EnergyLab

Apps-XM series

AMETEK

solartron analytical

Apps-XM series

- ***Smaller Footprint***
- ***Competitively Priced***
- ***Best In Class XM Accuracy***

EnergyLab **XM** is one of Solartron Analytical's Apps-XM series of **X**treme **M**easurement products that are each precisely focused on the requirements for specific applications.

These exciting new products have a much smaller footprint than most competitive units - delivering unmatched **XM** measurement performance while taking less of your restricted lab space.

Each **XM** module is individually calibrated using Solartron Analytical's unique multi-point calibration and tested to rigorous standards ensuring best accuracy.

- ***Highest accuracy DC and EIS***
- ***Best in class impedance***
- ***Highly repeatable sub 100 µΩ measurements***
- ***Auxiliary channel DC and EIS for anode/cathode characterization.***

Apps-XM

EnergyLab XM	for batteries, fuel cells and supercapacitors
EchemLab XM	for corrosion / coatings and physical electrochemistry
SolarLab XM	for solar / PV cells
Materials Lab XM	for dielectrics, insulators and electronic materials

EnergyLab xm

Xtreme Measurement

EnergyLab XM is an application specific **XM** (**X**treme **M**easurement) product that is primarily focused on battery / fuel cell / supercapacitor research.

EnergyLab XM includes a reference grade potentiostat, frequency response analyzer (FRA) and 2A booster. The unit may be operated in boosted or unboosted mode (with automatic switching), providing optimum test conditions and accuracy for a wide range of energy devices.

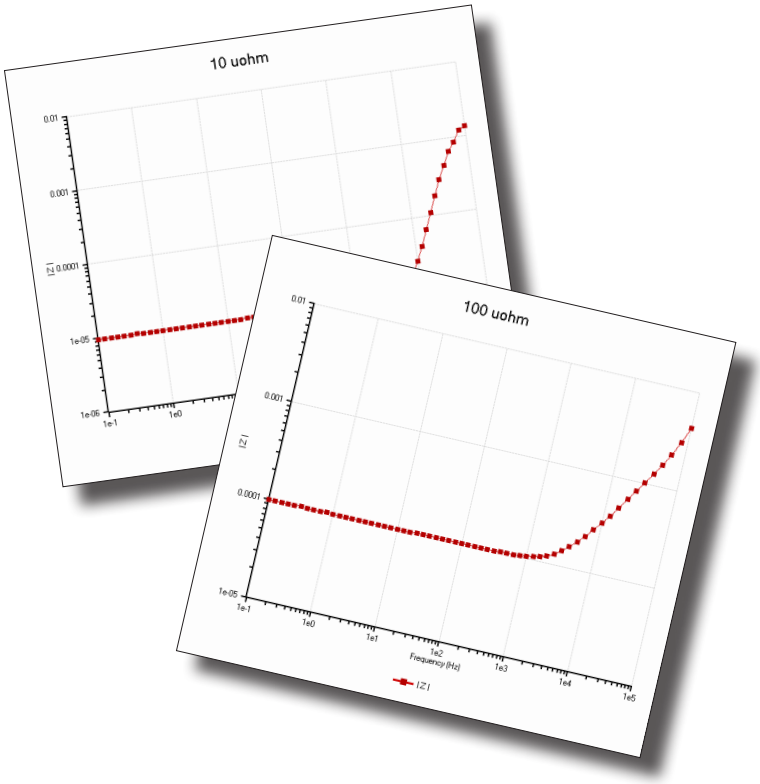
EnergyLab XM's extreme sensitivity allows complete characterization of prototype low current or low impedance new generation cells.

If high current is needed (for example to measure cells in the sub 100 µΩ range), external power boosters can be connected and automatically controlled, allowing fully integrated high current tests at up to 100 A.

All modes (boosted and unboosted) make use of Solartron Analytical's unique auxiliary channel capability allowing simultaneous DC/impedance testing of complete cells and anodes/cathodes.

EnergyLab XM's impedance accuracy contour plot (back page) highlights Solartron's best in class measurement performance, brought to you in a small, lower price package in the new Apps-XM series of products.

The **EnergyLab XM** is able to make very accurate, extreme low impedance measurements in the micro-ohm region using a wide range of internal and external power boosters. These example plots show the quality of 10 µohm and 100 µohm data that is available from the system.



EnergyLab XM Xtreme Measurement

XM Potentiostat and FRA

EnergyLab XM's reference grade potentiostat uses high technology waveform synthesis to ensure smooth waveforms are applied in all modes of operation, whether connected direct to the cell, or via boosters.

- Fast data acquisition at up to 1 MS/s for fast CV/ fast pulse techniques.
- Ultra-smooth "analog" waveform generation

EnergyLab XM's advanced impedance measurement capability couples this true reference grade potentiostat with a 40 MS/s frequency response analyzer (FRA) to ensure smoothest waveforms and best accuracy.

- Solartron Analytical's unique multi-point calibration (no use of "generic" calibration)
- 40x oversampling allows harmonic and Fast Fourier Transform techniques over entire frequency range
- Auxiliary channels for anode/cathode impedance

Auxiliary Voltage Channels

Four differential auxiliary voltage channels are included as standard, providing:

- Time domain voltage and impedance at multiple points in the test cell
- Anode/cathode tests
- Boosted and non-boosted connection modes
- Synchronous measurement from ancillary devices, pH transducers etc.

Power Boosters

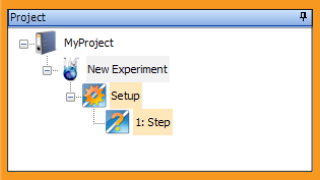
Fully integrated power boosters enable precise characterization of the latest generation ultra-low impedance cells.

- Internal 2A booster as standard
- External booster options (up to 100A)

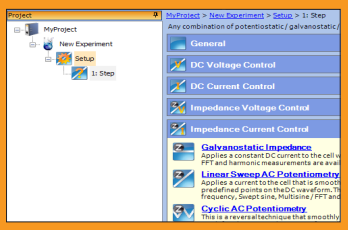
XM-studio software easy as 1... 2... 3... 4...

XM-studio software provides the complete range of facilities in one very easy to use package. From test setup, to experiment execution, to data analysis and final report; the software provides ready built templates to get you started, and tests can be setup and run in just a few mouse clicks:

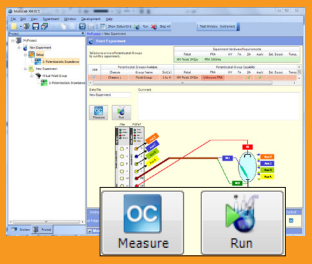
1 Create new experiment



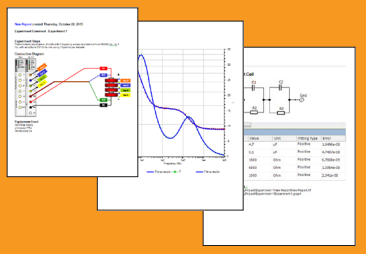
2 Select Step type (Impedance in this case):

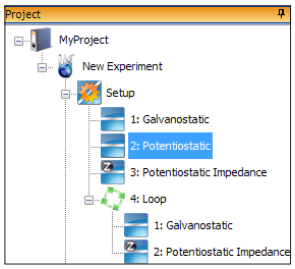


3 Check your cell connections - match the diagram in the "Experiment" menu, and click "Run"



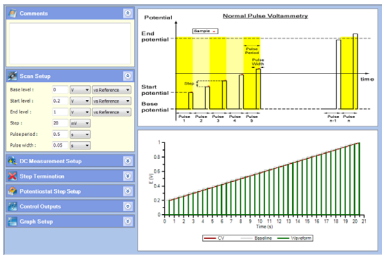
4 Analyze the data using equivalent circuit fitting, and automatically generate reports using your favorite word processor software



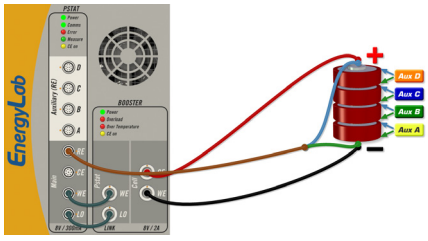


XM software is fully featured and graphically oriented for ease of use:

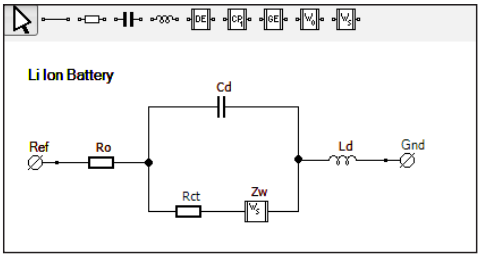
- Experiment sequences are setup using intuitive standard copy/paste, and drag & drop techniques.
- New experiments can be derived from previous experiments, by copying and then adjusting step parameters and test sequencing.



- Extensive use of graphical waveforms in the software enable full understanding of test parameters and experiment settings. The effect of parameter changes are seen real-time at setup, allowing setup errors to be identified and corrected before the test is run.



- **XM** software shows connection diagrams that ensure that your cell is correctly connected before the test starts.



- Equivalent circuit fitting is included, no need to export data
- R, C, L, Warburg constant phase elements, distributed elements...

Accessories

EnergyLab XM is specifically designed for energy applications but when paired with suitable accessories it can be used in other electrochemical applications including corrosion and coatings, as well as physical electrochemistry.

External Power Booster

EnergyLab XM is compatible with external power boosters that extend its current and impedance measurement range - especially important for new generation ultra-low impedance batteries, fuel cells and supercapacitors.

- Floating design - enables tests on grounded cells
- Time domain and impedance tests on anodes/cathodes and short stacks up to 8V
- Can boost current up to 100 A and extend impedance measurements to 1 μΩ
- External boosters provide 100 kHz impedance bandwidth for SOFC and other high frequency applications
- Automatically controlled by EnergyLab XM and XM software

Corrosion Cell

The cell permits a series of metal specimens and liquid environments to be tested quickly and uniformly. Most of the common electrochemical techniques for corrosion testing can be employed under aggressive conditions (except for HF) and at ambient or elevated temperatures.

Flat Cell

The practical design of the Flat Cell makes it simple to use for corrosion and/or coatings research. It can accommodate a wide range of electrode sizes, eliminating the need for machining or special mechanical procedures.

Rotator

The model 636A is suitable for use in hydrodynamically modulated systems. Its solid state controlled servosystem allows the electrode speed to follow an input signal with minimum distortion. This excellent performance is due to the use of a high speed, low inertia, permanent magnet DC motor and a high voltage, bipolar power supply. The rotational speed is adjustable to within 1% of the input setting 50 to 10,000 RPM. A voltage signal proportional to the rotational speed is available as an output.

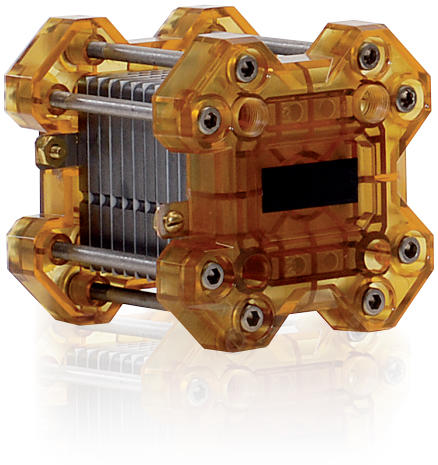
Integrated Battery Test Systems

Solartron Analytical and Princeton Applied Research have partnered with MACCOR Inc. to offer integrated solutions that incorporate automated battery cycling with electrochemical analysis systems, that include multiplexing and interconnect cables, and integrated impedance analysis software.

These integrated solutions improve productivity by switching automatically between MACCOR's test equipment and electrical impedance systems. This provides greater data integrity with more reliable and reproducible test results; while reducing idle time and in-test waiting from operators currently moving test cells from one instrument to another.

Applications

Fuel Cells, Batteries, and Supercapacitors



There is ever increasing demand for new generation "breakthrough" energy storage devices that are smaller, lighter, higher energy, lower cost, have much faster recharge capability, low self-discharge, and improved lifetime. Many new technologies are appearing on the market enabled by new materials developments and nanotechnology that are set to improve many of these factors in the near future, possibly by orders of magnitude. As an example, there are recent reports about potential recharge times of just one minute for automotive Li batteries, which would represent 1-2 orders of magnitude improvement over present technologies.

Solartron Analytical equipment is able to characterize a wide range of cell technologies at a research and development level, including Li-ion, NiMH, metal-air, SOFC, magnesium based batteries, ultra-thin organic cells, etc. Smaller batteries, supercapacitors and micro fuel cells, such as those used in mobile communications and PC applications can be tested directly by Solartron's single and multi-channel potentiostat systems (e.g. XM and CellTest systems), and external power booster options may be added to these systems for testing high power cells.

Xtreme Measurement

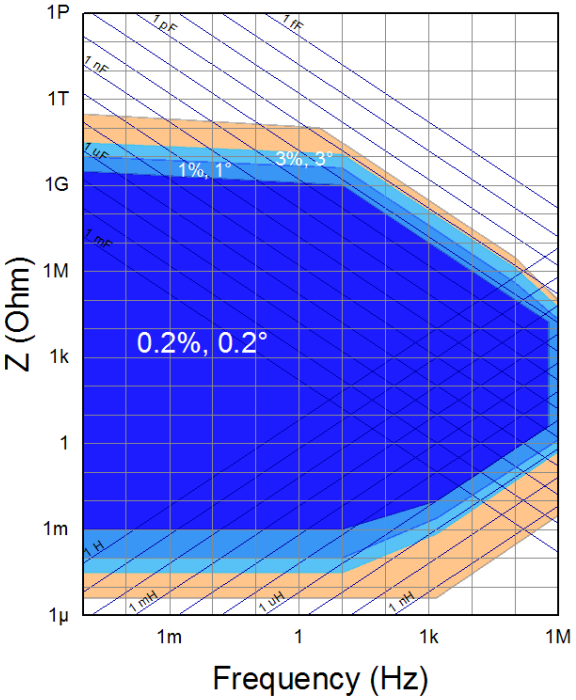
EnergyLab XM

Specifications

Potentiostat/Galvanostat	
Cell connections	2, 3, or 4 terminal
Instrument Connections	CE, WE, RE, LO
Floating measurements	yes
Impedance measurement bandwidth	1 MHz (via FRA)
Maximum time record	Unlimited
Counter Electrode (CE)	
Smooth “analog” scan generator	64 MS/s interpolated and filtered
Voltage polarization (and compliance) range	±8 V
Current polarization range	Pstat ±300 mA Booster ±2 A
Recommended voltage scan rate	25 kV/s to 1 µV/s
Recommended current scan rate	1 kA/s to 200 µA/s
Bandwidth (decade steps)	1 MHz to 10 Hz
Polarization V/I error (setting+range)	0.1% + 0.1%
Minimum pulse duration	1 µs
Slew rate	>10 V/µs
Reference Inputs (RE)	
Connections	Differential input
Cable Shields	Driven (3T) / Ground (4T)
Maximum voltage Measurement	±8 V
Ranges	8 V to 3 mV
Accuracy (reading % + range % + offset)	0.1% + 0.05% + 100 µV
Maximum resolution	1 µV
Input impedance	>100 GΩ, <28 pF (3T)
Input bias current	<10 pA
Maximum ADC sample rate	1 MS/s
Working Electrode (WE)	
Maximum current	Pstat ±300 mA Booster ±2 A
Ranges	Pstat 300 mA to 30 nA Booster 3 A to 30 nA
Accuracy (reading % + range % + offset)	0.1% + 0.05% + 30 fA
Maximum resolution	1.5 pA
Compliance voltage range (floating)	±8 V
Maximum ADC sample rate	1 MS/s
Auxiliary electrodes (A, B, C, D)	
Differential Auxiliary Electrodes	4 (same spec. as RE)
DC Measurement	Synchronized to RE
Impedance measurement bandwidth	1 MHz (via FRA)

Frequency Response Analyzer	
Maximum sample rate	40 MS/s
Frequency range	10 µHz to 1 MHz
Frequency resolution	1 in 65,000,000
Frequency error	±100 ppm
Minimum ∫ time per measurement (single sine, FFT or harmonic)	10 ms
Signal Output	
Waveform	Single sine, multi-sine
Single Sine	Linear / logarithmic
Multi-sine / harmonic frequencies	All or selected
Analysis channels	
Accuracy (ratio)	±0.1%, ±0.1°
Anti-alias, digital filters, DC bias reject	Automatic
Analysis channels	RE, WE, Aux A/B/C/D
Analysis modes:	Single sine, FFT, harmonic
DC Bias rejection	Automatic

Impedance Accuracy



- External high power boosters extend accuracy to 1 µΩ
- 3T connections > 1kΩ , 4T otherwise
- 4T connections and gstat mode < 1Ω
- Faraday cage and suitable screening recommended

USA

Tel: (865) 425-1289
Fax: (865) 481-2410

Europe

Tel: +44 (0) 1252 556800
Fax: +44 (0) 1252 556899

Visit our website for a complete list of our global offices and authorized agents

solartron.info@ametek.com www.solartronanalytical.com

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