GAMRY INSTRUMENTS

Helping You Achieve Your Potential

Over Three Decades 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 Gamry Instruments' potentiostats 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 Instruments' multichannel setup is designed to allow you to get full capabilities out of each individual channel. We do NOT multiplex measurements like some other manufacturers, meaning as you add channels, there is no performance degradation.

No Lost Bandwidth

Gamry Instruments' 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!

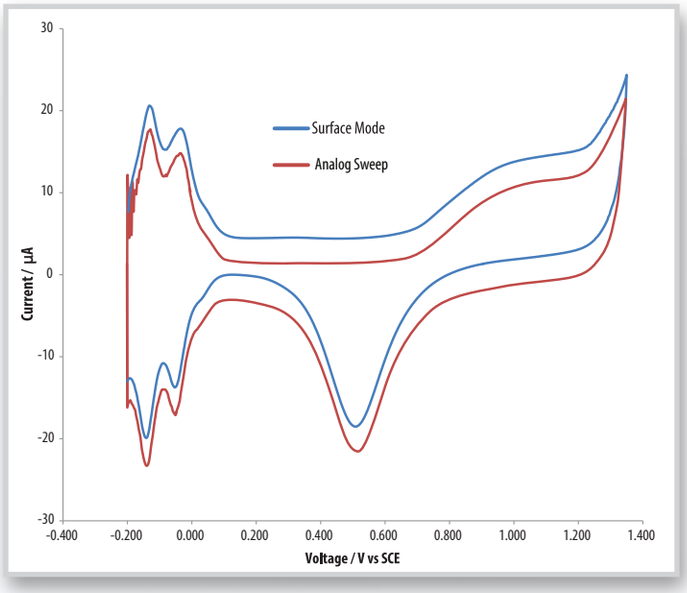
Gamry Instruments provides you with the complete solution to get the answers you need. We carefully consider every detail of system design. Everything from board layout, component selection, signal processing, and all the way down to the tip of our smart cell cables, is designed to deliver maximum performance. 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

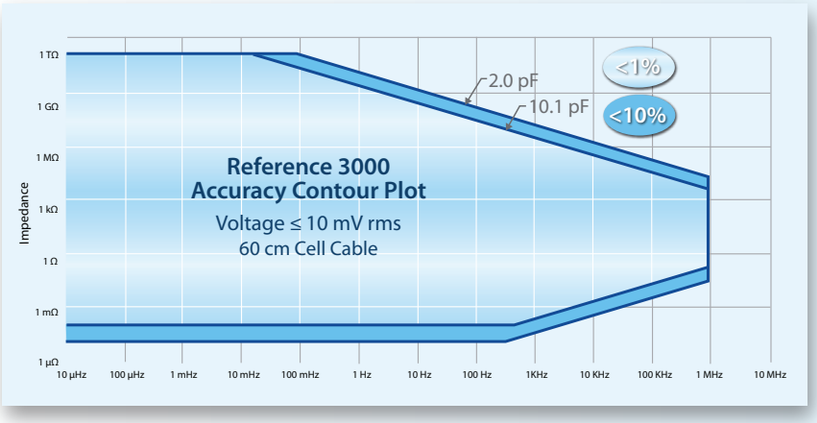
Gamry Instruments' open-source scripting and eChem Toolkits provide you with ability to customize experiments you haven't even thought of yet. Our Sequence Wizard™ lets you string together any number of experiments. The Sequence Wizard contains options for looping based on time, cycle number, or a variable. 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 Instruments 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.



Comparison of Surface Mode vs. Analog Sweep. Pt WE in 1 *M* H_2SO_4. Surface mode current offset 3 µA for easy comparison.



Specs that Don't Lie

Gamry Instruments 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 Instruments' flexible hardware and software cover a wide range of applications—corrosion, physical electrochemistry, sensors, bioelectrochemistry, energy storage and conversion devices, coatings, semiconductors, photovoltaics, and more.

Corrosion Measurement

Gamry Instruments offers the world's most complete selection of electrochemical tools for the materials scientist and corrosion engineer. Every Gamry Instruments 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 Instruments potentiostat running physical and electroanalytical techniques, coupled with EIS, is the perfect tool for characterizing new sensor materials, membranes, and protocols. Gamry Instruments' 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 Instruments potentiostat combined with the physical electrochemistry software to measure the kinetics and study the mechanisms of electrochemical reactions. 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 Instruments Reference™ family instruments are designed for high-impedance systems like coatings. Visit our website at www.gamry.com, and download our papers on evaluating paints with EIS.

Energy Devices

Gamry Instruments' suite of instruments and techniques allow you to characterize any number of energy devices—batteries, supercapacitors, fuel cells, electrolyzers, and photovoltaics. Whether you're testing full cells, half-cells, or stacks, Gamry Instruments 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 benefits from our Transmission Line circuit elements. Gamry Instruments' 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 Instruments' 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#, Python, Powershell, and Visual Basic to develop your own applications. Numerous examples are provided to get you started.

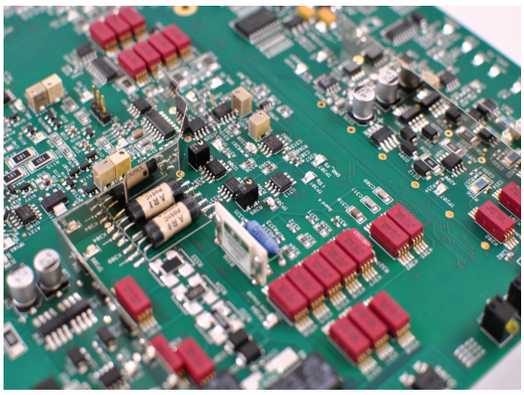
```
; Run a controlled potential IV curve from VInit to VFinal
function Cpiv (Pstat, VInit, VFinal, ScanRate, SampleTime, IRToggle)

    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)
```

Writing the experimental techniques in an open-source scripting language means that Gamry Instruments 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 Instruments' flexibility allows you to do all of these and more.

Reference™ 3000 Potentiostat/Galvanostat/ZRA

HIGHLIGHTS

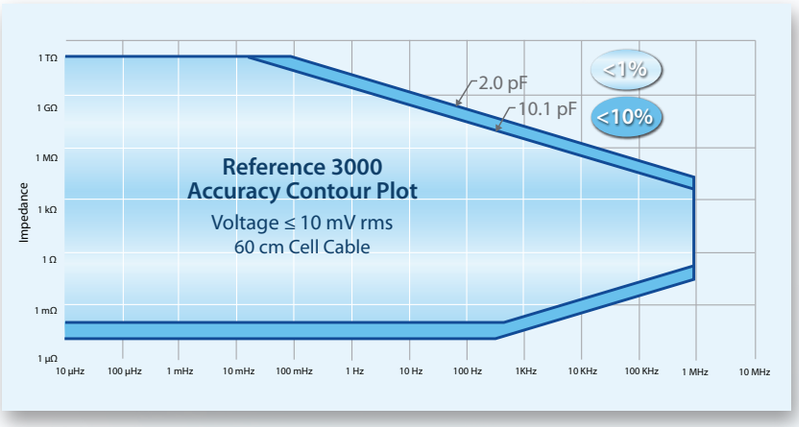
- 3 A Maximum
- Up to ±32 V
- EIS from 10 µHz to 1 MHz
- Electrically isolated
- 11 current ranges
- 3 µs timing



Top-of-the-Line Performance

The Reference 3000 is a high-current, high-performance potentiostat with 11 current ranges from 3 A to 300 pA. This instrument also includes a switchable compliance mode for either high-current or high-voltage operations: ±3 A at ±15 V or ±1.5 A at ±32 V. 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 µHz 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 to 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 ±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

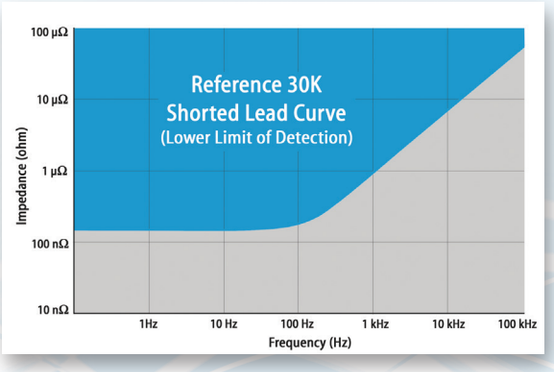
Higher Currents

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 ±30 A. The Booster only operates with the Reference 3000 and works 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 µΩ.

Reference™ 620 Potentiostat/Galvanostat/ZRA

HIGHLIGHTS

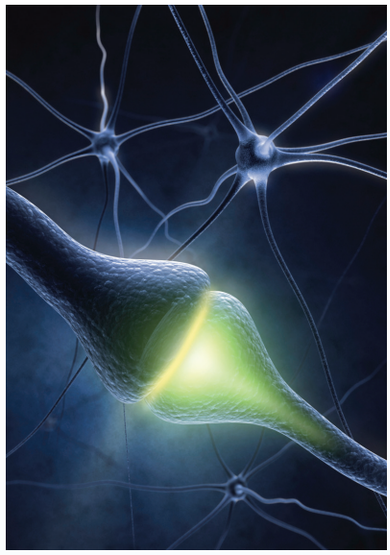
- 600 mA Maximum
- EIS from 10 µHz to 5 MHz
- Field deployable
- Floating
- 3 µs timing

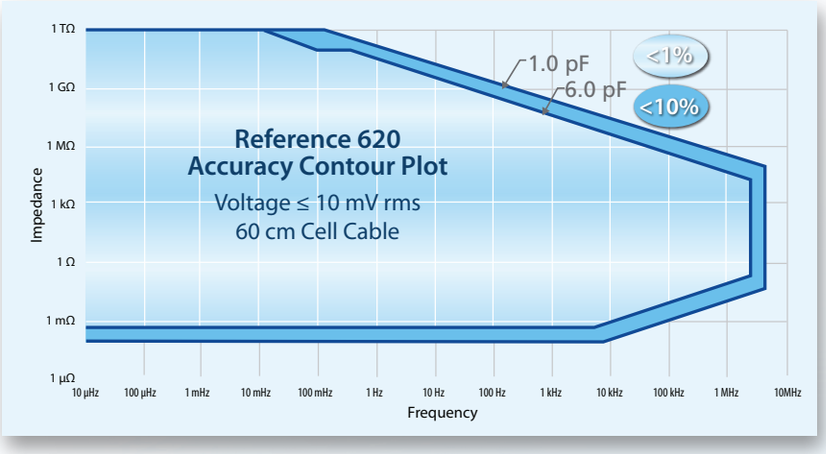
Premium Performance

The Reference 620 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 ±22 V, and an applied voltage limit of ±11 V.

Like the Reference 3000, the Reference 620 is a compact, portable instrument. Weighing only 3 kg and roughly the size of Bard and Faulkner's electrochemistry textbook, the Reference 620 is easily transported from the lab to the field.

With noise levels of ≤ 2 µV rms, the Reference 620 is possibly the quietest potentiostat on the market. Combine this with the 3 µs timebase and you get a combination that is perfect for fast-scan experiments at UMEs, nanoelectrodes, and scanning applications.





Accurate EIS

The Reference 620 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+ allows you to measure higher-impedance samples such as paints and coatings.

The Reference 620 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 to string together up to eight Reference family potentiostats for bipotentiostat or n-stat configurations.

Interface™ 5000 Potentiostat/Galvanostat/ZRA

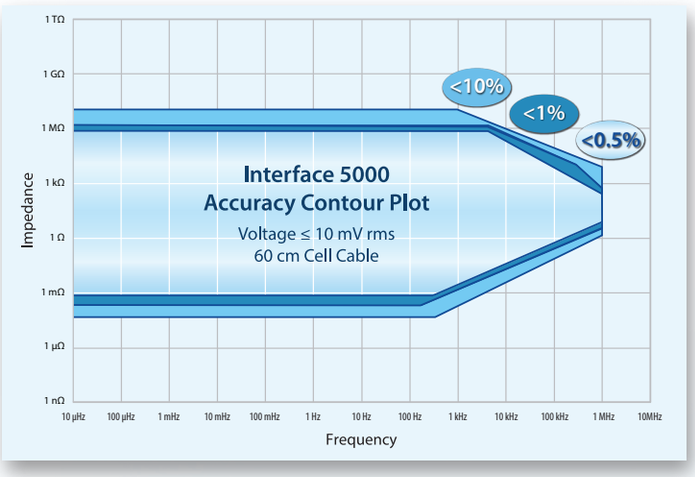
Powerful

The Interface 5000 potentiostat/galvanostat/ZRA is designed for the battery researcher studying materials and whole cells. With currents up to 5 A at ±6 V, it is ideal for charge/discharge and low-impedance EIS experiments. Dual electrometers allow you to monitor both 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 typical techniques such as cyclic voltammetry, chronoamperometry, chronopotentiometry, cyclic charge/discharge, potentiostatic, galvanostatic, read voltage, and galvanostatic EIS (up to 20 kHz). The Interface 5000E includes all of Gamry Instruments' software capabilities including potentiostatic and galvanostatic EIS up to 1 MHz.

HIGHLIGHTS

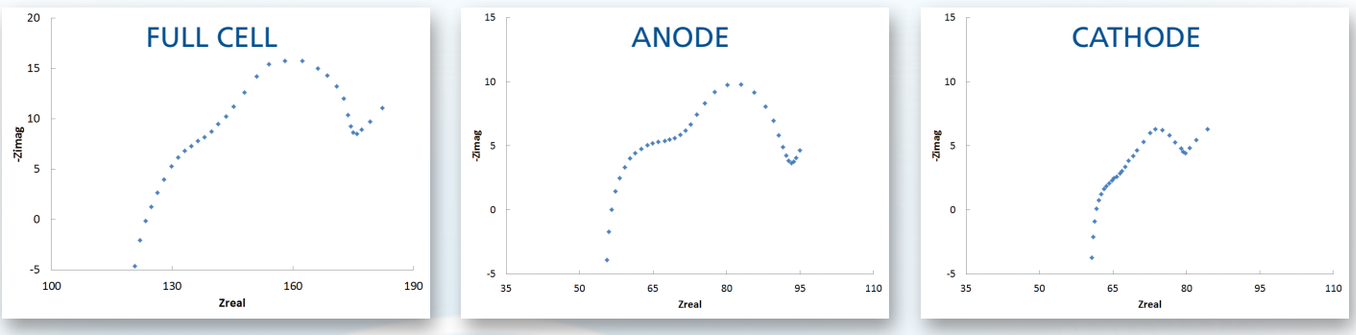
- 5 A Maximum Current
- EIS to 1 MHz
- Monitor anode and cathode simultaneously
- Floating

Low Impedance EIS



The Interface 5000 is ideal for testing low impedance devices and covers the frequency range of 10 µHz 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 µΩ.

Monitor Both Half-Cells



Dual electrometers allow you to monitor voltages for both 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

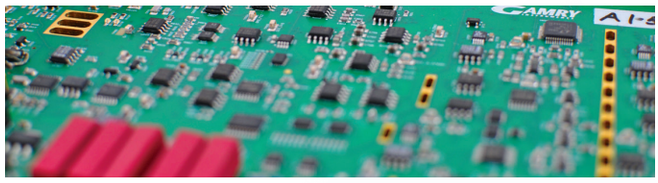
The Monitor port on the front of the instrument provides a means for monitoring temperature using an RTD probe and auxiliary voltages. Voltage out and digital I/O capabilities are also included. The rear of the instrument includes a Sync port for bipotentiostat or n-stat configurations with other Interface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

Interface™ 1010 Potentiostat/Galvanostat/ZRA

HIGHLIGHTS

- 1 A Maximum Current
- EIS from 10 µHz to 2 MHz
- Floating

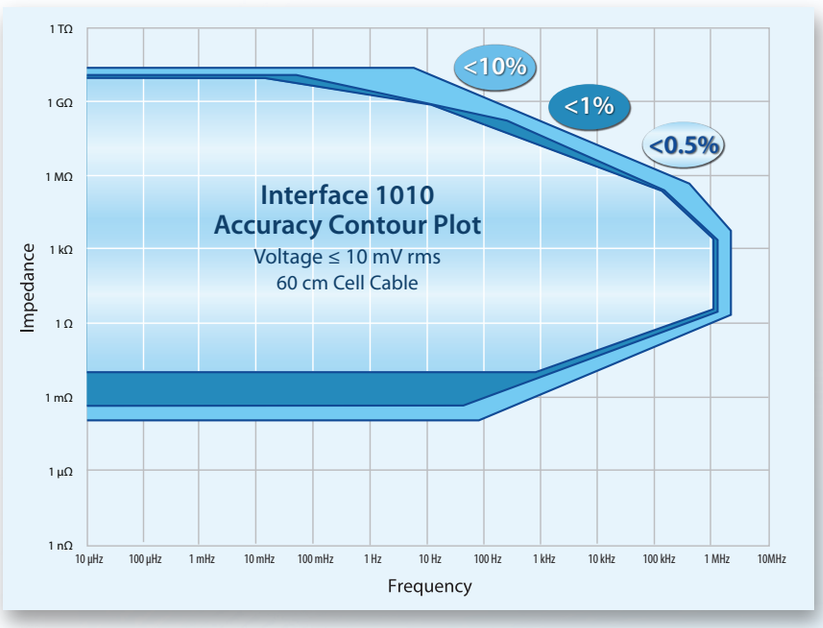
Versatile



The Interface 1010 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 1010 comes in three separate models. The Interface 1010T 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 1010B is a great potentiostat that can run all traditional physical electrochemistry, pulse voltammetry, DC Corrosion, electrochemical energy techniques, and EIS up to 20 kHz. It even includes our eChem Basic Toolkit. The Interface 1010E includes everything in the 1010B plus EIS up to 2 MHz, critical pitting temperature electrochemical frequency modulation, electrochemical noise, electrochemical signal analyzer, eChemAC toolkit, and eChemDC Toolkit.

Low Noise



Ten active filters on the voltage and current channels reject external signal and noise that adversely impact your measurements. The Interface 1010 automatically selects the best filter for the acquisition mode, while still offering expert users the choice for manual adjustments.

The Interface 1010 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 Instruments 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 ensures 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 Instruments' multichannel setup is designed to allow you to get full capabilities out of each individual channel. We do NOT multiplex measurements like some other manufacturers, meaning as you add channels, there is no performance degradation.

PRODUCTIVITY

HIGHLIGHTS

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

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 Instruments' potentiostats 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 Instruments' 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 Gamry Instruments.

EIS Box™
Multiplexed EIS Instrument

HIGHLIGHTS

- 8 channels
- EIS from 10 µHz to 100 kHz
- Floating
- Rack-mountable

Test Multiple Batteries

The EIS Box is a multiplexed eight-channel instrument designed for impedance measurements on batteries (or other devices such as supercapacitors or fuel cells) and is typically used in conjunction with a battery cycler.

Convenience and Speed

Test up to eight batteries or supercapacitors at once, all contained within a rack-mounting small case. If you want value in a research-grade instrument that runs EIS for small- and medium-sized energy-storage and power-conversion devices, then the EIS Box is for you! The EIS Box can apply and measure currents from 5 A to ~0.05 µA, on your batteries, double-layer capacitors, fuel cells, and photovoltaics.

Developed to increase the throughput of your impedance testing program and under the control of an external computer, the EIS Box connects one cell at a time, which makes an electrochemical measurement on that cell.

The EIS Box is integrated into all Gamry Instruments' EIS applications that run under the Gamry Instruments Framework™ software and the Sequence Wizard. Increase your throughput by testing multiple cells in a single test run.

Packed with Features

With six-decade current auto-ranging for large and small batteries, electrical isolation from earth ground, and analog and digital filtering, the EIS Box has what you need for testing your power devices. A sine-wave generator on the EIS Box allows the instrument to make accurate impedance measurements at frequencies up to 100 kHz. A unique DSP (Digital Signal Processing) data-acquisition mode lets the EIS Box to reject noise, from the instrument itself, from the electrochemical cell, and from the lab environment. When other instruments require a cell in a Faraday shield to make quiet measurements, the EIS Box often can be used with the cell exposed on a bench top.

Connects to Your Computer in Two Ways

The EIS Box connects to its host computer through an Ethernet or USB connection.

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^2 scale, less than a monolayer of material! Gamry Instruments' Resonator™ software controls both the eQCM 10M and a Gamry Instruments potentiostat.

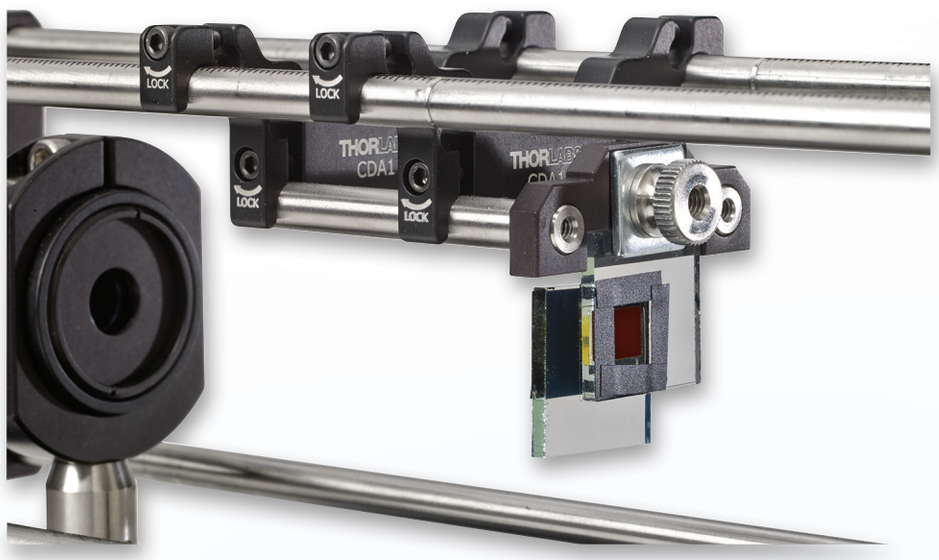
The eQCM 10M rapidly scans a frequency window around the two resonant frequencies. The advantage of scanning through the two resonant frequencies is that you no longer need to cancel the parasitic capacitance in order to maintain oscillation. Additionally, the relative impedance spectrum is displayed each time a data point is acquired, giving you insight into bubble formation on your electrode or improper cell setup. With two resonant frequencies, you can do basic dissipation monitoring. When f_s and f_p respond similarly your film is rigid; but when f_s and f_p respond differently the film is not rigid.

Resonator software also lets you adjust the driving amplitude of the crystal. This is especially important when working in an ionic liquid 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.

Dye Solar Cell Characterization

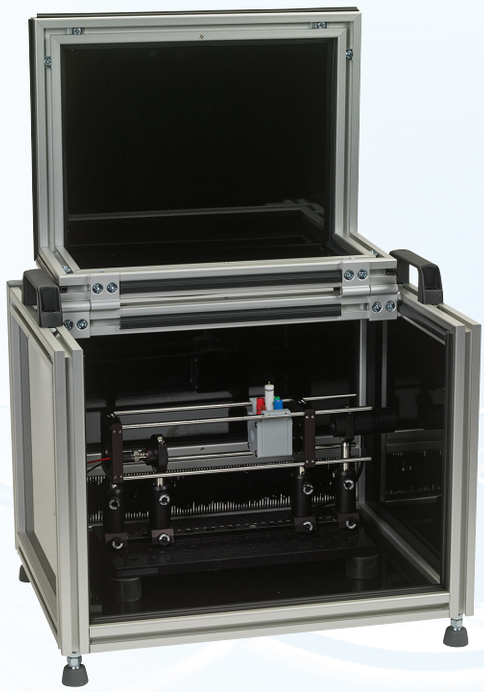
HIGHLIGHTS

- Up to 1 MHz
- A variety of 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 uses two Gamry Instruments 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 synchronized 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. A variety of LEDs is available.



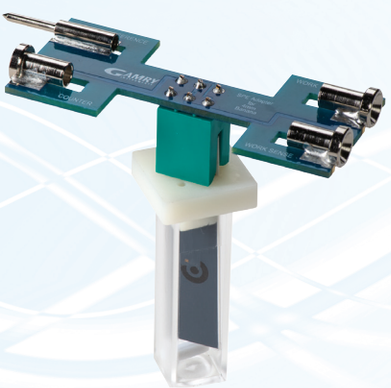
Laboratory Course in Electrochemistry

The Full Laboratory Course in Electrochemistry is designed as a semester-long class with eleven distinct experiments. The kit contains all the supplies needed for twenty students to complete every experiment within the manual (minus reagents). Most of the experiments use screen-printed electrodes: they are easy to use, and generate low amounts of waste.

The individual experiments are created so that they can be used as stand-alone experiments within a different course, such Analytical, Quantitative, or Instrumental Chemistry. This feature makes the course fully modular, able to fit your institution's individual electrochemical needs. As with the full course kit, each experiment kit includes supplies for twenty students to complete the lab.

Individual experiments to choose from include:

- Cyclic Voltammetry
- Chronoamperometry/Chronocoulometry
- Pulse Voltammetry
- Stripping Voltammetry
- Acetaminophen Detection
- DigiElch Digital Simulations
- Microelectrodes
- Glucose Determination
- Electrochemical Polymerization
- Electrochemical Impedance Spectroscopy
- Corrosion



IMX8™ Electrochemical Multiplexer
Faraday Shield™ Faraday Cage

Turn One Channel Into Many

The IMX8 Electrochemical Multiplexer is an affordable way to expand the throughput of your lab. The IMX8 is ideal for corrosion inhibitor testing, EIS studies, monitoring of field probes for corrosion tests, chemical sensor development, and microbial fuel cells (MFCs).

The IMX8 partners with a Gamry Instruments 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 IMX8 is great for automating repetitive experiments, and for increasing throughput on long-term experiments where data can be taken periodically. You can even stack IMX8s 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 ±5 V 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 IMX8.

Shield Those Experiments

Low-current experiments ranging from micro-electrodes to EIS of coatings can be susceptible to picking up electromagnetic (EM) noise from the surrounding environment. Gamry's Faraday Shield is the ideal solution to block this EM noise from your measurements. The Faraday Shield comes with or without a conductive glass door and also includes multiple entry ports, grounding lugs, mounting post, and an adjustable shelf.

The Faraday Shield 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.

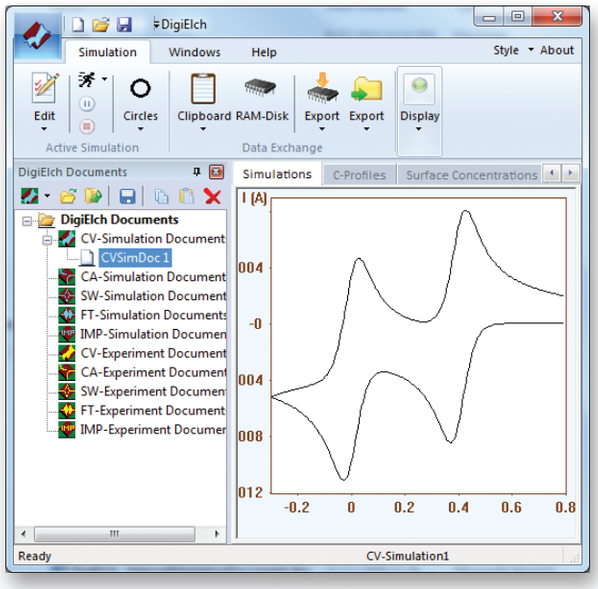
- Pass-throughs for cables, feed gas, thermostatic control (water)
- Electrical isolation from earth ground
- Adjustable plastic shelf for reducing capacitive effects and changing sample height
- Ring stand rod for mounting clamps, various connectors, or adapters to hold glassware, cables, or any other laboratory equipment

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 Instruments 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.

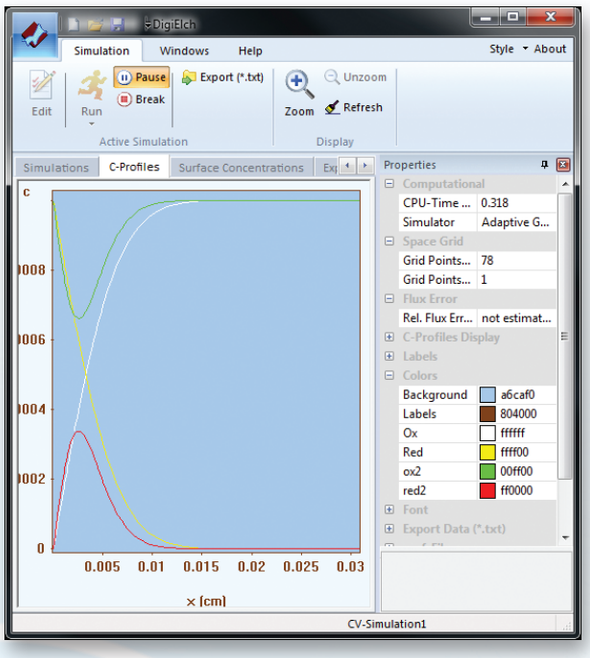
Get fast and accurate simulation of the current response for any user-defined mechanism consisting of charge-transfer steps and first- or second-order chemical reactions. 1D simulation of finite and semi-infinite diffusion. Two different simulation methods are available: a fast "fixed grid simulator"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



Charge-Coupled Transfers

DigiElch allows you to model intermolecular 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+ or Interface 1010 to run physical experiments. The experimental setup with DigiElch includes hardware settings for the instrument 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.

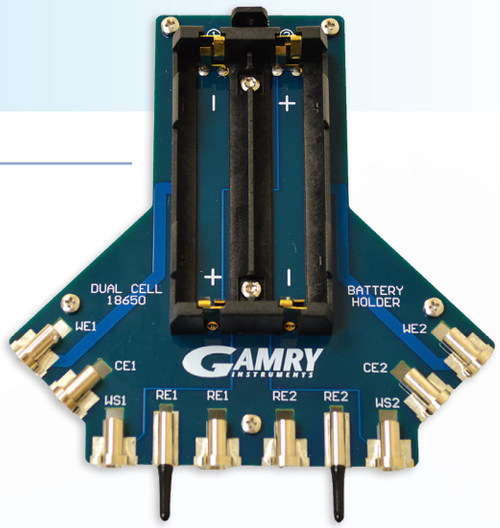
Battery Holders

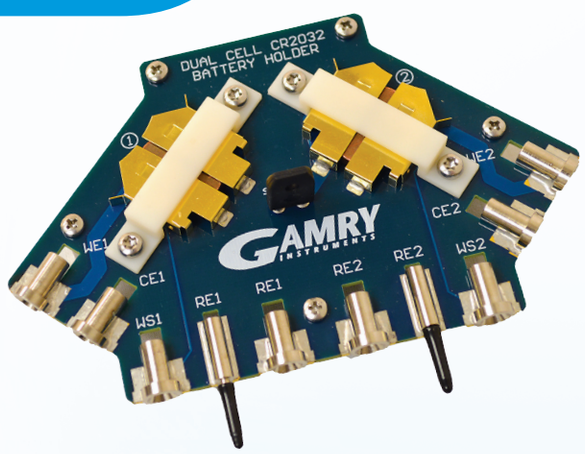
HIGHLIGHTS

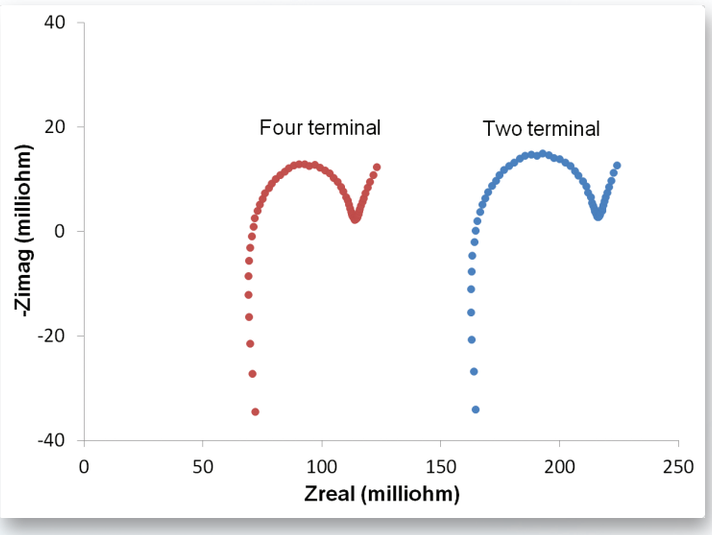
- Coin cells, 18650s, pouch cells, and nearly all other cells
- Four-terminal EIS measurements

Battery Holders

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

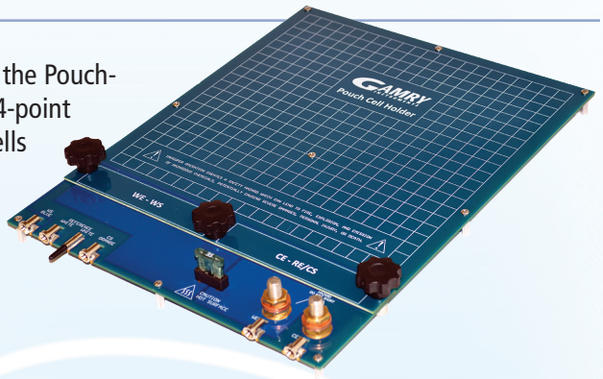


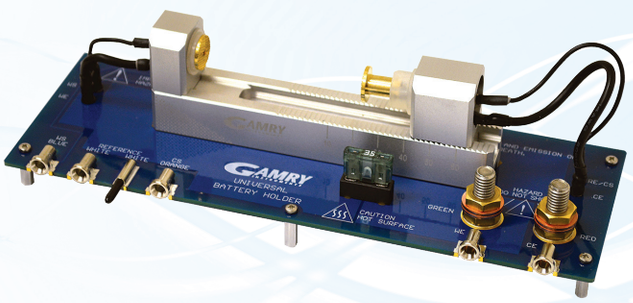




Pouch Cell Holder™

Specially engineered to test pouch cells, the Pouch-cell Holder allows you to perform 4-point measurements for small to large pouch cells at up to 30 A current. It is compatible with all of our potentiostats, including the 30k Booster.





Universal Battery Holder™

From coin cells to long cylindrical cells, the Universal Battery Holder can hold them all! You get convenience and 4-point measurements, plus current-carrying ability up to 30 A. The Universal Battery Holder works with all our potentiostats including the 30k Booster.

Cells & Accessories

Lithium Battery Materials Cell Kit

This Lithium Battery Materials Cell Kit is 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 PTFE 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.

HIGHLIGHTS

- Designed for testing of new battery materials

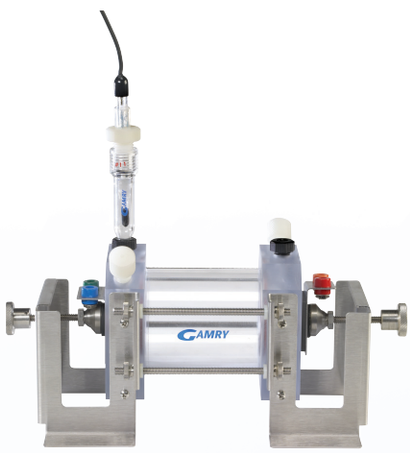
FlexCell™

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 TDC5 Temperature Controller. The TDC5 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 TDC5 is based on an Omega® Temperature Controller which offers an impressive array of features. The TDC5 itself is controlled by your computer and the Critical Pitting Temperature software. Heating and cooling sources connected to your cell are turned on and off by the TDC5 to maintain the desired temperature. The TDC5 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 TDC5 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.

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^2 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-Thred port for a Luggin capillary/bridge tube for use with Gamry Instruments' SCE, Ag|AgCl, and $Hg|Hg_2SO_4$ reference electrodes (electrodes ordered separately), one Ace-Thred 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.

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-Threds 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 PTFE 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.

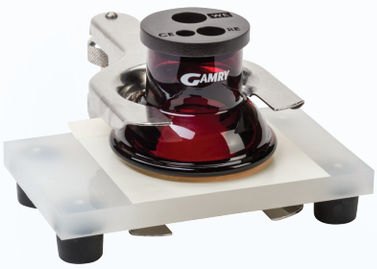
Cells & Accessories

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 are a few of its many applications. Designed for flexibility and convenience, this cell kit can hold any of Gamry Instruments' available working electrodes. Dr. Bob's Cell utilizes a pear-shaped flask which permits handling low volumes (down to 1–2 mL).

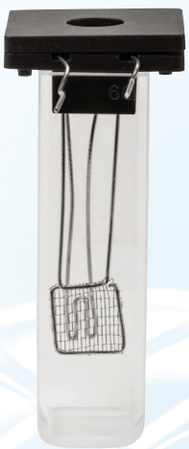
Working electrodes are available in platinum, carbon (glassy or fiber), and gold. They may be obtained in either a macro version with a 3 mm diameter or as a microelectrode with a 10 µm diameter.

PTC1™ Paint Test Cell



The design of the PTC1 Paint Test Cell is very simple in order to keep cost down, for most users require many cells for testing. The flat sample under test is clamped between a glass tube with an O-ring seal and the PTFE base. The tube is partly filled (20–50 mL) with the test electrolyte and sealed with a rubber stopper. A reference electrode (possibly saturated calomel) and a graphite rod counter electrode are mounted through the stopper.

The Raman Glass Cell Kit can be used for spectroelectrochemical Raman experiments on flat samples in solution. The cell design is similar to Gamry Instruments' PTC1 Paint Test Cell. In order to block ambient light which can interfere with the experiment, the glass cell has a red Ray-Sorb® coating which drastically reduces transmission of light up to a wavelength of 600 nm. The matching cell lid allows access for a reference electrode, counter electrode, as well as immersion shaft for the Raman probe.



Spectroelectrochemical Cell

Three different cell kits can be used for spectroelectrochemical applications. The UV-Vis Cuvette Cell Kit includes a Pt-mesh working electrode and Pt-wire counter electrode. Both electrodes fit into a Spectrosil® Far-UV quartz cuvette with a standard pathlength of 1 cm. Its usable wavelength range from 170–2700 nm allows background-free measurements. Two mounting lids hold the electrodes in place and provide access for a Ag|AgCl skinny reference electrode (not included).

The Raman Cuvette Cell Kit can be used for spectroelectrochemical experiments which use transparent and electrically conductive ITO substrates as working electrode. The set includes two polished float glass substrates with ITO coating (sheet resistance of 10-15 Ω) on one side as well as mounting clips for proper electrical contact. A Pt-wire serves as counter electrode. The set also includes our Spectrosil® Far-UV quartz cuvette with a pathlength of 1 cm and two mounting lids which provide access for a Ag|AgCl skinny reference electrode (not included).

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 displays the rotation rate and is controlled by a rotation rate knob. The electrode assembly of the rotator has a versatile design that allows you to use 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. You can also machine cylinder samples using your own material.

Flat Specimen Holder

The Flat Specimen Holder is designed to hold flat, circular or square samples for use in the Multiport Corrosion Cell. This optional holder is designed to handle circular samples from 25 to 30 mm in diameter or square samples with sides of length up to 23 mm. The actual exposed electrode face is 10 mm in diameter with an area of 0.785 cm^2. Samples can be up to 7 mm thick.

Made from tough, durable PEEK, the holder can withstand temperatures up to 80°C. Contact is made on the front of the sample through the use of Pogo® pins.

Working, Reference, and Disposable Electrodes

Working Electrodes

Gamry Instruments offers several working electrodes for traditional physical electrochemical and electroanalytical experiments, as both microelectrodes and macroelectrodes:

- Carbon-fiber
- Glassy carbon
- Gold
- Platinum

Reference Electrodes

Reference electrodes are critical to acquiring good electrochemical data. Using poor-quality reference electrodes can accentuate drift in the reference-lectrode potential, and results in quantitative and qualitative errors in data collection and analysis beyond simple inaccuracies in the measured potential. High-performance potentiostats can also be susceptible to instability if the reference electrode's impedance is too high.

- Standard calomel electrode (SCE)
- Ag|AgCl
- $Hg|HgSO_4$

Screen-printed Electrodes (SPEs)

Disposable electrochemical sensors based on the technology of screen printing are designed for economy and practicality. With their simplicity, disposability, and short response times, SPEs can be very efficient in your work. Often you can analyze a single drop of solution!

- Carbon
- Platinum

Stand for Screen-printed Electrodes

Our custom-designed stand holds an SPE horizontally for drop-analysis.

Electrochemical Knowledge at Your Service

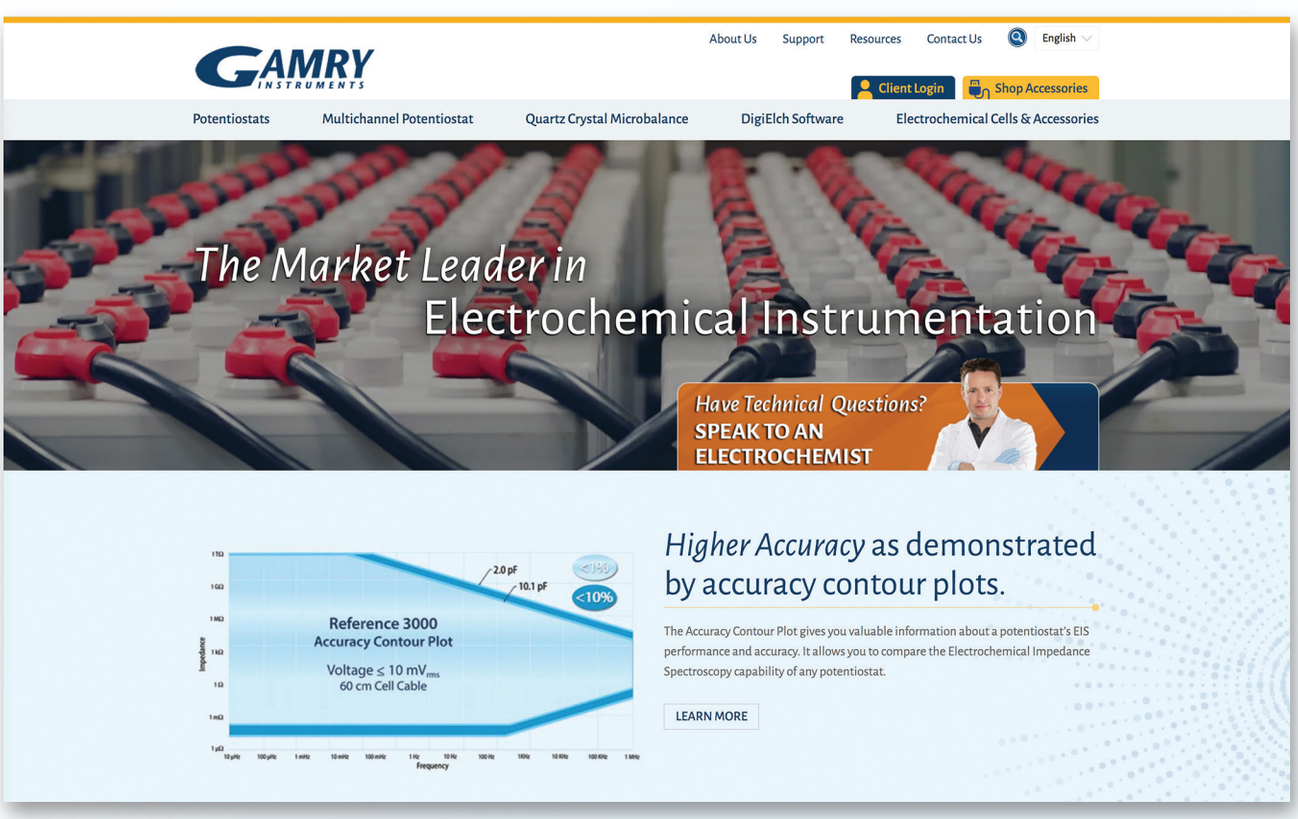
Courses and Training

Gamry Instruments wants you to get the best-quality data from our instrumentation. Therefore we offer a variety of short courses on a range of current electrochemical topics. See our website, www.gamry.com, for more details on the latest webinars and classes we offer.

Website

Our website is chock-full of information to assist your electrochemical journey, from application notes and technical notes, to operation manuals and quick electrochemical calculators.

Gamry Instruments even offers an Extended System Assurance program for up to 4 years of factory recalibrations, software updates, and feature enhancements.



Technical Support

Whether it's repairs, re-calibration, or just learning how to set up a basic experiment with our equipment, our unmatched technical support team is here to help you. They will guide you through the basics, and even help with simple custom scripts for our Sequence Wizard to run your experiment the way you want.

Notes

Notes

POTENTIOSTAT/GALVANOSTAT/ZRA SPECIFICATIONS*

	Reference 3000/3000AE	Reference 620	Interface 5000	Interface 1010
SYSTEM				
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	± 3A @ 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–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
CONTROL AMPLIFIER				
Compliance	±32 V @ 1.5 A	±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	2500, 1100, 335, 50, 5.2, 0.5 kHz	1050, 250, 43, 4.4, 0.5 kHz	1100, 320, 39, 4, 0.4 kHz
EIS MEASUREMENT				
EIS	10 µHz–1 MHz	10 µHz–5 MHz	10 µHz–1 MHz	10 µHz–2 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
Accuracy	1% @ 0.5 mΩ	1% @ 1 mΩ	1% @ 0.5 mΩ	1% @ 0.8 mΩ
ELECTROMETER				
Input Impedance	> 10^{14} Ω || < 0.2 pF	> 10^{14} Ω || < 0.2 pF	> 10^{12} Ω || < 2 pF	> 2 × 10^{13} 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
Common Mode Rejection Ratio (CMRR)	> 80 dB (100 kHz), > 60 dB (1 MHz)	> 65 dB (1 MHz)	> 98 dB (10 kHz), > 88 dB (100 kHz)	> 86 dB (10 kHz), > 60 dB (1 MHz)
POTENTIAL				
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
CURRENT				
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 Instruments covers the world over with more than 40 international distributors and representatives available to assist you. Countries without representation can deal with Gamry Instruments directly.

GAMRY
INSTRUMENTS

Call Gamry Instruments or your local representative today to discuss your application. Learn how Gamry can help you.

Rev. 3

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