

**GAMRY**  
INSTRUMENTS

*Helping You Achieve Your Potential*

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# Over 25 years of Redefining Electrochemical Measurements

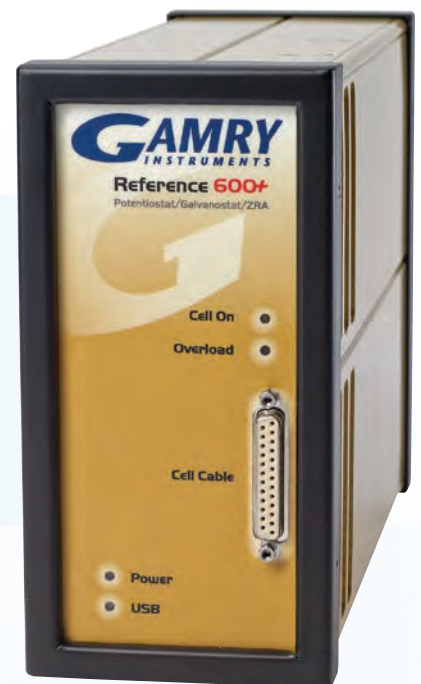


## High Performance at a Low Cost of Entry

Our selection of instruments provides ease-of-entry that can then grow with your lab as you need more capabilities. The instrument has the same hardware even on the lower tiered models so you're getting the same performance at a lower price point.

## Electrical Isolation

All of Gamry's instruments are electrically isolated from ground. If you need to run multiple working electrodes in a single cell, we can easily do that. If you need to couple a potentiostat to other instruments, we can do that. If you need to connect to a grounded electrode, we can do that. Electrical isolation is designed in from the ground up (pun intended).



## Flexibility without Compromise

Gamry's multichannel setup is designed to allow you to get full capabilities out of each individual channel. We do NO multiplexing of measurements like some other manufacturers, meaning as you add channels, there is no performance degradation.

## No Lost Bandwidth

Gamry's modular multichannel gives you the ability to place the instrument next to your cell when needed, giving you the best possible result. Long cables degrade performance. To get the best result, take your potentiostat right to your cell!



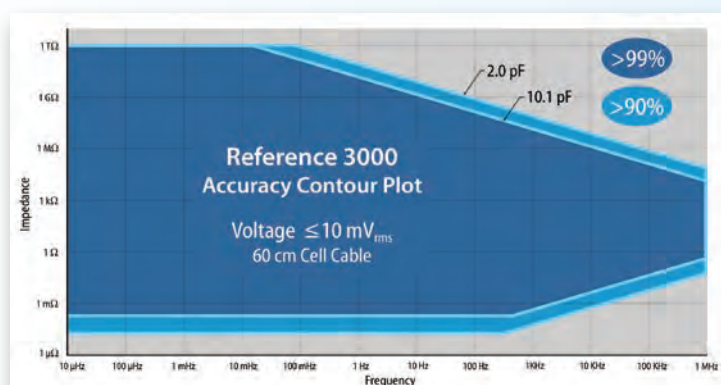
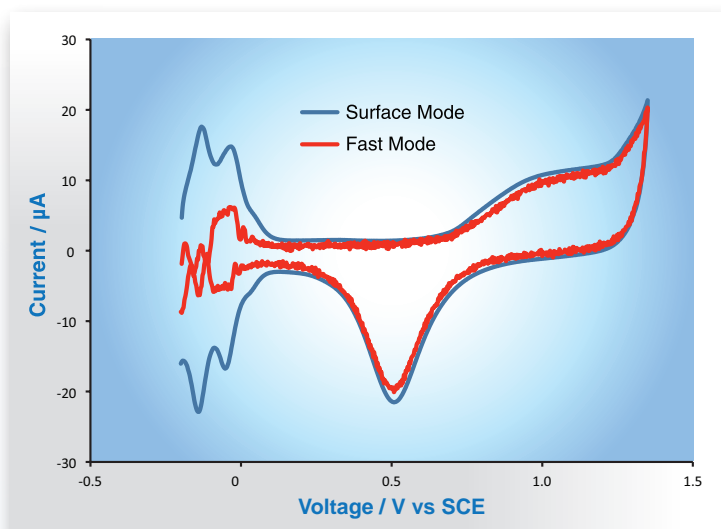
Gamry Instruments provides you with the complete solution to get the answers you need. We carefully consider every detail of system design. Everything from board layout, component selection, signal processing, and all the way down to the tip of our smart cell cables, is designed to deliver maximum performance. Our software is intuitive and easy to use yet powerful enough underneath to allow you to customize experiments and interfaces to suit your needs. This combination of features and capabilities give you the maximum amount of performance at incredible value.

## Software with No Limits

Gamry's Open-Source Scripting and eChem Toolkits provide you with ability to customize experiments you haven't even thought of yet. Our Sequence Wizard lets you string together any number of experiments. The Sequence Wizard contains options for looping based on time, cycle number, or a variable. Run cyclic voltammograms with increasing vertex potentials or a series of chronoamperometry experiments with increasing step sizes. Imagine cyclic charging and discharging with increasing or decreasing current, load, or power levels. Throw in a delay into your loop and you can now tell the software to obtain an EIS spectrum once an hour for the next 24 hours.

## Digital Signal Processing

Gamry potentiostats incorporate digital signal processing (DSP) technology. This allows us to oversample and average in order to improve signal-to-noise ratios and provide accurate capacitance measurements. Our instruments have three sampling modes – Fast, Noise Reject, and Surface. Fast corresponds to signal acquisition much like a normal digital potentiostat – sampling at the end of each step. Noise reject oversamples and averages during the last 20% of a step. Surface mode oversamples and averages during the entire step to ensure accurate capacitance measurements by cyclic voltammetry.



## Specs that Don't Lie

Gamry publishes Accuracy Contour Plots for all of our instruments using realistic signal amplitudes and actual cell cables. We specify our instrument performance all the way to the tip of the cell cable.



# Applications

Gamry's flexible hardware and software covers a wide range of applications – corrosion, physical electrochemistry, sensors, bioelectrochemistry, energy storage and conversion devices, coatings, semi-conductors, photovoltaics, and more. Here are some highlights.

## Corrosion Measurement

Gamry offers the world's most complete selection of electrochemical tools for the material scientist and corrosion engineer. Every Gamry potentiostat can run the complete repertoire of DC techniques, EIS, Electrochemical Noise, and EFM. Gamry has long been the electrochemical corrosion leader.



## Physical Electrochemistry/ Bioelectrochemistry/Sensor Development

Research on amperometric, potentiometric and electrochemical biosensors continues to accelerate. A Gamry potentiostat running physical and electroanalytical techniques, coupled with EIS is the perfect tool for characterizing new sensor materials, membranes, and protocols. Gamry's QCM can also be used as a tool to help characterize interfaces or improve sensor design.

Academic and industrial electrochemists can also use their Gamry potentiostat combined with the physical electrochemistry software to measure the kinetics and study the mechanisms of electrochemical reactions. Add in any of our spectroelectrochemistry systems to provide even more insight. Finally, complete your research by modeling reactions and mechanisms using the DigiElch Electrochemical Simulation Software.



## Coatings Evaluation

Coatings evaluation demands a high-performance potentiostat. The Gamry Reference family instruments are designed for high impedance systems like coatings. Visit the Gamry website and download our three papers on evaluating paints with EIS.



## Energy Devices

Gamry's suite of instruments and techniques allow you to characterize any number of energy devices – batteries, supercaps, fuel cells, electrolyzers, and photovoltaics. Whether you're testing full cells, half cells, or stacks, Gamry has what you need. Perform cyclic charge/discharge with a few simple clicks. Drop an EIS measurement into the middle of a charging step. We even give you the option to charge under constant current, constant load, or constant power.

Impedance is an integral part of analyzing energy devices. Besides the standard potentiostatic and galvanostatic techniques, we have a hybrid EIS technique where you perform a potentiostatic EIS experiment under galvanostatic control. Speed up those EIS measurements using our unique OptiEIS™ multisine technique. Our power-leveling algorithm maximizes signal-to-noise ratio while ensuring that you don't damage your sample. Anyone performing EIS on porous electrodes will benefit from our Transmission Line circuit elements. Gamry's software includes our exclusive Autofit™ routine that takes the guesswork out of estimating initial parameters for EIS circuit elements.

## Custom Applications and Open-Source Scripting

Gamry's software includes all of the traditional techniques and then some. Our software includes over 85 standard techniques and numerous custom techniques. Our own Open-Source Scripting language allow you to modify any technique available. We also have eChem Toolkits that provide you with the ability to utilize development environments such as LabVIEW, C, C++, C+, and Visual Basic to develop your own applications. Numerous examples are provided to get you started.

Writing the experimental techniques in an open-source scripting language means that Gamry can easily modify any experiment to your needs. Perhaps you're only interested in acquiring data for the last 100 seconds of a 10 hour potentiostatic hold. Maybe you want to automatically calculate a corrosion rate and tabulate the results for a series of repetitive experiments. Maybe you want to automatically write the results to a database. Gamry's flexibility allows you to do all of these and more.

```
; Run a controlled potential IV curve from Vinit to Vfinal
function Cpip (Pstat, Vinit, Vfinal, ScanRate, SampleTime, IRToggle)

    InitializePstat (Pstat, IRToggle)

    Pstat.PrintHardwareSettings ()

    ; Create a ramp generator for this pstat
    Signal = VRAMP.New ("SIGNAL", Pstat, Vinit, Vfinal, ScanRate, SampleTime)
    Signal.SetAcquisitionControl(NIL, NIL, NIL, SAMPLINGMODE_NR)

    Pstat.SetSignal (Signal)

    Curve = CPIV.New ("CURVE", Pstat)
    Curve.SetPlot (CPIV_LOGIV, 1.0e-12, 0.050, 1.0)

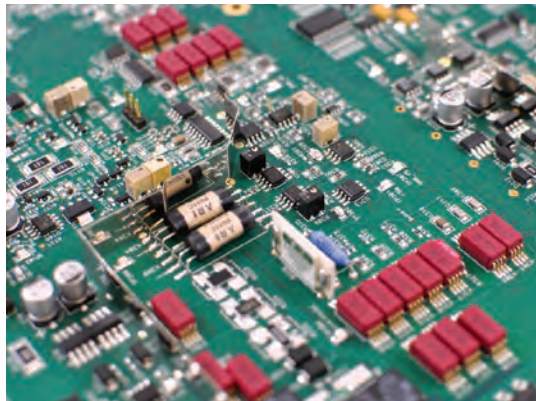
    Pstat.InitSignal ()           ; Initialize the signal generator via the Pstat
    Pstat.SetCell (CellOn)

    Notify ("Autoranging")
    Pstat.FindIERange ()
    Notify ("Running Potentiodynamic Curve")
    Curve.Activate ()
    Curve.Run ()                 ; Actually run the curve here
    Pstat.SetCell (CellOff)
```

# Reference 3000 Potentiostat/Galvanostat/ZRA

## HIGHLIGHTS

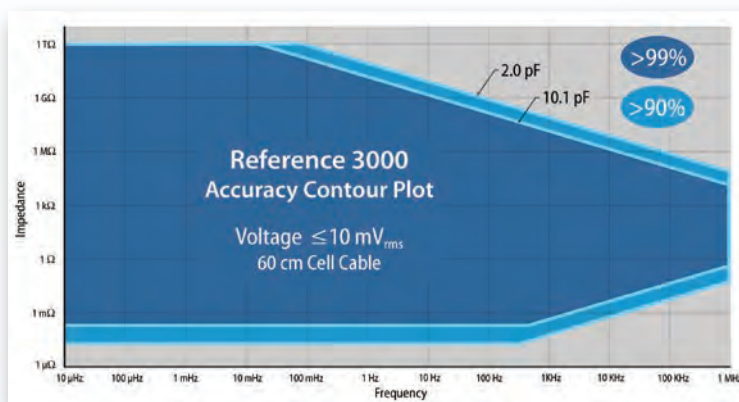
- 3 A Maximum
- Up to +/- 32V
- EIS from 10  $\mu$ Hz to 1 MHz
- Electrically isolated
- 11 current ranges
- 3  $\mu$ s timing



## Top of the Line Performance

The Reference 3000 is a high-current, high-performance potentiostat with 11 current ranges from 3 amps to 300 picoamps. This instrument also includes a switchable compliance mode for either high-current or high-voltage operations –  $\pm 3A$  at  $\pm 15V$  or  $\pm 1.5A$  at  $\pm 32V$ . A special stack mode, enabled with a high-voltage electrometer allows you to apply and measure right up to the compliance limit.

## Built in EIS



With on-board electronics for electrochemical impedance spectroscopy, the Reference 3000 can make accurate measurements over a frequency range from 10  $\mu$ Hz to 1 MHz. Modes include potentiostatic, galvanostatic, and a unique hybrid mode where potentiostatic EIS is run galvanostatically to ensure you don't accidentally damage your sample.

Our combination of DSP and signal filtering ensure the best possible measurement. Compare our Accuracy Contour Plot with any of our competitors and you'll quickly see why the Reference 3000 delivers best-in-class performance.



## Portable

Weighing only 5 kg means the Reference 3000 is small enough to move to wherever your experiment takes you. Combine that with the fact that the instrument is electrically isolated from ground and you get a perfect corrosion measurement system. Whether you're working with autoclaves, salt spray chambers, pipelines, rebar in concrete, or any other type of grounded cell, you can be sure the Reference 3000 will deliver the results you need.

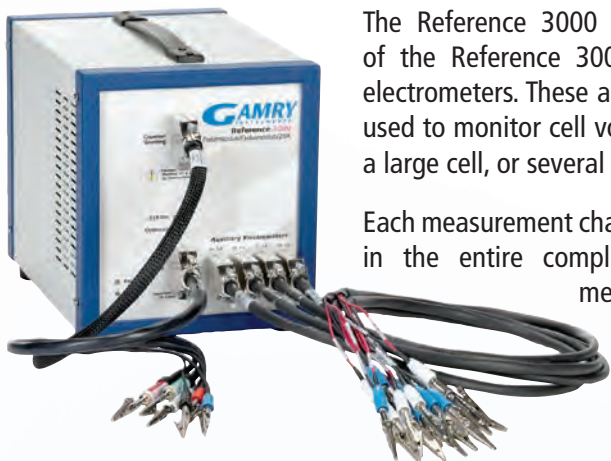
The Reference 3000 includes both current interrupt and positive feedback iR compensation. Our control loop algorithms accurately measure and correct for uncompensated resistance - this way you can be sure you're getting the signal you requested.

## Optional Signals

A variety of inputs and outputs, including a thermocouple input, are available through the rear of the instrument. The rear of the instrument also includes a Sync port for string together up to eight Reference family potentiostat for bipotentiostat or n-stat configurations.

# Reference 3000 Auxiliary Electrometer & Reference 30k Booster

## Eight Additional Electrometers



The Reference 3000 with Auxiliary Electrometer is a variant of the Reference 3000 that has eight additional differential electrometers. These additional measurement channels could be used to monitor cell voltages in a stack, potential distribution in a large cell, or several auxiliary processes all at once.

Each measurement channel can measure a  $\pm 5$  V signal anywhere in the entire compliance voltage range. Stack impedance measurements up to 100 kHz are also possible. Imagine characterizing eight cells in a stack simultaneously.

## HIGHLIGHTS

- Stack impedance up to 100 kHz
- Multiple reference electrodes
- Monitor additional voltages

## Higher Currents

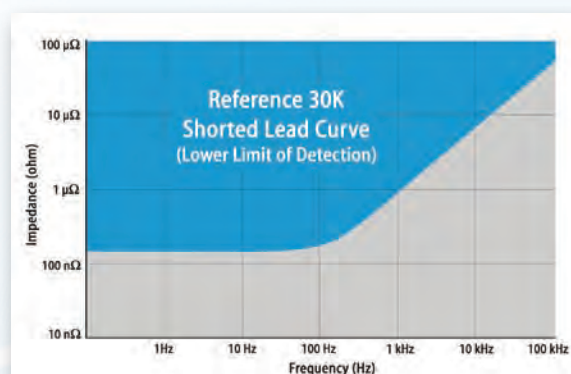
The Reference 30k Booster for the Reference 3000 is an external hardware option which increases the current limit of the Reference 3000 by a factor of 10 to  $\pm 30$  Amps. The Booster will only operate with the Reference 3000 and will work with all Reference 3000 functions including the Auxiliary Electrometer option. The Reference 30k Booster replaces the current leads (Counter and Working) from the Reference 3000 while the Reference 3000 voltage sense leads (including those of the AE) keep their original function.



## HIGHLIGHTS

- 30 A Maximum
- EIS to 300 kHz
- Pass-through mode
- Floating

## Ultra Low Impedance



The Reference 3000 plus the Reference 30k Booster is an ideal system for the evaluation of new technologies for batteries, fuel cells, and next generation supercapacitors. The compliance limits of the Reference 30k allow complete discharge (through zero volts) and can accurately measure impedance values below  $100 \mu\Omega$ .

# Reference 600+ Potentiostat/Galvanostat/ZRA

## HIGHLIGHTS

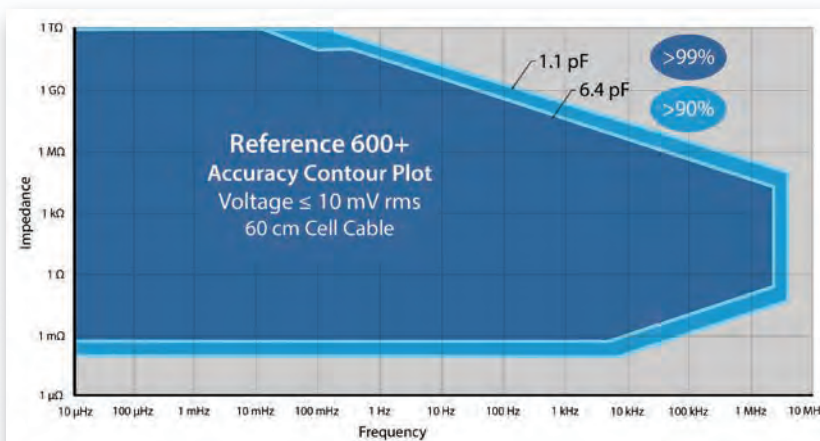
- 600 mA Maximum
- EIS from 10  $\mu$ Hz to 5 MHz
- Field deployable
- Floating
- 3  $\mu$ s timing

## Premium Performance

The Reference 600+ is the lower-current instrument in the Reference family and is best for low-current applications demanding the lowest noise levels. It has 11 current ranges from 600 mA to 60 pA, a compliance voltage limit of  $\pm 22$ V, and an applied voltage limit of  $\pm 11$ V.

Like the Reference 3000, the Reference 600+ is a compact, portable instrument. Weighing only 3 kg and roughly the size of the Bard and Faulkner electrochemistry book, the Reference 600+ is easily transported from the lab to the field.

With noise levels of  $\leq 2$   $\mu$ V rms, the Reference 600+ is possibly the quietest potentiostat on the market. Combine this with the 3  $\mu$ s timebase and you get a combination that is perfect for fast-scan experiments at UMEs, nanoelectrodes, and scanning applications.



## Accurate EIS

The Reference 600+ includes the same DSP and filtering that the Reference 3000 does and therefore delivers the same accurate impedance. The lowest current range on the Reference 600+ though allows for the measurement of higher impedance samples such as paints and coatings.

The Reference 600+ includes both current interrupt and positive feedback iR compensation. Our control loop algorithms accurately measure and correct for uncompensated resistance - this way you can be sure you're getting the signal you requested.

## Options

A variety of inputs and outputs, including a thermocouple input, are available through the rear of the instrument. The rear of the instrument also includes a Sync port for string together up to eight Reference family potentiostat for bipotentiostat or n-stat configurations.





# Interface 5000 Potentiostat/Galvanostat/ZRA



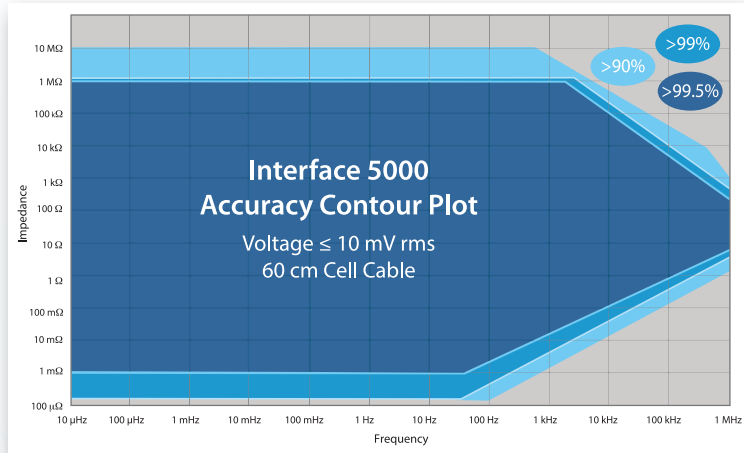
## Powerful

The Interface 5000 potentiostat/galvanostat/ZRA has been designed for the battery researcher studying materials and whole cells. With currents up to 5 A at  $\pm 6$  V, it is ideal for charge/discharge and low impedance EIS experiments. Dual electrometers allow you to monitor both the anode and cathode simultaneously during experiments. Now you can fully characterize your cell in a single experiment. The Interface 5000 comes in two models, the Interface 5000P and the Interface 5000E. The Interface 5000P can perform read voltage, charge/discharge, potentiostatic, galvanostatic, and galvanostatic EIS (up to 20 kHz). The Interface 5000E includes all of Gamry's software capabilities including potentiostatic and galvanostatic EIS up to 1 MHz.

## HIGHLIGHTS

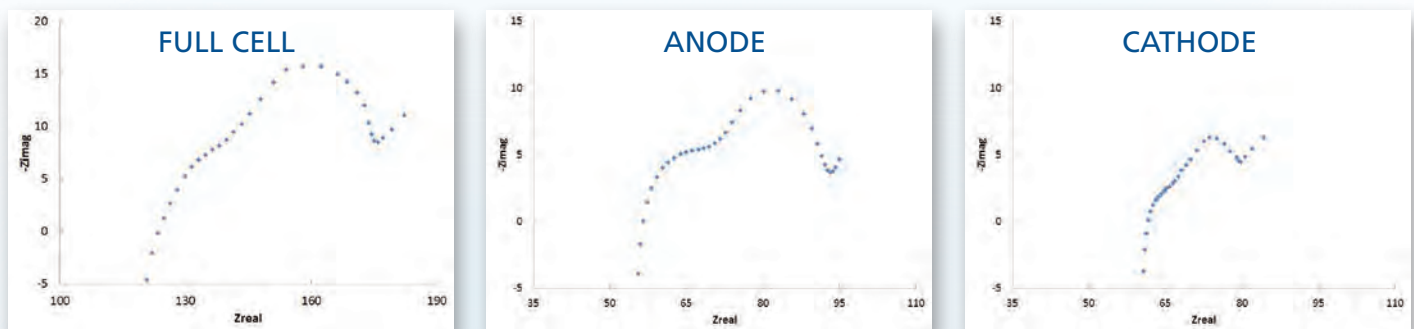
- 5 A Maximum Current
- EIS to 1 MHz
- Monitor anode and cathode simultaneously
- Floating

## Low Impedance EIS



The Interface 5000 is ideal for testing low impedance devices and covers the frequency range of 10  $\mu$ Hz to 1 MHz at 99% accuracy. The current-carrying leads and sense leads have been separated to reduce mutual inductance, thereby giving you more bandwidth at low impedances. You can accurately characterize devices down to 150  $\mu\Omega$ .

## Monitor Both Half Cells



Dual electrometers allow you to monitor voltages for both the working and counter electrode during experiments such as charge/discharge or EIS when a reference electrode is used. Imagine being able to characterize both half cells in addition to the entire cell in the same experiment, saving you valuable time.

## Options

The Monitor port on the front of the instrument provides a means for monitoring temperature using an RTD probe and auxiliary voltages. Voltage out and digital I/O capabilities are also included. The rear of the instrument includes a Sync port for bipotentiostat or n-stat configurations with other Interface family instruments.

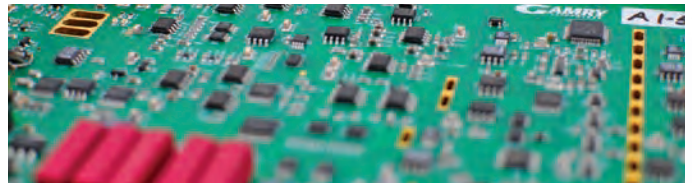
# Interface 1000 Potentiostat/Galvanostat/ZRA

## HIGHLIGHTS

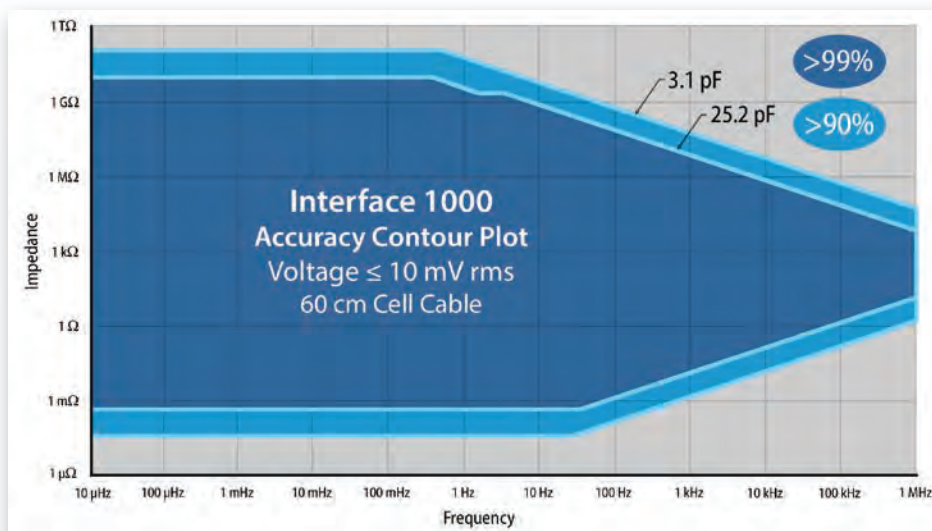
- 1 A Maximum Current
- EIS from 10  $\mu$ Hz to 1 MHz
- Floating

## Versatile

The Interface 1000 is a potentiostat/galvanostat/ZRA for use in general electrochemistry applications. It is the ideal instrument for labs on a budget doing corrosion measurements, single-cell battery testing, sensor development, and physical electrochemistry.



The Interface 1000 comes in four separate models. The Interface 1000T is ideally suited for teaching labs. It is able to run a variety of physical electrochemistry techniques and even potentiostatic EIS up to 20 kHz. The Interface 1000B is a great potentiostat that can run all traditional physical electrochemistry and pulse voltammetry techniques. It even includes our eChem Basic Toolkit. The Interface 1000A includes everything in the 1000B plus DC Corrosion, Electrochemical Noise, Electrochemical Energy, Critical Pitting Temperature, Electrochemical Frequency Modulation and eChemDC Toolkit. The Interface 1000E includes everything in the 1000A plus Electrochemical Impedance Spectroscopy and eChemAC Toolkit.



## Low Noise

Ten active filters on the voltage and current channels reject external signal and noise that adversely impact your measurements. The Interface 1000 automatically selects the best filter for the acquisition mode, while still offering expert users the choice for manual adjustments.

The Interface 1000 acquires data at 60 kHz, using digital signal processing (DSP), in order to oversample for the best signal-to-noise ratio possible. Combine DSP acquisition with the low intrinsic noise level of the instrument to

see why Gamry brings new meaning to low noise. A sophisticated two-stage cell switch is utilized in the design of the instrument. The first stage is a relay which insures pure electrical isolation. The second stage consists of an ultra-fast MOSFET switch with zero contact bounce. This second stage allows for better signal application with minimal spikes, as well as the ability to perform current interrupt.

## Options

The Monitor port on the front of the instrument provides a means for monitoring temperature using an RTD probe and auxiliary voltages. Voltage out and digital I/O capabilities are also included. The rear of the instrument includes a Sync port for bipotentiostat or n-stat configurations with other Interface family instruments.



# Multichannel Potentiostat/Galvanostat/ZRA

## Full Capabilities

Gamry's multichannel setup is designed to allow you to get full capabilities out of each individual channel. We do NO multiplexing of measurements like some other manufacturers, meaning as you add channels, there is no performance degradation.



## No Lost Bandwidth

Gamry's modular multichannel gives you the ability to place the instrument next to your cell when needed, giving you the best possible result. Long cables degrade performance. To get the best result, take your potentiostat right to your cell!



## Isolation

All of Gamry's instruments are electrically isolated from ground. If you need to run multiple working electrodes in a single cell, we can easily do that. If you need to couple a potentiostat to other instruments, we can do that. If you need to connect to a grounded electrode, we can do that. Electrical isolation is designed in from the ground up (pun intended).

## nStat or nStats

Gamry's multichannel systems are adaptable, allowing you to mix and match potentiostat capabilities and don't constrain you to a single chassis.

Gamry's multichannel system is designed to give you maximum performance and maximum flexibility. When you need more than an off-the-rack system, you need a Gamry.

## HIGHLIGHTS

- Up to eight Interfaces in one chassis
- Multichannel value, single channel capability

# eQCM 10M

## Electrochemical Quartz Crystal Microbalance

### HIGHLIGHTS

- 1-10 MHz
- Any cell
- Adjustable driving amplitude

### A Valuable Tool

The eQCM 10M™ is a rapid, impedance-scanning electrochemical quartz crystal microbalance (EQCM). An EQCM adds a valuable tool in the analytical toolbox of anyone investigating interfacial processes. Corrosion, ion intercalation, ion adsorption, polymer growth, and sensor binding events are all interfacial processes that produce mass changes. These mass changes can be measured by monitoring the resonant frequencies of an oscillating quartz crystal.



The eQCM 10M is a versatile instrument that accommodates any crystal from 1-10 MHz in any cell or holder. Its resolution allows you to detect mass changes on the ng/cm<sup>2</sup> scale. This is less than a monolayer of material. Gamry's Resonator software controls both the eQCM 10M and a Gamry Potentiostat.

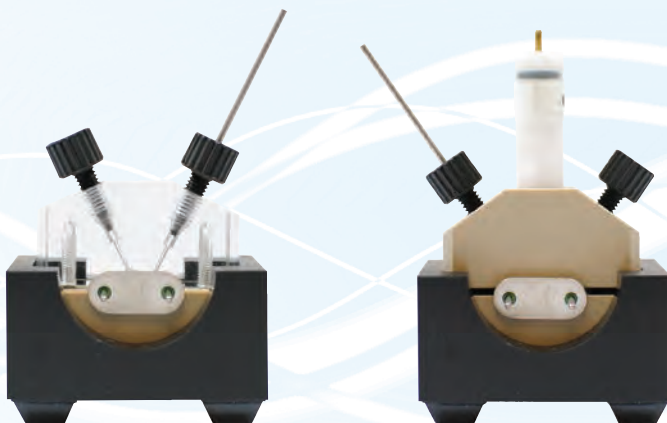


The eQCM 10M rapidly scans a frequency window around the two resonant frequencies. The advantage of scanning through the two resonant frequencies is that you no longer need to cancel the parasitic capacitance in order to maintain oscillation.

Additionally, the relative impedance spectrum is displayed each time a data point is acquired, giving you insight into bubble formation on your electrode or improper cell

setup. Having the two resonant frequencies also allows you to do basic dissipation monitoring. When  $f_s$  and  $f_p$  respond similarly your film is rigid, however, when  $f_s$  and  $f_p$  respond differently the film is not rigid.

Resonator also allows you to adjust the driving amplitude of the crystal. This is especially important when working in an ionic liquid (IL) or a viscous solution where damping is especially high. The ability to manually increase the driving amplitude for heavily-loaded crystals offers a significant advantage over straight dissipation or time-resolved techniques. Data analysis is done in our flexible and customizable Echem Analyst™. We give you a variety of plotting options to allow you to display the data as you want. You can plot straight mass change versus time, mass versus charge, mass versus potential, or a basic form of dissipation versus time.



# Spectroelectrochemistry



## Spectro-115E/115U

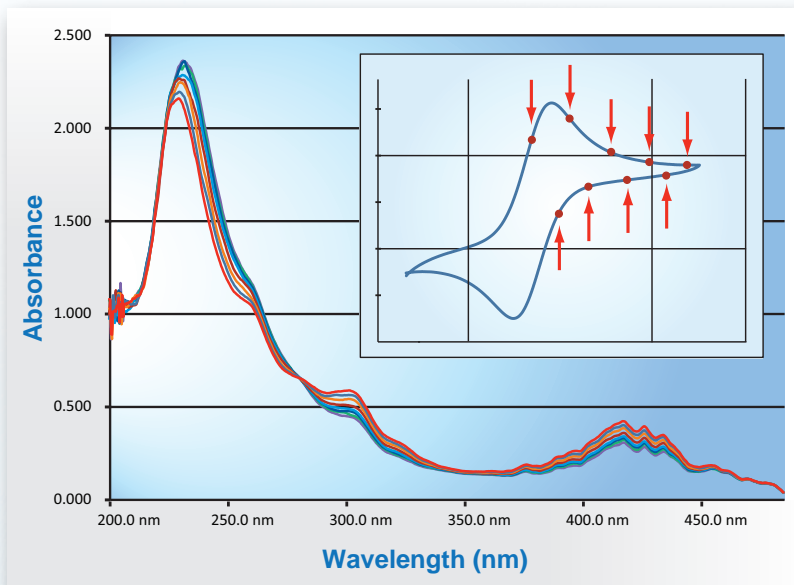
Spectroelectrochemistry is a coupled technique combining electrochemistry and spectroscopy. Gamry's spectroelectrochemistry systems, the Spectro-115E™ (350-1050 nm) and Spectro-115U™ (200-850 nm) can be combined with a Gamry potentiostat.

Each system utilizes a miniature CCD spectrometer, USB 3.0 communication, and temperature compensation. The 115E and 115U can be easily configured for absorption or transmission. The deuterium/tungsten light source, with a spectral output of 200 - >1100 nm can be configured to provide both D<sub>2</sub> and W. The light source also includes a safety shutter.



## HIGHLIGHTS

- Simultaneous data acquisition
- Ultra-low thermal drift
- Fiber-based spectrometers



# Raman Spectroelectrochemistry

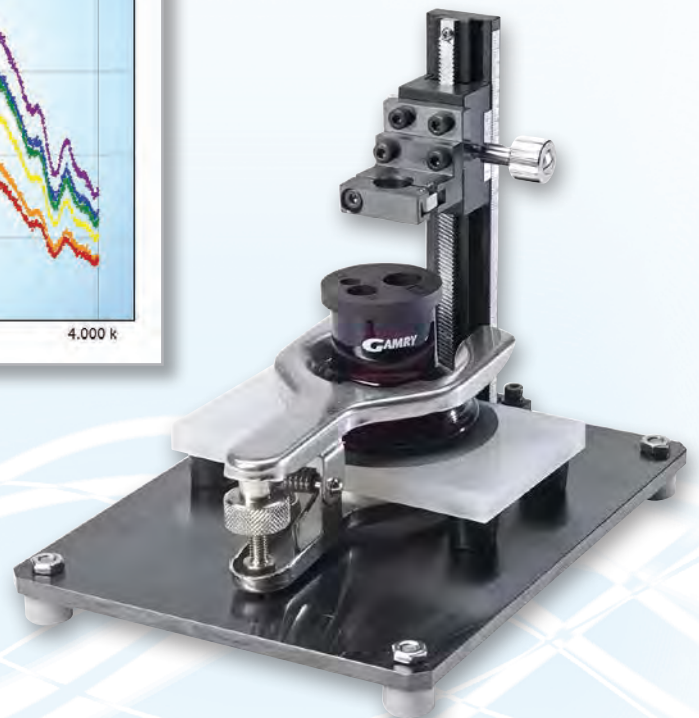
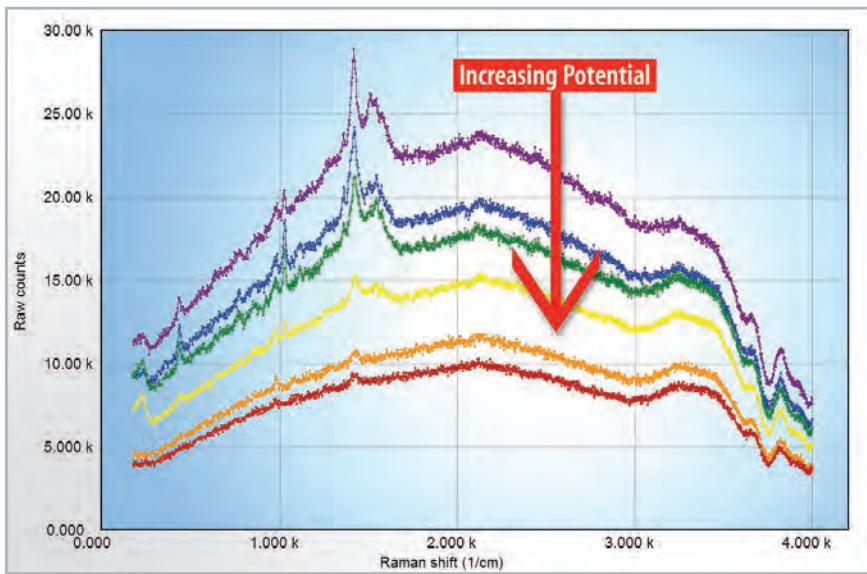
## HIGHLIGHTS

- 532 or 785 nm
- Films or solution

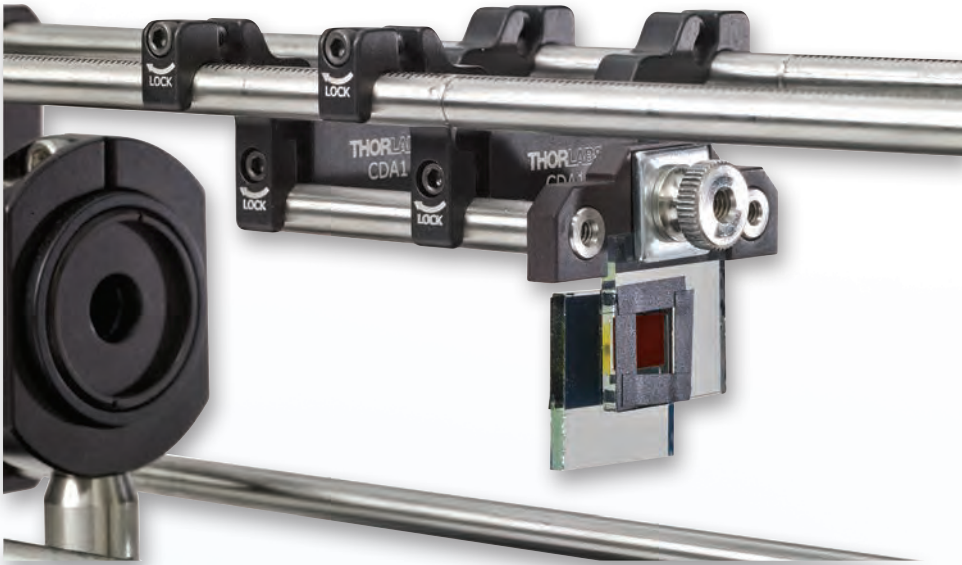


Gamry's iRaman system comes with two laser options – 532 or 785 nm. The thermoelectric-cooled 2048 pixel CCD provides for Raman shift coverage up to 4000  $\text{cm}^{-1}$  with 3  $\text{cm}^{-1}$  resolution.

The system has two different cell setups. One setup utilizes an immersion probe for measurements in liquids while the second setup is for measurements with our ITO Cuvette Cell kit. The immersion shaft has an optional height optimization holder.



# Dye Solar Cell Characterization

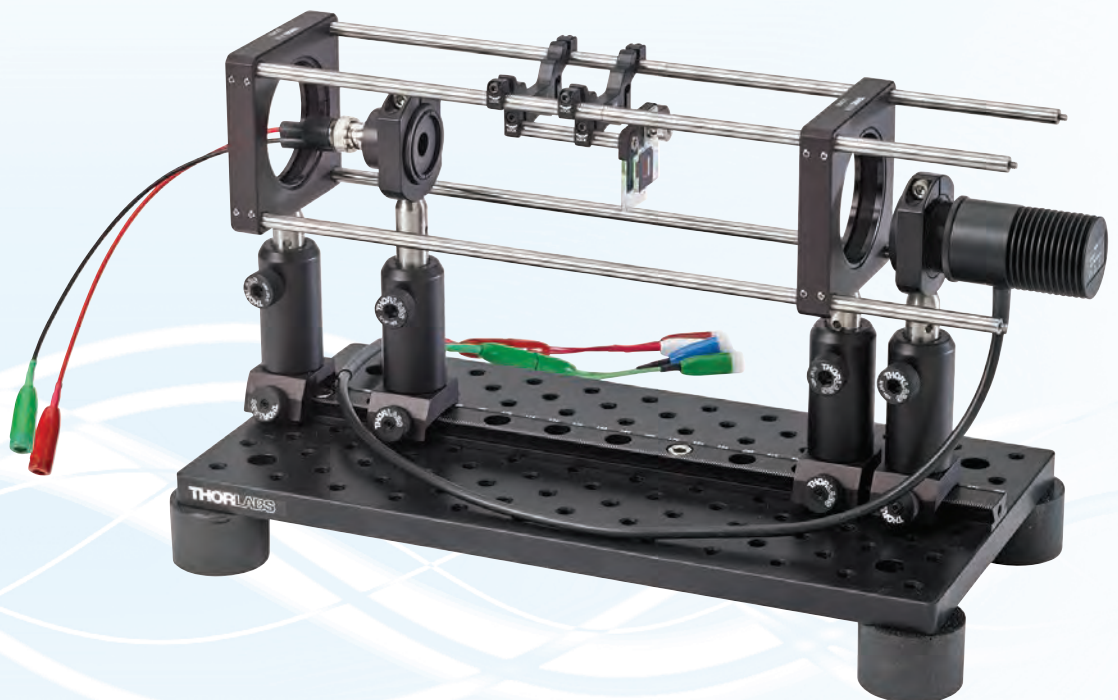


## HIGHLIGHTS

- Up to 1 MHz
- Red, White, Blue, Orange, Yellow LEDs available

Intensity Modulated Photocurrent Spectroscopy and Intensity Modulated Photovoltage Spectroscopy (IMPS/IMVS) are techniques that can be used to characterize Dye Solar Cells (DSCs). Our system utilizes two Gamry potentiostats to fully characterize DSSCs, allowing you to extract recombination and charge-extraction parameters. One potentiostat drives an LED while the second potentiostat is used to characterize the cell. Data acquisition between the two potentiostats is synced so that phase information between the driving potentiostat and the acquiring potentiostat is obtained.

The system includes a miniature optical bench with a dummy cell for background subtraction. Our 3D-printed cell holder can accommodate large and small cells. There are several LEDs available.



# ECM8 Electrochemical Multiplexer VistaShield Faraday Cage

## Turn One Channel Into Many



The ECM8™ Electrochemical Multiplexer is an affordable way to expand the throughput of your lab. The ECM8 is ideal for corrosion inhibitor testing, EIS studies, monitoring of field probes for corrosion tests, chemical sensor development, and microbial fuel cells (MFCs).

The ECM8 partners with a Gamry Potentiostat to convert a single potentiostat into a powerful instrument suitable for sequential multichannel operations. Each multiplexer allows you to sequentially take measurements on up to eight electrochemical cells. The ECM8 is great for automating repetitive experiments, and for increasing throughput on long-term experiments where data can be taken periodically. You can even stack ECM8s to a single potentiostat to get more than eight channels.

Many MFC studies involve long-term potentiostatic tests with periodic sampling of current in order to calculate the energy output. Each of the eight multiplexer channels also incorporates a local potentiostat to polarize the same when not actively participating in a measurement. Each local potentiostat in the multiplexer can output a current of 30 mA at  $\pm 5V$  that could be used to drive the MFC. Periodic cycling to monitor current is then all that is needed to calculate the energy output of each device – all this with only one potentiostat and one ECM8.

## Shield Those Experiments

Low current experiments ranging from microelectrodes to EIS of coatings can be susceptible to picking up electromagnetic (EM) noise from the surrounding environment. A Faraday cage is the ideal solution for shielding your experiment from the harmful EM noise. Gamry's VistaShield Faraday Cage is made from powder-coated 304 Stainless Steel and is designed to stand up to a wide variety of laboratory environments. The Faraday cage's conductive glass window allows experimenters to visually observe the cell during an experiment without breaking the shielding.



The VistaShield includes two ports on one side for cell cables and a number of ports on the back for gas and water flow. Inside there is a grounding lug for connection to a suitable ground. There is also a mounting post for holding a cell.

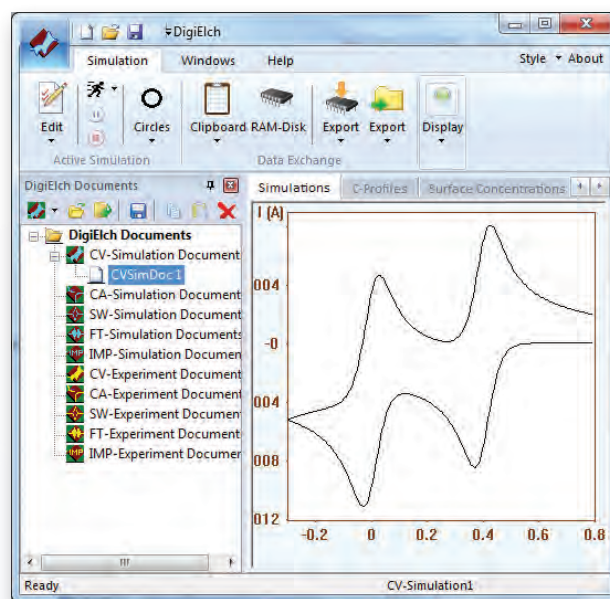


# DigiElch Electrochemical Simulation Software

## Simulate More Than Just CV

DigiElch is an electrochemical simulation software program that does much more than just cyclic voltammetry. Other experiments include chronoamperometry, square wave voltammetry, electrochemical impedance spectroscopy, and Fourier Transform voltammetry. DigiElch was originally developed by Manfred Rudolf and now Gamry is the exclusive worldwide provider of this program. The most common electrode geometries can be simulated including thin layer cells and the exact (two-dimensional) simulation of band and disk microelectrodes. Effects such as IR-drop and double layer charging can be included in all these simulations.

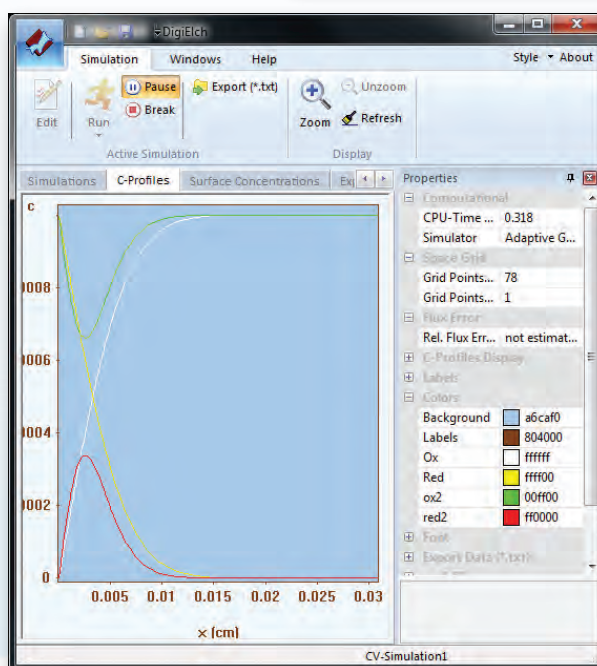
Get fast and accurate simulation of the current response for any user-defined mechanism consisting of charge-transfer steps and first- or second-order chemical reactions. 1D simulation of finite and semi-infinite diffusion. Two different simulation methods are available - a fast "fixed grid simulator" and a slower "Adaptive Grid Simulator".



## Charge-Coupled Transfers

DigiElch allows for modeling of termolecular charge transfer reactions such as the proton coupled electron transfer (PCET). You also have the ability to model surface adsorption and redox catalysis reactions on electrode surfaces with unprecedented detail. Import experimental (or re-import of simulated) curves for data fitting. DigiElch even has improved computational efficiency via parallel processing.

A Professional option exists which includes all the features of DigiElch Standard, plus a non-linear regression strategy applied to multiple data files simultaneously to determine thermodynamic and kinetic parameters from your experimental data.



## Control a Potentiostat

DigiElch can be optionally paired up with a Reference 600 to run actual experiments. The experimental setup with DigiElch includes hardware settings for the Reference 600 such as current range, filters and control amplifier bandwidth in addition to experimental details like electrode type, diffusion geometry and chemical species. The files collected in this way are immediately ready for fitting in DigiElch 7.

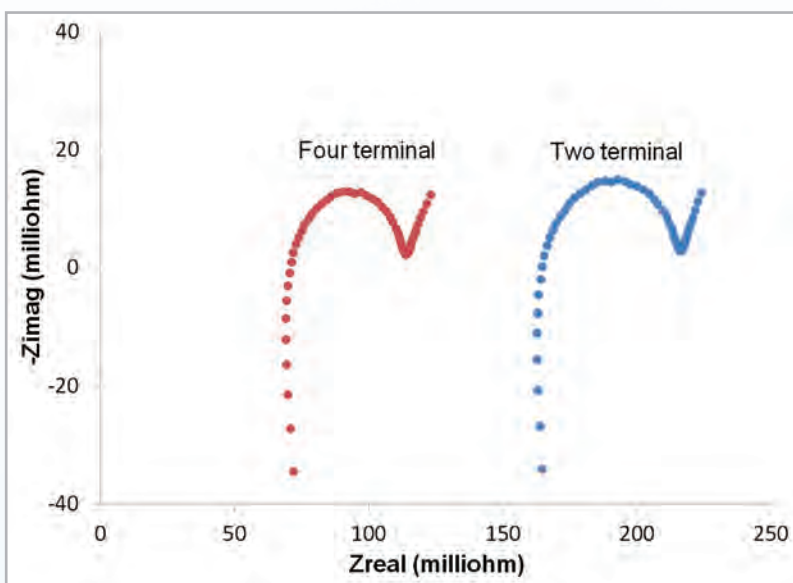
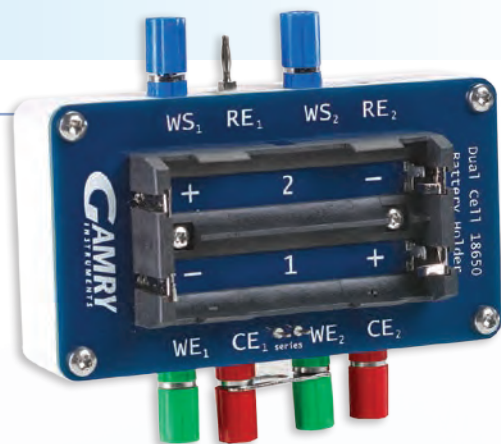
# Cells & Accessories

## HIGHLIGHTS

- Coin cells or 18650s
- Four-terminal EIS measurements

## Battery Holders

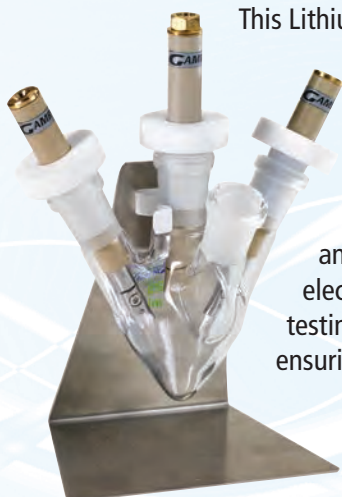
Gamry's battery holders are designed for four-terminal Kelvin-type measurements. Anyone doing EIS on coin cell or 18650s needs four-terminal measurements in order to eliminate additional impedances due to cable connections. The contacts on each holder have been gold plated to reduce contact impedance and cable connections have been designed to reduce mutual inductance between current-carrying leads and sense leads.



## HIGHLIGHTS

- Designed for testing of new battery materials

## Lithium Battery Materials Cell Kit



This Lithium Battery Materials Cell Kit has been designed to hold a variety of electrode configurations for full and half-cell analysis of materials and electrolytes. The pear-shaped flask reduces the volume of electrolyte necessary. The cell is also equipped with tapered Teflon® joints to ensure an air-tight cell.

You can assemble your materials and electrodes inside a glovebox and then remove the cell for electrochemical testing. Three different electrode holders are available to ensure maximum flexibility for testing. Each electrode can also be fully disassembled for cleaning, ensuring a long lifetime of operation.

# Cells & Accessories

## FlexCell

The FlexCell, used to determine the Critical Pitting Temperature according to the ASTM G150 standard, is designed to counteract a problem that plagues most other flat sample designs – crevice corrosion around the specimen seal. First popularized by Avesta Steel, the cell utilizes a flooded gasket seal design to inhibit crevice corrosion between the sample and its holder. This simple, yet elegant, design results in an easy to use, reliable, crevice-free system.



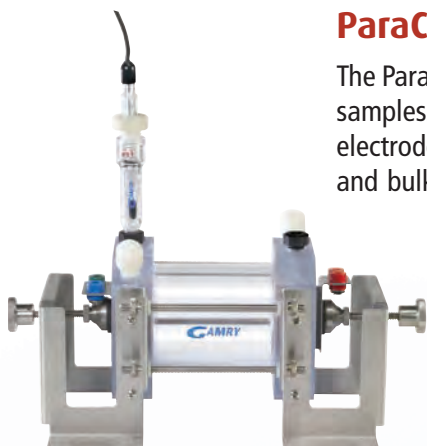
The wrap-around heating mantle is most often controlled with a TDC4 Temperature Controller. The TDC4 interfaces with a Gamry potentiostat to control both heating and cooling processes. Temperature limits, step sizes, delay periods, etc. are all under user control. The TDC4 is based on an Omega Temperature Controller which offers an impressive array of features. The TDC4 itself is controlled by your computer and the CPT110 Critical Pitting Temperature Software. Heating and cooling sources connected to your cell are turned on and off by the TDC4 to maintain the desired temperature. The TDC4 is a closed loop system, meaning it measures the temperature of the cell using a platinum RTD, and uses feedback to control the heater and/or cooler. The TDC4 can be used in an on/off mode or a PID (Proportional, Integral, Derivative) mode. The on off mode uses hysteresis parameters to control its switching, while the PID mode uses tuning parameters.

## MultiPort

The MultiPort Corrosion Cell is the workhorse of a corrosion lab, accommodating 1 L standards testing for ASTM G5, G59, and G61. The two-piece design allows you to insert oversized samples in the cell, and makes it compatible with the Flat Specimen Holder. The Ace-Threads allow for vertical adjustment to accommodate a wide range of sample volumes. Vertical adjustment combines with the ball joint to make sure your reference electrode bridge tube is placed close to the surface of your corrosion sample. The standard working electrode assembly used in the MultiPort is described in ASTM G5 – a cylindrical sample that is drilled-and-tapped with a 3-48 UNF thread. The working electrode is screwed onto the support rod. A Teflon compression gasket insures a leak-free seal. The depth of the working electrode in the MultiPort is adjustable, allowing easy orientation of the working electrode and the reference electrode bridge tube.



# Cells & Accessories



## ParaCell Kit for Flat Specimens

The ParaCell Electrochemical Cell Kit is designed for convenient mounting of a wide variety of flat samples. The design of the ParaCell places the working electrode and either a graphite counter electrode or a second working electrode in an opposed geometry. The cell is designed so that large and bulky samples (e.g., a 30 cm. wafer) can be accommodated on either end for experiments involving two electrodes such as galvanic corrosion or electrochemical noise.

The central hole on each end plate exposes a nominal area of 2.6 cm<sup>2</sup> where the working electrode and counter or second working are exposed.

## EuroCell

The EuroCell is a general purpose electrochemical cell with an operational volume of 50-200 mL. It is equipped with 5 multi-purpose ports. In the normal cell configuration, these ports are used as follows: one central 24/40 ground glass joint for a working electrode, one Ace-Thread port for a Luggin capillary/bridge tube for use with Gamry's SCE, Ag/AgCl, and Hg/Hg<sub>2</sub>SO<sub>4</sub> reference electrodes (electrodes ordered separately), one Ace-Thread port for a counter electrode, one 14/20 ground glass port for inert gas purging/blanketing (an adapter is supplied), one 14/20 ground glass port usable for temperature sensing, reagent addition, gas venting, etc.



## Dr. Bob's Cell



Dr. Bob's Cell is our smallest electrochemical cell kit, with operational volumes of 1-30 mL. Enzyme and catalysis studies, development of electrochemical sensors, basic research into battery mechanisms, and determination of redox potentials of inorganic complexes represent a few of its many applications. Designed for flexibility and convenience, this cell kit can hold any of Gamry's available working electrodes. Dr. Bob's Cell utilizes a pear-shaped flask which permits handling low volumes (down to 1-2 mL).

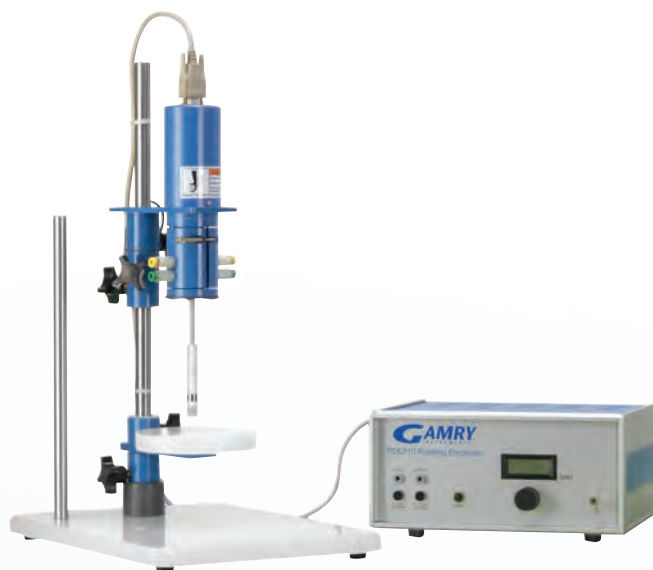
Working electrodes are available in Platinum, Carbon (Glassy or Fiber), and Gold. They may be obtained in either a macro version with a 3 mm diameter or as a microelectrode with a 10 micron diameter.

# RDE710 Rotating Electrode

The RDE710 Rotating Electrode is a research-grade rotator and features the ability to use rotating ring-disk, disk, and cylinder electrodes. The rotation rate is adjustable from 50 – 10,000 rpm (revolutions per minute). The controller has a Liquid Crystal Display (LCD) which indicates the rotation rate and is controlled by a rotation rate knob. The electrode assembly of the rotator has a versatile design that allows for the use of diverse electrode types. Different shaft and electrode tips can be selected depending on your desired use.

Rotating ring-disk electrodes are used where products generated at the disk electrode are monitored at the ring electrode. A number of ring-disk electrode configurations are available including platinum-platinum, gold-gold, glassy carbon-glassy carbon, and platinum-glassy carbon. Rotating disk experiments are performed where defined mass transport to the sample electrode is desired. An example of this type of experiment would be catalyst evaluation.

Rotating cylinder experiments are important in the oil industry to simulate the corrosion environment inside a pipeline, thus avoiding the need to assemble expensive flow loop setups. The rotator is an ideal tool because flow conditions at the rotating cylinder are generally turbulent even at low rotation rates. Cylinders can be made from a variety of different metals to evaluate their performance including 1018 carbon steel, 316 stainless steel and 430 stainless steel. Users can also machine cylinder samples using their own material.





# Notes



# POTENTIOSTAT / GALVANOSTAT / ZRA SPECIFICATIONS\*

	Reference 3000/3000AE	Reference 600+	Interface 5000	Interface 1000
<b>SYSTEM</b>				
Cell Connections	2, 3, 4, 5 or 21*	2, 3, 4, or 5	2, 3, 4, or 5	2, 3, 4, or 5
Maximum Current	± 3 A @ 15 V or ± 1.5 A @ 32 V	± 600 mA	± 5 A	± 1 A
Current Ranges	11 (300 pA – 3 A)	11 (60 pA – 600 mA)	6 (50 µA - 5 A)	9 (10 nA to 1 A)
Current Ranges (including internal gain)	13	13	8	11
Minimum Current Resolution	92 aA	20 aA	150 pA	3.3 fA
Maximum Applied Potential	± 32 V	± 11 V	± 6 V	± 12 V
Rise Time	< 250 ns	< 250 ns	< 1 µs	< 1 µs
Minimum Timebase	3.333 µs	3.333 µs	10 µs	10 µs
Noise and Ripple (typical)	< 2 µV rms	< 2 µV rms	< 20 µV rms	< 20 µV rms
<b>CONTROL AMPLIFIER</b>				
Compliance	± 32 V	± 22 V	± 8.5 / ± 2.5 V	± 22 V
Output Current	> ± 3 A	> ± 600 mA	> ± 5 A	> ± 1 A
Speed Settings	5	5	5	5
Unity Gain Bandwidth	1100, 330, 50, 5.0, 0.5 kHz		1050, 250, 43, 4.4, 0.5 kHz	1100, 320, 39, 4, 0.4 kHz
<b>EIS MEASUREMENT</b>				
EIS	10 µHz - 1 MHz	10 µHz - 5 MHz	10 µHz - 1 MHz	10 µHz - 1 MHz
Voltage AC amplitude	3 V max	3 V max	3 V max	3 V max
Current AC amplitude	3 A max	600 mA max	5 A max	1 A max
<b>ELECTROMETER</b>				
Input Impedance	> 10 <sup>14</sup> Ω    < 0.2 pF	> 10 <sup>14</sup> Ω    < 0.2 pF	> 10 <sup>12</sup> Ω    < 2 pF	> 2x10 <sup>13</sup> Ω    < 0.3 pF
Input Current (typical)	< 6 pA	< 10 pA	< 25 pA	< 25 pA
Bandwidth	> 15 MHz at -3 dB	> 15 MHz at -3 dB	> 12 MHz at -3 dB	> 15 MHz at -3 dB
CMR	> 80 dB (100 kHz), > 60 dB (1 MHz)		> 98 dB (10 kHz), > 88 dB (100 kHz)	> 86 dB (10 kHz), > 60 dB (1 MHz)
<b>POTENTIAL</b>				
Applied Accuracy	± 1 mV ± 0.2% of setting	± 1 mV ± 0.2% of setting	± 1 mV ± 0.2% of setting	± 1 mV ± 0.2% of setting
Applied Resolution	200 µV, 50 µV, 12.5 µV/bit	200 µV, 50 µV, 12.5 µV/bit	200 µV, 50 µV, 12.5 µV/bit	200 µV, 50 µV, 12.5 µV/bit Measured
Accuracy	± 1 mV ± 0.2% of reading	± 1 mV ± 0.2% of reading	± 0.5 mV ± 0.2% of reading	± 1 mV ± 0.3% of reading
Measured Resolution	High Resolution Electrometer: 400 µV, 100 µV, 10 µV, 1 µV/bit High Voltage Electrometer: 1.6 mV, 400 µV, 40 µV, 4 µV/bit	400 µV, 100 µV, 10 µV, 1 µV/bit	200 µV, 20 µV, 2 µV/bit	400 µV, 100 µV, 10 µV, 1 µV/bit
<b>CURRENT</b>				
Applied/Measured Accuracy	± 5 pA ± 0.05% of range ± 0.2% of value (3 A - 3 nA) or 0.5% of value (300 pA)	± 10 pA ± 0.05% of range ± 0.2% of value (600 mA-6 nA) or 0.75% of value (600 pA) or 1.5% of value (60 pA)	± 25 pA ± 0.05% of range ± 0.2% of value	± 10 pA ± 0.05% of range ± 0.3% of value
Applied/Measured Resolution	0.003% full-scale/bit	0.003% full-scale/bit	0.003% full-scale/bit	0.003% full-scale/bit
Bandwidth	> 10 MHz (3 A – 3 mA), > 0.15 MHz (30 µA)	> 10 MHz (600 mA – 600 µA), > 0.15 MHz (6 µA)	> 5 MHz (5 mA)	> 1.5 MHz (10 µA), > 0.15 MHz (1 µA)

Selected Specifications\* \*Reference 3000AE contains 16 additional connections. Specifications subject to change.

Gamry covers the world over with more than 40 international distributors and representatives available to assist you. Countries without representation can deal with Gamry directly.

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INSTRUMENTS



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