

International Battery Seminar Showcased Advances In Fast Battery Charging And Battery Test Equipment

by David G. Morrison, Editor, [How2Power.com](#)

Attendees at the recent [International Battery Seminar & Exhibit](#), which was held March 20-23 in Orlando, heard talks on the latest developments in battery technologies. Presentations on the status of lithium-metal and all solid-state batteries, Li-ion batteries with extremely long operating life, and the status of solid-state batteries for automotive were a few of the many interesting talks given at this year's edition of this long running conference.

Meanwhile, the extensive exhibition that accompanied the conference featured an array of vendors that seemingly encompassed all aspects of the battery ecosystem; from cell R&D to manufacturing, to battery pack design and production, and the various components and software for battery charging and management, plus all manner of test equipment for evaluating cells, battery packs and battery management systems. Additionally, there were multiple vendors involved with battery recycling and other design, test and sales-related services.

Many of the exhibitors are doing work in the power electronics realm—developing new technologies for fast charging batteries, or providing the latest high-performance, power supply instruments for battery testing. In some cases, these power supplies are general-purpose products suitable for battery test. In other instances, they are more-specialized instruments. In this article, I highlight some of the battery charging technologies and power supply products and related test products that were on display in the latest International Battery Seminar exhibition.

Advances In Battery Charging

At its booth in the exhibition, [Iontra](#) showed its battery charging technology for Li-ion batteries. The company's charging control technology, which Iontra licenses to battery users (OEMs), provides up to a 2x to 3x improvement in charging speed and cycle life, at the same time, without changing the battery, according to Daniel Higgs, director of revenue at Iontra. Higgs notes that their technology also creates a safer charge and supports cold weather charging.

According to Higgs, their use of a proprietary algorithm to perform custom digital signal processing (DSP) enables charging to be carried out with maximum current uniformity on a battery's electrodes, which avoids energy hot and cold spots that would otherwise lead to shortened battery life. With this approach "plating and dendrite formation [two major causes of battery degradation] are effectively solved for," says Higgs.

As Higgs explains, existing battery charging technologies measure battery current and voltage during charging and process these signals in a way that checks for early-stage damage to cells. However, Iontra's approach is preventive. "We take these same measurements and run them through our DSP algorithm which accounts for 32 battery-related parameters, and detect signs of pre-degradation in the cells. Then we adjust charging to prevent damage in the first place. Where others are measuring and minimizing certain mechanisms of damage, we are completely preventing them."

Higgs says that several groups, including UL Solutions (formerly, Underwriters Laboratories) have investigated and validated their results. Moreover, Iontra is currently working with customers in the power tool and smartphone spaces, who are in the process of commercializing their technology. This follows Iontra's plan to go to market initially with technology that improves battery charging.

However, according to Higgs, there will also be future applications for the technology in the development of battery materials and in battery manufacturing. For these future applications, Iontra's core algorithm enables "probing" of the battery cells to assess quality and performance of both production cells and new cell designs, lowering R&D costs by speeding up time to market of new battery cells and new products using batteries. For more information contact [Daniel Higgs](#).

Another exhibitor, [BattGenie](#), presented information on its software and system integration solutions for Li-ion battery management systems. Its software is designed to achieve "safer, longer-lasting and faster charging batteries." Using the company's battery models they analyze how it is degrading and apply optimized, proprietary charge algorithms.

According to the website, "BattGenie uses physics-based battery models (porous electrode P2D models) to simulate and control the battery in any application. Depending on the battery materials and usage conditions, the physics-based models account for various physical degradation phenomena such as Li-plating, SEI layer formation, intercalation-induced stresses, and so on. Using our patented mathematical techniques, these models are used to calculate and implement optimal charge profiles, enabling batteries to be charged in under 15-min. without compromising on cycle life."

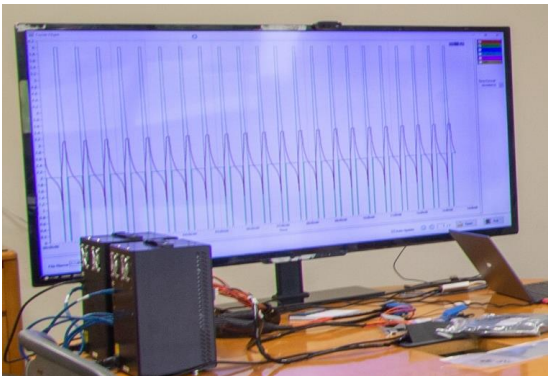
In addition to enabling faster charging, the software's optimized charge profiles can extend battery life. According to the company, it has demonstrated more than a doubling of battery cycle life versus that achieved with conventional

charging methods, which has been independently tested and validated by NREL, a national lab.

According to Chintan Pathak, co-founder and CPO of BattGenie, the company's SW and solutions for BMS target consumer electronics and EVs. The company is already working with a number of top-tier OEMs in the EV, electric aircraft and the consumer device markets. Moreover, it has also developed an energy storage system for grid storage (consisting of second-life batteries) that is operational at the Everett Transit Center, in Everett, Wash. For more information, contact [Chintan Pathak](#).

[AMP Energy Management Systems](#), a startup founded 6 years ago, presented an exhibit on its Energy Management System (AMP EMS), which is a combination of software and hardware solutions for charging, energy management and battery management for electric vehicles, topped up by cloud connectivity. AMP also showcased its EVCC (charge controller for electric vehicles), which is a combination of software and hardware for fast charging of EV batteries up to 350 kW. AMP's EVCC enables level 3 dc fast charging and V2G (vehicle to grid power transfer) serving as a complete charging management system for electric vehicle applications. Featuring a highly modular design, the EVCC's software stack enables an effortless interface to existing charging systems, according to the vendor.

The company also showed its Fast Charge Junction Box (FCJB), which combines AMP's CCS Software Stack embedded in an Electric Vehicle Charge Controller (EVCC) with high-voltage contactor controls. The AMP FCJB facilitates communications between an EVSE and the vehicle. This combined solution is fully integrated and tested, highly flexible, capable of real-time OTA updates, and supports ultrafast charging and V2G + bi-directional capability. For more information, contact the [company](#).

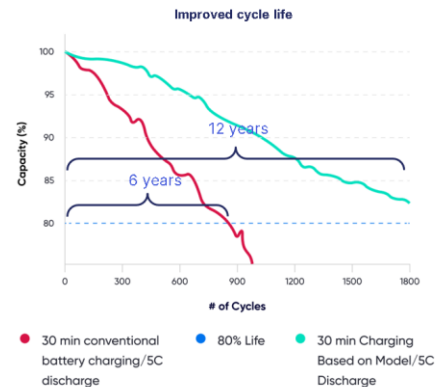


A cell using Battery Streak's electrodes running 6C fast charge and 2C discharge cycles continuously. When this demo was performed at the Battery Seminar, an IR thermometer showed that the temperature of the cell always remained just below body temperature.

BATTGENIE BENEFIT

Improved Battery Lifespan

(16 Ah NMC pouch cell)



BattGenie's battery models enable a doubling of battery life in terms of the number of achievable charge and discharge cycles.

While companies like those discussed above are developing improved algorithms to enabling faster charging, there are also efforts underway to create better battery materials to achieve the same objective. A case in point is [Battery Streak](#), an exhibitor at the International Battery Seminar whose motto is "charge lightning fast." This company is commercializing anode and cathode materials originally developed at UCLA.

Unlike graphite-based anodes found in conventional Li-ion batteries, Battery Streak's anodes are fabricated from nanostructured titanium niobium oxide. According to the company, the mesoporous nanostructures of its anodes store charge on the material surface. This process is much faster than the chemical storage process that takes place in conventional batteries and generates substantially less heat per unit of current. Put another way, batteries based on Battery Streak's electrodes charge more like capacitors.

According to David Grant, president of Battery Streak, Li-ion batteries made with these materials can accept 6C charging while maintaining long cycle life. That translates to charging an EV battery up to 80% capacity with just a 10-minute charge. In contrast, fast EV chargers currently on the market charge conventional Li-Ion batteries at less than a 1C rate. In its exhibit, the company ran a live demo of a cell using its materials cycling continuously with a 6C charge and 2C discharge.

In addition, batteries made with these electrode materials exhibit higher Coulombic efficiency, by preventing fast-charging side effects, such as electrolyte breakdown and metal ion dissolution. This leads to dramatically less heat generated while charging, and ultimately to longer battery lifetimes with capacity retention greater than 80% after 3,000 cycles. Naturally, there's a tradeoff for the fast-charging performance in terms of energy density. For more information, contact [Dan Alpern](#), the VP of marketing.

Power Supplies For Battery Testing

Power supplies play an important role in testing of batteries as evidenced by several of the exhibits at the International Battery Seminar. As with power supplies developed for other industrial applications, newer units offer a combination of higher power performance and new or improved features.

For example, [TDK-Lambda](#) showed its GENESYS+ series of programmable dc power supplies, which offer very high power density. For example, a 1U unit in this series delivers 7.5 kW. The Genesis Plus was introduced about a year ago according to George Scherma, regional sales manager for the North Central Region at TDK-Lambda Americas, who observed that this 1U unit is lighter than the company's 5-kW power supply which was formerly offered in a 2U enclosure. However, Scherma noted that the company now has a 10-kW unit in a 2U enclosure.



TDK-Lambda's Genesys+ series programmable dc power supplies deliver 7.5 kW in a 1U height, 10 kW in 2 U or 15 kW in 3U while also offering many advanced features.

He adds that a key feature of the Genesis+ power supply is its high-speed parallel bus which allows easy paralleling of units up to 60 kW in a rack. With units connected in a master-slave configuration, the processor employed in this power supply is fast enough to digitally adjust the output of the slave units to maintain accurate current sharing.

Other features of the Genesys+ include an arbitrary waveform

generator with auto-trigger capability, programmable slew rate control on output voltage and current, constant power limiting, internal resistance programming and numerous interfaces.

Another power supply manufacturer, [GW Instek](#), displayed its PEL 5000C series and AEL-5000 series of dc and ac/dc loads, respectively, which the company introduced last year. The PEL 5000C series offers dc loads up to 192 kW at 1200 V, while the AEL-5000 series provides ac loads up to 24 kW in a single unit, which can be paralleled up to 192 kW. These are non-regenerative units.

The PEL-5000C series single-channel electronic loads provide 150-V, 600-V and 1200-V models with a power range of 6 kW to 24 kW. The series has a total of 24 models featuring different combinations of power, voltage, and current. It can test and verify the specifications of batteries, electric vehicle chargers/charging stations, electric vehicle batteries and solar panels.

For battery testing, the PEL-5000C provides four battery discharge modes, namely CC+CV battery discharge test mode, CP+CV battery discharge test mode, CC+ UVP battery discharge test mode, and CP+ UVP battery discharge test mode. Users can choose a suitable test mode according to the test requirements.

In addition to the four battery discharge modes, the PEL-5000C also provides time-period discharge, pulse discharge, and RAMP discharge modes. Users can set the discharge time, or discharge in the pulse current mode, or even set the rising/falling slew rate of the discharge current. These functions can be very flexible in the simulation of the battery discharge current waveform when an electric vehicle is running.



PEL-5000C High Power Compact DC Load

- Maximum power up to 192KW
- Up to 8 units of master/slave parallel control
- 5-digit digital voltage, current and power meter
- Large LCD Display

According to Johnson Huang, sales director, power testing is a strategic direction of the company and he notes that the 1200-V capability is important for testing 800-V EV batteries and those with higher voltages.

The PEL-5000C series single-channel electronic load provides 150-V, 600-V and 1200-V models with a power range of 6 kW to 24 kW. For battery testing, it provides four battery discharge modes plus other discharge modes.

Some power supply manufacturers have expanded into battery testing by developing specialized products. For example, [CAENels](#) described its offering as “One battery test system for all your experiments. Your battery lab in the cloud.” Their product combines battery test instrumentation with an environmental chamber capable of very high precision. Their equipment performs battery cycling while making electroimpedance and spectroscopy measurements on the cells under test.

Meanwhile [Unico](#), showed its “High Performance Drive Systems for EV & Battery Testing”. This company started by making dc SCR drives for paper manufacturing and automotive metal stamping in the 1960s, and later expanded into oil and gas, and various ac and dc test products including battery test in the late 1990s. One of their specialties is mixing and matching ac and dc drives on a common bus.

According to Tom Kadow sales manager at Unico, the company is currently developing standardized components for pack testing. One will be a rack mount, programmable/adjustable power supply rated for 200 kW at 800 V with a range of 50 V to 800 V dc. This unit will be bidirectional so it can function as both a power supply and a load, either sourcing or sinking energy as required. This product will be introduced this year.

The company will also be launching a high-density product this year for cell testing. The 2U rack unit will include an integrated front-end rectifier and be bidirectional. It will contain multiple slots (channels) for coin cells or higher power for pouch cells. Channels will be fully isolated, but may be ganged for higher power and current.

Size will be one of the distinguishing characteristics of this test instrument. “It has tremendous density, both in terms of power and in channel count. Some of the competitor’s offerings that we have seen are 2x to 3x the size,” says Kadow.

The company will also introduce a compression fixture for pouch cells. This fixture will enable application of cooling to simulate in-application conditions with sensors for measuring temperature and voltage. More specifically, the fixture will include provisions to route hot or cold water through it to regulate temperature, and each side of the fixture will be able to connect to a separate cooling loop in case the user wants to regulate each side to a different temperature. For more information, contact [Rod Line](#).

In addition to the vendors discussed above, there were many other companies at the International Battery Seminar with specialized power supply instrumentation for battery testing. For instance, [Neware Technology](#) is a battery testing equipment manufacturer that provides battery cyclers, which perform battery charge and discharge. These cyclers, which the company has been supplying for 25 years, are for use in both development and production testing. One of Neware’s newer products is an all-in-one testing system that includes a test chamber.

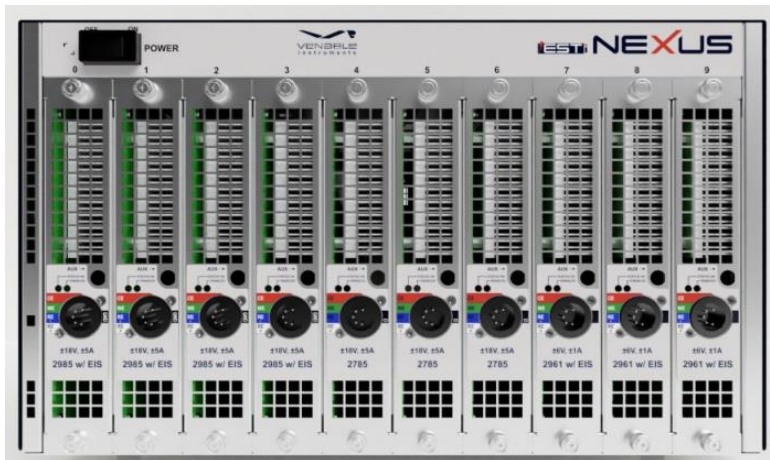
According to Louie Liu, sales rep for Neware Technology, this is the only cycler of its kind with cycler and environmental chamber in one. This unit, which was introduced last year, can test coin cells, cylindricals and

small battery packs. However, there are plans to expand the types of cells that can be tested. For more information, contact [Louie Liu](#).

Other companies exhibiting at the International Battery Seminar offer a range of more-specialized power supply-based instrumentation for battery testing and related applications.

[Venable Instruments](#), a company familiar to many power electronics engineers for its frequency response analyzers (FRAs), showed its Energy Storage Test Instrument (ESTi), which can be used in testing of any energy storage cell. This includes not only batteries but also supercapacitors and fuel cells. ESTi, which was introduced a few years ago, has a single-channel. However, last year the company introduced ESTi Nexus, a 10-channel version capable of measuring programmable voltage, current, constant power, and electronic load for energy storage cell tests.

Each version of ESTi contains both a potentiostat which applies a controlled voltage across a cell and a galvanostat which provides controlled current injection into a cell. According to Manfred Trent, embedded software engineer at Venable Instruments, the company took the knowledge it acquired in developing its FRAs and its related application in power supply design, and applied it to the development of the potentiostat/galvanostat with EIS (electrochemical impedance spectroscopy) used in ESTi.



ESTi Nexus, a 10-channel version of the company's Energy Storage Test Instrument (ESTi), is capable of measuring programmable voltage, current, constant power, and electronic load for energy storage cell tests.

Capable of supplying up to 18 V and 5 A, the instrument can be used make impedance and other measurements of energy storage devices in either an R&D or production environment. Michelle Widmer, general manager at Venable Instruments, says ESTi Nexus has a number of unique features including its output power (up to 90 W and 5 A); and its flexibility in mixing and matching V/A channel configurations with EIS, operational with 4 to 10 channels per unit.

It's also differentiated by its fully independent, isolated high-precision test channels with full potentiostatic and galvanostatic control, and its ability to perform EIS at up to 200 kHz per channel. The instrument is also thermally calibrated from 0°C to 50°C—"No one can touch this specification," says Widmer. For more information, contact [Michelle Widmer](#).

Another exhibitor was [Hioki's](#) battery instrumentation group, which is focused on providing testing for all of the process steps involved in Li-ion battery manufacturing. At the International Battery Seminar, the company showed two instruments. One was the BT5525 battery insulation tester, which is used in cell inspection. This instrument detects contamination that could cause defects, thereby improving battery cell productivity through high-speed testing.

According to the vendor, the new battery insulation tester employs a groundbreaking technique for determining minuscule breakdown defects that other instruments cannot detect. It is also immune to external noise that is common in production lines.

To facilitate large-scale battery production testing, the Hioki engineers have increased the charging speed by 25 times and the discharging speed by 4 times. The instrument stores the measured waveforms, which can then be accessed through an external application for an in-depth analysis of malfunctioning battery cells. The BT5525 was introduced in December of 2022.

The company also showed a prototype of an instrument that has not yet been released—the RM3546 welding resistance meter. This weld resistance meter is used for determining the quality of tab welds and bus bar welds. In the past, thermal imaging was used to detect weld defects, however thermal imaging methods cannot be scaled for modern high-throughput battery cell production lines.

The RM3546 has a resolution of 1 nΩ (1 x 10⁻⁹ Ω) and is designed to accurately measure extremely low resistance values. The instrument automatically compensates for temperature variations of the device under test so that welds can be tested immediately after welding, allowing integration into the production process.

When used with Hioki Z3003 multiplexers, the RM3546 can test up to 20 channels. This instrument is expected to be introduced in November of this year. For more information contact [Juan Monsalve](#), product manager for RM3546.

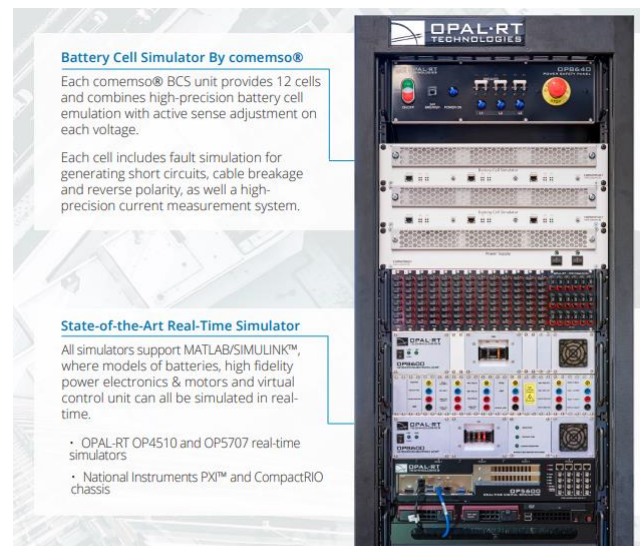
Another company exhibiting battery-specific test equipment was [Chroma Systems Solutions](#) which was showing its “battery cell, module, pack automated test solutions.” As noted on their website, the company offers “high-precision, integrated battery charge/discharge cycle test systems designed for lithium-ion and other chemistries and applications including EV batteries and energy storage systems. Chroma’s battery test equipment provides advanced features including regenerative discharge systems that recycle energy from the battery back into the channels in the system to the grid. Systems are configurable and flexible with multiple channel capabilities that can be upgraded as testing requirements change.”

In addition to the battery test systems the company offers an array of individual test instruments, among which several are relevant to battery testing including electronic loads, electrical safety testers, battery safety testers and regenerative grid simulators.

Still other vendors in the exhibition showed test products for testing not just batteries, but complete battery management systems. For example, [Opal RT](#) showed its Battery Management System HIL test solution, which provides real-time simulation for battery management systems, particularly in electric vehicles. Developed in partnership with comemso, this product combines comemso’s Battery Cell Simulator with Opal-RT’s real-time simulator and houses the hardware in National Instruments’ PXI and CompactRIO chassis.

Intended for use in product development, this test solution is meant to enable new technology to be integrated “as soon as it is introduced into the vehicle.” The company adds that its “real-time solution easily migrates existing physical test beds onto real-time HIL simulation platforms for testing your BMS.”

The products discussed in this article were just a sampling of the many and varied battery-related products shown or demonstrated at this year’s International Battery Seminar & Exhibit. For a full list of exhibitors who participated, see the conference [website](#).



Opal-RT’s Battery Management System HIL test solution controls every aspect of the customer’s BMS system. Features include fault insertion, charge/discharge, single-cell balancing current, protection, CAN communication and battery stack voltage and current emulation.