

Electrophysiology & Live-Cell Imaging



- Chambers
- Perfusion
- Temperature control
- Patch Clamp and oocyte electrophysiology



Introduction

Leveraging the combined expertise of three industry-leading brands (HEKA, Multi Channel Systems, and Warner Instruments), Smart Ephys is proud to offer a wide range of versatile, integrated solutions designed to address the needs of electrophysiology & live cell imaging research.

We are happy to assist in finding the right instruments for your application and to help you assemble the best products for a complete rig. For convenience, most of these products can be accessed at www.warneronline.com.

Warner Instruments offers a range of amplifiers optimized for many electrophysiological applications, including:

- Patch clamp
- Oocyte clamp
- Extracellular
- Intracellular
- Epithelial transport (Ussing)



An Integrated Systems Approach



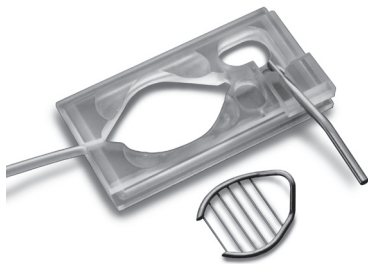
The Complete Rig

Our expert application scientists will consult with you to identify the best components needed to assemble a complete rig.



Heated Platforms

Platforms function as the base for Series 20 Chambers and provide clamping to make a seal between the chamber and coverslip.



Recording Chambers and Slice Anchors

Our chamber selection guide, available online and in our print catalog, is useful for choosing the best chamber for your experiment. The guide lists chambers by application, bath type, bath volume, and coverslip size.



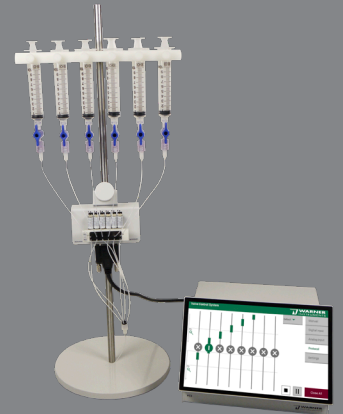
Stage Adapters

Stage adapters are available for all major microscopes and stages currently on the market.



Solution Heaters

In-line solution heaters are a simple and effective way to warm solutions flowing into Series 20 Chambers.



Valve Controllers

Our perfusion valve control systems are robust, easy to operate, and designed to control six or eight valves. There are several types of valves to choose from. Gravity or pressure driven systems available.

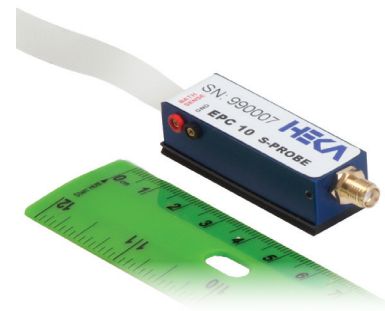


Temperature Controllers

Available in dual and single channel versions for heat only and peltier driven peripherals. All temperature controllers use ultra low noise power supplies for sensitive electrophysiology recording.

Recording

Patch Clamp Recording



HEKA EPC 10 USB Amplifier and PATCHMASTER NEXT

Warner Instruments can now provide the gold standard in the field of patch clamp amplifiers, the HEKA EPC 10 USB. Combining it with the amplifier control, acquisition and analysis software, PATCHMASTER NEXT, it creates a complete patch clamp system that allows data generation from a variety of recording configurations:

- Whole cell recordings (conventional and perforated)
- Single channel recordings
- Bilayer recordings
- Loose Patch recordings
- Intracellular voltage recordings with high resistance electrodes
- And many more

The main technical features of the EPC 10 USB which make it a unique instrument include:

- Integrated acquisition board for low noise and easy setup
- Fully computer controlled; allows complete automation of experiments
- Optional small S-Probe headstage, only 49 x 17 x 14.5 mm, 25 g
- Optional bath sense for amperometry
- 1–4 headstages
- Linking two instruments supports up to 8 headstages
- 3 feedback resistors per headstage
- Onsite, user-performed calibration of headstage

To ensure full functionality, the EPC 10 USB computer controlled amplifier and acquisition system has to be combined with the appropriate software; a PATCHMASTER NEXT license is included with each of the systems listed. Please learn more about PATCHMASTER NEXT in the Acquisition and Software section. Upon user request, we can provide a direct link library (dll) that allows the use of custom-made software (e.g., Matlab® or C) to control the hardware.

SELECTED SPECIFICATIONS

Amplification range	0.005 mV/pA up to 2000 mV/pA
Holding potential	Up to $\pm 2V$
Bandwidth	Up to 100 KHz
Noise in medium gain range including acquisition board	Up to 1 kHz: ~ 180 fA rms (theoretical limit) Up to 3 kHz: ~ 320 fA rms (theoretical limit) Up to 10 kHz: ~ 580 fA rms
Noise in high gain range including acquisition board	Up to 1 kHz: ~ 31 fA rms Up to 3 kHz: ~ 72 fA rms Up to 10 kHz: ~ 350 fA rms
Filter 1	10KHz, 30 KHz, 100 KHz using 6 pole Bessel and HQ
Filter 2	100 Hz – 15 KHz using 4-pole Bessel or Butterworth
Current range	Low gain: $\pm 2 \mu A$ Medium gain: ± 20 nA High gain: ± 200 pA
Digital IO	16 digital outputs and 16 input channels including trigger
Analog IO	Up to 5 analog input channels, up to 3 output channels

ORDERING INFORMATION

Order #	Product
89-5273	EPC 10 USB System with Red Star Headstage
89-5274	EPC 10 USB Double System with Red Star Headstages
89-5275	EPC 10 USB Triple System with Red Star Headstages
89-5276	EPC 10 USB Quadro System with Red Star Headstages
89-5277	EPC 10 USB System with S-Probe Headstage
89-5278	EPC 10 USB Double System with S-Probe Headstages
89-5279	EPC 10 USB Triple System with S-Probe Headstages
89-5280	EPC 10 USB Quadro System with S-Probe Headstages

*Contact sales for information about units without software included.



EPC 800 USB

HEKA EPC 800 USB

The EPC 800 USB is a hybrid amplifier that can either be operated remotely with the appropriate HEKA software or the dII (similar to the EPC 10 USB) or in manual mode using the front panel controls. In contrast to other manually controlled amplifiers, the EPC 800 USB provides front panel controls, automatic compensation of pipette capacitance, cell capacitance and serial resistance as well as all offsets. The EPC 800 USB technology is similar to the EPC 10 USB, but it does not include a built-in data acquisition board. Therefore it can be paired with any data acquisition system suitable for patch clamp recordings.

ORDERING INFORMATION

Order #	Product
89-5004	EPC 800 USB patch clamp amplifier, Single

SELECTED SPECIFICATIONS

Amplification range	0.005 mV/pA up to 2000 mV/pA
Holding potential	Up to ± 1 V
Bandwidth	Up to 100 KHz
Noise in medium gain range including acquisition board	(measured with an open input, 8-pole Bessel filter including acquisition board and 50 G Ω resistor) DC to 1 kHz < 0.03 pA RMS DC to 3 kHz < 0.08 pA RMS DC to 10 kHz < 0.225 pA RMS
Filter 1 + 2	6 pole + 4 pole Bessel, 100 Hz-100 KHz
Current range	Low gain: ± 2 μ A Medium gain: ± 20 nA High gain: ± 200 pA
Telegraphing output	Gain, Filter, C _{Slow} Mode (VC/CC)

Acquisition Hardware



LIH 8+8

HEKA LIH 8+8

The HEKA EPC10 USB amplifiers feature an integrated acquisition board. All other HEKA, as well as the Warner amplifiers require an acquisition system for recording and stimulation with PATCHMASTER NEXT or CHARTMASTER. The HEKA LIH 8+8 acquisition system samples with up to 200 KHz and two instruments can be linked to increase the number of recording channels. The LIH 8+8 connects to a Windows PC or Apple OS computer via a USB 2.0 port.

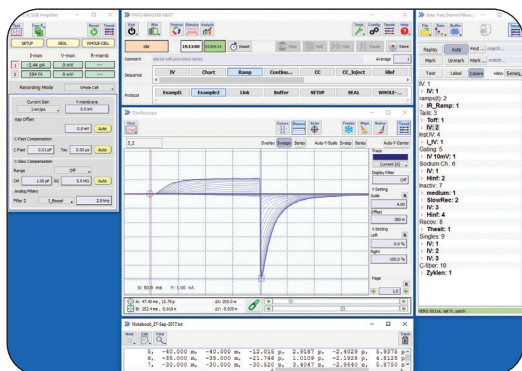
SELECTED SPECIFICATIONS

Digital IO TTL 3.3V and 5V compatible	16 digital outputs and 16 input channels including trigger
Analog Inputs	8 channels, ± 10 V
Analog Outputs	4 channels, ± 10 V

ORDERING INFORMATION

Order #	Product
89-5035	LIH 8+8

Recording Software



HEKA PATCHMASTER NEXT

PATCHMASTER NEXT provides all the same functionality as the older PATCHMASTER but with a new, restructured, and more modern user interface. This improved version of PATCHMASTER is much easier to program and use. As before, PATCHMASTER NEXT provides amplifier control and data acquisition and analysis capabilities. It also allows the user to automate their entire experiment and features built-in functionality for many other extensions (LockIn, imaging, spectroscopy, photometry). This makes PATCHMASTER NEXT the most versatile patch clamp software available.

Both software packages feature:

- Extended real time analysis
- Comfortable data management
- Solution management
- Export of data to e.g. Matlab, Igor, ASCII and others
- Software updates are always free of charge.

Contact sales for more information on iOS compatibility and additional imaging functionality through SmartLux.

HEKA CHARTMASTER

CHARTMASTER is identical to the original PATCHMASTER with the exception that it lacks the EPC10 amplifier control capability. This makes CHARTMASTER the right tool for working with non-HEKA amplifiers.

ORDERING INFORMATION	
Order #	Product
89-5245	PATCHMASTER NEXT
89-5048	CHARTMASTER
89-5050	SmartLux Imaging Add-on

HEKA FITMASTER

HEKA FITMASTER provides extensive offline-analysis of data collected either with CHARTMASTER or PATCHMASTER.

- Import data recorded with PATCHMASTER or CHARTMASTER
- Import data in ASCII-format
- Curve fitting via parameter optimization: exponential, polynomial, Hodgkin-Huxlet, Gaussian and more
- Action potential analysis

Software updates are free of charge.

ORDERING INFORMATION	
Order #	Product
89-5046	FITMASTER
89-5047	FITMASTER Professional, GLP standard

We offer a free webinar that supports beginners getting started with PATCHMASTER NEXT software.



Microelectrode Holders



Warner holders

Warner Instruments' precision made holders are ideal for any application which uses fluid filled glass microelectrodes and micropipettes. They provide the important link between live cells and high impedance amplifiers in applications such as patch clamp recording, intracellular and extracellular recordings, iontophoresis and ion specific measurements.

Our standard microelectrode holders are available in numerous choices of ports and venting, body style and electrical coupling.

Holder Materials

The highest quality materials are used in the fabrication of Warner electrode holders. Holder bodies and caps are made from either acrylic or polycarbonate, and are annealed and vapor polished.

Glass Size

To insure a good fit, holders are bored for specific glass sizes. Standard bore sizes are 1.0, 1.2, 1.5, 1.7 and 2.0 mm. The bore is made 0.1 mm oversize to accommodate small variations in glass diameters. Tightening the threaded end cap compresses a silicone rubber gasket providing a good seal around the glass.

Headstage Connections

Competitively priced holders are available for virtually any commercially available headstages in use. This includes headstages made by Axon, HEKA, Warner, and others.

Below are some examples of popular HEKA and Warner electrode holders, for a complete list please visit our website. We also stock capillary glass tubing, reference cells, silver wire, and replacement components to rebuild our pipette holders.

Warner

ORDERING INFORMATION		
Order #	Model	Product
64-0827	QSW-B15P	Q Series holder, port, straight style, fits 1.5 mm capillary, Ag wire (Heka)
64-0839	QSW-T15P	Q Series holder, port, straight style, fits 1.5 mm, Ag wire (Axon)



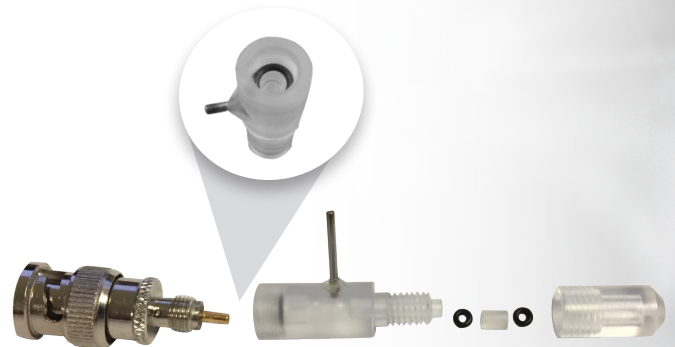
HEKA holders

HEKA's pipette holders are made of extremely low-noise polycarbonate material and offers two major improvements that virtually eliminate pipette movement and air leakage by elongating the holder's cap and the addition of a third O-ring.

The longer cap allows for the insertion of a small polycarbonate cylinder, keeping the first O-ring firmly in place, even after removal of the cap for cleaning purposes.

The second O-ring is nestled at the other end of the short cylinder featuring a precision mill cut that holds it in place.

The design provides the highest pipette stability, eliminates air leaks, and extends the life time of O-rings. Most importantly, this holder will increase the rate of successful recordings and increase productivity.



Exploded view of holder components

HEKA

ORDERING INFORMATION	
Order #	Product
89-5229	Pipette holder BNC Type 1.5mm
89-5150	Pipette holder SMA Type 1.5mm (for S-Probe)

Recording & Imaging Chambers

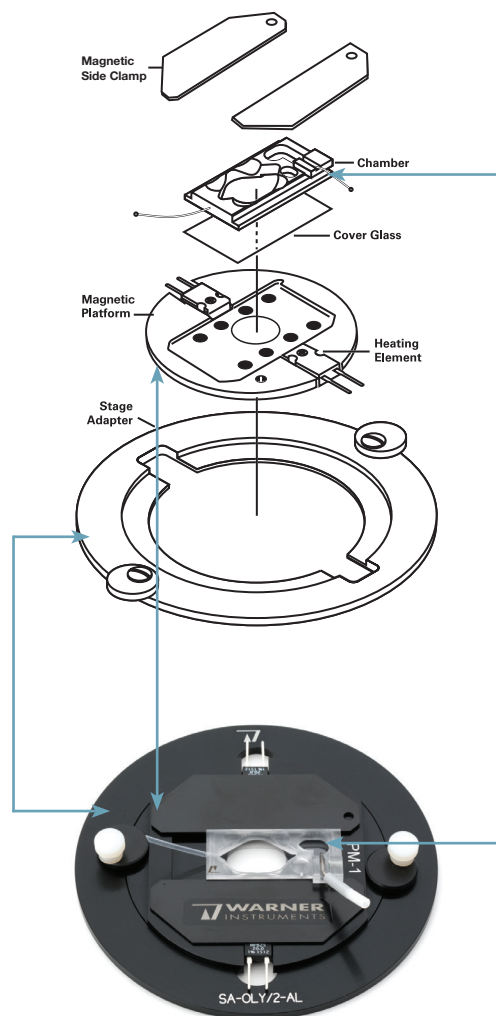


Warner Instruments is the industry standard when it comes to imaging and recording chambers. We offer a wide variety of specialty chambers accommodating many applications. We also provide stage adapters to match almost every microscope stage.

Several components are needed for the proper use of an imaging and recording chamber:

- Chamber and coverslip (included)
- Platform
- Stage adapter

Image courtesy of Alison North
Rockefeller University.

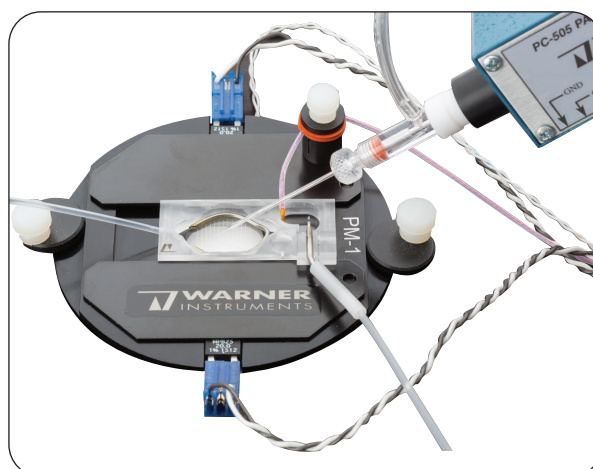


*Chamber and platform with
Olympus inverted stage adapter*

The image on the right illustrates how the components assemble to form a system.

The coverslip is sealed to the chamber and the sample is placed on the coverslip. If using slice preparations, the slice is held in place using a slice anchor (or hold-down) specifically designed for the chamber in use. Those hold-downs are press-fit into the respective chamber and are not weight dependent.

The chamber is placed into a platform. Warner Instruments has two platform styles available, with the magnetic design being simpler to use and much more convenient. The platform is then placed in a stage adapter which allows all Warner products to be placed onto a microscope stage.



RC-26 chamber with slice anchor and patch electrode

Finding Chambers by Application



This table lists applications with suitable chambers.



APPLICATION	CHAMBER
Closed Bath Chambers	RC-20 and RC-20H Small Volume Closed Bath Imaging Chambers
	RC-21BR Large Closed Diamond Bath
	RC-21BRFS Slotted Bath with Field Stimulation
	RC-30HV, and RC-30WA Confocal Imaging Chambers
	RC-37 Series Perfusion Inserts for 35 mm Dishes
	QR-43C Closed Bath Chamber
Field Stimulation Chambers	RC-21BRFS Slotted Bath with Field Stimulation
	RC-27NE Narrow Bath Chamber with Field Stimulation
	RC-37 Series Perfusion Inserts for 35 mm Dishes
	RC-49MFSH magnetic imaging/recording chamber
	QR-47FSLP Slotted Bath Chambers
Large Volume Chambers (> 300 µl)	RC-21BR Large Closed Diamond Bath
	RC-27 Large Rectangular Open Bath Chamber
	RC-27D and RC-27LD Ultra-quiet Imaging Chambers for Slice Studies
	RC-27N Narrow Rectangular Baths
	RC-27NE Narrow Bath Chamber with Field Stimulation
	RC-27L Large Bath Chamber with Slice Supports
	RC-30HV, and RC-30WA Confocal Imaging Chambers
	QR-40HP High Profile Open Bath Chamber
	QR-40LP, QR-41LP, QR-42LP, and QR-48LP Low Profile Open Bath Chambers
Microincubation Chambers	PDMI-2 Open Perfusion Micro-Incubator
	DH-35 Culture Dish Heater
	DH-35i Culture Dish Incubator
	DH-40i Micro-Incubation System
	QE-1 Quick Exchange Platform
	QE-2 Quick Exchange Heated Platform with Perfusion
	QR-40HP High Profile Open Bath Chamber
	QR-40LP, QR-41LP, QR-42LP, and QR-48LP Low Profile Open Bath Chambers
	QR-43C Closed Bath Chamber
	QR-47FSLP Slotted Bath Chambers
Oocyte Chambers	RC-1Z Oocyte Recording Chamber
	RC-3Z Oocyte Recording Chamber
	RC-26Z Open Diamond Bath for Oocyte Studies
	QR-40HP High Profile Open Bath Chamber
	QR-40LP, QR-41LP, QR-42LP, and QR-48LP Low Profile Open Bath Chambers
Patch Clamp Chambers	RC-24 and RC-24E Fast Exchange Diamond Bath Chambers
	RC-24N Fast Exchange Open Diamond Bath
	RC-25 and RC-25F Open Diamond Bath Chambers for Round Coverslips
	RC-26 and RC-26G Open Diamond Bath
	RC-26GLP Low Profile Open Diamond Bath
	QR-40HP High Profile Open Bath Chamber
	QR-40LP, QR-41LP, QR-42LP, and QR-48LP Low Profile Open Bath Chambers
	QR-47FSLP Slotted Bath Chambers
Suitable for Upright Microscopy	RC-1Z Oocyte Recording Chamber
	RC-3Z Oocyte Recording Chamber
	RC-21BDW Open Diamond Bath and RC-21BR Large Closed Diamond Bath
	RC-21BRFS Slotted Bath with Field Stimulation
	RC-21BRW Open Round Bath
	RC-25 and RC-25F Open Diamond Bath Chambers for Round Coverslips
	RC-26 and RC-26G Open Diamond Bath
	RC-26GLP Low Profile Open Diamond Bath
	RC-26Z Open Diamond Bath for Oocyte Studies
	RC-27N Narrow Rectangular Baths
	RC-27NE Narrow Bath Chamber with Field Stimulation
	RC-30HV, and RC-30WA Confocal Imaging Chambers
	QR-40HP High Profile Open Bath Chamber
	QR-40LP, QR-41LP, QR-42LP, and QR-48LP Low Profile Open Bath Chambers
	QR-43C Closed Bath Chamber
	QR-47FSLP Slotted Bath Chambers

We offer many chambers that provide special properties and are optimized for specific applications. The following table provides an overview.

Chamber	Order #	open bath	closed bath	small volume (< 100 µl)	medium volume	large volume (> 300 µl)	patch studies	tissue or slice studies	oocyte studies	epithelial or ussing studies	special design	micro-incubation chamber	35 mm culture dish system	50 mm culture dish	field stimulation	upright microscopy	platforms	
Series 20 Chambers	RC-20	●	●	●													P-5, PM-5	
	RC-20H	●	●	●													P-5, PM-5	
	RC-21BR	●	●		●											●	P-2, PM-2	
	RC-21BRFS	●	●		●										●	●	P-2, PM-2	
	RC-21BDW	●			●											●	P-2, PM-2	
	RC-21BRW	●	●	●	●											●	P-2, PM-2	
	RC-22	●	●	●	●												P-1, PM-1	
	RC-22C	●	●	●	●												P-1, PM-1	
	RC-24	●	●	●				●	●								P-1, PM-1	
	RC-24E	●	●	●	●			●	●									P-1, PM-1
	RC-24N	●	●	●				●										P-1, PM-1
	RC-25	●	●	●	●			●	●									P-3, PM-3
	RC-25F	●	●		●			●									●	P-4, PM-4
	RC-26	●	●	●	●			●	●								●	P-1, PM-1
	RC-26G	●	●	●	●			●	●								●	P-1, PM-1
	RC-26GLP	●	●	●	●			●	●								●	P-1, PM-1
	RC-26Z	●	●		●				●								●	P-1, PM-1
RC-27	●	●	●	●				●									P-6, PM-6	
RC-27L	●	●	●	●				●									P-6D, PM-6D	
RC-27N	●	●	●	●				●								●	P-6, PM-6	
RC-27NE	●	●		●				●							●	●	P-6, PM-6	
RC-49MFSH	64-1725	●			●		●	●							●	●		
Series 30 Chambers	RC-30HV		●	●	●	●					●					●		
	RC-30WA		●	●	●	●					●					●		
	PFC-1		●	●	●	●				●								
Ultra Quiet Imaging Chambers	JG-23W/HP	●			●						●						P-1, PM-1	
	JG-23W/LP	●			●						●						P-1, PM-1	
	RC-27D	●			●	●					●					●	PM-7	
	RC-27LD	●			●	●					●					●	PM-7D	

Chamber	Order #	open bath	closed bath	small volume (< 100 µl)	medium volume	large volume (> 300 µl)	patch studies	tissue or slice studies	oocyte studies	epithelial or ussing studies	special design	micro-incubation chamber system	35 mm culture dish	50 mm culture dish	field stimulation	upright microscopy	platforms
Oocyte Chambers	RC-1Z	•		•												•	
	RC-3Z	•		•					•							•	
Quick Coverslip Exchange Chambers	QR-40LP	•				•	•	•	•			•				•	OE-1
	QR-40HP	•				•	•	•	•			•				•	OE-1
	QR-41LP	•			•		•	•				•				•	OE-1
	QR-42LP	•		•			•	•				•				•	OE-1
	QR-43C		•				•	•				•				•	OE-1
	QR-47FSLP	•			•		•	•				•			•	•	OE-1
	QR-48LP	•		•			•	•				•					OE-1
Culture Dish Inserts	RC-37W	•			•								•				
	RC-37WS	•			•								•				
35 mm dishes	RC-37F	•			•								•				
	RC-37FC		•		•								•		•		
	RC-37FS	•			•								•		•		
Culture Dish Platforms	QE-1	•										•					
	QE-2	•										•		•			
Micro-incubation	DH-35	•										•	•				
	DH-35iL	•										•	•				
	DH-40iL	•										•	•				

Chambers

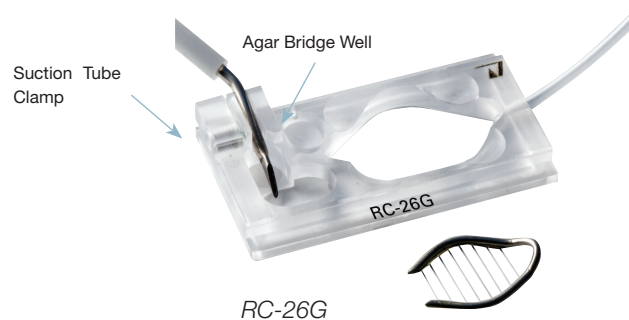
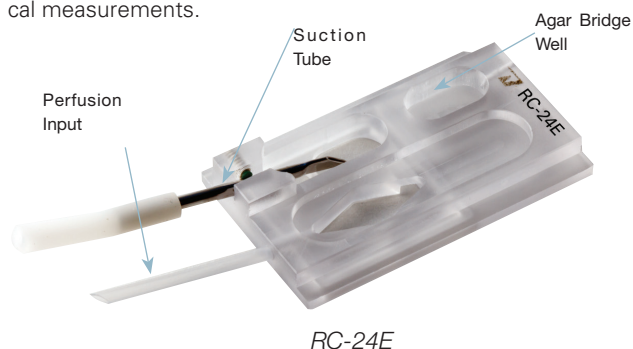
Open Bath Chambers

Examples are provided that illustrate the basic composition of the chambers.

The majority of the chambers consist of these sections:

- **Imaging/recording zone**
- **Perfusion input**
- **Suction tube**
- **Agar bridge well**

Most of the chambers incorporate diamond-shaped fluidics reservoir yielding laminar flow throughout the bath. Low profile chambers allow excellent access without interfering with optical measurements.



RC-26, RC-26G and RC-26GLP

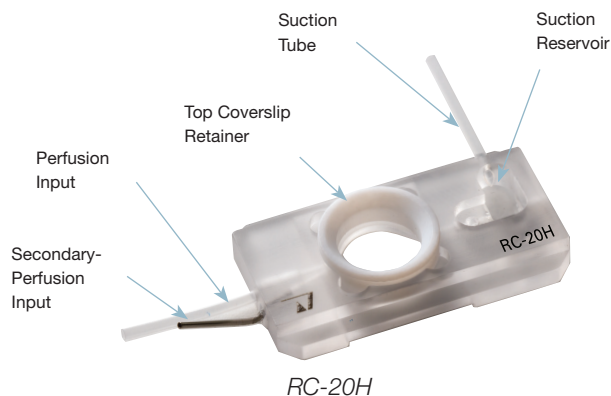
The RC-26, RC-26G and RC-26GLP provide a large volume in an open bath diamond shaped chamber that accommodates large specimens such as slice preparations.

- Optimized for patch clamp studies
- Can be used for tissue slice samples or cell coverslips
- Large imaging area
- Supports upright and inverted microscopes
- Slice anchor available

ORDERING INFORMATION

Order #	Product
64-0234	RC-26, 170 μ L volume
64-0235	RC-26G, 234 μ L volume

Closed Bath Chambers



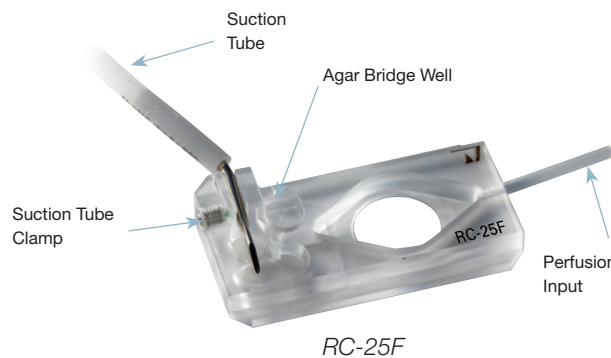
RC-20 and RC-20H

The RC-20 and RC-20H are closed-bath chambers. A secondary perfusion input can be used to inject substances or remove air bubbles. The chamber also enables a short working distance.

- Closed-bath design
- Very small volume
- Uses 15 mm round coverslip
- Gas tight design at chamber interface

ORDERING INFORMATION

Order #	Product
64-0222	RC-20, 35 μ L volume
64-0223	RC-20H, 70 μ L volume



RC-25 and RC-25F

The RC-25 and RC-25F chamber.

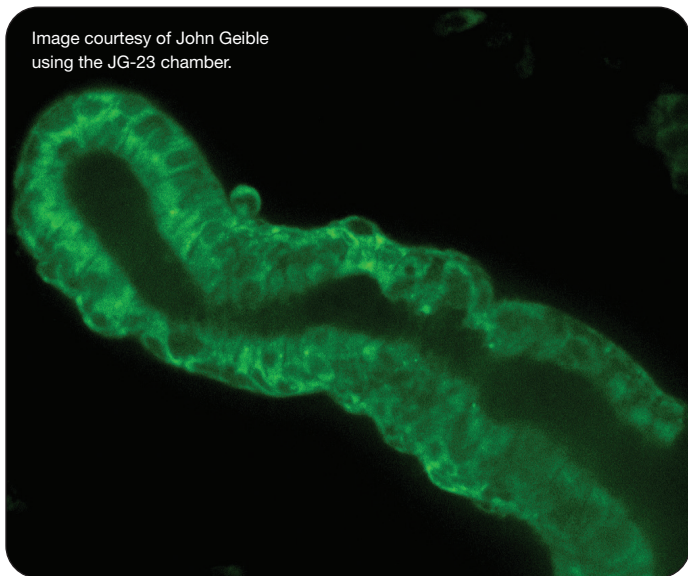
- Designed for physiological measurement of cell cultured coverslips
- Diamond-shaped for laminar solution flow
- Applications such as patch clamp, intracellular/extracellular recordings and imaging
- Small bath volume facilitates fast solution exchange
- Uses 12mm (RC-25) or 15mm (RC-25F) round coverslips

ORDERING INFORMATION

Order #	Product
64-0232	RC-25, 90 μ L volume
64-0233	RC-25F, 133 μ L volume

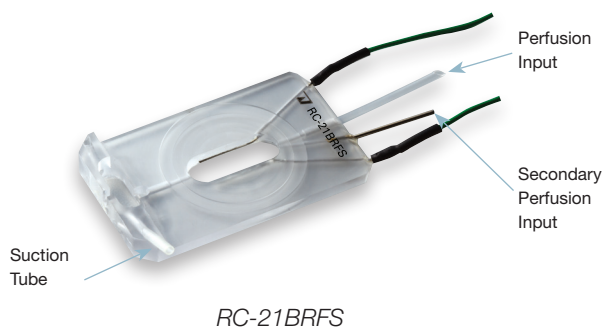
Field Stimulation Chambers

Image courtesy of John Geible using the JG-23 chamber.



Warner Instruments provides field stimulation chambers. All field stimulation chambers are equipped with platinum electrodes that are attached on the sides of the bath. The cables are terminated with 1 mm pins.

- Designed for field stimulation studies involving cardiac myocytes
- Available in open and closed bath chamber design
- Ideal for fluorescence, calcium and time lapse imaging studies



RC-21BRFS

RC-21BRFS

The RC-21BRFS is a modified version of the RC-21.

- Closed bath design
- Small bath volume with slotted bath
- Requires 25mm round cover glasses for top and bottom of the chamber
- Volume of 263 μ l
- Gas tight design at chamber interface

ORDERING INFORMATION

Order #	Product
64-0226	RC-21BRFS for field stimulation



RC-27NE2

RC-27NE2

The RC-27NE2 is a modified version of the RC-27 with a narrower bath and smaller volume.

- Narrow open bath design
- Rectangular shape
- Accommodates tissue and brain slice specimens
- For applications such as patch clamp and physiological measurements on cultured cells

ORDERING INFORMATION

Order #	Product
64-0240R2	RC-27NE2 narrow bath for field stimulation



RC-49MFSH

RC-49MFSH

The QR-49MFSH is designed for the quick exchange platform QE-1.

- O-Ring seal permits quick exchange of coverslips
- Low profile design allows low entry angle electrodes
- Platinum field stimulation electrodes
- Uses popular 18 mm round coverslips
- Embedded heating elements

ORDERING INFORMATION

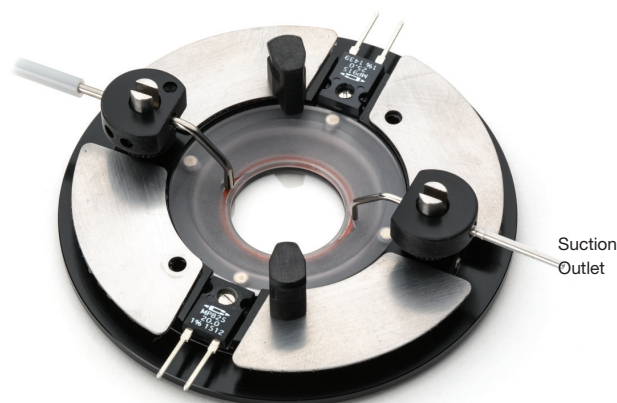
Order #	Product
64-1725	RC-49MFSH magnetic imaging/recording chamber with removable electrodes for field stimulation and heating elements

Chambers

Platforms

Each chamber requires a specific platform. Most of the chambers are supported by three families of platforms, the P, PH and PM. The P-family comes with clamps that are held in place with screws. These clamps press down to secure the chamber.

The mechanical system of the PH-family is identical, but these platforms can be heated. The third family, PM, are magnetic, so no tools are required to remove the chambers and replacement of the chambers is quick and convenient.



Model QE-1 with QR-42LP low profile 15 mm coverslip chamber



Stage Adapters

The platforms have identical outer dimensions. A stage adapter is needed to mount a platform onto a microscope stage. The cutout of the stage determines the corresponding adapter. Warner Instruments adapters support stage cutouts from all manufacturers, including:

- Burleigh Gibraltar
- Leica
- Nikon Marzhauser
- Olympus
- Prior & Ludl
- Scientifica
- Zeiss
- Multiwell stages

Please visit our website to find a suitable adapter.

QE-1

This platform is designed to serve the QR-40 family as well as 35mm glass bottom dishes.

- Supports inverted and upright microscopes
- Resistive heating elements for temperature control
- Provides microincubation in combination with DH-35iL or DH-40iL
- Removable perfusion and suction holders
- Adapter available for Willco Wells, Corning, and Falcon dishes

ORDERING INFORMATION

Order #	Product
64-0375	Quick change platform, heated base, for QR-40 series chambers
64-1542	Quick change chamber, heated base, for 50 mm culture dishes

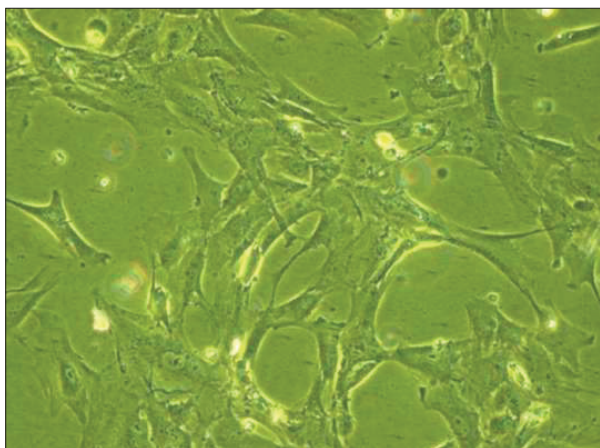
Perfusion Inserts for 35 mm Dishes

RC-37WS and RC-37FS

These chambers make perfusion of cell culture dishes a simple matter.

- Glass bottomed 35mm cell culture dishes
- Narrow bath design
- Use DH-35iL platform providing microincubation

ORDERING INFORMATION	
Order #	Product
64-0365	RC-37WS chamber insert for Willco 35mm cell culture dishes for field stimulation
64-0366	RC-37FS chamber insert for Falcon 35mm cell culture dishes for field stimulation



Microincubation System DH-35iL and 40iL

Warner Instruments also provides microincubation platforms such as DH-40iL and DH-35iL. The DH-40iL is designed to support glass-bottomed 35 mm cell culture dishes and the QR-40 family open bath chambers. The DH-35iL supports glass-bottomed 35 mm cell culture dishes and Series 30 open bath chambers.

- Permitting imaging, temperature and gas environment control
- Compatibility with Corning, Falcon, MatTek, Nunc, Willco Wells and WPI Dishes (DH-40iL only in open configuration)
- Unique dish clamps providing easy cell access

ORDERING INFORMATION	
Order #	Product
64-0349	DH-35iL culture dish incubation system supporting 35 mm quick exchange chambers
64-0388	DH-40iL culture dish incubation system supporting QR-40 family and 35 mm quick exchange chambers

Quick Release Chambers



QR-40LP

QR-40 Family

The QR-40 chamber family was designed for research requiring the fast exchange of round cover slips. The quick release magnetic imaging chambers are compatible with the QE-1 quick exchange platform, DH-35iL and DH-40iL culture dish incubators.

- Dual o-ring seal system enabling quick coverslip exchange, ideal for rapid screening assays
- Closed bath design promoting smooth continuous solution exchange as well as stable imaging focus
- Anodized aluminum base guarantees effective heat transfer

ORDERING INFORMATION	
Order #	Product
64-1943	QR-40LP for 25 mm coverslip, low profile
64-1944	QR-41LP for 18 mm coverslip, low profile
64-1945	QR-42LP for 15 mm coverslip, low profile
64-1946	QR-48LP for 12 mm coverslip, low profile
64-1947	QR-40HP for 25 mm coverslip, high profile
64-1949	QR-41SLP for 25 mm coverslip, slotted bath
64-1951	QR-47FSLP for 25 mm coverslip for field stimulation

Chambers

Chamber Accessories



Coverslips

Warner Instruments provides a number of borosilicate glass coverslips in different thicknesses and sizes for microscopy and imaging. Please visit our website to find the right coverslips for your application.



Slice Anchors

The slice anchors are designed for an easy-press fit into the chamber's bath area. This allows control of the cord line pressure that is applied to the tissue slice. Most anchors are made of a type 316 stainless steel with Lycra® threads and finished with a plastic coating. Some anchors are completely constructed with plastic. Please visit our website to find the right anchor for Series 30 or Series 40 chambers.

Silicone Grease

An artist's acrylic brush is an effective tool for applying silicone lubricant to a glass coverslip and polycarbonate chamber. By "painting" the grease onto the bottom surface of a polycarbonate chamber, it is easy to evenly spread lubricant and create a water-tight seal.

The silicone grease kit includes:

- Tube of Dow Corning® 111 Valve Lubricant & Sealant
- Two acrylic paint brushes (sized #2 and #4)
- Several pallets

ORDERING INFORMATION

Order #	Product
64-0378	Silicone grease kit, includes brushes and pallets
64-0275	Stopcock grease

Temperature Control Systems

Temperature Controllers



Researchers have long understood the importance of temperature regulation in the study of cellular function:

- Sources of heat flux
- Space and time factors
- Outgassing of perfusate solutions
- How temperature is sensed
- In-line solution heating
- Chamber platform heating
- Solution reservoir heating
- Microscope objective heating
- Heated enclosures

Transmission of thermal energy can happen through the microscope objective, the perfusion solution, the chamber platform and any other physical elements of the working environment. We provide temperature control of three parts:

- Platform
- Solution
- Microscope objective

Heated platforms will transmit the heat to the chambers on the sides only, therefore the temperature will have a gradient from the sides to the middle of the chamber.

Heating the solution can work well if the flow rate is sufficient. Objectives are a huge heat sink, especially in case of immersion.



Single Channel TC-324C Resistive Temperature Controller



These are the products and applications that we offer:

ORDERING INFORMATION			
Order #	Product	Properties	Suggested Applications
64-2400	TC-324C	Single channel temperature controller	<ul style="list-style-type: none"> • Syringe heater • Stage insert heater • In-line solution heater, culture dish incubation system
64-2401	TC-344C	Dual temperature controller	
64-1545	TC-124A	Battery-powered single channel temperature controller	<ul style="list-style-type: none"> • Microscope objective heater • Syringe heater • Stage insert heater

The temperature is adjustable up to 65° C. The instruments are optimized for low noise setups.

Temperature Control Systems

Bipolar Temperature Control

Heating & Cooling

These systems are designed to work with our bipolar temperature controllers (CL-100, CL-200A) to provide both heating and cooling via our SC-20 inline solution heater/cooler and QE-1HC platform.

These bipolar temperature controlled apparatus require the Liquid Cooling system, order number 64-1922, in order to function properly.



Dual Channel CL-200A Bipolar Temperature Controller



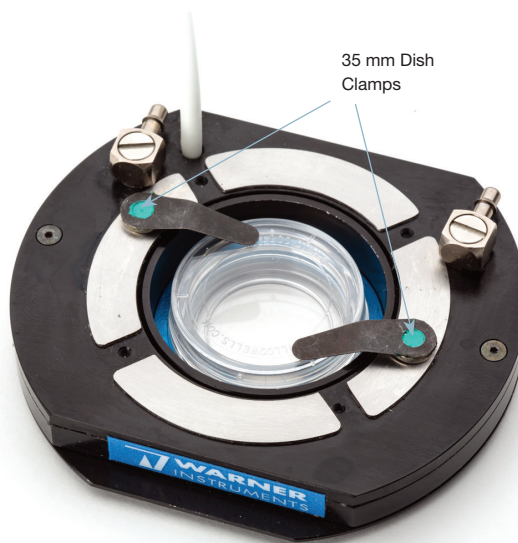
Single Channel CL-100 Bipolar Temperature Controller



SC-20 In-Line heater/cooler



LCS-1 Liquid Cooling Device



Model QE-1HC with 35 mm glass bottom dish

ORDERING INFORMATION		
Order #	Product	
64-1723	CL-200A Bipolar dual channel temperature controller	<ul style="list-style-type: none"> In-line solution heater/cooler
64-0352	CL-100 Bipolar single channel temperature controller	<ul style="list-style-type: none"> Stage insert heater/cooler
64-0353	SC-20 In-Line heater/cooler	5ml/min 2 Inputs, 1 output
64-1659	QE-1HC quick exchange platform	Easy access for imaging
64-1922	LCS-1 Liquid Cooling Device Required accessory for systems using CL-100/200	<ul style="list-style-type: none"> Used to temperature manage the water jacket Electrically and mechanically quiet



In-Line Solution Heaters

The simplest and most direct approach for the application of heat to a sample is to preheat the perfusion solution immediately prior to its delivery to the chamber. Warner Instruments provides a wide variety of solution heaters including single channel slow-flow and fast-flow models.

If multiple solutions are required, the multi-line solution heater is the best option to be able to quickly change your solution and heat it properly. Our in-line solution heater can heat up to 50° C.

ORDERING INFORMATION					
Order #	Product	Max Flow Rate	Inputs	Outputs	Heating/Cooling
64-0103	SF-28 In-Line solution heater	2 ml/min	1	1	H
64-0102	SH-27B In-Line solution heater	5 ml/min	1	1	H
64-0104	SHM-6 6-line solution heater	5 ml/min	6	1	H
64-0105	SHM-8 8-line solution heater	5 ml/min	8	1	H
64-1430	SHM-828 8-line solution heater	5 ml/min	8	8	H

In-Line Solution Heater Holders

We provide the following in-line-solution heater holders:

ORDERING INFORMATION	
Order #	Product
64-1555	SSH-1, holder for SH-27B and SF-28
64-1556	SSH2, holder for SC-20
64-1557	Holder for SHM-6, SHM-8, SHM-628
64-1558	Holder for FR-50 and FR-55S flow valves

Objective Heaters

Objective heaters are extremely important for immersion optics.

- Reduced thermal gradient between objective and sample
- Have no direct contact between warmer and objective
- Fit microscope objectives from most manufactures

ORDERING INFORMATION		
Order #	Product	
64-1664	OWS-1	Objective Warmer System, for 23-30 mm objectives, includes TC-124A temperature controller
64-1676	OWS-2	Objective Warmer System, for 30-35 mm objectives, includes TC-124A controller

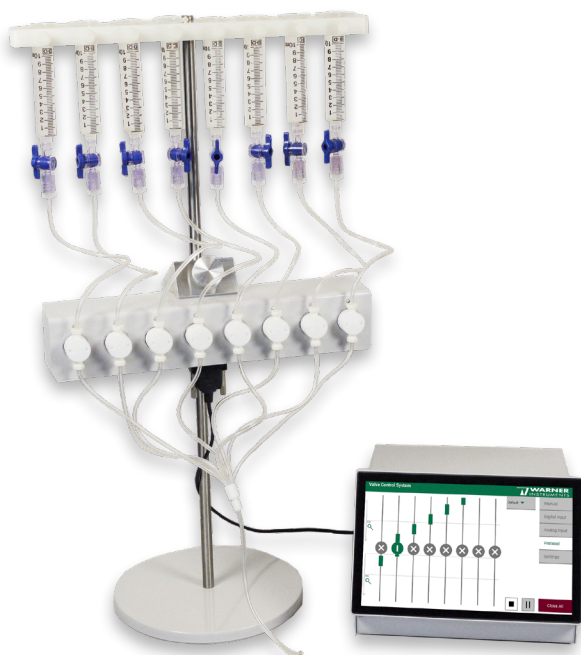
Perfusion Control

Perfusion Systems

Perfusion is required to keep the specimen alive and can also be used for heating or cooling. Most of the perfusion systems available consist of a set of syringes filled with solution and a valve controller that opens and closes the valves of each syringe. Syringe tubing consolidates in a manifold which is connected to the chamber.

To avoid overflow of the solution, suction must be applied. This is usually done with a vacuum system.

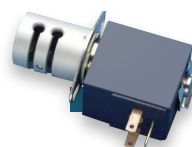
Alternatively, a peristaltic pump can be used for delivering solution as well as for suction.



Touch and PC Software controlled Valve Control Systems

The VCS systems are configured to control up to 8 Pinch -, PTFE -, or Mini - valves. Each valve is individually accessed by a manual touch display, the included PC software, an external analog signal, or an external digital signal (TTL).

- Digital or analog switching for Patch Clamp applications
- UI programmable valve protocols
- Save and load protocols on hard drive
- Download protocols to valve controller for permanent storage
- Run and monitor protocols



Pinch Valve



PTFE Valve



Mini Valve

The controllers support three different valves: **Pinch, PTFE and Miniature Valves.**

Pinch Valves are the simplest valves to maintain as the solution never gets in touch with the valve and tubing can easily be changed. Valves are dual acting (3-way) with both normally open and closed sides. Y connectors at the valve input permit solution flow to waste with the valves off.

PTFE Valves are available for applications where resistance to chemicals is a concern. The valves are 2-way, either on or off.

Miniature Valves are designed for slow flow perfusion systems where smaller diameter tubing is used. The valves mount directly to a compact Delrin manifold. The 3-way valves allow for solutions to flow to waste if desired. These are ideally suited for use with the SF-77C Fast-Step Perfusion Stepper Systems.

The perfusion systems is comprised of the following:

- Valve control unit with 7" touch display
- Valves
- Valve bracket, including an 8 ft long cable to be connected to valve controlled
- MP series manifold (Pinch and PTFE), ML series (Mini)
- 60cc (10cc for mini-valves) reservoirs (syringes)
- Reservoir holder
- Ring lab stand
- Stopcocks for each reservoir
- Tubing connector

ORDERING INFORMATION

Order #	Product	Channels	Valves	Specialty
64-3084	VCS-6-PINCH	6	pinch	-
64-3085	VCS-6-PTFE	6	PTFE	-
64-3086	VCS-6-Mini	6	mini	-
64-3087	VCS-6-Mini-LT	6	mini	large tubing
64-3080	VCS-8-PINCH	8	pinch	-
64-3081	VCS-8-PTFE	8	PTFE	-
64-3082	VCS-8-Mini	8	mini	-
64-3083	VCS-8-Mini LT	8	mini	large tubing

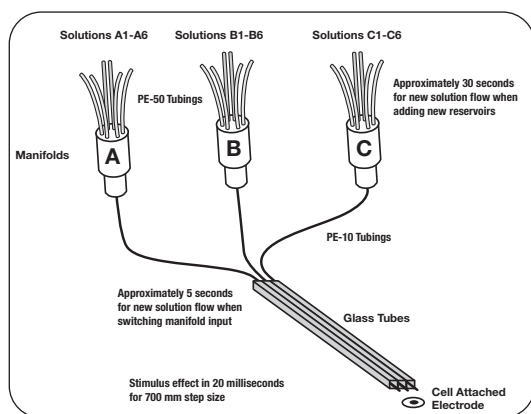
Perfusion Systems



Fast-Step Perfusion Systems

Combining a Warner Mini-perfusion Valve Control System and the SF-77C Fast-Step Perfusion system results in a unique system that enables a user to rapidly select between several perfusion reservoirs, saving time and effort.

- Millisecond solution changes between tubes
- Solution change within individual ports within 5 seconds
- 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



ORDERING INFORMATION		
Order #	Model	
64-3109	VCS-77CSP	Complete VCS-6 Fast-Step Perfusion System, right handed micromanipulator
64-3110	VCS-77CSPL	Complete VCS-6 Fast-Step Perfusion System, left handed micromanipulator
64-3111	VCS-77CSP8	Complete VCS-8 Fast-Step Perfusion System, right handed micromanipulator
64-3112	VCS-77CSP8L	Complete VCS-8 Fast-Step Perfusion System, left handed micromanipulator

Perfusion Accessories

Peristaltic Pump PPS2

If only one incoming and suction solution is required, the PPS2 is the perfect device.



- 2 channels (1 in/1 out or 2 in or 2 out)
- Control of instrument via touch-screen
- SW control (requires USB connection to Windows-PC)
- Control using TTL and analog voltage provided by e.g. acquisition board
- Flow rate 0.1 up to 30 ml/min in 0.1ml/min steps
- Link both channels by percentage, e.g. suction is 105% of incoming solution
- Bubble detector for suction control



If the incoming solution does not need to get changed, the PPS2 replaces a perfusion system and vacuum system for suction.

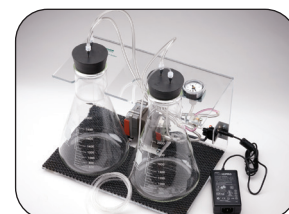
ORDERING INFORMATION

Order #	Product
89-0688	Peristaltic Pump, 2 channels

*Contact sales for higher channel configuration.

Dedicated Workstation Vacuum DWV

The DWV provides suction to prevent solution overflow in the chambers using a perfusion system.

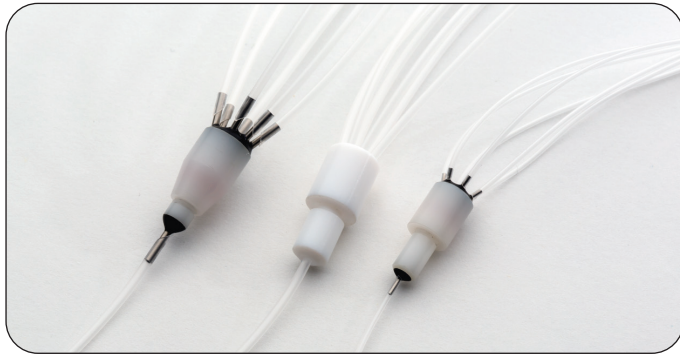


- Completely self-contained liquid waste system
- High quality low-noise vacuum pump, 40 dB(A) maximum
- Dual flask design for improved vacuum stability

ORDERING INFORMATION

Order #	Product
64-1940	Dedicated Workstation Vacuum

Perfusion Systems



Manifolds

Manifold inputs converge to the common output with minimum dead space. They are designed for use with PE-160, PE-50, and PE-10 polyethylene tubing, but they can also be used with other tubings with similar dimensions.



Vacuum and Flow Regulator

The FR-50/FR-55S is a convenient tool to adjust both solution flow rates and vacuum pressure in a variety of applications. The solution flow is adjustable from zero to a maximum of 10 mL/min (measured with a solution head of 30 cm). The units have calibrated adjustment rings to permit returning to a predetermined setting.

ORDERING INFORMATION

Order #	Product
64-0220	FR-50, flow valve
64-0221	FR-50S, flow valve with on/off-switch

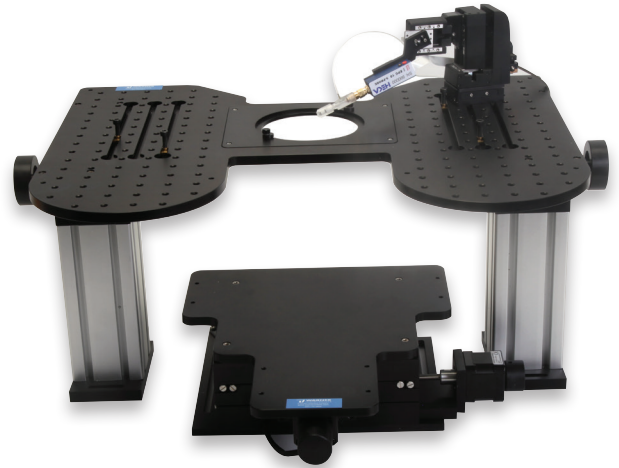
Miscellaneous Perfusion Accessories

Warner Instruments also provides the following accessories:

- Syringes, syringe holder
- Tubing
- Valve control parts
- Gas humidification system
- Gas bubbler manifolds
- Perfusion pressure kits
- Manifold holder

Please visit our website for a full selection of our accessories.

Ephys Accessories



Hybrid Stage

We offer a hybrid stage for patch clamp studies and other experiments. The XY-translator can either be used manually or motorized. The platform is available for inverted or upright microscopes with US or metric threads. It supports the most common microscopes. This part list is not comprehensive, please visit our website for a full list of options.

ORDERING INFORMATION

Order #	Product
Stage with XY translator for Inverted Microscope	
64-2365	Fits Nikon Eclipse T inverted, US thread
64-2373	Fits Nikon Eclipse T inverted, metric thread
64-2366	Fits Leica DMI8 inverted, US thread
64-2374	Fits Leica DMI8 inverted, metric thread
64-2367	Fits Olympus IX-73 inverted, US thread
64-2375	Fits Olympus IX-73 inverted, metric thread
64-2368	Fits Zeiss Axiovert inverted, US thread
64-2376	Fits Zeiss Axiovert inverted, metric thread
Stage with XY translator for Upright Microscope	
64-2369	Fits Nikon E600 FN1 upright, US thread
64-2377	Fits Nikon E600 FN1 upright, metric thread
64-2370	Fits Leica DM LFS upright, US thread
64-2378	Fits Leica DM LFS upright, metric thread
64-2371	Fits Olympus BX-51WI upright, US thread
64-2379	Fits Olympus BX-51WI upright, metric thread
64-2372	Fits Zeiss Axioscop 2FS upright, US thread
64-2380	Fits Zeiss Axioscop 2FS upright, metric thread
Accessories	
64-2384	Stainless steel insert for stage
64-2385	Stainless steel insert, 3 pieces
69-5000	Wheel input device for hybrid stage, requires 69-5001
69-5001	Controller for hybrid stage



Luigs & Neumann

Sensapex



Programmable Pipette Puller PMP-102

The PMP-102 is a horizontal puller that pulls two identical pipettes.

- 25 programmable sequences
- Programmable multi-pulling steps
- Pneumatic adjustable pulling force
- 22 pre-programmed sequences for commonly used pipette tips

Micromanipulators

Micromanipulators are required to position the micropipette for recording or injection relative to the specimen. Warner Instruments provides micromanipulators from both Sensapex and Luigs & Neumann* that are well optimized for both microinjection and patch clamp. Please visit our website or contact sales for more information.

*Available in North America only.

LUIGS & NEUMANN	
Mini Compact Units	
Traverse path	X/Y/Z = 20mm (motorized) / X/Y/Z = 23mm (manual)
Motor resolution	9.8nm
Reproducibility	<1µm
Dimensions	151 x 151 x 210mm
Junior RE/LE (3 axis)	
Traverse path	X = 22mm; Y/Z = 16mm
Motor resolution	7.8nm
Reproducibility	<1µm
Dimensions	115 x 112 x 131mm

SENSAPEX	
Selected Specifications	
Traverse path	X/Y/Z = 20mm
Motor resolution	5nm
Reproducibility	100nm
Dimensions	39 x 93 x 101mm

ORDERING INFORMATION	
Order #	Product
69-0151	PMP-102 programmable puller, 110-120 VAC, 60 Hz
69-0151E	PMP-102 programmable puller, 220-240 VAC, 50/60 Hz
69-0172	Replacement heat coil

Ephys Accessories

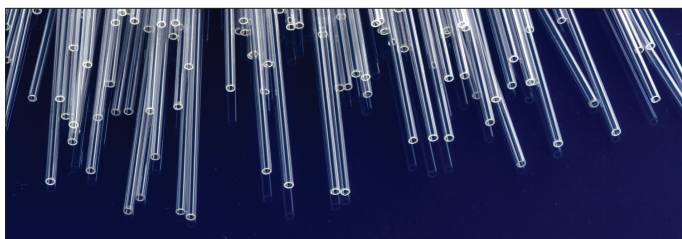


Microforge-Grinding Center (MFG-5)

Glass micropipette polishing, shaping, tipping, bending, beveling, and grinding — all in one compact platform.

- Rapid and easy switching between microforge and microgrinder by turning the tool manipulator
- Precise, convenient movement controls for heater/grinder, pipette locations and optical focus
- Universal pipette holder for one to seven barrel pipettes and 0-180 degree beveling
- Up to 40X, long working distance objective and 10X eyepiece optics combination, plus scale eyepiece for precision measurement.
- Adjustable, precision power supply for variable grinder speed and heating level
- Pressurized air for pipette tip clearing, expanding, and cooling. Foot switch controllable.

ORDERING INFORMATION	
Order #	Product
64-1612	Microforge Grinding Center, 110/120 VAC
64-1616	Microforge Grinding Center, 220/240 VAC



Capillary Glass

Warner Instruments provides a wide range of capillary glass.

- Length 75–150mm
- With and without filament
- Clark borosilicate, aluminosilicate and premium borosilicate glass
- Thin wall and standard
- Outer diameter 1–300mm

Please visit our website to see the full selection.

Ephys Systems

Microinjection



Microinjector

Microinjector

The use of microcapillary pipette based techniques for intracellular/extracellular microinjection and perfusion has become a popular procedure in numerous areas of experimental biology research.

The PLI Microinjectors feature:

- Injection pressure of 0.2-60 PSI (413 kPa)
- Injection Time of 0.01 to 99.99 seconds
- Injection time accuracy of $\pm 0.01\%$ (Crystal Time Base)
- Injection count display: 0-9999 injections
- All PLI feature Input, Balance, and Clear pressures (positive)
- The PLI-100A also includes Holding and Fill pressures (negative)
- Trigger mode: front panel, footswitch or TTL (Gate In)

We also offer ancillary components needed to complete a micro-injection system, including:

- Micromanipulator and magnetic base
- Electrode holder
- Light source
- Microscope

Please contact your sales rep for help configuring your ideal set up.

ORDERING INFORMATION		
Order #	Product	Properties
64-1735	PLI-100A	5 pressures
64-1738	PLI-90A	3 pressures
64-1737	PLI-FS Foot switch	–
Accessories		
64-1626	Acrylic pipette holder for 1.0 mm pipettes	
64-1627	Acrylic pipette holder for 1.2 mm pipettes	
64-1628	Acrylic Pipette Holder for 1.5 mm pipettes	
64-1629	Acrylic pipette holder for 2.0 mm pipettes	

Oocyte Recording



OC-725D

Warner OC-725D

This amplifier is the industry standard for oocyte clamping. A differential headstage is available separately.

The amplifier features:

- Unique bath clamp circuitry which does not require series resistance compensation
- High compliance voltage (± 180 V)
- Two clamp speeds for slow and fast response time

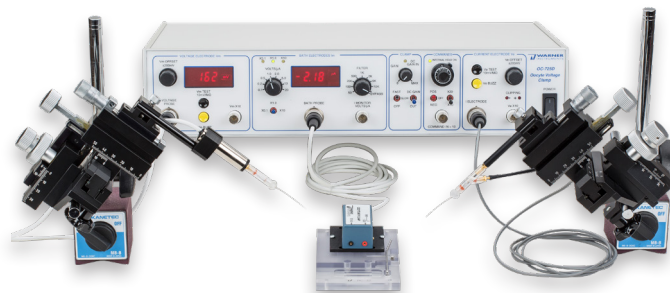
SELECTED SPECIFICATIONS

Amplification range	0.001 up to 100 V/ μ A
Holding potential	up to ± 200 mV
Bandwidth	10 KHz
Compliance Voltage	± 180 V
Filter output	1 KHz, 4 pole Bessel

ORDERING INFORMATION

Order #	Product
64-3068	OC-725D Oocyte amplifier
For accessories see right hand table	

Oocyte chambers in a variety of designs are available; please contact sales for more information and assistance with selection.



TEV-700

Warner TEV-700

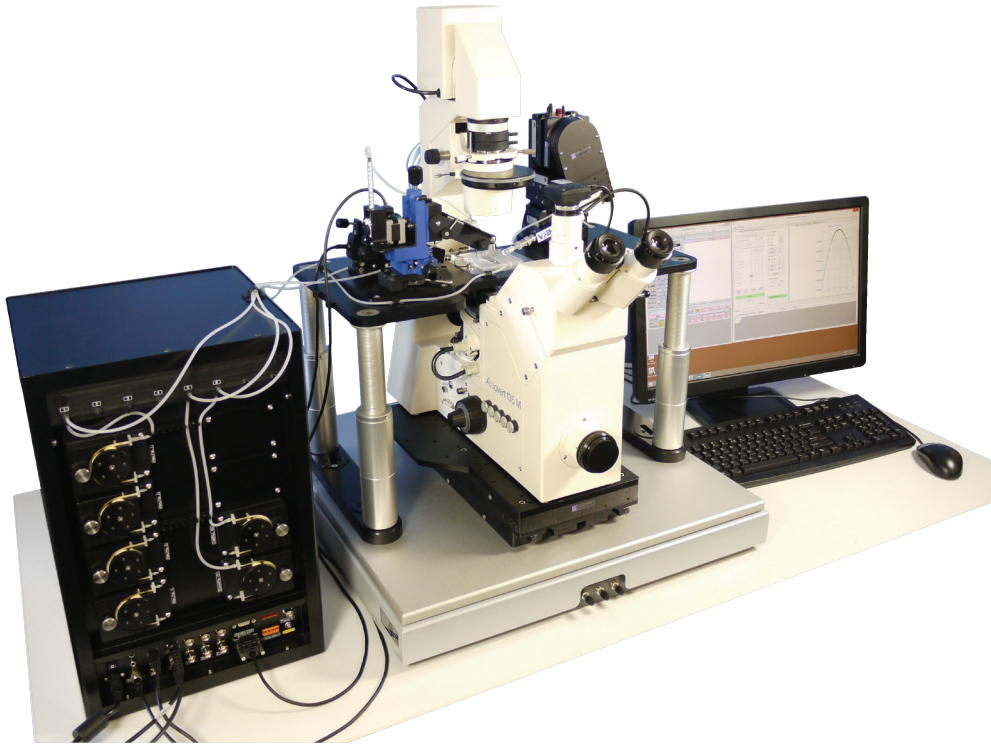
This system is designed to provide the necessary components needed to perform traditional oocyte recording. The system is comprised of an OC-725D, RC-3Z chamber and two micromanipulators. A microscope, cold light source, and baseplate are recommended. This system also requires separate data acquisition.

ORDERING INFORMATION

Order #	Product
64-3068	OC-725D Oocyte amplifier
64-3068	TEV-700 Complete oocyte clamp workstation
OC-725D Voltage Electrode Holder (Purchased Separately)	
64-1007	E Series Electrode Holder, straight style, fits 1.0 mm capillary, Ag wire
64-1008	E Series Electrode Holder, straight style, fits 1.2 mm capillary, Ag wire
64-1009	E Series Electrode Holder, straight style, fits 1.5 mm capillary, Ag wire
64-1010	E Series Electrode Holder, straight style, fits 2.0 mm capillary, Ag wire
OC-725D Current Electrode Holder (Purchased Separately)	
64-1051	E Series Electrode Holder, 45° with handle, fits 1.0 mm capillary, Ag wire
64-1052	E Series Electrode Holder, 45° with handle, fits 1.2 mm capillary, Ag wire
64-1053	E Series Electrode Holder, 45° with handle, fits 1.5 mm capillary, Ag wire
64-1054	E Series Electrode Holder, 45° with handle, fits 2.0 mm capillary, Ag wire

Ephys Systems

Automated Pipette Based Patch Clamp



PatchServer

The PatchServer is the only automatic patch clamp system world-wide that is able to establish single channel and whole cell recording configurations, using tools and techniques from the manual patch approach. The PatchServer is an add-on tool for manual patch clamp setups. It utilizes standard glass electrodes and employs the step-by-step manual patch clamp procedure of a human experimenter.

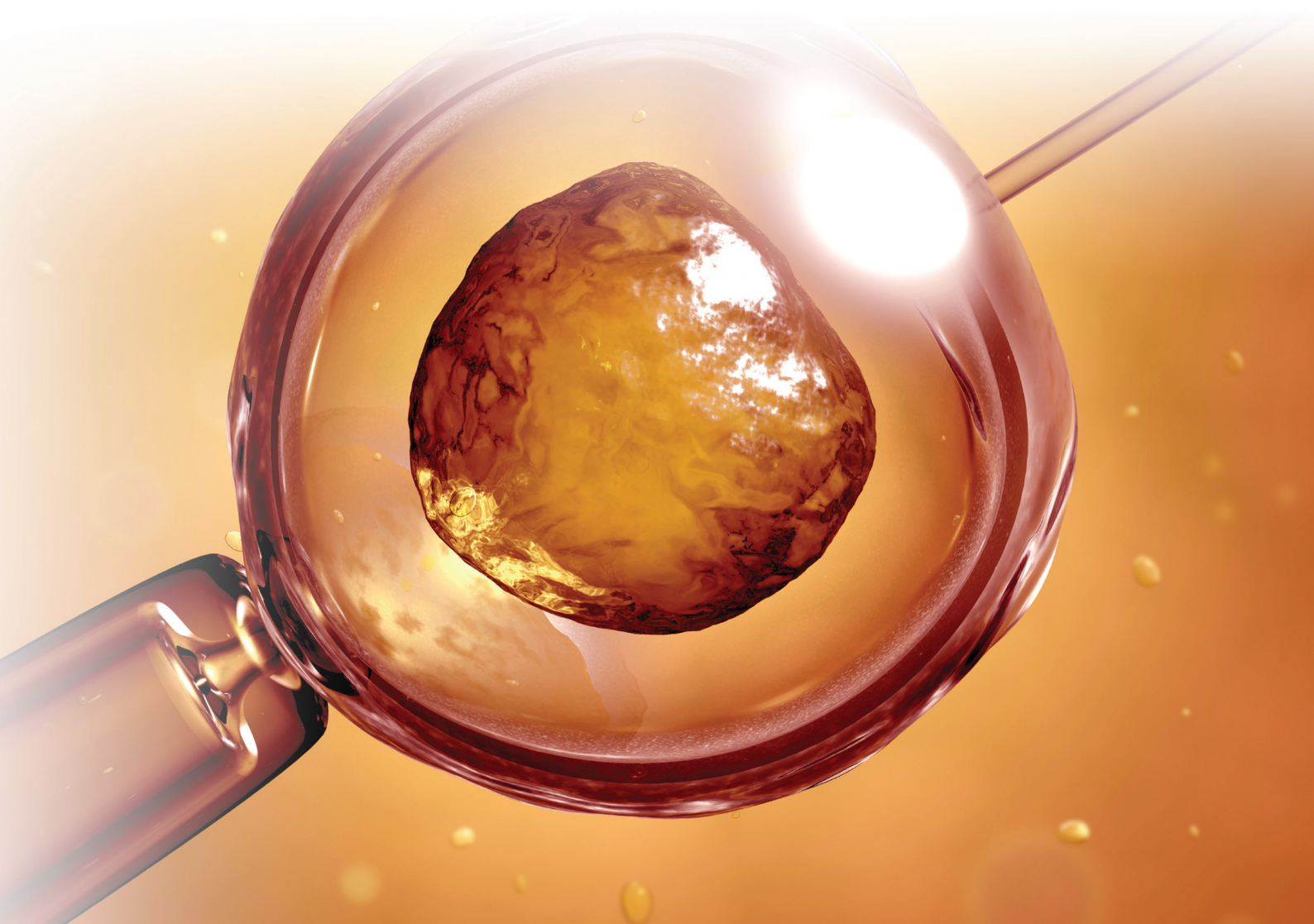
- Makes manual patching more simple and efficient
- Automatically establishes all recording configurations
- Utilizes manual patch clamp technology (glass pipettes)
- Highest data quality with increased data production rate

ORDERING INFORMATION

Order #	Product
89-1166	PatchServer-Basic-1
89-1167	PatchServer-Basic-4

Come see us at the following annual meetings...

- ▶ Biophysical Society
- ▶ Experimental Biology
- ▶ Society for Neuroscience





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February 2021

www.warneronline.com