

Trans Epithelial Electric Resistance (TEER) Measurements

During the last two decades TEER measurements have become universally established as the most convenient, reliable and non-destructive method to evaluate and monitor the growth of epithelial tissue cultures *in vitro*. The confluence of the cellular monolayer is quickly

determined by a sharp increase in TEER.

TEER measurement technology, which was first introduced by WPI in the mid-1980's, has since been perfected and expanded to include a range of TEER related manual and automatic instrumentation.

EVOM²TM

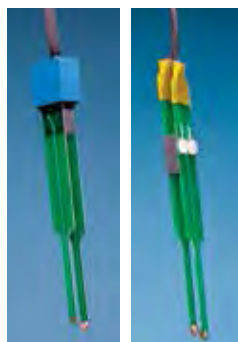
Epithelial Voltohmmeter

- **Manual TEER measurements of epithelial cells in 6-, 12-, and 24-well plates**
- **Electrically isolated meter that plugs into a standard outlet for continual readout without push buttons**
- **Compatible with Endohm chambers**
- **STX2 manual electrodes and test electrode included with every meter**



The EVOM was the first instrument designed specifically to perform routine Trans Epithelial Electrical Resistance (TEER) measurement in tissue culture research. EVOM2 is the next generation, redesigned for ease of use. The EVOM2 not only qualitatively measures cell monolayer health, but also quantitatively measures cellular confluence. The unique electronic circuit of the EVOM2 and the included STX2 electrode detect the confluence of the cellular monolayer. When combined with WPI's Endohm chamber, the EVOM2 can also be used to perform more accurate quantitative measurements or lower resistance measurements like trans endothelial electrical resistance measurements.

The isolated power source of the EVOM2 was specifically designed to avoid adverse effects on tissue and the formation of electrode metal deposits, even when it is plugged into a standard wall outlet. Now, the EVOM2 is always on when you need it. In addition, its rechargeable battery allows up to 10 hours of mobile use. The four and a half digit readout provides



STX2 **STX3**

a range of 1-9,999 Ω. The included test electrode lets you calibrate the resistance measurements for an accurate reading every time, and the voltage meter never needs calibration. An analog BNC output is standard with the EVOM2, providing an output port for recording data or remote display of the EVOM2 output.

EVOM2 comes complete with the popular STX2 "chopstick" electrodes, 4 mm wide and 1mm thick. Each stick of the electrode pair contains a silver/silver-chloride pellet for measuring voltage and a silver electrode for passing current. The small size of each electrode is designed to facilitate placement of the electrodes into a variety of standard cell culture wells.

EVOM2 SPECIFICATIONS

MEMBRANE VOLTAGE RANGE	±200 mV
RESOLUTION	0.1 mV
RESISTANCE RANGE	0 to 9999 Ω
RESISTANCE RESOLUTION	1 Ω
AC SQUARE WAVE CURRENT	±10 μA nominal at 12.5 Hz
POWER	Internal rechargeable 6V NiMH 2700 mAh battery with external 12 VDC supply for recharging
NOMINAL BATTERY RUN TIME	10 hours
BNC OUTPUT	1-10 V (1 mV/ohm)
DIMENSIONS	19 x 11 x 6 cm (7.25" x 4.25" x 2.30")
WEIGHT	1.4 kg (3 lb)
ELECTRODE CONNECTION	RJ-11 connector (telephone style)
TEST RESISTOR	External, 1000 Ω
ENVIRONMENTAL RANGE	10-38°C (50-100°F) 0-90% non-condensing relative humidity

EVOM2 Epithelial Tissue Voltohmmeter (includes **STX2** electrode set)

REPLACEMENTS AND ACCESSORIES

STX2	Replacement "Chopstick" Electrode Set
STX3	Adjustable Tip Spread "Chopstick" Electrode Set
3993	Electrode Adapter (for electrodes with 2 mm pins)
91736	Replacement Battery, Rechargeable NiMH
91750	EVOM2 Test Resistor

TEER measurements in High Throughput

STX100

Series Electrodes

- **Designed for 24-well HTS plate (Corning Costar and BD Falcon) and with 96-well plates (Millipore and BD Falcon)**
- **Improved accuracy down to 5 Ohm**
- **Sterilized with EtO, alcohol or bactericide**

With the development of a High Throughput Screening (HTS) protocol for faster drug discovery, a new line of cell culture filter plates have been introduced by several major cell culture insert manufacturers. These HTS plates normally have either 24 or 96 individual cell culture inserts "bonded" together as one plate so that it can be handled by a robot apparatus. In response to these developments, WPI has developed an automatic REMS system and a manual electrode, STX100, for TEER measurements using HTS plates.

STX100's design is based on the same reliable design principle as the universally used STX2 electrode, with several important modifications. The size of the electrode tip has been reduced to 1.5 mm to facilitate positioning through the narrower slit of the HTS plate. The STX100 electrode itself is constructed using a stronger material for higher durability and maximum usage applications. The bottom section of the electrode is shaped to fit neatly into the "keyhole" shaped filter well. This enables the STX100 electrode to produce increased accuracy and reproducibility of TEER readings ($\pm 5\Omega$) compared to the standard STX2. Several versions of STX100 are available, designed to fit the Corning Costar 24-well HTS plate, the Falcon 24 well HTS plate, and the Millipore

Multiscreen CaCo 96-well plate. Measurement can be directly performed when the HTS plate is in either a common or divided tray, reducing the possibility of contamination as well as mechanical damage to the cultured cells.

STX100C	STX100 for Corning Costar HTS Transwell-24
STX100F	STX100 for BD Falcon HTS Multiwell Insert System
STX100M	STX100 for Millipore Multiscreen™ HTS 96-Well Plate
STX100C96	STX100 for Corning HTS 96-Well Plate

OPTIONAL ACCESSORIES

13685	Modular Cable, 7 ft
13347	Chart Recorder Adapter
2851	Standard BNC Cable, 5'2"
500184	Standard BNC Cable, 10 ft (3m)

CaliCell™

Cell culture cups with synthetic membrane for testing STX electrodes, Endohm and Ussing chambers

It takes a long time and a lot of work to grow a batch of cells, so you will want to make certain that your test apparatus is functioning properly. The CaliCell™ provides a quick and positive way to test STX electrodes, EVOMs, Endohm, and Ussing chamber.

The CaliCell™ is a major improvement in TEER electrode calibration. Its membrane makes use of our unique electric current constriction technology to produce resistance readings comparable to those obtained with real cell cultures. The CaliCell™ does not have to be refrigerated, and can be cleaned and sterilized with alcohol. Readings will not drift over time as long as the unit is kept in good physical condition.

CALICELL-12	12 mm Calibration Cell for Endohm-6/Endohm-12
CALICELL-24	24 mm Calibration Cell for Endohm-24



Screening (HTS) cell culture filter plates



Endohm™

For TEER measurement of endothelial cell cultures in individual cups

- **Compatible with EVOM2**
- **Improved accuracy of 1-2 Ohm**
- **Accommodates 6mm, 12mm, 24mm cups and Costar Snapwell cup**
- **Sterilized with EtO, alcohol or a bactericide**

Using WPI's EVOM2 resistance meter, Endohm chambers provide reproducible resistance measurements of endothelial tissue in culture cups. Transfer cups from their culture wells to the Endohm chamber for measurement rather than using hand-held electrodes. The chamber and the cap each contain a pair of concentric electrodes: a voltage-sensing silver/silver chloride pellet in the center plus an annular current electrode. The height of the top electrode can be adjusted to fit cell culture cups of different manufacture. Endohm's symmetrically apposing circular disc electrodes, situated above and beneath the membrane, allow a more uniform current density to flow across the membrane than with **STX2** electrodes. The background resistance of a blank insert is reduced from 150 Ω (when using WPI's hand-

held **STX2** electrodes) to less than 5 Ω . With Endohm's fixed electrode geometry, variation of readings on a given sample is reduced from 10-30 Ω with **STX2** electrodes (depending on the experience of the user) to 1-2. Compared with other resistance measurement methods, Endohm with EVOM2 offers a much more convenient and economic solution to "leaky tissue" measurement. Because of the uniform density of the AC square wave current from EVOM2, errors owing to electrode polarization or membrane capacitance are largely eliminated. Endohm together with EVOM2 offers the most accurate and economical endothelial ohmmeter now available. To date, cups from Costar, Millipore, ICN Biomedicals, and Falcon have been tested. Endohm chambers may be sterilized with EtO, alcohol or a bactericide (also see: Cidex, Microsurgery section); not autoclavable.

ENDOHM-6	Endohm for 6 mm culture cup (24 wells per plate)
ENDOHM-12	Endohm for 12 mm culture cup (12 wells per plate)
ENDOHM-24SNAP	Endohm for 24 mm & Costar Snapwell™ cup (6 wells per plate)
	<i>Requires EVOM2, EVOM, EVOMX or Millicell ERS-2</i>
53330-01	Replacement Endohm Cable

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Automated TEER Measuring System



The **REMS AutoSampler** automates measurements of electrical resistance of transepithelial, transendothelial or Caco-2 cell membranes being grown to confluence on microporous filters of high throughput screening (HTS) 24- and 96-well microplates. It is a PC-controlled, tissue resistance measurement system that offers reproducibility, accuracy, flexibility and ease-of-operation for this kind of measurement. Automated measurement of tissue resistance in cell culture microplates provides the important advantages of speed, precision, decreased opportunity for contamination and the instant availability of measured resistance data on a computer. These measurements are useful in applications such as drug bioavailability studies and studies on the mechanisms of drug transport.

The main components of the REMS AutoSampler include: the robotic sampler that moves the electrode over each well of the microplate, the electrode which is located on the robotic arm, a base plate for the 24- and 96-well tray, a Windows-based data acquisition card, the REMS interface unit and the REMS software to operate the system on a Windows-based computer.

The REMS AutoSampler automates TEER measurements previously made with WPI's **EVOM** Epithelial Voltohmmeter. Automated tissue resistance measurements up to 20 k can be performed on 24- or 96-well HTS microplates. Microplates presently supported include the Corning Costar HTS Transwell-24, Falcon HTS Multiwell insert systems, and Millipore Multiscreen™ CaCo 96-well plate.

The REMS AutoSampler is designed to facilitate integration with other robotic systems. Special locating bars are installed on the REMS base platform that allow other system robots to place an HTS tray into a precise location on the REMS base.

The REMS AutoSampler will automatically measure and record tissue resistance from a user-specified matrix of culture wells on the microplate. According to the specified sequence, the robotic arm moves over the identified wells taking TEER measurements. By means of a x-y-z locating system, the electrode-containing arm is positioned precisely and reproducibly over each well. The ability of the REMS AutoSampler

REMS AUTOSAMPLER SPECIFICATIONS

MEMBRANE RESISTANCE RANGE	0 to 2000 Ω and 0 to 20 k Ω
AC SQUARE WAVE CURRENT	+/- 20 μ A @ 12.5 Hz
ELECTRODE POSITIONING	Resolution in X, Y and Z: +/- 1 mm
ELECTRODE PERFORMANCE	Repeatability in X, Y and Z: +/- 0.25 mm
ELECTRODE ARM SPEED	X- and Y-axis: 250 mm/sec Z-axis: 247.3 mm/sec
TYPICAL MEASUREMENT TIME	24-WELL 1 min, 10 sec
SCAN PATTERN	Choice of any well pattern sampling
LINE VOLTAGE	User specified: 100/120 V or 220/240 V
DIMENSIONS	53.5 x 43.7 x 37.1 cm (21 $\frac{1}{2}$ x 17 $\frac{3}{16}$ x 14 $\frac{1}{4}$ in.)
WEIGHT	24 kg (52 lb)

to reproducibly and precisely locate the electrode results in highly reproducible TEER measurements. TEER measurements are stored in the computer as the electrode moves from one well to the next. The Windows-based software provides user-friendly features to acquire, display and store the tissue resistance measurements.

The REMS electrode is very compact and robust in design. Each of two rod-shaped probes, 1.5 mm in diameter, consists of a pair of electrodes: one electrode for injecting current and the other for measuring the voltage. The use of two pairs of electrodes eliminates the error caused by the electrode-liquid interface. To take a measurement, the robot inserts one probe into the center of the filter well and the other into the opening slot of the 24- or 96-well plate. The use of AC current to measure resistance provides several advantages over DC current, including:

- Absence of offset voltages on measurements;
- There is a zero net current being passed through the membrane and, therefore, it is not adversely affected by a current charge;
- No electrochemical deposition of electrode metal.

The REMS AutoSampler also features a rinse and calibration check station. If occasional rinsing of the REMS electrode is required it may be sent to a rinse station by pressing the rinse station button on the menu bar.

REMS Automated Tissue Resistance Measuring System

Includes robot sampler, base plate, data acquisition board; computer, display, keyboard, mouse; software for Windows XP or Vista; and electrode for either 24-well plate (Corning Costar HTS Transwell-24 or Falcon HTS Multiwell) or 96-well plate (Millipore Multiscreen CaCo) — SPECIFY WHEN ORDERING.

ACCESSORIES

REMS-24	Replacement REMS STX Electrode for 24-well HTS Plate
REMS-96	Replacement REMS STX Electrode for Millipore™ 96-well Plate

Contact WPI for detailed information.

World Precision Instruments

www.wpiinc.com

Multi-Channel Voltage / Current Clamp



More channels and a wider range of voltage clamp commands than WPI's classic DVC-1000. The superior design of the cartridge electrodes makes 100-volt current excursion unnecessary, so this safe, low-voltage system is easier to adjust and use.

EVC4000 employs the voltage clamp technique to monitor membrane permeability as a function of membrane voltage or applied chemicals. When combined with WPI's patented EKC and EKV cartridge electrodes, EVC4000 can efficiently voltage or current clamp up to four sample membranes simultaneously using safe moderate voltages on the current wire leads. The superior design of the cartridge electrodes makes 100-volt current excursion unnecessary, so this safe, low-voltage system is easier to adjust and use. Extremely stable and accurate, each module, with its companion preamplifier, can operate independently in one of three different modes: Voltage Clamp (VC), Current Clamp (CC), or Open Circuit Potential (PD) measurement. EVC4000 can be controlled from the front panel of the instrument or from computer generated commands applied at the rear panel of the instrument. A feature unique to EVC4000 is an electronic potentiostat in the preamplifier box that maintains the serosal electrode invariant potential at zero relative to system ground. The preamplifier apparatus actively maintains one surface of the test membrane close to ground potential under all operating conditions.

References

W. K. MacNaughton (2000) "Role of constitutive cyclooxygenase-2 in prostaglandin-dependent secretion in mouse colon *in vitro*." *Journal of Pharmacology and Experimental Therapeutics* 293, 2, 539-544

EVC4000-4	4-Channel Voltage Clamp & preamps (shown above)
EVC4000-3	3-Channel Voltage Clamp & preamps
EVC4000-2	2-Channel Voltage Clamp & preamps
EVC4000-1	1-Channel Voltage Clamp & preamp

Specify line voltage

EVC4000 SPECIFICATIONS

PREAMPLIFIER	
Input Resistance	10 ¹² Ohms
Input Leakage Current	100 pA, max.
Maximum Input Voltage	±15 volts
VOLTAGE CLAMP	
Panel Display	±200 mV ±0.1 mV
Clamp Voltage / External Input	100 mV per Volt
Range of Voltage Electrodes	±32 Volts
Max. Clamp Voltage	±100 mV
Fluid Resistance Compensation	0 to 1000 Ohms
CURRENT CLAMP	
Panel Display	±999 µA ±1 µA
Maximum Clamp Current	±1 milliampere
Current Clamp Output	1 µA / mV
DISPLAY RESOLUTION	
Voltage	0.1 mV
Current	1 µA
DIMENSIONS	
	18.25 x 7.2 x 9.6 in. (46 x 18 x 24 cm)
SHIPPING WEIGHT (EVC4000-4)	
	26 lb (12 kg)

OPTIONAL ACCESSORIES

SYS-EVC4000	Replacement Voltage Clamp & EVC3 Preamplifier
EVC3	Replacement Preamplifier Module
EK1	Ussing Electrode Kit (2 voltage, 2 current)
EKV	Extra Ussing Voltage Electrode (each)
EKC	Extra Ussing Current Electrode (each)
2851	BNC Cable
3485	Post Mounting Kit for Preamp

Ussing System

For electrophysiological investigation of epithelial transport

- Direct connect low-resistance electrodes
- Simplified operation, easy to control temperature and clean after use
- Luer type leak-free attachment of tubing and electrodes
- Recessed electrode ports to avoid air bubble formation
- Secure membrane holding by sharp stainless steel pins or O-ring
- Specialized chamber adapts cell culture insert (Costar Snapwell) for monolayer cell culture
- Chambers with rectangular openings for tubular tissues from small animals

WPI's Ussing System offers researchers a quick, effective means of making low-resistance electrical connections to the Ussing chamber without need of long agar bridges or Calomel half-cells. Ag/AgCl half-cells screw into short tubes which plug firmly into place in the chamber's luer ports. These direct-connect electrodes eliminate the inconvenience and expense of Calomel half-cells in open liquids. The System includes one Ussing Chamber (eight sizes available), Support Stand, Electrode Kit, Glass Circulation Reservoir (two sizes available), and a Tubing start-up kit (25 feet of 0.375-in. tubing, 10 feet of 0.156-in. tubing, plus four male luer fittings, two compressor clamps, one Y-connector, and one clip). Sixteen possible system configurations are listed at right. Components are also available separately. (Preamplifier in photo not included.)

Ussing Chambers

WPI's classical Ussing Chambers are well established perfusion chambers that are easy to operate, easy to control temperature, and easy to clean after use. Hundreds of them are used daily by scientists in the field.

Ussing Chambers are machined from solid acrylic with eight entry ports for fluid lines, electrodes, or agar bridges. For easy, leak-free attachment of tubing and electrodes, all eight ports are luer type. The four ports for voltage and current electrodes are recessed to prevent formation of air bubbles in the chamber. The fluid compartments in each side of the chamber are separated by the epithelial membrane being studied. Sharp stainless steel pins on one side of the chamber hold the membrane in position and mate with holes in the opposite chamber interface. (In the CHM4, tissue is held by an O-ring instead of pins.)

The CHM5 chamber adapts the Costar Snapwell, a cell culture insert for monolayer cell culture, into WPI's "classical" epithelial voltage clamp system. Until now, classical Ussing Chambers have not been widely used for monolayer cell culture inserts because most inserts have a very deep profile, limiting good fluid perfusion at the surface of the membrane — and limiting voltage electrodes from measuring the potential close to the surface of the membrane. CHM5 solves these problems: Perfusion fluid is introduced into the chamber at an angle so that it will flow directly to the surface of the membrane. The voltage electrode is also inserted into the chamber at an angle so as to reduce the distance between the surface of the membrane and the electrode.



Complete Ussing System includes stand, glass reservoir, electrodes, Ussing chamber and tubing (EVC3 preamp and post mounting kit not included—see page 18).

Two small chambers with rectangular openings are designed for tubular tissue from small animals such as the mouse intestinal tract membrane (CHM6) and rat intestinal tract membrane (CHM7). The rectangular opening more closely matches the shape of the tissue than would a circular opening, significantly increasing the membrane area available for testing. The larger membrane area increases the transport rate of low permeability chemicals; it also reduces the electrical resistance of the system for easier current clamping.

Optional Drains

Drains may be added to Ussing chambers to allow quick and complete evacuation of radioactive or toxic substances. To have drains added at the time of order, add a "D" to the part number (such as "USS1LD"); cost of the drain (\$105 to \$140) will be added to the cost of the chamber or system ordered.

Cartridge Electrodes

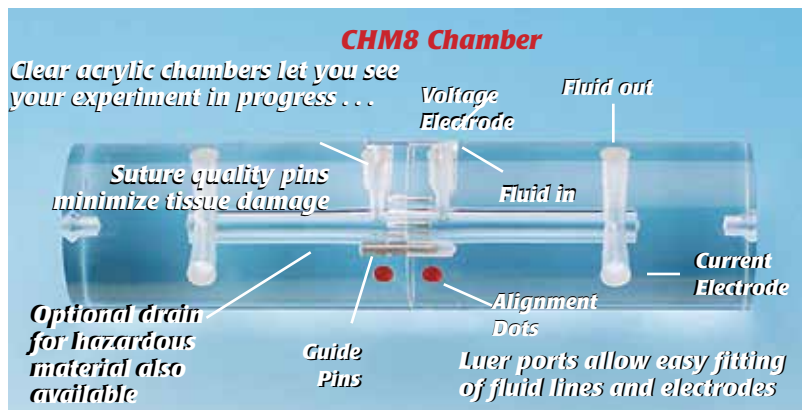
The Electrode Kit contains four voltage/current electrodes, plus four luer-tipped cartridges. Electrodes are threaded and screw securely into the end of each cartridge. The luer tip then plugs securely into the luer openings of the chamber. The cable from each electrode terminates with a 2 mm pin which may be plugged into voltage/current clamps such as WPI's DVC1000 or EVC-4000.

The miniature electrode-gel cartridge is a small plastic tube with a male luer tip identical to those at the tip of hypodermic syringes. The tube may be filled with different gel materials; agar is commonly used but other gel materials may also be satisfactory.

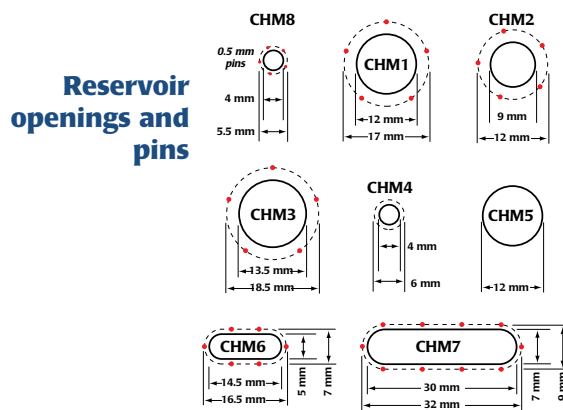


EKV and EKC Cartridge Electrodes

U.S. Patent No. 4,912,060



Assembled chambers are 101.6 mm (4 in.) long.



	CHM1 (Medium)	CHM2 (Small)	CHM3 (Large)	CHM4 (Extra Small)	CHM5 (Snap)	CHM6 (Rect., Small)	CHM7 (Rect., Large)	CHM8 (Extra Small)
Reservoir Opening	12 mm	9 mm	13.5 mm	4 mm	12 mm	5 x 14.5 mm	7 x 30 mm	4 mm
Half-Chamber Volume	1.0 mL	0.75 mL	1.2 mL	0.5 mL	1.7 mL	0.8 mL	5.5 mL	0.5 mL
Pin Circle Diameter	17 mm	12 mm	18.5 mm	6 mm*	N/A	7 x 16.5 mm	9 x 32 mm	5.5 mm

*O-ring diam.



Circulation Reservoirs

Hand-blown borosilicate glass, with jacketed chambers for temperature control. Available in two sizes — #5210 holds 20 mL per side, and #5362 (at left) holds 10 mL per side (useful when expensive chemicals are involved). Reservoir condenser caps prevent air bubbles and turbulence in fluid reservoirs.

Water Bath

The Julabo circulating bath (see next page) is ideal for controlling temperatures of external systems. With a powerful 15L/min flow rate, the pump provides optimum heat exchange. The tap water cooling feature is standard with a range of 20-100°C. The bath opening is 15cm x 15cm x 15cm and can hold 3-4.5L of liquid.



USSING SYSTEMS, LARGE RESERVOIR

USS1L	Medium Chamber, Stand, Reservoir, Electrodes, Tubing
USS2L	Small Chamber, Stand, Reservoir, Electrodes, Tubing
USS3L	Large Chamber, Stand, Reservoir, Electrodes, Tubing
USS4L	Extra Small Chamber, Stand, Reservoir, Electrodes, Tubing
USS5L	Snap Chamber, Stand, Reservoir, Electrodes, Tubing
USS6L	Small Rectangular Chamber, Stand, Reservoir, Electrodes, Tubing
USS7L	Large Rectangular Chamber, Stand, Reservoir, Electrodes, Tubing
USS8L	Extra Small Chamber, Stand, Reservoir, Electrodes, Tubing

USSING SYSTEMS, SMALL RESERVOIR

USS1S	Medium Chamber, Stand, Reservoir, Electrodes, Tubing
USS2S	Small Chamber, Stand, Reservoir, Electrodes, Tubing
USS3S	Large Chamber, Stand, Reservoir, Electrodes, Tubing
USS4S	Extra Small Chamber, Stand, Reservoir, Electrodes, Tubing
USS5S	Snap Chamber, Stand, Reservoir, Electrodes, Tubing
USS6S	Small Rectangular Chamber, Stand, Reservoir, Electrodes, Tubing
USS7S	Large Rectangular Chamber, Stand, Reservoir, Electrodes, Tubing
USS8S	Extra Small Chamber, Stand, Reservoir, Electrodes, Tubing

* Add EVC4000 at reduced price when buying Ussing System with equivalent number of channels

EVC4000-1	1-Channel Voltage Clamp & Preamps
EVC4000-2	2-Channel Voltage Clamp & Preamps
EVC4000-3	3-Channel Voltage Clamp & Preamps
EVC4000-4	4-Channel Voltage Clamp & Preamps

* Drain option, \$105 to \$140, varies according to chamber.

System components also available separately:

xxxxD	Drain option (add "D" to part number of chamber or system)
CHM1	Medium Chamber
CHM2	Small Chamber
CHM3	Large Chamber
CHM4	Extra Small Chamber with O-Ring Seal
CHM5	Snap Chamber (fits Costar Snapwell cups)
CHM6	Small Rectangular Chamber
CHM7	Large Rectangular Chamber
CHM8	Extra Small Chamber with Mounting Pins
EK1	Ussing Electrode Kit (2 voltage, 2 current)
EKC	Extra Ussing Current Electrode (red) (each)
EKV	Extra Ussing Voltage Electrode (blue) (each)
5210	Large Glass Circulation Reservoir, (20 mL per side)
5233	Replacement Condenser for 5210
5362	Small Glass Circulation Reservoir, (10 mL per side)
5361	Replacement Condenser for 5362
3955	EKV Cartridges, 35 mm (pkg of 12)
3960	EKC Cartridges, 58 mm (pkg of 12)
3669	Tubing Kit (flexible hose and luer fittings)
3579-20	Replacement luer fittings for tubing connections (pkg of 20)
5153	Support Stand
3485	Post Mounting Kit for Preamp

Circulating Bath

The Julabo circulating bath is ideal for controlling temperatures of external systems. With a powerful 15L/min flow rate, the pump provides optimum heat exchange. The tap water cooling feature is standard with a range of 20-100°C. The bath opening is 15cm x 15cm and can hold 3–4.5L of liquid.

- LED temperature display (0.1°C resolution)
- Stainless steel bath tank
- Adjustable high temperature cut out and dry running protection.
- PID temperature control
- Large capacity for temperature applications with larger external systems and open systems
- Internal bath for simultaneous applications with smaller objects
- Built in cooling coil for tap water connection when you require a temperature less than the ambient temperature



JULABO BATH SPECIFICATIONS

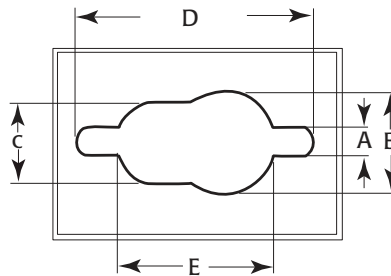
Temperature Selection digital
 Temperature Indication LED
 Resolution 0.1°C
 Temperature Control PID1
 Heater Wattage 230V–2.0kW
 115V–1.0kW

Circulating Pump

Discharge, max. at 0 bar 15L/min
 Pressure, max. at 0 l 0.35 bar
 Ambient Temperature 5–40°C
 Mains Power Connection (230V/50Hz) ... 190–253V/50Hz
 Current Input (230V) 9A
 Mains Power Connection (115V/60Hz) ... 103–127V/60Hz
 Current Input (115V) 9A
 Bath Tank Stainless steel
 Working Temperature Range 20–100°C
 Temperature Stability ±0.03
 Bath Opening (WxL) 15 x 15cm
 Bath Depth 15cm
 Filling Volume 3–4.5L
 Dimensions 17 x 33 x 36cm
 Weight 7.0kg
 Recommended Bath Fluid soft/decalcified water

503843	Julabo Circulating Bath, 115V
503844	Julabo Circulating Bath, 230V
504122	Julabo Circulating Bath, 100V (Japan)
504142	Julabo Circulating Bath, 13L volume, 110V
504141	Julabo Circulating Bath, 13L volume, 220V

Rodent Brain Matrices



WPI offers one of the largest selections of brain matrices available. Made of acrylic, or stainless steel, these matrices are sturdy and can be heated, chilled, autoclaved (stainless steel only), scrubbed — and stand up to rigorous daily use. Coronal matrices have the additional feature of a mid-line sagittal cut to facilitate splitting of the left and right hemispheres. Sections can be as fine as 1-mm. The olfactory/spinal/notch is cut into each matrix.

Order #	Subject	Material	Section	A	B	C	D	E	Cavity Depth	Weight
RBMA-200C	Adult Mouse, 40-75g	Acrylic	Coronal	3.18	11.1	8.73	19.1	12.2	7.4	0.5 lb
RBMA-200S	Adult Mouse, 40-75g	Acrylic	Sagittal	3.18	11.1	8.73	19.1	12.2	7.4	0.5 lb
RBMA-300C	Rat, 175-300g	Acrylic	Coronal	4.7	15.9	12.7	36.6	23.8	7.61	0.5 lb
RBMA-300S	Rat, 175-300g	Acrylic	Sagittal	4.76	15.9	12.7	36.6	23.8	10.91	0.5 lb
RBMA-600C	Rat, 300g-600g	Acrylic	Coronal	4.76	19.8	14.7	36.6	24.7	10.91	0.5 lb
RBMA-600S	Rat, 300g-600g	Acrylic	Sagittal	4.76	19.8	14.7	36.6	24.7	10.91	0.5 lb
RBMS-200C	Adult Mouse	Stainless Steel	Coronal	3.18	11.1	8.73	19.1	12.2	7.4	1.0 lb
RBMS-200S	Adult Mouse	Stainless Steel	Sagittal	3.18	11.1	8.73	19.1	12.2	7.4	1.0 lb
RBMS-300C	Rat, 175-300g	Stainless Steel	Coronal	4.76	15.9	12.7	36.6	23.8	7.61	1.0 lb.
RBMS-300S	Rat, 175-300g	Stainless Steel	Sagittal	4.76	15.9	12.7	36.6	23.8	7.61	1.0 lb
RBMS-600C	Rat, 300g-600g	Stainless Steel	Coronal	4.76	19.8	14.7	36.6	24.7	10.91	1.0 lb
RBMS-600S	Rat, 300g-600g	Stainless Steel	Sagittal	4.76	19.8	14.7	36.6	24.7	10.91	1.0 lb