



# Product Catalog

Potentiostats/Galvanostats

Scanning Electrochemical Systems

Materials Test Systems

Solar Test Systems

Accessories

The AMETEK logo, consisting of a red triangle pointing to the right, followed by the word 'AMETEK' in a bold, white, sans-serif font with a registered trademark symbol.



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Princeton Applied Research (PAR) and Solartron Analytical are the global leaders in the design, manufacture, and support of instrumentation for research in electrochemistry and materials analysis. Over a combined 110 years of development knowledge are in our instruments and accessories, advancing the research into the physical and electrochemical properties of batteries, fuel cells, capacitors, corrosion inhibitors, organic coatings and sensors, as well as the characterization of materials for dielectrics and solar cells.

# Brief History



**1948** Solartron was founded by two engineers, E. R. Ponsford and L. B. Copestick, based in Kingston on Thames, United Kingdom.

**1960s** Princeton Applied Research was founded by a group of scientists from Princeton University and the Plasma Physics Laboratory (1961). Princeton Applied Research introduced its first electrochemical station, the Model 170, developed for the polarography market (1969).

**1970s** Already known for exceptional Frequency Response Analyzers, Solartron Analytical launched the 1170, the world's first digital FRA (1970).

Princeton Applied Research was acquired by EG&G, a multifaceted, high technology company with a strong presence in the scientific instrument business (1977).

**1980s** Solartron Analytical introduced its first electrochemical interface, the 1186A (1980).

The Model 173, when combined with the new 276 GPIB, became the first computer assisted potentiostat (1983). Princeton Applied Research launched the Model 273, the first digital potentiostat on the market (1984).

**1990s** Solartron Analytical launched the 1260A Impedance/Gain-Phase Analyzer, capable of working in stand-alone mode or in conjunction with a potentiostat (1990).



**2000s** The VersaSTAT Series launched using Princeton Applied Research VersaStudio software platform (2007).



Solartron Analytical released the ModuLab Series, introducing a modular platform for customized electrochemical and materials systems (2008).

**2011** Princeton Applied Research launched VersaSCAN, building on the 20+ year history in the sale and support of electrochemical scanning systems.

**2013** The PARSTAT MC family is released and with Solartron Analytical's CellTest 1470E provided a complete portfolio to the growing multichannel potentiostat market.



**2016** Solartron Analytical launched the Apps XM Series, an application based series for research of electrochemistry, energy storage, photovoltaics, and materials.



## Energy Storage

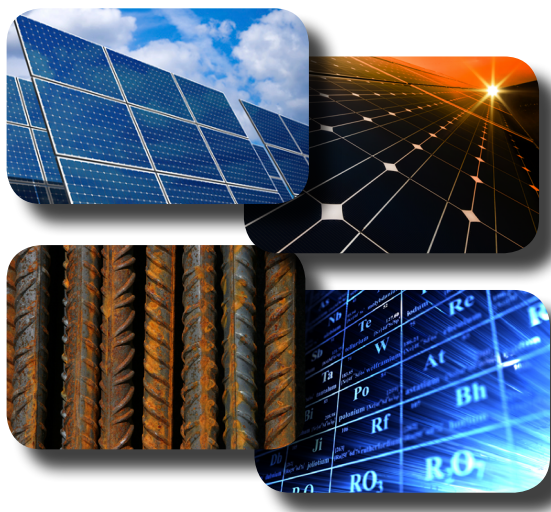
Both Energy Storage and Energy Conversion devices have roles associated with the need for portable power. Specific technologies include batteries, capacitors, fuel cells and solar cells. In commercial devices, these technologies are often used in combination as part of a power system. The power available from a device is the product of its voltage and current. The voltage of a single device is defined by its specific chemistry; whereas, the current of a single device is defined by its size (electrode area). Single devices are combined in stacks, in series or parallel, to meet the most demanding applications, such as electric vehicles.

The evolving need requires the improvement in capability to provide pulse-power, long run-time and cycle life. Power sources also have engineering constraints of volume and weight. New materials and advancements of engineering play a key role in meeting the market demand.

Electrochemical Impedance Spectroscopy (EIS) has become the go-to method to evaluate State-of-Charge, State-of-Health, and failure mechanisms of rechargeable batteries. Due to the high operating voltage and low-impedance of Li-ion batteries, the highest-levels of accuracy are required for both DC and AC measurements. Our portfolio offers a range of products to test from new materials as a half-cell to common commercial forms of coin cells, cylindrical and pouch cells.

## Corrosion

AMETEK offers a range of electrochemical instruments and accessories to assist corrosion scientists in their research. Whether a potentiostat/galvanostat for corrosion rate measurements, a corrosion cell for experimenting with coupons, or a scanning system for both quantitative and qualitative measurements, all of our products are backed by Princeton Applied Research and Solartron Analytical's excellent reputation for design and support.



## General and Research Electrochemistry

General and physical electrochemistry encompass many areas of investigation. These include fundamental physical electrochemistry, where the focus is on the kinetics and thermodynamics of electron transfer reactions, nanotechnology, or research conducted at the nanoscale, and electroanalysis, which involves the use of electrochemical processes to quantify an electroactive analyte.

## Surface Imaging and Scanning

Scanning systems combine the functionality of electrochemical measurements with an advanced positioning system in order to map localized. A modular base provides flexibility to gain information on local events for various applications, ranging from pitting corrosion to sensor development to electrode kinetics. The spatial resolution of these scanning techniques provides complementary information to the traditional integrated response of bulk electrochemical methods.

The Princeton Applied Research VersaSCAN Electrochemical Scanning System is capable of performing the following techniques using a single scanning base –

- Scanning Electrochemical Microscope System (SECM)
- Constant Distance SECM (VS STYLUS)
- Scanning Vibrating Electrode Technique (SVET)
- Localized Electrochemical Impedance Spectroscopy (LEIS)
- Scanning Kelvin Probe (SKP)
- Scanning Droplet Cell (SDC)
- Optical Surface Profiling (OSP)

## Materials Analysis

Solartron Analytical provides a range of integrated solutions that enable researchers to measure the combined electrical, thermal and mechanical properties of materials. Testing over a wide temperature range -268 to >1200° C is simplified using PC software with integrated temperature control facilities. Remote controlled furnaces and cryostats with purpose designed sample holders simplify testing of solids, liquids and powders. Materials can also be tested in specialized atmospheric conditions with use of single or dual gases for fuel cell, solid oxide and super ionic conductor applications.

Materials that can be tested include insulators, dielectrics, ionic conductors and electronic materials using a wide range of time domain and AC electrical techniques including I-V, fast pulse, C-V, Mott-Schottky, impedance, capacitance, and tan delta. Our systems provide full integration of time domain and AC techniques that provide charge carrier excitation and analysis without changing sample setup and connections.

# How To Choose A Potentiostat



Princeton Applied Research and Solartron Analytical offer the widest portfolio of potentiostats in the industry. A primary purpose of this Product Catalog is to highlight the differentiation of these products and develop the strategy to guide you to the model that best fits your needs. Each product has further details available in its brochure and on our website.

## Application

Our recommendation is to start with Application. By starting at your application, we have our first decision-point towards which Family of products and accessories are most well suited.

Simply stated: "What are you studying?"

- Energy: Batteries, Capacitors, Fuel Cells, Solar Technology
- Corrosion: Bare Metals (Oil and Gas, Defense), Coatings, Biomedical, Galvanic Couples
- Physical Electrochemistry: Electrochemical Sensors, Nanotechnology, Electrodeposition
- Materials: Dielectrics, Insulators, Piezoelectrics

## Performance / Specifications

This is core in the decision-making process. The potentiostat must be able to control the cell, apply the signal and measure the response of the system. Translating application test needs into product specifications can be complicated. To make an informed decision, you should ensure that you understand each specification and how it impacts the system and your measurements.

Applications require different breath of measurements with different accuracy needs. Common specifications are:

- Maximum and Minimum Measurable Current
- Compliance and Polarization Voltage
- Impedance Capability
- Accuracy of Measured Values: Current, Voltage, Impedance
- Resolution of Applied Signals and Measured Values
- Communication Protocol
- Expandability, Options
- Software, Programmability



## Technical, Applications Support

Princeton Applied Research and Solartron Analytical have a strong global support team. This provides support in many regional languages and time zones. We have decades of experience partnering with leaders of academic research, government labs, and commercial industry.

You may interface with this team during the product selection process to give you confidence that the proposed system will meet your needs.

Additionally, this global team generates key technical content such as Frequently Asked Questions, How-To Guides, and general knowledge on products, applications and techniques. You may meet this team during their support of short-courses, local seminars, and product installations.

## Citations, References

With our position as innovators of potentiostat and frequency response analyzer design, many of our models have more than 1,000 peer-reviewed publications.

This creates a world-wide community of users across a range of applications sharing best practices.

## Incumbency

Incumbency is a powerful force in the decision making process. The loyalty to a company, brand, or product is often driven by familiarity and compatibility from a software platform that is known, stable, and up-to-date.

Working in a single software package gives users access to existing test protocols, overlaying previous data files; even across varying models.

## Accessories

Potentiostats often interface with accessories to become test systems. These may be ancillary equipment, cells, or cables.

Specific Examples are:

- Power Boosters
- Low Current Interfaces
- Cell Kits
- Reference Electrodes
- Speciality Cables
- Integrated Systems, such as Cryostats, Furnaces, Rotators, Microbalances



# Single Channel Potentiostat | Galvanostat

## ModuLab XM ECS



The Solartron Analytical XM based platform uses unique calibrations which provide best in world EIS accuracy. Accurate and repeatable sub 100  $\mu\Omega$  measurements with 3  $\mu\Omega$  of noise for State-of-Charge and State-of-Health determinations. Ethernet communication for wide-variety of control options

- The ModuLab ECS XM system can be tailored for your different range of electrochemical experiments through boosters and option interfaces
- Can be expanded even beyond traditional electrochemistry including materials and photovoltaic measurements
- Exclusive Femto module for low current measurement

## EnergyLab XM



The EnergyLab XM uses the same XM based platform to deliver ModuLab performance to a focused application, the study of single-cell energy storage devices.

- Supplied internal capability to 2 A
- Range of external current boosters
- Supplied four (4) auxiliary differential voltage inputs for anode/cathode simultaneous impedance

## EchemLab XM



The EchemLab XM, which also uses the XM based platform, is a wide application based instrument with sufficient voltage to study stacks of energy storage devices or complex physical electrochemistry techniques.

- Supplied internal capability to  $\pm 100$  V polarization
- Supplied internal capability to  $\pm 100$  V compliance
- Supplied four (4) auxiliary differential voltage inputs for DC or EIS analysis of cells within a stack

Specifications	ModuLab XM ECS	EnergyLab XM	EchemLab XM
Polarization, Compliance Voltage	$\pm 8$ V up to $\pm 100$ V	$\pm 8$ V	$\pm 100$ V
Max Current Output	$\pm 300$ mA up to $\pm 100$ A	$\pm 2$ A up to $\pm 100$ A	$\pm 300$ mA up to $\pm 100$ A
Min Current Range	$\pm 30$ nA (1.5 pA resolution) to $\pm 30$ pA (1.5 fA resolution)	$\pm 30$ nA (1.5 pA resolution)	$\pm 30$ nA (1.5 pA resolution)
Advanced EIS Functions Accuracy to sub 100 $\mu\Omega$ Auxiliary Voltage Inputs Multi-Sine (improved speed) Harmonic Analysis (cell linearity) Integrated EIS Modeling	With all FRA Modules	Standard	



## PARSTAT 4000A



As modular-design has become a focus within the industry, the PARSTATs stand alone in their ability to deliver high compliance voltage and wide dynamic current range, as standard, to cover a range of applications.

- Industry-leading DC Accuracy of both Applied and Measured Voltage ( $\pm 0.025\% \pm 1$  mV). This measures a 4.3 V battery 4x more accurately than other systems.
- Wide-dynamic current range both standard and expandable
- User-selectable stability modes and high compliance to overcome the most complex cell requirements common to corrosion systems

## PARSTAT 3000A



The PARSTAT 3000A is designed for functionality in a small-footprint and quiet design. The PARSTAT 3000A continues the tradition of the PARSTAT family, providing the most designed-in capability with its internal dual voltage ranges, as standard, for both high voltage and high resolution experiments.

- Auxiliary voltage input (6-WIRE) for simultaneous impedance
- $\pm 30$  V range for studying stacks or titanium corrosion
- $\pm 6$  V range to achieve high voltage resolution for standard experiments

## PARSTAT 3000A-DX



The PARSTAT 3000A-DX is a hardware-synchronized bipotentiostat providing EIS capability across two-channels. This system can also operate different experiments to take advantage the different performance features of each channel maximizing the range of function available.

- Hardware-Synchronization as a bipotentiostat for sophisticated experiments like the RRDE analysis of Fuel Cell Catalysts
- Up to  $\pm 30$  V and up to  $\pm 2$  A on individual channels
- Small-footprint multichannel potentiostat

Specifications	PARSTAT 4000A	PARSTAT 3000A	PARSTAT 3000A-DX
Compliance Voltage	$\pm 48$ V	$\pm 30$ V	$\pm 30$ V (Channel 2)
Max Current Output	$\pm 4$ A up to $\pm 20$ A	$\pm 1$ A	$\pm 2$ A (Channel 1)
Min Current Range	$\pm 40$ pA (1.2 fA resolution) down to $\pm 80$ fA (2 aA)	$\pm 4$ nA (122 fA resolution) down to $\pm 4$ pA (122 aA)	$\pm 4$ nA (122 fA resolution) down to $\pm 4$ pA (122 aA) (Ch1)
EIS Maximum Frequency	10 MHz, Included	7 MHz, Included	7 MHz, Included (Channel 2) 1 MHz, Included (Channel 1)
E and I Monitors	Supplied, BNC	Supplied, DB9	Supplied, DB9
Software	VersaStudio, Fully Enabled; VersaStudio Developers Kit		



# Single Channel Potentiostat | Galvanostat

## VersaSTAT 3



The VersaSTAT Family combines our popular option-based hardware and software platforms to create the most popular line of instruments. These are USB-based communication. The VersaSTAT 3 provides sufficient function for most standard electrochemical experiments. This includes energy, physical electrochemistry, and corrosion experiments.

- Standard  $\pm 2$  A current capability
- Standard  $\pm 200$  nA current range with 6 pA resolution
- 2 different E and I Filters

## VersaSTAT 4



The VersaSTAT 4 improves on low-current measurement capabilities by extending the current range and providing access to lower cutoff frequency filters.

- Standard  $\pm 2$  A current capability
- Standard  $\pm 4$  nA current range with 122 fA resolution
- 5 different E and I Filters for improved Signal-to-Noise

## VersaSTAT 3F



The VersaSTAT 3F potentiostat provides user-selectable modes for grounding. Operation in “floating” (isolated) mode ensures compatibility with grounded electrodes, such as autoclaves, or grounded electrolytes from pumps or other potentiostats.

- User-selectable operation in ‘floating’ or ‘grounded’ mode
- Standard  $\pm 2$  A current capability
- Standard  $\pm 4$  nA current range with 122 fA resolution
- 5 different E and I Filters for improved Signal-to-Noise

Specifications	VersaSTAT 3	VersaSTAT 4	VersaSTAT 3F
Max Current Output *	$\pm 2$ A (standard) up to $\pm 20$ A	$\pm 2$ A (standard) up to $\pm 20$ A	$\pm 2$ A (standard) up to $\pm 20$ A
Compliance Voltage	$\pm 12$ V	$\pm 12$ V	$\pm 12$ V
EIS Capability	1 MHz, Option	1 MHz, Option	1 MHz, Option
Min Current Range	$\pm 200$ nA (6 pA resolution) down to $\pm 4$ pA (122 aA)	$\pm 4$ nA (122 fA resolution) down to $\pm 4$ pA (122 aA)	$\pm 4$ nA (122 fA resolution) down to $\pm 4$ pA (122 aA)
E and I Filters	200 kHz to 1 kHz, including None	200 kHz to 1 Hz, including None	200 kHz to 1 Hz, including None
Grounding	Grounded, Earthed	Grounded, Earthed	Floating, Isolated

\*From August 2018, standard maximum current on all VersaSTAT models increased to 2-Amps. Upgrades to 2-Amp available for existing systems.



## PARSTAT MC



PARSTAT performance is available in a multichannel configuration in our PARSTAT MC series. The chassis is designed for robustness.

- Data Buffers
- User Replaceable Parts
- Hot-Swappable Function

This expandable platform is tailored through:

- Potentiostat Models: PMC-200, PMC-1000, PMC-2000A
- Channels: Up to 20 per chassis and 32 per system
- Current Range: Up to 20A and down to 4 pA (122 aA resolution)

## PMC Channels



The PMC-200 brings dual-channel capability to a single module while providing highest resolution measurements.

The PMC-1000 is the most popular channel to meet today's research needs, offering the highest current of the PMC Family.

The PMC-2000A is the highest voltage multichannel option. With standard 6-WIRE function, it is ideal for measuring energy-storage stacks.

## CellTest System



The 1470E CellTest System is an 8 channel system providing cost-effective DC experiments and options for Solartron Analytical EIS performance. CellTest is designed for the energy researcher with application-driven software, high current per channel standard, and advanced EIS function and accuracy.

- 4 A per channel, able to be combined to 32 A
- Solartron Analytical EIS performance in simultaneous (1400/1455) mode or sequential mode (stand-alone FRA)
- Auxiliary measurement channels for multiple anode/cathode electrode investigation (AC/DC)
- Wide range of external boosters

Specifications	PARSTAT MC PMC-200	PARSTAT MC PMC-1000	PARSTAT MC PMC-2000A	CellTest 1470E
Max Current Output	±1 A, per channel	±2 A	±1 A	±4 A
Compliance Voltage	±10 V	±12 V	±30 V	±10 V
Min Current Range	±2 µA (238 fA resolution)	±4 nA down to ± 4 pA (122 aA, 122 fA)	±4 nA (122 fA resolution)	±50 µA
Communication Protocol	USB			Ethernet or GPIB
Software	VersaStudio - EIS + Core DC VDK*	VersaStudio - Fully Enabled VDK	VersaStudio - Fully Enabled VDK	CellTest MultiStat
Advanced Features	2-Channels per Module	Low Current Interface Compatibility	6-WIRE Standard EIS to 7 MHz	MultiSine EIS Temperature Monitor Booster to 100 A

VDK\* = VersaStudio Developers Kit for LabView, etc.



# Scanning Electrochemical Systems



## VersaSCAN

The VersaSCAN is a single platform capable of providing spatial resolution to both electrochemical and materials-based measurements. Traditional electrochemical experiments measure an average response over the entire electrode/electrolyte interface. Samples often consist of local sites of passivate/active nature or sites of anodic/cathodic character. This need to investigate localized phenomenon led to the emergence of scanning probe electrochemistry.

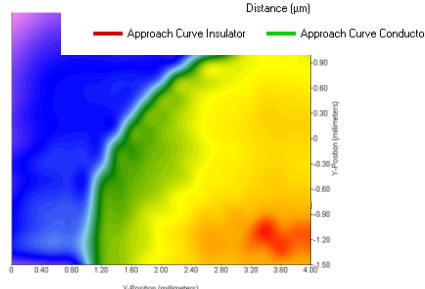
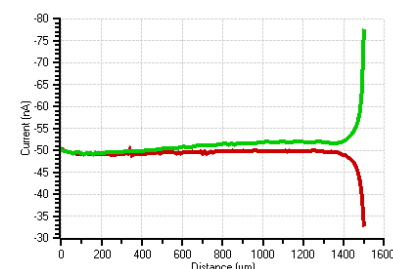
By making the measurement at a probe placed just above the surface of the sample, the response is taken from a subset of the sample. A small measurement probe positioned very close to the surface, but non-contact, reduces the sampling volume and provides a high spatial resolution. However, these small responses require superior measurement technology to record the measured parameter.

- Piezoelectric motors exclusively drive positioning. All axes give wide range (100-mm) and high resolution and repeatability. This overcomes a limitation of screw-based or hybrid-system designs
- On-Site Installation and Training provided by our Global Support Team
- Single platform capable of running several different scanning probe techniques of different resolution and application
- Leverages industry-leading measurement technology from PAR, Solartron Analytical and Signal Recovery products

## SECM

Scanning Electrochemical Microscope System

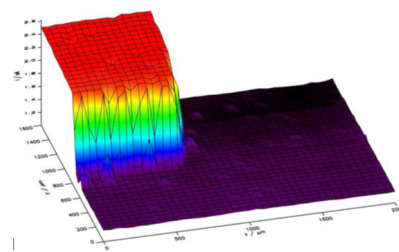
- SECM controls and monitors electrochemical reactions at the sample and ultramicroelectrode tip using a 2-channel potentiostat
- Low Current Interface integration provides improved current measurement sensitivity for ultimate resolution and versatility
- Includes AC-SECM technique



## VS STYLUS

Constant Distance SECM

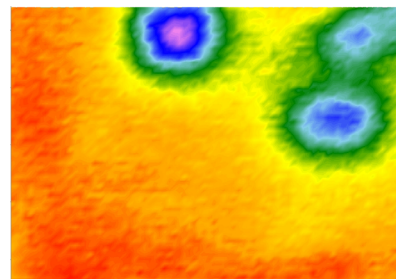
- VS-Stylus is developed and supplied through exclusive partnership with SENSàSION, EPFL
- Eliminates many of the experimental difficulties of Approach Curves and changing probe-to-sample distance that are associated with standard SECM techniques



## SVET

Scanning Vibrating Electrode Technique

- SVET uses a Pt/Ir microelectrode to map the voltage-field in solution from local current events, such as corrosion pits or galvanic couples
- Our SR 7230 ensures superior signal measurement enabling high-resolution measurements



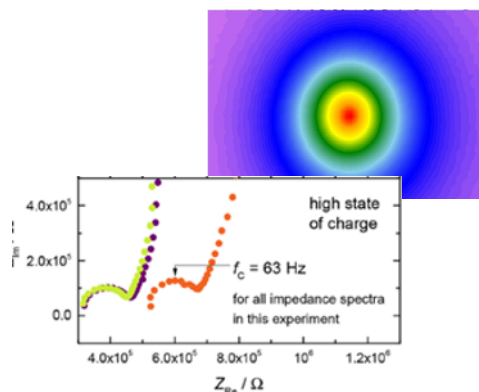
# Scanning Electrochemical Systems



## LEIS

Localized Electrochemical Impedance System

- LEIS provides spatial resolution to all of the applications that benefit from EIS measurements
- Wide measurement bandwidth and high measurement accuracy combine to benefit Local State-of-Charge (SoC) measurements and Coating failure analysis



## VersaSCAN Options



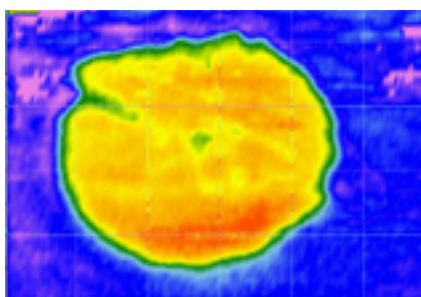
### VersaSCAN L-Cell

- Screws into optical table of VersaSCAN
- Approximately 1 Liter in volume
- Level adjustment mechanism
- Accepts large flat samples and 32mm diameter mounted samples

## SKP

Scanning Kelvin Probe

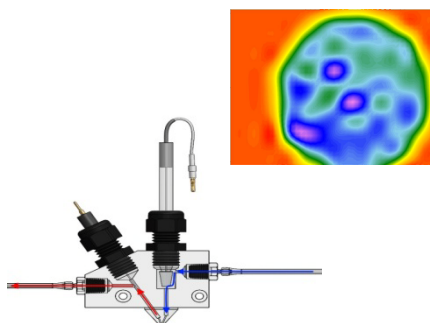
- SKP uses a relative work-function measurement, typically in atmospheric conditions, to map the anodic/cathodic nature of samples
- Superior probe design and signal measurement capability provide high-resolution measurements



## SDC

Scanning Droplet Cell

- SDC controls a flowing droplet at the surface of the sample. Users measure a subset of their sample using standard electrochemical methods
- Flowing the droplet ensures no impact of reaction products



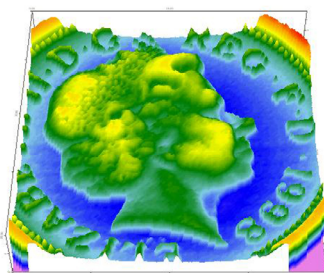
### VersaSCAN mL-Cell

- Screws into optical table of VersaSCAN
- Designed for small-volume experiments to maximize concentrations.

## OSP

Optical Surface Profiler

- OSP uses laser-based technology to accurately map topography of any sample
- When combined with other techniques, OSP data provides a mechanism for Constant-Distance measurements removing a key complication of data interpretation



### VersaCAM

- Imaging system useful for the initial positioning of probes
- Visualizes probe-to-sample distance

## ModuLab XM MTS



The ModuLab XM MTS can perform time domain (DC) and frequency domain (AC) tests. Accessories control temperature from cryostat to furnace levels and integrate through software control with the core measurement electronics to create a system to study a wide range of materials. As with other ModuLab-platform systems it can be expanded for electrochemical or photoelectrochemical experiments.

- Widest impedance range - 10  $\mu$ ohms to >100 TOhms
- Software switching between DC and AC experiments
- Options include – FemtoAmmeter and Sample/Reference modes (for dielectric/insulators)
- Configurable for specific materials applications and expandable to electrochemical and photoelectrochemical experiments

## Materials Lab



The Materials Lab XM uses the same XM based platform to deliver ModuLab performance to a focused application, the study of Materials. This focused design allows this instrument to occupy a small footprint. ModuLab software includes integrated equivalent circuit analysis, MultiSine, and Harmonic Analysis for non-linear materials.

- Application-focused on dielectrics, insulators, and electronic materials
- Impedance Range from 1 mOhm to 1 TOhm (1E15 Range)
- Auxiliary measurement port for synchronized measurement of optical, mechanical or other transducers.

## 1260A / 1296A



The 1260A Impedance Analyzer is the cornerstone of FRA technology. The 1260A can be used as a stand-alone unit, but its applications to Materials is greatly expanded when combined with the 1296A Dielectric Interface. This solution measures at both high-frequency and high-impedance.

- 1260A provides a wide frequency range - 32 MHz to 10  $\mu$ Hz for solid state materials
- Most referenced, most cited, most popular Impedance Analyzer available
- 1296A increases impedance measurement range to 100 TOhms (1E14 Ohms) for dielectrics

Specifications	ModuLab XM MTS	Materials Lab XM	1260A / 1296A
Maximum Frequency	1 MHz	1 MHz	32 MHz
Combines with DC for Electrochemical Measurements	Yes, with XM PSTAT 1 MS/s	No	Yes, with 1287A Electrochemical Interface
Highest Impedance	100 TOhms	1 TOhms	100 TOhms
Lowest Impedance	10 $\mu$ Ohms	1 mOhms	100 mOhms
Software	XM studio	XM studio	SMART, ZPLOT



## 129610A LHe/LN2 Cryostat System

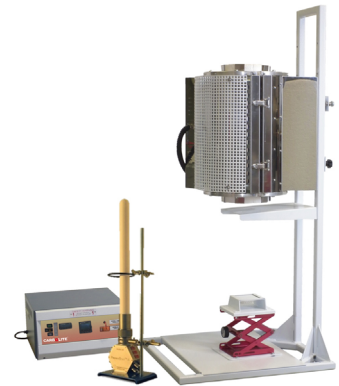
The 129610A cryostat may be used together with any Solartron materials test system to run I-V, Pulse, C-V, Impedance, Mott-Schottky and a wide range of other materials test techniques. It offers fully integrated temperature control.

- Cryogen not in contact with sample - prevents sample damage
- Temperature Range of 5 K to 600 K
- Compatible with liquid helium (LHe) and liquid nitrogen (LN2)
- Low cryogen usage (low running cost) - capillary tube around sample space

## 129620A High Temperature Test System

An integrated system uses a split tube furnace design together with a lab jack that allows easy sample access and positioning. The sample is positioned in a purpose designed sample holder between platinum electrodes that allow testing at very high temperature. Key applications are development of solid-state materials, included SOFC and solid-state batteries.

- Operating range room temperature to 1200°C using a precise temperature controller
- Various sample holder configurations are available depending on material requirements – 2 terminal/4 terminal/van der Pauw
- Dual gas configuration is available for SOFC type applications
- Controlled atmospheres



## 12962A Room Temperature Sample Holders

The 12962A sample holder allows accurate impedance tests of solid materials at room temperature. The sample holder consists of two parallel electrodes, one of which is fixed in position and the other which can be moved into contact with the sample by adjustment of a micrometer.

The sample holder makes use of guard ring and reference techniques in order to improve accuracy by reducing “fringing” effects at the edge of the sample.

- Electrode diameter of 20 mm standard. Options of 10 mm, 30 mm, 40 mm.
- 2 terminal connections
- Sample types of solid, liquid, powder
- Sample thickness range of 0.2 mm to 25.4 mm



## ModuLab XM PhotoEchem



The ModuLab XM PhotoEchem combines the powerful ModuLab Frequency Response Analyzer and Potentiostat technology. Existing systems can be upgraded to ModuLab XM PhotoEchem with an option card and optical bench.

## SolarLab XM



SolarLab XM is an application specific XM product that is primarily focused on solar cell / photovoltaic research, developed in conjunction with Professor Laurie Peter of the University of Bath, UK.

Technique	Parameters
IMPS	Effective Diffusion Coefficient of Electrons
IMVS	Effective Lifetime of Electrons
Photo Voltage Decay	Effective Lifetime of Electrons
I-V	Fill Factor, Pmax, Voc, Isc, Efficiency
Charge extraction - Dark	Trapped Charge Density
Charge extraction - Short Circuit	Trapped Charge Density
IPCE Option	Quantum Efficiency
AC Measurement	Impedance / Capacitance

Common* LED Options (nm)	Maximum Power (mA)	Bandwidth, FWHM (nm)
420	500	12
455	1000	18
470	1600	29
505	1000	30
530	1600	31
590	1600	14
625	1000	16
660	1200	25
Cold White	1000	N/A
Warm White	1000	N/A

Specification	
Wavelength Range	350 nm -1100 nm
Intensity Range	6 Decades (With ND Filter)
Maximum Beam Divergence	4 degrees
Maximum Beam Diameter / Cell Size	1 cm
IMPS / IMVS Transfer Function	Reference Photodetector
Calibration	NIST Traceable
LED Driver Maximum Current	10 A
Typical LED Stability at Max Power	< 2% Drift After 24 hours
LED Driver Maximum Frequency (IMPS and IMVS)	250 kHz

\*More LED Options are available. Contact us for details.



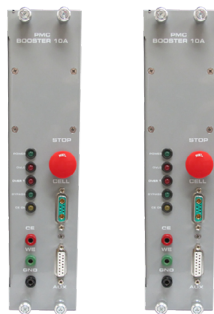
## LC Low Current Interface



- Femtoampere accuracy and attoampere resolution for both DC and AC (EIS) measurements
- Auto-current ranging capability from 200 mA - 4 pA (80 fA minimum range with PARSTAT 4000A)
- Users can add to existing systems without complicated tools or procedures
- Supported through VersaSCAN to provide industry-leading current resolution to localized, scanning techniques

## Power Booster - Solartron Analytical

- Compatible with Solartron potentiostats including: ModuLab XM ECS, EnergyLab XM, EchemLab XM, SolarLab XM, 1280Z, 1285A, 1287A, 1470E, 1480A and 1470A
- Wide frequency bandwidth for impedance measurements. Accurate EIS measurement up to 700 kHz.
- Up to 100 V and up to 100 A



## Power Booster - Princeton Applied Research MC

- 5 A and 10 A boosters in-chassis boosters available and compatible with the PMC-2000A and PMC-1000
- Up to 20 A when operated in parallel
- Installs in PMC CHS08A chassis with PMC-2000A and PMC-1000

## Power Booster - Princeton Applied Research

- 8 A / 50 V, 10 A / 20 V, and 20 A / 20 V Options
- Operates in boosted or normal mode
- Calibrated with the potentiostat for optimal performance
- Increases both current and compliance voltage
- Alternative Internal 2A booster options for VersaSTAT Family



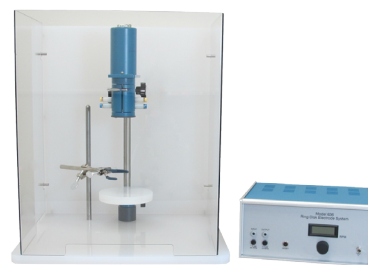


### QCM922A Electrochemical Quartz Crystal Microbalance

- Front panel display of resonant frequency and resistance changes
- Frequency range up to 30 MHz
- Wide variety of resonators in both standard and mirror finishes
- Integrates with our potentiostats for EQCM measurements or can be operated in stand-alone mode.

### 636A RRDE Rotating Ring-Disk Electrode

- Rotating Disk Electrode (RDE), Rotating Cylinder Electrode (RCE) or Rotating Ring-Disk (RRDE) configuration
- Fixed shaft or interchangeable electrode assemblies available
- PTFE or PEEK shroud options



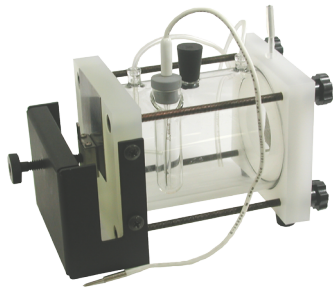
### Faraday Cage

- Designed to reduce electromagnetic interference and other noise from interfering with the measurements of the potentiostat
- Standard K0269B Faraday Cage is 27 x 30 x 41 cm and is large enough to accommodate the VersaSTAT LC
- An oversized faraday cage designed for use with the VersaSCAN is also available

### Battery Holders

- Replaces the standard cell cable by connecting directly to the potentiostat
- 5 options are available for the following form factors: 18650, AA, AAA, coin cell (2032) and a flexible screw-based design for custom cell geometries





## Flat Cell Kit

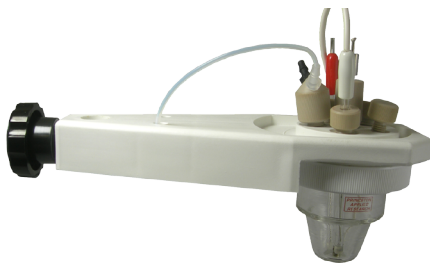
- Optimal construction for corrosion/coatings studies of flat specimens having a range of sizes and geometry
- Specially designed gasket to minimize crevice corrosion
- Platinum mesh counter electrode and Ag/AgCl reference electrode included
- Exposed sample area is 1 cm<sup>2</sup> with an option for a larger exposed area of 12.6 cm<sup>2</sup>

## Corrosion Cell Kit

- Cell configuration is modeled after a design commonly found in many ASTM standards
- Supplied with graphite counter electrodes and saturated calomel reference electrode (SCE)
- Jacketed version is available for studies at elevated temperatures



## Micro-Cell Kit



- Intended to be used for any application where solution volume is limited, requiring volumes ranging from 3 to 15 mL
- Purge tube assembly provided for bubbling or blanketing the solution with inert gas
- Platinum wire counter electrode and Ag/AgCl reference electrode included

## Analytical Cell Kit

- Designed with two cell top configurations, one for general use and the other for accommodating a rotating electrode (RDE, RRDE, RCE) connected to the 616 or 636 A/B rotator
- Supplied with a platinum wire counter electrode and Ag/AgCl reference electrode
- Operates with solution volumes from 5 – 50 mL



## Reference Electrodes



- A variety of chemistries and form factors are available.
  - The popular Saturated Calomel Electrode (SCE), with a standard 14/20 ground glass joint, is designed for use in the K0047 Corrosion Cell.
  - Ag/AgCl reference electrodes with either a standard 14/20 ground glass joint or a smaller form factor suitable for use in the Flat Cell Kit.
  - Non-aqueous and chloride free aqueous reference electrodes are offered.
- 

## Working Electrodes

- Physical electrochemistry applications benefit from our range of milli- and micro-electrodes
- Au, Pt, and Glassy Carbon (GC) milli-electrodes with  $2\text{ mm} \pm 0.2\text{ mm}$  diameter are available
- Au, Pt, and GC micro-electrodes with  $10\text{ }\mu\text{m} \pm 2\text{ }\mu\text{m}$  diameter are available
- These electrodes are ideally suited for the K0264 Micro-Cell Kit



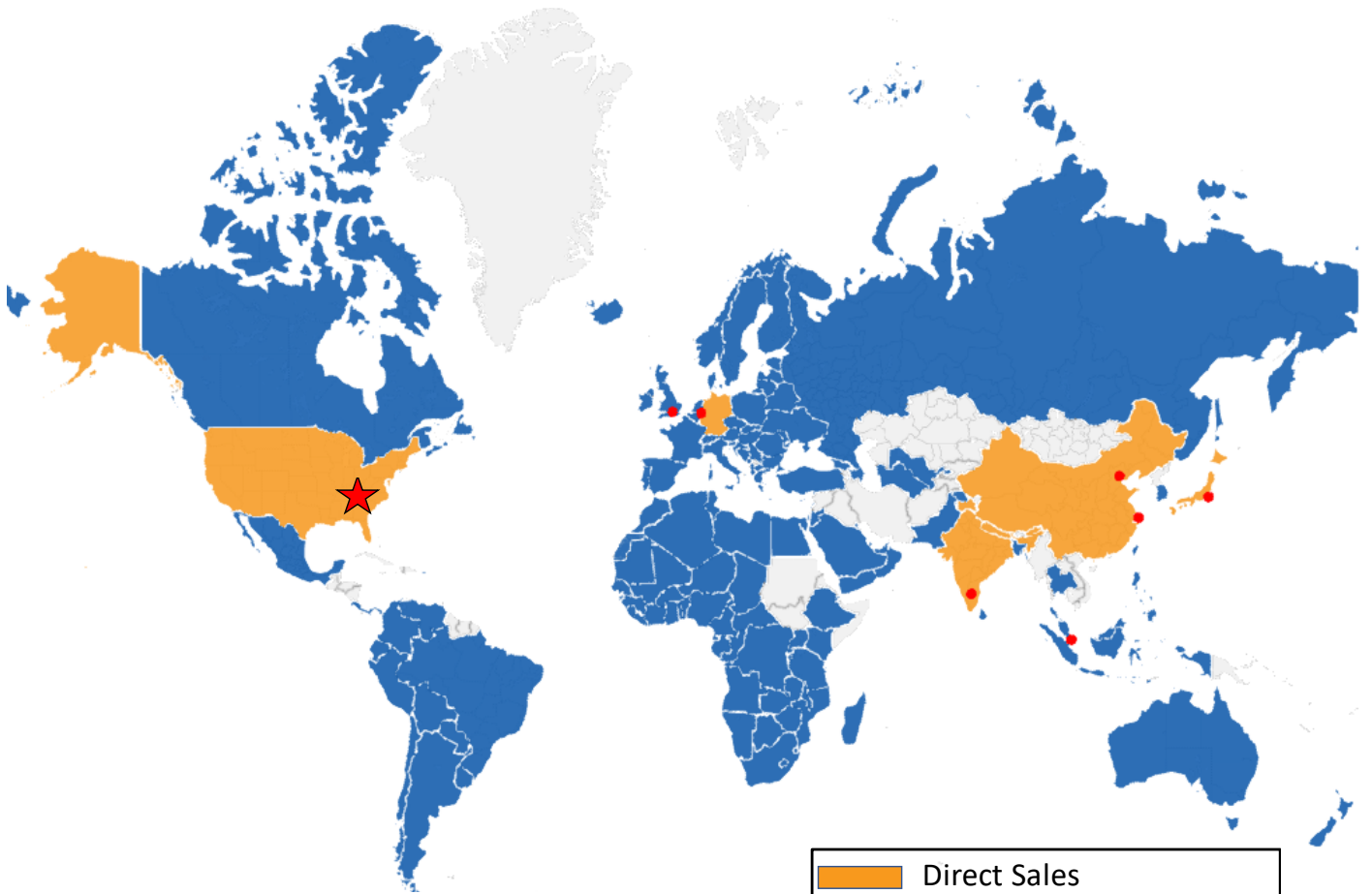
## Counter Electrodes



- Graphite rods for use in the K0047 Corrosion Cell Kit
- Pt coated mesh for use in the K0235 Flat Cell Kit
- Pt wire suitable for the K0264 Micro-Cell Kit



**The contents of this catalog contain a brief summary of the products offered by Princeton Applied Research and Solartron Analytical. For further detailed specifications, please view our complete listing of product brochures online at [www.ameteki.com](http://www.ameteki.com) or contact your local sales representative.**



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