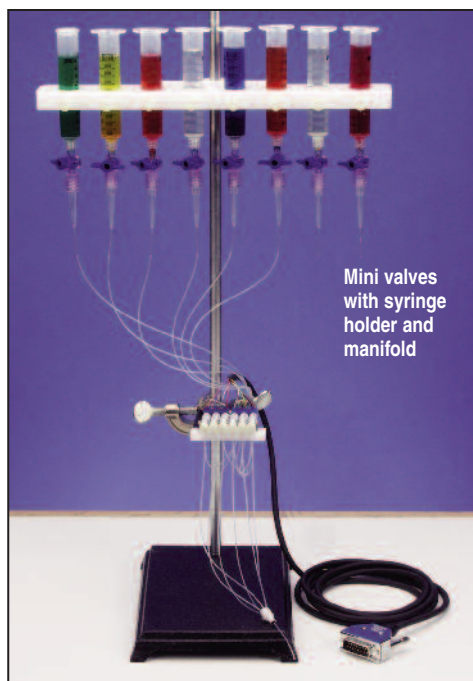
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VC-6 and VC-6M

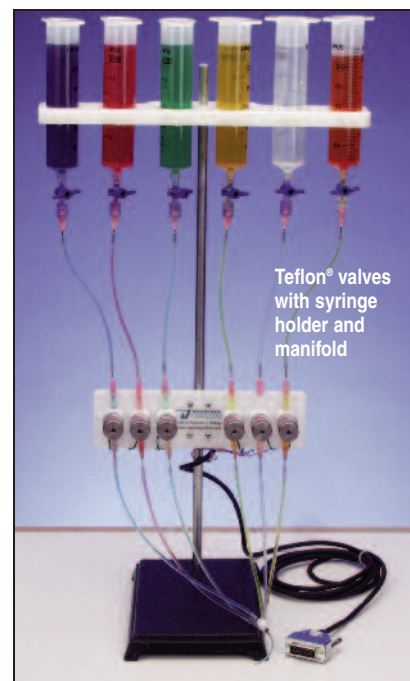
Valve Control Systems (continued)



Pinch valves
with syringe
holder and
manifold



Mini valves
with syringe
holder and
manifold



Teflon® valves
with syringe
holder and
manifold

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
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Size	8.9 x 20 x 25 cm (H x W x D)
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Warranty	Two year
----------	----------

Order # Model Product

Basic Perfusion Systems

EC1 64-0171	VC-66MBB	Mini-Valve Controller System, 6 Valves
EC1 64-0129	VC-66BB	Pinch Valve Controller System, 6 Valves
EC1 64-0132	VC-66BBT	Teflon® Valve Controller System, 6 Valves

Complete Perfusion Systems

EC1 64-0174	VC-66MCS	Mini-Valve Controller System, 6 Valves
EC1 64-0134	VC-64CS	Pinch Valve Controller System, 4 Valves
EC1 64-0135	VC-66CS	Pinch Valve Controller System, 6 Valves
EC1 64-0138	VC-66CST	Teflon® Valve Controller System, 6 Valves
EC1 64-0174LT	VC-66MLT	Controller System

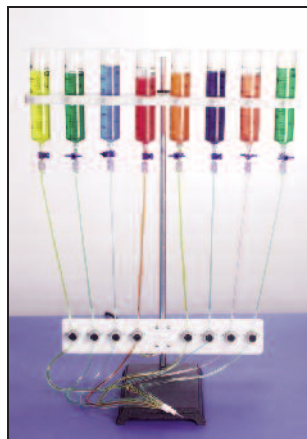
valve control systems

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

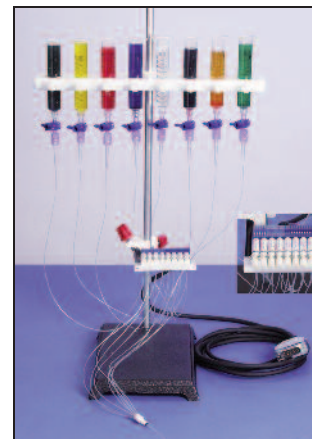
Valve Control Systems

A multi-valve perfusion system – flexible design for diverse applications

Model VC-8 Controller



Pinch Valve System



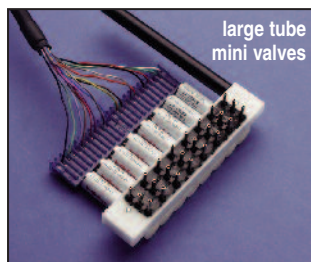
Mini-Valve System

- 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
EC1 64-0186	VC-8M	Valve Control System 8 mini valves
EC1 64-0186LT	VC-8MLT	Valve Control System 8 mini valves Large tubes for higher flow
EC1 64-0185	VC-8P	VC-8P Valve Control System 8 pinch valves
EC1 64-0187	VC-8T	Valve Control System 8 Teflon valves
EC1 64-1523	MAT-2	Overflow Sensor Fibretec Mats and Cable (4 Mats)

Parts and Accessories



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PV-1 replacement pinch solenoid valve



TV-2 replacement Teflon valve



SV-1 replacement mini solenoid valve



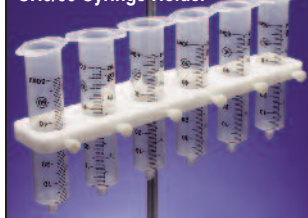
LPE Replacement Pipette Tips



DC-6 Drip Chambers



SH6/60 Syringe Holder



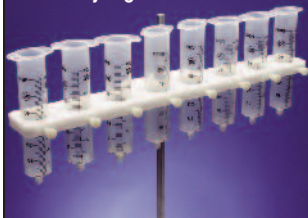
SH6/140 Syringe Holder



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



Order # Model Product

Replacement Valves for VC-6 Systems

EC1 64-0139	PV-1	Pinch Valve
EC1 64-0140	TV-2	Teflon® Valve
EC1 64-0175	SV-1	Mini Solenoid Valve

Accessories for VC-6 Systems

EC1 64-1428	LPE-10	Replacement Pipette Tips, pkg. of 10
EC1 64-0162	RS-1	Support Stand
EC1 64-0163	SH-6/60	Syringe Holder, six 60 cc syringes
EC1 64-0144	SH-6/140	Syringe Holder, six 140 cc syringes
EC1 64-0143	SH-8/10	Syringe Holder, eight 10 cc syringes
EC1 64-0385	SH-8/60	Syringe Holder, eight 60 cc syringes
EC1 64-0164	TC-3	Tubing Connectors (1/16 in ID), pkg. of 12 straight, 6 Y and 6 Luer Connectors
EC1 64-0165	SL-6	Stopcock with Luer Connector, pkg. of 6
EC1 64-1489	SN-18	Blunt End Needles 18 AWG, pkg. of 12
EC1 64-1490	SN-23	Blunt End Needles 23 AWG, pkg. of 12

Tubing for VC-6 Systems

EC1 64-0166	CFL-6	C-Flex (1/32 in x 6 ft, ID x L)
EC1 64-0168	TT-25	Teflon® (1/16 in x 25 ft, ID x L)
EC1 64-0167	TY-50	Tygon (1/16 in x 50 ft, ID x L)

Tubing for VC-6M Mini Systems

EC1 64-0752	PE-50/10	PE-50 Polyethylene Tubing, 10 ft
EC1 64-0753	PE-50/100	PE-50 Polyethylene Tubing, 100 ft

Additional PE Tubing

EC1 64-0754	PE-90/10	PE-90 Polyethylene Tubing, 10 ft
EC1 64-0755	PE-160/10	PE-160 Polyethylene Tubing, 10 ft
EC1 64-0756	PE-160/100	PE-160 Polyethylene Tubing, 100 ft

TY-50 Tygon Tubing





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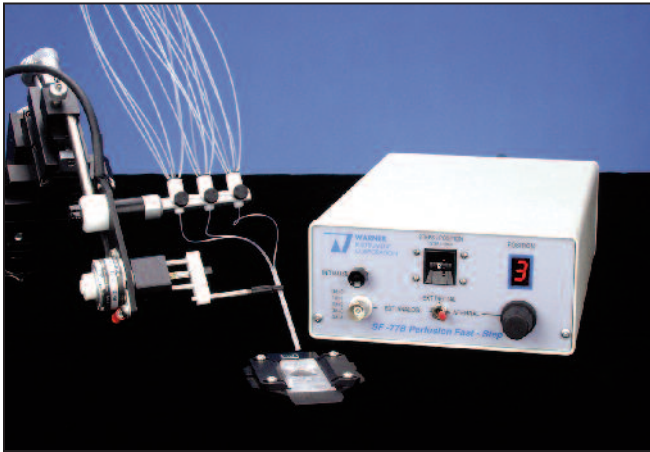
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SF-77B, SF-77BLT and SF-77BST

Perfusion Fast-Step

Highly effective stimulus solution delivery device



- 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 μ m 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 μ m and a barrel spacing of approximately 100 μ m. When using 100 μ m 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



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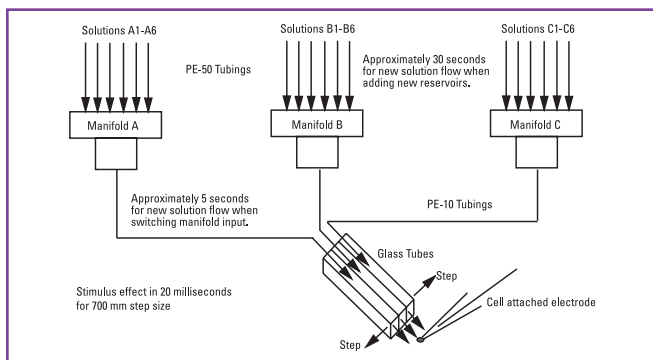
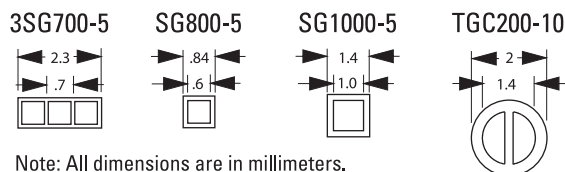
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SF-77B, SF-77BLT and SF-77BST

Perfusion Fast-Step (continued)



Specifications

Number of Steps	1 to 7 selectable
Step Size	Adjustable from 100 μ m to 1.5 mm steps in 100 μ m increments
Step Speed	Typically 20 msec for 700 μ m 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 MM-2, MM-4 and MM-6 manifolds use PE-50 tubing at input and PE-10 tubing at output
	ML Series ML-2, ML-4 and ML-6 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 μ l/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
EC1 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
EC1 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
EC1 64-0117	SF-77B/5M	Perfusion System with 5 manifolds, 115 VAC
EC1 64-1518	SF-77B/5M	Perfusion System with 5 manifolds, 220/240 VAC
EC1 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
EC1 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
EC1 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
EC1 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

EC1 64-0119	3SG700-5	3-Barrel Square Glass Tubes, 0.6 mm x 5 cm (ID x L), pkg. of 10
EC1 64-0120	3SG700-10	3-Barrel Square Glass Tubes, 0.6 mm x 10 cm (ID x L), pkg. of 10
EC1 64-0121	SG-800-5	Single Barrel Square Glass Tubes, 0.6 mm x 5 cm (ID x L), pkg. of 25
EC1 64-0122	SG-1000-5	Single Barrel Square Glass Tubes, 1 mm x 5 cm (ID x L), pkg. of 25
EC1 64-0124	GH-1	Glass Holder for 3SG700-5, 3SG700-10 and SG800-5 Glass
EC1 64-0125	GH-2T	Glass Holder for Theta Glass
EC1 64-0126	GH-10	Glass Holder for SG1000-5 Glass
EC1 64-0750	PE-10/10	Polyethylene Tubing 10 ft.
EC1 64-0752	PE-50/10	Polyethylene Tubing 10 ft.
EC1 64-0811	TG200-4	Theta Glass Tubes, 2.0 mm x 10 cm (OD x L), pkg. of 100



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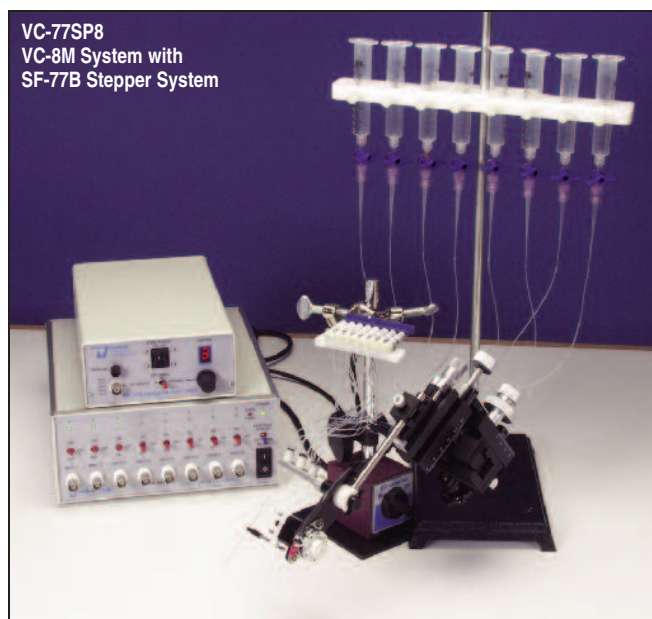
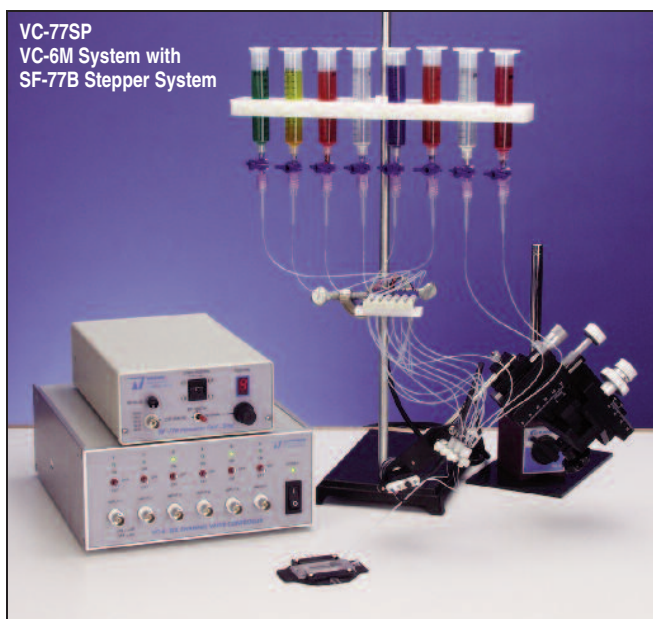
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VC-77SP and VC-77SP8

Perfusion Fast-Step

Mini-valve controller and fast stepper combo



- 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:

EC1 64-0174	VC-66MCS	Complete Mini-Valve System, 6-Channels
EC1 64-0114	SF-77B	Perfusion Fast-Step System
EC1 64-0056	MM-33R	Micromanipulator, Right Handed
EC1 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:

EC1 64-0186	VC-8M	Complete Mini-Valve System, 8-Channels
EC1 64-0114	SF-77B	Perfusion Fast-Step System
EC1 64-0056	MM-33R	Micromanipulator, Right Handed
EC1 69-0225	MB-B	Magnetic Base

For complete details of the VC-6 and VC-8 Complete Mini-Valve Perfusion Systems, see pages 76 to 78. For complete details on other Perfusion Fast-Step System, see pages 6 and 7.

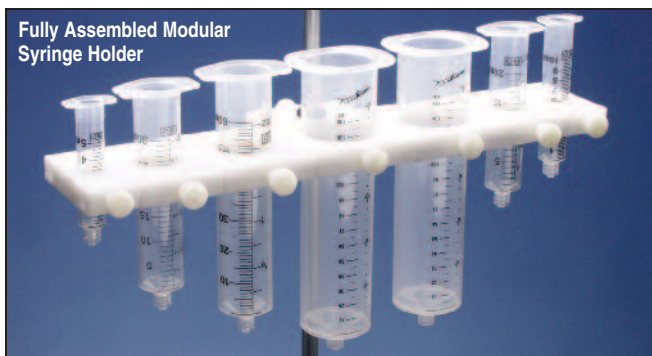
Order #	Model	Product
EC1 64-0177	VC-77SP	Complete VC-6 Fast-Step Perfusion System with right-handed micromanipulator, 115 VAC
EC1 64-1519	VC-77SP	Complete VC-6 Fast-Step Perfusion System with right-handed micromanipulator, 220/240 VAC
EC1 64-0177L	VC-77SPL	Complete VC-6 Fast-Step Perfusion System with left-handed micromanipulator, 115 VAC
EC1 64-0177LE	VC-77SPLE	Complete VC-6 Fast-Step Perfusion System with left-handed micromanipulator, 220 VAC
EC1 64-1590	VC-77SP8	Complete VC-8 Fast-Step Perfusion System with right-handed micromanipulation, 115 VAC
EC1 64-1590E	VC-77SP8E	Complete VC-8 Fast-Step Perfusion System with right-handed micromanipulation, 220 VAC
EC1 64-1509L	VC-77SP8L	Complete VC-8 Fast Step Perfusion System with left-handed micromanipulator, 115 VAC
EC1 64-1509EL	VC-77SP8EL	Complete VC-8 Fast Step Perfusion System with left-handed micromanipulator, 220/240 VAC

MSH and SH Series

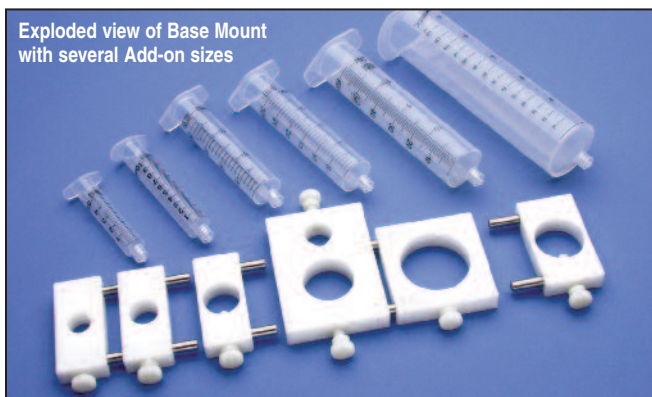
Modular and Fixed Syringe Holders Series

Designed to Fit 5, 10, 20, 30, 60, and 140 cc Syringes

Fully Assembled Modular Syringe Holder



Exploded view of Base Mount with several Add-on sizes

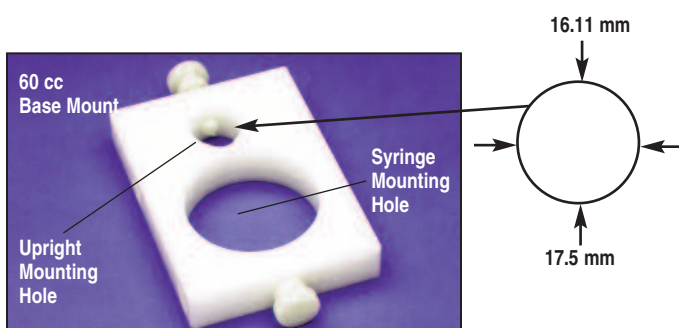


MSH Series Holder System

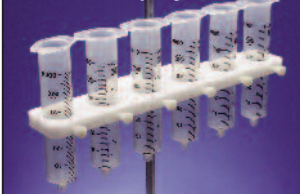
The Modular Syringe Holder System offers users the ability to assemble a family of differently sized syringes into a single apparatus. Warner Instruments offers a full range of add-on holders to fit every application. Made from high quality Delrin and 316 stainless steel, this system assures excellent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



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

Order # Model Product

Base Mounts

EC1 64-0145	MSH/5M	Syringe Base Mount, 5 cc
EC1 64-0146	MSH/10M	Syringe Base Mount, 10 cc
EC1 64-0147	MSH/20M	Syringe Base Mount, 20 cc
EC1 64-0148	MSH/30M	Syringe Base Mount, 30 cc
EC1 64-0149	MSH/60M	Syringe Base Mount, 60 cc
EC1 64-0150	MSH/140M	Syringe Base Mount, 140 cc

Add-on Units

EC1 64-0151	MSH/5	Syringe Add-On, 5 cc
EC1 64-0152	MSH/10	Syringe Add-On, 10 cc
EC1 64-0153	MSH/20	Syringe Add-On, 20 cc
EC1 64-0154	MSH/30	Syringe Add-On, 30 cc
EC1 64-0155	MSH/60	Syringe Add-On, 60 cc
EC1 64-0156	MSH/140	Syringe Add-On, 140 cc

Fixed Syringe Holders

EC1 64-0143	SH-8/10	Syringe Holder, 8 x 10 cc syringes
EC1 64-0163	SH-6/60	Syringe Holder, 6 x 60 cc syringes
EC1 64-0385	SH-8/60	Syringe Holder, 8 x 60 cc Syringes
EC1 64-0144	SH-6/140	Syringe Holder, 6 x 140 cc Syringes

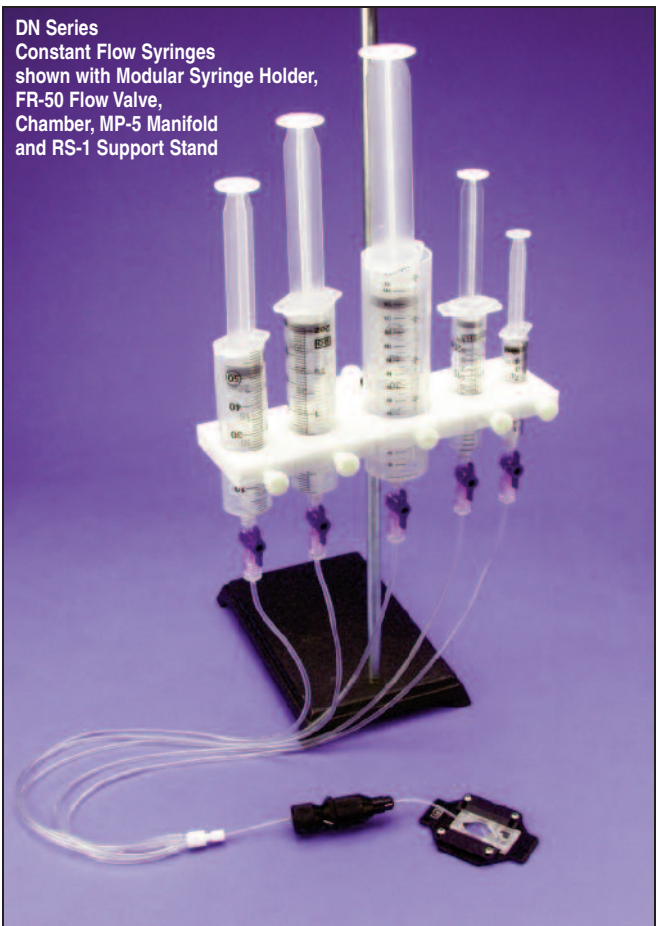
Accessories and replacement parts

EC1 64-0165	SL-6	Stopcock with Luer Connector, pkg. of 6
EC1 64-0162	RS-1	Support Stand

DN Series

Constant Flow Syringes

Eliminates changes in flow rate as the reservoir empties



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 volume 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 13.

If you want to use the DN Series of 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	EC1 64-0146	EC1 64-0152
10 cc	20 cc	EC1 64-0147	EC1 64-0153
20 cc	60 cc	EC1 64-0149	EC1 64-0155
30 cc	60 cc	EC1 64-0149	EC1 64-0155
60 cc	140 cc	EC1 64-0150	EC1 64-0156

Order #	Model	Product
EC1 64-0157	DN/5	Constant Flow Syringe, 5 cc, pkg. of 6
EC1 64-0158	DN/10	Constant Flow Syringe, 10 cc, pkg. of 6
EC1 64-0159	DN/20M	Constant Flow Syringe, 20 cc, pkg. of 6
EC1 64-0160	DN/30M	Constant Flow Syringe, 30 cc, pkg. of 6
EC1 64-0161	DN/60M	Constant Flow Syringe, 60 cc, pkg. of 6

Accessories and replacement parts

EC1 64-0220	FR-50	Flow Valve
EC1 64-0221	FR-55S	Flow Valve with On-Off Switch
EC1 64-0165	SL-6	Stopcock w/Luer Connector, pkg. of 6
EC1 64-0162	RS-1	Support Stand
EC1 64-0209	MP-5	5 to 1 Perfusion Manifold
EC1 64-0755	PE-160/10	PE-160 Polyethylene Tubing, 10 ft
EC1 64-0756	PE-160/100	PE-160 Polyethylene Tubing, 100 ft



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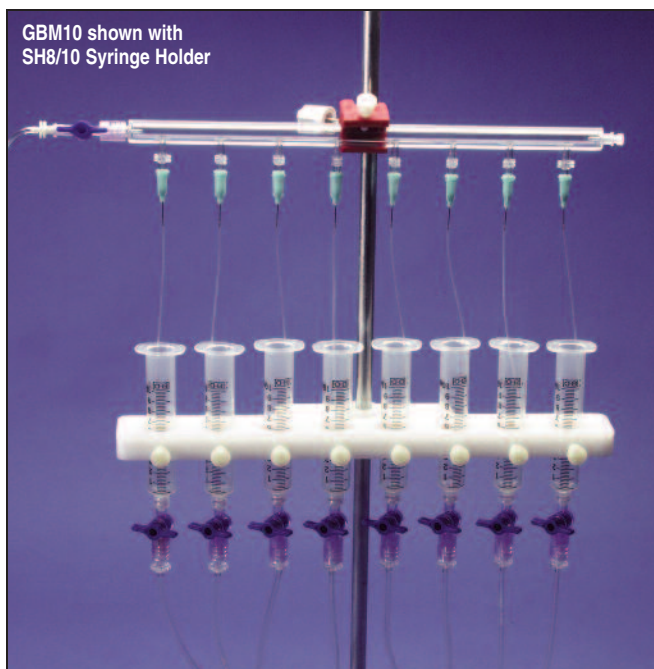
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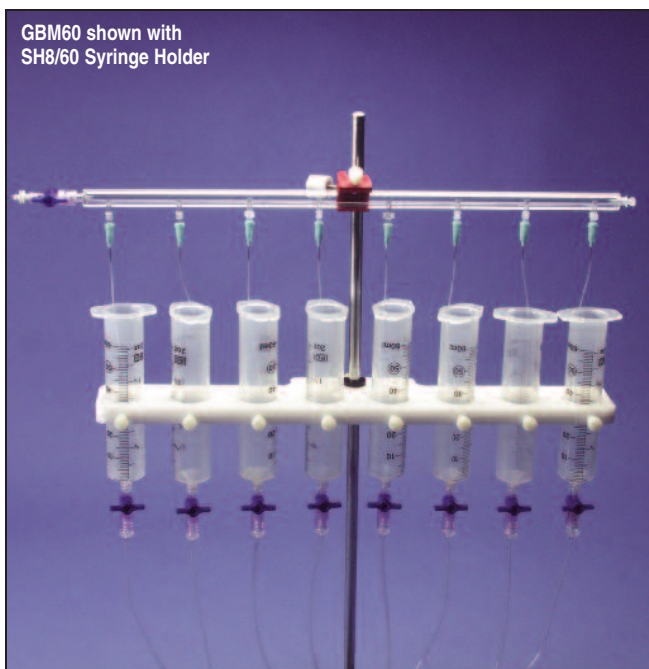
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GBM10 and GBM60

Gas Bubbler Manifold



accessories



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.

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

Order #	Model	Product
EC1 64-1587	GBM10	Gas Bubbler Manifold for 10 cc syringes
EC1 64-1588	GBM60	Gas Bubbler Manifold for 60 cc syringes
EC1 64-0752	PE-50/10	PE-50 Polyethylene Tubing, 10 ft
EC1 64-0753	PE-50/100	PE-50 Polyethylene Tubing, 100 ft

Tubing and Connector Kit, Syringe Needles



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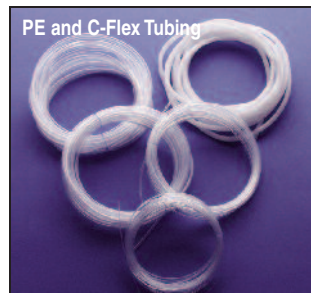
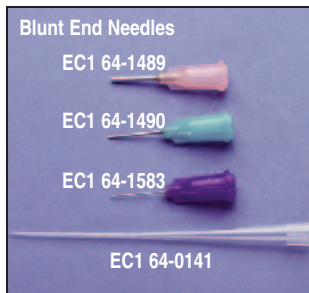
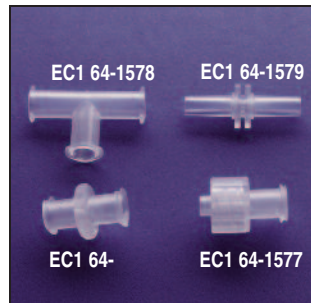
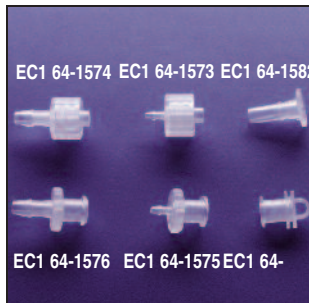
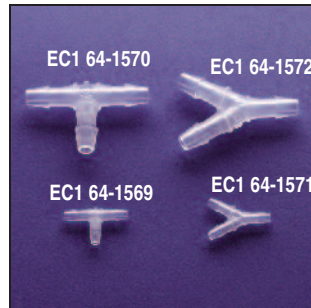


Warner Instruments offers a complete tubing and connector kit. This kit is ideal for use with Warner's Imaging and Recording Chambers. The kit is comprised of barbed and Luer fittings, blunt end needles, and an assortment of PE and C-Flex tubing. All barbed and Luer fittings are made from polypropylene 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
EC1 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 #	Model	Product	Kit Qty
EC1 64-1566		Tube Fitting Barb 1/8 To 1/8 in	10
EC1 64-1567		Tube Fitting Barb 1/8 To 1/8 in	10
EC1 64-1568		Tube Fitting Barb 1/8 To 1/8 in	10
EC1 64-1569		Tube Fitting Tee Barb 1/8 in	10
EC1 64-1570		Tube Fitting Tee Barb 1/8 in	10
EC1 64-1571		Tube Fitting Y Barb 1/8 in	10
EC1 64-1572		Tube Fitting Y Barb 1/8 in	10
EC1 64-1573		Tube Fitting Barb 1/8 in To Luer Male	10
EC1 64-1574		Tube Fitting Barb 1/8 in To Luer Male	10
EC1 64-1575		Tube Fitting Barb 1/8 in To Luer Female	10
EC1 64-1576		Tube Fitting Barb 1/8 in To Luer Female	10
EC1 64-1577		Tube Fitting Luer Male To Luer Female	10
EC1 64-1578		Tube Fitting Luer Tee Female	10
EC1 64-1579		Tube Fitting Luer Male To Luer Male	10
EC1 64-1580		Tube Fitting Luer Female To Luer Female	10
EC1 64-1581		Tube Fitting Luer Female Plug	10
EC1 64-1582		Tube Fitting Luer Male Plug	10
EC1 64-1489	SN-18	Blunt Needle plastic hub, 18G, 0.5 in	12
EC1 64-1490	SN-23	Blunt Needle plastic hub, 23G, 0.5 in	12
EC1 64-1583	SN-30	Blunt Needle plastic hub, 30G, 0.5 in	12
EC1 64-0141	LPE-50	Luer to PE-50 tubing adapter	8
EC1 64-0166	CFL-6	C-Flex tubing (1/2 in ID x 6 ft) 1/2 OD mm	6'
EC1 64-0750	PE-10/10	Polyethylene Tubing 0.28 ID x 0.61 OD mm	10'
EC1 64-0752	PE-50/10	Polyethylene Tubing 0.58 ID x 0.97 OD mm	10'
EC1 64-0754	PE-90/10	Polyethylene Tubing 0.86 ID x 1.27 OD mm	10'
EC1 64-0755	PE-160/10	Polyethylene Tubing 1.14 ID x 1.57 OD mm	10'



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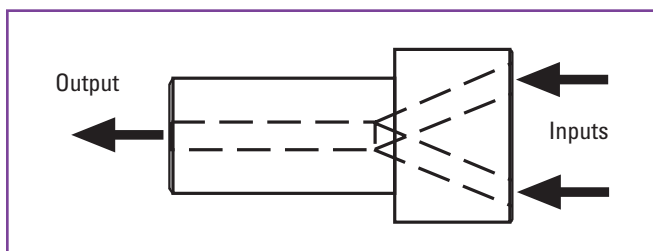
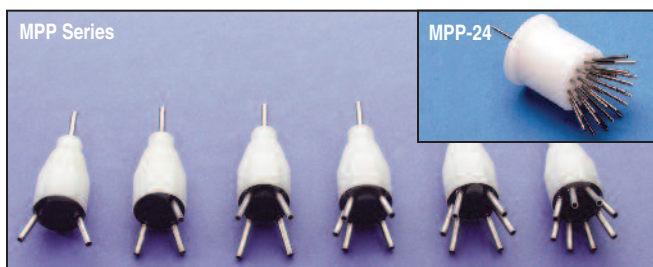
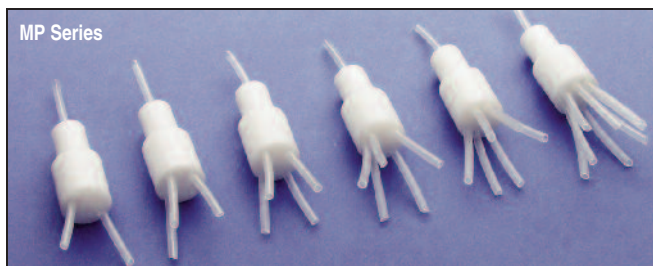
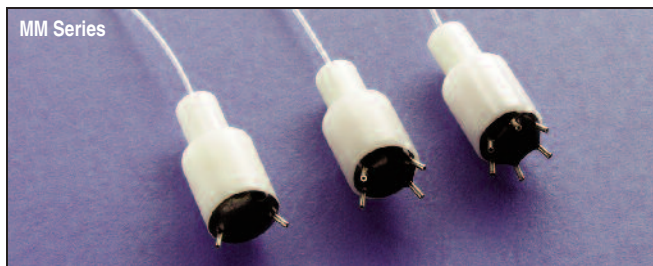
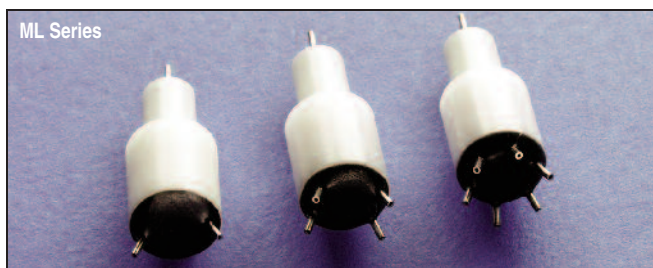
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ML, MM, MP and MPP Series

Manifolds and Flow Control Hardware

accessories



	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
EC1 64-0200	ML-2	Miniature Manifold, 2 ports
EC1 64-0201	ML-4	Miniature Manifold, 4 ports
EC1 64-0202	ML-6	Miniature Manifold, 6 ports
EC1 64-0199	ML-8	Miniature Manifold, 8 ports
EC1 64-0203	MM-2	Miniature Manifold, 2 ports
EC1 64-0204	MM-4	Miniature Manifold, 4 ports
EC1 64-0205	MM-6	Miniature Manifold, 6 ports
EC1 64-0206	MP-2	MP Manifold, 2 ports
EC1 64-0207	MP-3	MP Manifold, 3 ports
EC1 64-0208	MP-4	MP Manifold, 4 ports
EC1 64-0209	MP-5	MP Manifold, 5 ports
EC1 64-0210	MP-6	MP Manifold, 6 ports
EC1 64-0211	MP-8	MP Manifold, 8 ports
EC1 64-0212	MPP-2	MPP Manifold, 2 ports
EC1 64-0213	MPP-3	MPP Manifold, 3 ports
EC1 64-0214	MPP-4	MPP Manifold, 4 ports
EC1 64-0215	MPP-5	MPP Manifold, 5 ports
EC1 64-0216	MPP-6	MPP Manifold, 6 ports
EC1 64-0217	MPP-8	MPP Manifold, 8 ports
EC1 64-0339	MPP-24	MPP Manifold, 24 ports



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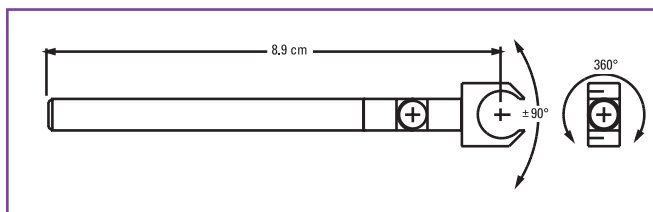
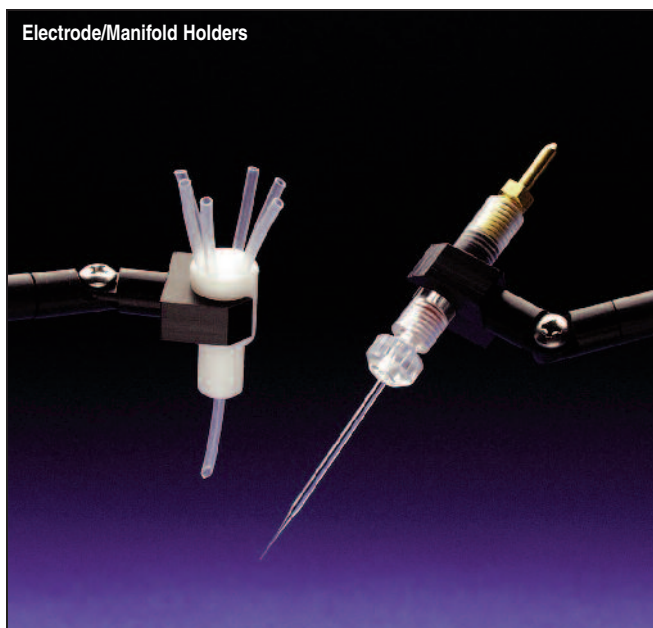
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MHH-25/MHH-38 and FR-50/FR-55S

Manifolds and Flow Valves



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 $\pm 90^\circ$ 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
EC1 64-0218	MHH-25	Holder for 6.3 mm (1/4 in) Devices
EC1 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
EC1 64-0220	FR-50	Flow Valve
EC1 64-0221	FR-55S	Flow Valve with On-Off Switch

Harvard CO₂ Gas/pH Controller



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Precise solution pH control using CO₂ gas



- CO₂ 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" CO₂ through the solution or flowing gas over the surface of the medium. CO₂ 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 CO₂ 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 CO₂ 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 CO₂ gas delivery.

By-Pass Mode: the flow of CO₂ is continuous and the flow rate is controlled by adjustment of the regulator.

Momentary Mode: CO₂ 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 CO₂ 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	12 VDC (Universal 90/240 VAC, 50/60 Hz adapter)
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
EC1 70-2116		Harvard CO ₂ Gas/pH Controller
Accessories and Replacement Parts		
EC1 69-0494		Replacement pH Electrode
EC1 65-0105		Input/Output Connector Fitting, pkg. of 5
EC1 72-1015	R-3603	Tygon Tubing, ¼ x ⅝ in (OD x ID x 50 ft)



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Oxystreamer®

Dual Stream O₂ and CO₂ Controller

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



- Provides two identical streams of any mix of O₂ and CO₂ 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 inherent 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.**

gas controllers

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 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 Adapters
Weight	4.54 kg (10 lbs)

Order #	Model	Product
EC1 64-0383	SL ₂ CO	Oxystreamer – 0 to 50 ml/min max

spill detection



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OS-250

Overflow Sensor System

Because microscopes and liquids don't mix

Control Unit



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

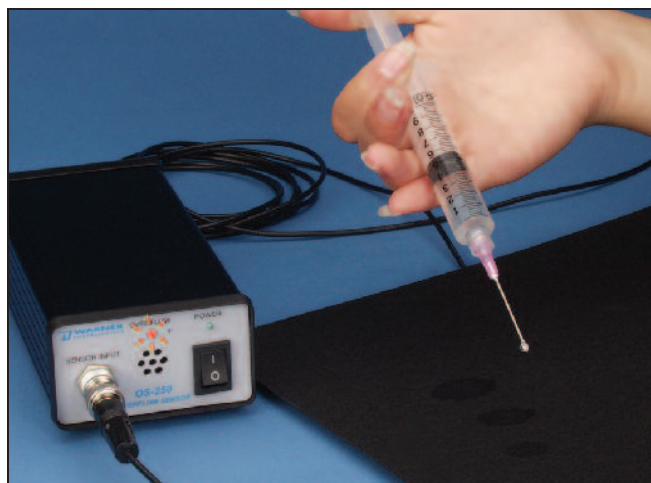
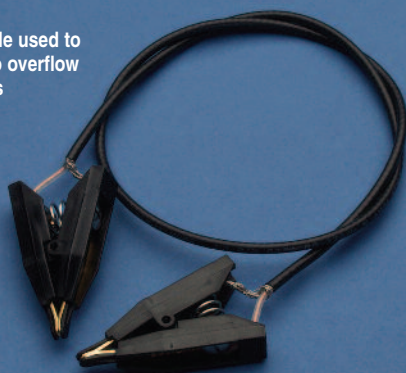
Warner Instruments is pleased to provide a product designed to detect solution leaks on your microscope before they cause a problem. As little as 3 drops of liquid will cause the OS-250 to react.

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.

JC-1

Jumper cable used to
connect two overflow
sensor mats



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

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
EC1 64-1520	OS-250	Overflow Sensor System

Accessories and Replacement Parts

EC1 64-1522	MAT-1	Overflow Sensor Replacement Mats, set of 4
EC1 64-1523	MAT-2	Overflow Sensor Mats and Cable (4 Mats)
EC1 64-1589	JC-1	Jumper Cable used to connect two overflow sensor mats



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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 as 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
EC1 64-1546		Spill Sensor System, Battery Powered

Accessories and Replacement Parts

EC1 64-1522	MAT-1	Overflow Sensor Replacement Mats, set of 4
EC1 64-1523	MAT-2	Overflow Sensor Mats and Cable (4 Mats)
EC1 64-1589	JC-1	Jumper cable used to connect two overflow sensor mats