

Energy Storage



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Batteries

Manufacturers of electronic devices such as laptop computers, mobile phones, PDAs, camcorders and power tools are striving for the ultimate battery technology to power their products. Achieving best battery cycle life, standby performance, shortest charge time, longest discharge time, smallest size and weight are vital in these highly competitive markets.

Battery types currently being developed include plastic lithium ion (PLI), nickel metal hydride (NiMH), zinc-air, and lithium polymer (LP).

Fuel cells

Fuel cells are seen as a highly efficient, zero emission, noiseless power source, which may, in the future, replace batteries and even the internal combustion engine.

Essentially, a fuel cell generates electricity by releasing the chemical energy present in hydrogen and oxygen through the oxidation of hydrogen.

The development of this technology has been rapid as the search for clean air technology is pursued as a replacement to fossil fuels. This is driven by environmental concerns.

Supercapacitors

Batteries and fuel cells are very good at providing power for continual load functions but are not so good at pulsed or instantaneous load applications.

Supercapacitors are often used in conjunction with other energy sources to provide peak load capability, for example providing power for engine starting applications or to provide fast acceleration in electric vehicles.

Applications

- **Mobile phone development:** GSM / PCN / CDMA testing, standby times, rapid charge capability, climatic performance; analysis of novel electrolytes / anode / cathode / separator materials
- **Medical device technology:** pacemakers, tachycardia devices, neurostimulators
- **Zero emission / hybrid vehicles**
- **Satellite power systems**
- **Micro fuel cells** for Bluetooth and 3G communication applications
- **Portable power tools:** screwdrivers, drills etc
- **Defense weapon systems:** missile guidance, support systems

Characterization of these new and modified materials / electrolytes through the use of customized battery testing instrumentation can prove invaluable in optimizing cell performance. In addition to standard DC multichannel experimental routines such as cyclic voltammetry, charge-discharge testing and ohmic-drop experiments, impedance (AC) testing is now being incorporated. This technique is widely recognized for providing valuable data on the cycle life of secondary (rechargeable) cells and for non-destructive research on primary cells.

Numerous types of cell technologies have emerged for a vast array of different applications. These include transportation, residential power and portable applications, such as PCs, personal organisers and mobile communication technologies.

Various fuel cell technologies exist. These include phosphoric acid (PAFC), proton exchange membrane (PEM), molten carbonate (MCFC), solid oxide (SOFC), alkaline, direct methanol fuel cells (DMFC), regenerative fuel cells and zinc air fuel cells (ZAFC).

Supercapacitors have additional advantages over other energy sources: they are generally much more able to operate in extreme temperature conditions; can be charged much faster than batteries; are very low maintenance devices; and can be charged / discharged thousands of times without degradation. This leads to a wide range of applications.



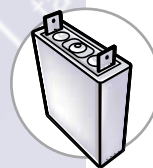
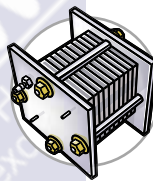
Multichannel

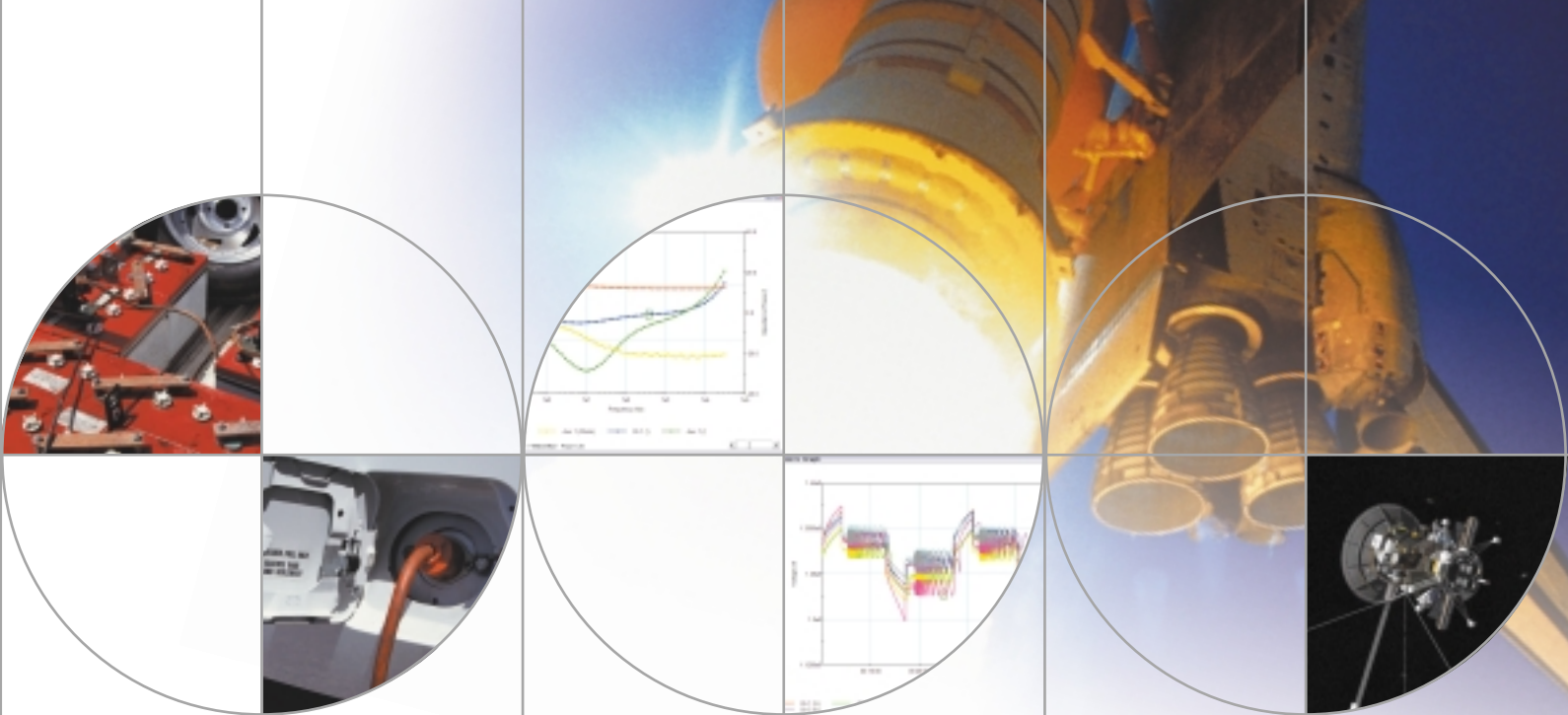
The Solartron CellTest® System signals a major advance in testing technology for fuel cell, battery and portable equipment manufacturers.

The CellTest system comprises of one or more 1470E eight channel potentiostats, each with their complement of up to eight 1455 (1MHz) or 1451 (100kHz) frequency response analyzers (FRAs), allowing simultaneous DC and impedance tests to be run on multiple cells. The whole system can be run from a single PC via Ethernet connection allowing remote control of the instrumentation.

CellTest System features include...

- 145x series FRAs providing simultaneous impedance measurements on all channels using single sine correlation and multi-sine / Fast Fourier Transform (FFT) analysis techniques
- Ultra-fast impedance measurements using the latest signal processing techniques
- DC data acquisition at up to 10,000 samples per second used for GSM / CDMA mobile phone testing
- Instantaneous switching between steps in a test schedule for combined charge / discharge cycling and impedance analysis
- Floating measurement capability allowing tests on cells connected to ground, or higher current tests by connecting channels in parallel
- Auxiliary channel option providing DC and impedance measurements of anodes / cathodes or cells within a stack or battery





Single Channel

Temperature / auxiliary voltage options

The **14703A** temperature and control output option provides eight temperature measurement channels that are compatible with E, J, K and T type thermocouples. By appropriate selection of thermocouple type, fuel cells, for example, can be tested at very high temperatures, beyond 1000°C, or climatic tests can be run on cells below 0°C. The 14703A also provides control output switches that may be used to control external devices such as, power boosters, valves, relays, heaters etc.

The **14702A** option provides eight auxiliary voltage inputs that can be connected across anodes or cathodes within the cell to provide high-speed DC voltage measurements of individual electrodes (e.g. for ohmic drop experiments). In addition, the 14702A offers the unique capability of measuring the impedance of individual electrodes in a cell whilst simultaneously measuring the impedance of the entire cell.

A single channel solution with measurement resolution and accuracy to 1µV for the reference electrodes and 1pA for the working electrode, the 1287 Electrochemical Interface (ECI) is ideal for electrochemical analysis or measurements where signal levels are extremely low. Using floating measurements on all connections, it can collect electrochemical data on grounded structures in the field or laboratory. The 1287 (ECI) enables all types of DC analysis to be performed including cyclic voltammetry, step / pulse techniques, chronoamperometry / potentiometry, etc. The software provides real-time analysis, multiple display formats, Tafel fitting and integration capabilities.

1287 features include...

- Voltage and current range up to 14.5V / 2A allows testing of a wide range of energy storage devices
- 4-terminal techniques for accurate characterization of batteries / fuel cells, enabling lead resistance and impedance effects to be minimized
- Wide bandwidth for running impedance tests from 10µHz up to 1MHz frequency range

Impedance

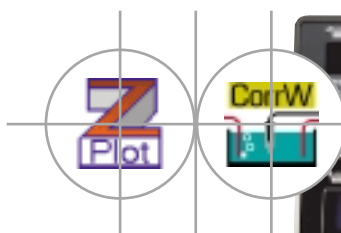
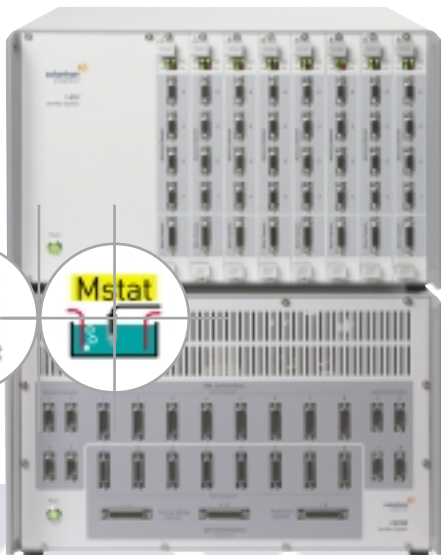
All Solartron frequency response analyzers (FRAs) utilize the single sine correlation impedance measurement technique, which provides excellent noise and harmonic rejection. The technique is particularly suited to electrochemical applications since signal levels are usually very low (of the order of millivolts) and are inevitably buried in noise.

Solartron's multichannel FRAs (145x series) provide multi-sine / FFT analysis in addition to the single sine technique, giving further benefits in speed of analysis for multiple cell applications.

When making high frequency impedance measurements, Solartron's driven shield technology minimizes the unwanted effects of cable impedance enabling Solartron potentiostats / FRAs to be used over a full 10µHz to 1MHz frequency range.

Power Boosters

External power boosters may be added to any of the test systems, providing higher voltage and current capability for testing fuel cell stacks or multi-cell batteries.



Materials

Batteries, supercapacitors and fuel cells make use of specially developed materials such as separators, membranes and ceramic electrolytes. Such materials can exhibit a wide range of properties as a function of temperature, for instance, ceramic electrolytes are high impedance materials at room temperature but are good ionic conductors at high temperature.

These materials are typically characterized by high impedance test equipment such as the 1260 / 1296 Materials Test System that can be combined with a furnace or cryostat for high or low temperature impedance tests on these materials.

The 1260 / 1296 test system is capable of measuring impedance levels up to 100 Tohms (10^{14}), enough range for characterizing even the highest impedance ceramics and membranes and can be used over 12 decades of frequency from 10 μ Hz to 10MHz.



Solartron CellTest

Solartron CellTest software provides control of 1470s and FRAs for testing multiple batteries, fuel cells or supercapacitors. The software provides the full range of AC and DC experiments to allow complete characterization of energy storage devices.

Multistat / ZPlot / Corrware

Multistat / ZPlot / CorrWare provide multiple or single channel electrochemical testing using any Solartron potentiostat and frequency response analyzer. In addition to DC and AC test control, the software provides access to a wide range of data manipulation and fitting utilities.

Solartron Analytical Ltd is a world leader in instrumentation and software for the characterization of materials and electrochemical systems using precision electrical measurement techniques.

These techniques find particular use in the fields of corrosion, battery and fuel cell research, dielectric analysis and electrochemistry. The product portfolio includes industry standard frequency response analyzers, potentiostats, electrochemical software (ZPlot and CorrWare) and battery test equipment.

Arun Technology, an operating unit of metal analyzers using optical emission techniques for determining elemental content. The units in static laboratory or mobile format are used in foundries, steelworks, or scrapyards for metals analysis or material identification.

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Solartron Analytical Ltd

Unit B1 Armstrong Mall Southwood Business Park
Farnborough Hampshire GU14 0NR UK
Tel: +44 (0)1252 556800 Fax: +44 (0)1252 556899

19408 Park Row Suite 320
Houston Texas 77084-4860 USA
Tel: (1) 281-398-7890 Fax: (1) 281-398-7891

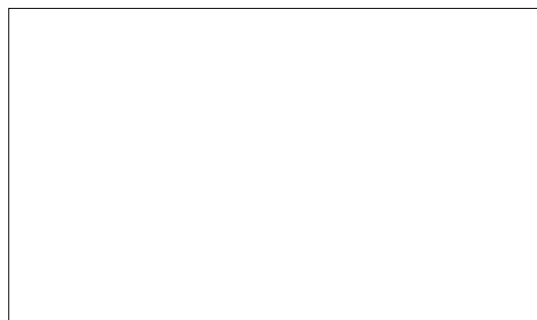
info@solartronanalytical.com www.solartronanalytical.com

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