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BATTERY POWER PRODUCTS & TECHNOLOGY

Solutions for OEM Design Engineers, Integrators & Specifiers of Power Management Products

FedEx Expands Hybrid-Electric Fleet by 50 Percent with Conversion Program

FedEx Corp. has added 92 hybrid-electric trucks to its delivery fleet, the first standard FedEx delivery trucks converted to hybrid-electric systems. The addition of the 92 trucks increases the FedEx fleet of hybrid-electric vehicles by more than 50 percent, from 172 to 264. FedEx has the largest fleet of hybrid delivery trucks in North America and continues to demonstrate the everyday viability of these vehicles. The FedEx hybrid-electric fleet has logged more than four million miles of revenue service since being introduced in 2004, reducing fuel use by 150,000 gallons and carbon dioxide emissions by 1,521 metric tons, which is equivalent to removing 279 cars from the road annually.

The hybrid conversions were produced in Charlotte, N.C., during the past six months and created 50 new, temporary green jobs in the area. The converted hybrids were developed with Freightliner Custom Chassis Corp. (FCCC) and Eaton Corp., which provided the hybrid-electric systems. The standard FedEx trucks used in the retrofit program were 2000 or 2001 models with 300,000 to 500,000 miles driven. An added benefit of the conversion program is that it not only reduces pollution but also extends the life of the vehicles, helping to eliminate waste production and creating a reduce-and-reuse program.

The retrofit hybrid trucks are projected to improve fuel economy by 44 percent, decrease particulate matter by 96 percent and reduce smog-causing (NOx) emissions by 75 percent compared to the standard FedEx Express delivery truck.

The 92 retrofitted hybrid vehicles will be placed into service in California, primarily in the Los Angeles, San Diego and San Francisco metropolitan areas.

"Hybrid technology helps FedEx reduce emissions and fuel use as we work to increase the efficiency of our vehicle fleet," said Mitch Jackson, director of Environmental Affairs and Sustainability, FedEx Corp. "We are eager for additional government and industry support to find more affordable options for hybrid trucks, so that we may adopt them into our fleet at a faster pace."

In addition to the use of 264 hybrid vehicles in North America, Asia and Europe, FedEx has taken the following steps to increase vehicle fuel efficiency and reduce emissions in its fleet:

In converting the standard delivery vehicles, the power-train equipment, including the engine, transmission, fuel tank and drive shaft, were replaced with a 2007 Cummins ISB 200 hp engine and Eaton hybrid-electric system. Costs were reduced by utilizing the existing chassis and body.

The vehicles feature a diesel engine coupled with an electric motor/generator and lithium-ion batteries. These batteries capture and store energy during the regenerative braking phase of vehicle operation, eliminating the need to plug into an electrical source.

Tadiran Introduces Cost-Effective, High Energy TLM Military Grade Lithium Batteries

Tadiran has introduced TLM Military Grade batteries, a family of rugged, high energy lithium metal oxide batteries developed specifically for military and aerospace applications.

TLM Military Grade cylindrical batteries feature an open circuit voltage of 4 V, with a discharge capacity of 500 mAh (20 mA at 2.8V RT), capable of handling 5 A continuous pulses and 15 A maximum high current pulses. These batteries are constructed with a carbon-based anode, multi metal oxide cathode, organic electrolyte and shut-down separator for enhanced safety. TLM Military Grade batteries also feature low self-discharge and a wide operating temperature range of -40°C to 85°C. These batteries comply with MIL-STD 810G specs for vibration, shock, temperature shock, salt fog, altitude, acceleration (50,000 gn) and spinning (30,000 rpm) and conform to UN 1642 and IEC 60086 standards for crush, impact, nail penetration, heat, overcharge and short circuit, and can be shipped as non-hazardous goods.

TLM Military Grade batteries meet the demanding requirements of single use applications such as avionics, navigation systems, ordinance fuses, missile systems, telemetry, electronic warfare systems, GPS tracking and emergency/safety devices, shipboard and oceanographic devices.

INSIDE

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Alber CRT-400

- Fast battery test results you can trust.
- The Alber Cellcorder CRT-400 uses the patented DC Internal Cell Resistance test method.
- The Cellcorder allows trending over time to detect problems before they happen.
- Results are unaffected by noise and ripple.
- Software has versatility to be elementary or advanced depending on your needs.
- Many connection options allow ease of use for any battery configuration.
- Bluetooth option relays voice test status to speed up testing.
- Streamlined design makes carrying easy.
- Custom carrying case holds accessories such as lighted probes, different jaw options, Bluetooth headset and printer.
- Optional hydrometer sends data to Cellcorder software for easy exporting to Excel.

Contact Albér for more info and demo
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New Batteries on the Market

Infinite Power Solutions Launches Its Thinergy Micro-Energy Cell Product Family

Infinite Power Solutions, Inc. (IPS) has unveiled its Thinergy family of micro-energy cell (MEC) products. Small and powerful, these ultra-thin MECs are reliable, safe and eco-friendly.

IPS reports that its Thinergy MECs, when recharged over their lifetime, provide tens of watt-hours of energy, equivalent to or more than traditional primary cells that are hundreds of times larger in total volume. Combined with ambient energy harvesting, Thinergy MECs deliver perpetual power to wireless sensor nodes and other micro-systems for more than a decade of maintenance-free operation. As a result, these unique products represent a new class of electronic component that bridges the performance gap between batteries and supercapacitors. In fact, the discharge current demonstrated by Thinergy MECs makes it the first technology suitable for replacing supercapacitors in many applications.

IPS has announced four standard products within its Thinergy MEC family. Two products are available now, the Thinergy MEC101 and Thinergy MEC120, with capacity options up to 1.0 mAh and 0.4 mAh, respectively. The other two products (one larger and one smaller in both size and capacity) will be available later this year.

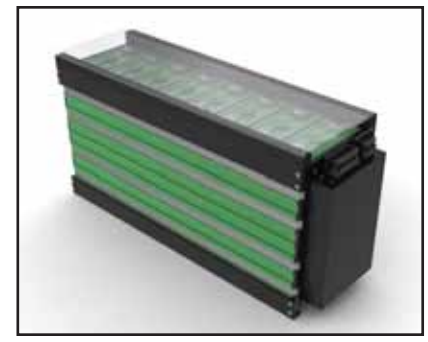
IPS conservatively specifies its Thinergy MEC cycle life to 10,000 cycles at 100-percent depth of discharge (DOD) and 80 percent capacity retention. Although testing is ongoing, IPS expects its devices to achieve more than 20,000 recharge cycles with 100 percent DOD and more than 100,000 recharge cycles with shallow cycling to 50 percent DOD.

Energizer Unveils New Power Solutions

From power for iPhone and Smart phones to netbooks and camcorders, Energizer continues to develop portable power solutions for on-the-go consumers. Making its debut will be the new line of Energizer Energi To Go branded rechargeable power packs and emergency charger products for all types of mobile electronic devices.

The Energi To Go line, which currently features the Energi To Go Portable Power for Cell Phones, is expanding to include rechargeable power packs that use lithium polymer battery technology to power a wide variety of mobile electronic devices including Smart and cell phones, iPhone, iPod and MP3 players, GPS units, digital cameras and camcorders, netbooks and laptops.

The Energizer Energi To Go product line extension is through a licensing partnership with XPAL Power, a California-based tech company that specializes in creating rechargeable power packs that use lithium polymer battery technology.



International Battery Introduces High-Power Modular Packaging for its Ultra-Large-Format Lithium Batteries

International Battery, a US manufacturer, designer and developer of large-format lithium-ion rechargeable cells and batteries, has introduced three classes of standardized modules for its ultra-large-format lithium batteries, nested, slim and wide, to accommodate various customer-specific geometries. Each module can supply up to 4 kilowatt-hours of storage.

These new modules create an energy storage system that incorporates eight large format International Battery cells connected in series. Each cell has a unique recognizable Battery Management System (BMS) board. Modules can be connected in series or parallel configurations to meet the desired voltage and energy requirements. The system can accommodate 30 modules for a maximum voltage of 760 volts and can incorporate any of the company's cells ranging from 40 to 200 Ah capacity per cell.

The cells are monitored and balanced by the BMS and provide information to a controller directly or through a systems' control board that International Battery can provide. The BMS has sufficient intelligence to determine any pre-determined safety or operational non-conformance and provide for reliable implementation of a latchable interlock system.

International Battery presently offers six cell models in two chemistries, where the basic (pre-packaged) cells offer performance at or beyond industry standards, achieving energy densities of: 154 Wh/kg and 278 Wh/Liter in the 740 Wh 200 Ah lithium nickel cobalt manganese cell, or 107 Wh/kg and 192 Wh/Liter in the 512 Wh 160 Ah lithium iron phosphate cell.

EaglePicher Medical Power Announces New Li/CFx Battery Technology

EaglePicher Medical Power, LLC has introduced its enhanced Lithium Carbon Monofluoride (Li/CFx) battery technology with end-of-life enhanced capability. The technology includes a proprietary new Elective Replacement Indicator (ERI) / End of Life (EOL) Indicator to predict battery depletion six months in advance, potentially requiring fewer replacement surgeries over time.

The enhanced Li/CFx battery chemistry provides higher energy density for use in a variety of implantable applications including telemetry-capable pacemakers and ICDs, neurostimulation devices, drug pumps, body fluid pumps and monitors.

The new technology will be available in a number of configurations ranging from under 350 mAh to 10 Ah.

Integrated Circuits & Semiconductors

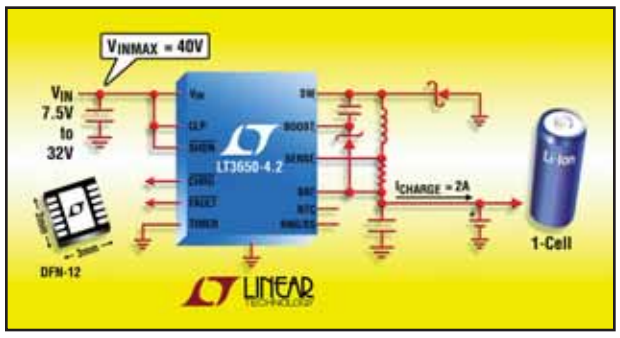
Vishay Releases New Power Metal Strip Battery Shunt Resistor

Vishay Intertechnology, Inc. has released a new Power Metal Strip battery shunt resistor that combines a 36 W power capability in the 8518 size package with resistance values down to 100 μΩ.

The WSBS8518 battery shunt resistor features a proprietary processing technique that produces low resistance values of 100 μΩ, 125 μΩ, and 250 μΩ. This provides increased accuracy in battery shunt applications for gas, diesel, hybrid, and electric cars, trucks and scooters, as well as electric forklifts and other heavy industrial applications.

With a tolerance of 5 percent, the new resistor provides more accurate data to determine battery charge and discharge, thus helping designers meet specific customer battery management requirements.

The WSBS8518 features an all-welded construction that allows operation with continuous currents as high as 600 A. The resistor offers low inductance values of < 5 nH and a low thermal EMF of < 3 μV/°C. The device is lead (Pb)-free and RoHS-compliant.



32 Volt Monolithic Li-Ion/Polymer Battery Chargers Deliver Up to 2 Amps in a Compact Package

Linear Technology Corp. has introduced the LT3650-4.1 and LT3650-4.2, compact, monolithic high-voltage battery chargers for single-cell Li-Ion/Polymer batteries. The device's switchmode architecture minimizes power dissipation without compromising board space. The LT3650-4.1/4.2 operates from 4.75 V to 32 V and has a 40 V absolute maximum rating for added system margin. User selectable timer or C/10 termination requires no external microcontroller and simplifies the design. Charge current is programmable and dynamically adjustable up to 2 A; the power device is integrated on chip to save board space. The LT3650-4.1/4.2 does not require external high-precision resistors to set the float voltage, further saving cost and space. Applications include industrial handheld instruments, 12 V to 24 V automotive and heavy equipment, desktop cradle chargers and small notebook or tablet computers. The LT3650-4.1 offers a 4.1 V battery float voltage, allowing high temperature safety margin, while the LT3650-4.2 features a 4.2 V final charge voltage for optimized battery run time.

The LT3650-4.1/4.2's high operating frequency of 1 MHz and current mode architecture allow the use of small inductors and capacitors, minimizing noise and filtering needs. Final float voltage accuracy is specified at ±0.5 percent, charge current accuracy is ±5 percent and C/10 detection accuracy is ±2.5 percent. Once charging is terminated, the LT3650-4.1/4.2 automatically enters a low current standby mode that reduces the input supply current to 85 uA. In shutdown, the input bias current is reduced to 15 uA. The LT3650-4.1/4.2 maximizes battery life during all non-charging periods, draining less than 1 uA from the battery. For safety and autonomous charge control, the LT3650-4.1/4.2 includes features such as automatic restart and preconditioning, a thermistor input for temperature-qualified charging, programmable input current limit, bad battery detection and binary coded status output pins.

The LT3650-4.1 and LT3650-4.2 are housed in a compact, low-profile 12-pin 3 mm by 3 mm DFN package, and are offered in both E and I grade versions, both operating from -40°C to 85°C. Pricing starts at $2.80 and $3.22, for the E & I grades respectively, in 1,000-piece quantities.

Low Power Cryptographic Battery Authentication IC

Atmel Corp. has released its AT88SA100S ultra low-cost, cryptographic battery authentication IC for mobile-phones, cameras, portable power tools and other battery-powered applications.

The AT88SA100S CrytpoAuthentication IC is the only battery authentication IC that uses a SHA-256 cryptographic engine and a 256-bit key that cannot be cracked using brute force methods. It is used to protect mobile phones, portable power tools, cameras and other microcontroller-based products from counterfeit battery packs.

Counterfeit batteries are often less expensive than those provided by the original equipment manufacturer (OEM) because they often do not have appropriate protective mechanisms to prevent short circuits, abnormal heat or leakage, ignition, rupture and other malfunctions. They also are likely to lose their charge sooner and wear out more quickly than authentic battery packs. It is estimated that 75 percent of the replacement batteries sold are clones.

The AT88SA100S ensures replacement batteries meet the product manufacturer's standards by providing secure, reliable authentication that can be used to prevent product operation and/or charging with counterfeit product.

The AT88SA100S has 256-bits of SRAM for key storage, a guaranteed unique 48-bit serial number stored permanently inside the chip and 88 one-time, user-programmable fuses that can be used for the storage of battery parameters or status information. The 256-bit key is stored in the on-chip SRAM at the battery manufacturer's site and is powered by the battery pack itself. Physical attacks to retrieve the key are very difficult to effect because removing the CryptoAuthentication chip from the battery erases the SRAM memory, rendering the chip useless.

Battery authentication is based on a "challenge/response" protocol between the microcontroller in the portable end-product (host) and the CrytpoAuthentication IC in the battery (client).

The AT88SA100S battery authentication IC is available now in production quantities in a 1.3 mm by 3 mm, green-compliant (exceeds RoHS) 3-pin SOT-23 package.

Techtium Unveils the Dedicated Li-Ion Solar Charging IC

Techtium Ltd. has unveiled the TEC103 solar application, a breakthrough power conversion solution for portable solar applications such as mobile phones, handheld solar chargers, Bluetooth headsets and Bluetooth car-kits.

The TEC103 IC for solar applications boosts a single PV cell voltage (from 0.4 to 0.5 VDC) to Li-ion voltage and controls the device's single cell Li-ion battery charging. This IC utilizes a synchronous DC-DC boost converter and optimal Li-Ion charge controller to reach conversion efficiencies of up to 85 percent of the solar PV power transferred to the Li-ion battery.

Techtium's TEC103 solar solution works at the single PV cell maximum power point and provides up to twice more power compared to alternatives like multi-cell solar modules and up to 10 times more power can be supplied in partly shaded conditions, dramatically raising the performance while offering cost effective solutions.

Current charging solutions typically require multiple solar cells in series, which drives up cost, reduces efficiency, and increases sensitivity to shading losses and PV array element mismatches.

The performance and efficiency of Techtium's TEC103 solar solution is achieved through a combination of system engineering excellence and innovative mixed-signal IC design that meets the highest design objectives of cost and performance.

Battery-Protection IC Reduces BMS Cost In Hybrid and Electric Vehicles

Maxim Integrated Products has introduced the MAX11080, a high-voltage, 12-channel battery-protection IC for high-cell-count lithium-ion (Li+) battery stacks. The first stackable fault monitor on the market, this device provides redundant cell monitoring to prevent Li+ batteries from exploding (thermal runaway). Up to 31 MAX11080s can be daisy-chained together to monitor as many as 372 cells. This capability prevents cascading electrical failures and eliminates the expensive isolation components required by discrete solutions. In a typical hybrid car, Maxim's solution reduces the cost of the battery-management system (BMS) by up to 80 percent.

Offering accuracy, ultra-low power consumption, built-in safety and self-diagnostic features and plenty of configurability, the MAX11080 solves the problems associated with safely monitoring large battery stacks. It is well suited for a spectrum of battery applications including automotive, industrial, power line and battery backup.

Dispatching of the need for costly isolation compo-

nents, Maxim's solution consumes 75 percent less space than discrete designs. Altogether, it can reduce the expense of a typical battery-management system from $250 to $50.

The company's high-voltage, small-geometry BiCMOS process enables the industry's highest voltage tolerance (80 V), excellent ESD performance (±2k V, Human Body Model), hot-swap capability and reliable performance over a wide temperature range. To protect against battery thermal runaway, the MAX11080's ultra-accurate overvoltage detection guarantees less than ±25 mV error over the full AEC-Q100 Type 2 temperature range (-40°C to 105°C).

The MAX11080 has 16 selectable overvoltage thresholds, as well as eight selectable undervoltage thresholds. The undervoltage-detection feature can be disabled if desired. The device includes a programmable detection-delay feature that allows the user to filter out transient events in the battery pack to eliminate false overvoltage or undervoltage alarms. The alarm line operates using a 4 kHz heartbeat signal, the absence of which indicates a valid overvoltage or undervoltage event. These features are critical for discriminating between legitimate and false alarms, preventing the application from shutting down unnecessarily.

Summit Introduces Programmable USB/AC Switch-mode Battery Chargers with Integrated CurrentPath Manager

Summit Microelectronics has introduced two more members of its third-generation programmable battery charger integrated circuit (IC) family. The SMB136 and SMB137B employ CurrentPath technology, providing dual input source (USB or AC/DC) with arbitration, dual output for system and battery and system operation with a dead or missing battery. Both products support all battery charging standards: USB 2.0 Specification, USB On-The-Go Supplement, USB Battery Charging Specification 1.0, IEEE1725 Standard, Chinese USB Charging Specification and others. Furthermore, the SMB136 and SMB137B are the only battery charger ICs with CurrentPath to detect the input source type (USB host/hub, AC/DC, etc.) and automatically optimize operation for the fastest and safest battery charging.

The SMB136 and SMB137B are based on a 3 MHz, switch-mode architecture, with minimal external components, which allows for very efficient power delivery and extremely compact solution size. High-efficiency operation enables fast charging due to higher output/charge currents, while reduced thermal dissipation improves user comfort, system reliability and Green operation. Summit's proprietary TurboCharge patent-pending technology enables high charge current, even from relatively low-power sources (example: up to 750 mA output from 500 mA USB source). As consumer devices continue to employ larger batteries, the SMB136 and SMB137B reduce charge time for consumer convenience.

The SMB136 and SMB137B incorporate CurrentPath functionality to allow both input and output current path control. The SMB136 features one power input (USBIN) that allows USB500/100 or AC/DC (700 to 1,400 mA) operation. The SMB137B features two power inputs, one for supporting AC/DC power sources and the second one for supporting USB power sources. Both solutions provide independent output current paths for the system and the battery, allowing the system to turn on with a missing or deeply-discharged battery. This charging configuration reduces the charge and discharge cycles on the battery, thereby extending its operating life. CurrentPath also allows accurate charge termination, since both devices can detect the current flowing into the battery vs. traditional solutions that can only detect the combined current for battery and system.

The SMB136 and SMB137B are well suited for any portable device, such as mobile phones, smart phones, portable media/MP3 players (PMP), portable GPS navigation devices, portable game consoles,and digital cameras/camcorders (DSC/DCC). The features and integration of the SMB136 and SMB137B make them especially suited for portable devices that require operation even with a missing battery, utilize higher-capacity batteries and feature very compact industrial designs.

Power Supplies

78 Watt AC/DC Input UPS with Internal Battery

GlobTek's GS-480 UPS design delivers up to 50 W of continuous output power while charging a Li-ion battery (12 V 6 Ahr) up to 38 W at 12.6 V). Models have single or dual DC regulated outputs, accepts universal input: 85 to 264 VAC or DC input 9 to 18 V, low ripple, Class B EMI Filter, built-in protection, over charge, over discharge and over temperature protection; and the design switches over to battery back-up without interruption. The GS-480 is designed to meet Safety International Agency Requirements to 606950 and complies with EMC Directives for CE and FCC Class B Applications. Modified and custom designs are also available.

Kepco Introduces a Bipolar Power Supply Optimized for Inductive Loads

Kepco has released the availability of its 200 and 400 watt BOP (Bipolar Operational Power Supply) models optimized for driving inductive loads. The modified BOP units are designed to operate in a stable manner in current or current limit mode for loads up to 1 Henry. They are also stable with any R-L series load combination.

All specifications of the unit in voltage mode are unchanged from the standard model. In current mode the bandwidth of the BOP is reduced modestly. Correspondingly, the rise and fall time of the unit is increased somewhat (model dependent). Further, it is possible to reduce the bandwidth in current mode, in a predictable way, using one customer installed component on the rear programming connector of the BOP.

This option makes the BOP more suitable for a wide variety of applications such as motor testing, testing of magnetic components (coils, speakers, etc.), industrial applications with inductive loads, driving CRT coils, cryogenic applications and powering correcting magnets for medical imaging applications or particle accelerators.

Compact Single DC Load Mainframe for Benchtop

Chroma's new 63600 series DC electronic loads are now available for use in a single mainframe. The 63600-1 mainframe allows for a space saving, lower cost electronic load for portable benchtop testing. Three load modules are available for the mainframe: 100 W by 2 (dual), 300 W and 400 W maximum power with three current ranges per load. The system I/O port on the rear panel of the 63600-1 mainframe is a 15-pin connector (D-SUB 15pin male connector). It includes 0 to 10 VDC analog signals to monitor voltage and current, external analog signal input and TTL compatible digital I/O signals.

The 63600's design uses DSP technology to simulate non-linear loads using a unique Constant Impedance (CZ) operation mode allowing realistic loading behavior. The 63600 series can draw its full rated current to almost zero volts ensuring the best loading performance for modern point-of-load devices.

Chroma's 63600 series DC electronic loads are designed for testing multi-output AC/DC power supplies, DC/DC converters, chargers, batteries, adapters and power electronic components and devices of all types. In use by small and large companies around the world, these loads are intended for use in all aspects of the product life cycle including R&D, production, quality control, incoming inspection, vendor screening and design verification testing.

Multi-Talented Device for Intelligent Supply

B&R has a new power supply for seamless supply of small drives. The device can be used internationally because of its large supply voltage range of 380 to 500 VAC, and it provides extensive possibilities for parameter settings and error diagnostics. Status information can be read via a fieldbus connection. This allows for evaluation of the load, output voltage changes or brake chopper threshold. Operation close to the power limits can therefore be easily detected by the central control system. In this way, machine functionality can be ensured at all times.

The output voltage range covers 36 to 80 VDC. An additional 24 VDC output provides the possibility to supply other automation components with current requirements up to 2 A. The new power supply module is designed for continuous power output of 1 kW. The main feature of the DC power supply module is a bus interface, the output voltage can be easily configured via a fieldbus connection. A chopper output offers the possibility to connect a braking resistor for applications where large amounts of power are fed back to the power supply.

FirstLine Three-Phase Uninterruptible Power Supply

Staco Energy Products Company has expanded their FirstLine three-phase Uninterruptible Power Supply (UPS) to include a new 37.5 kVA model. This true on-line, double-conversion UPS provides computer grade power quality at a price that is 20 percent to 30 percent below comparable kVA models. Despite its small footprint and low weight, the FirstLine has a standard battery run-time of more than six minutes (with optional batteries for virtually unlimited run time).

Sophisticated transformerless power technology provides reliable blackout protection and power conditioning. Front-end harmonic correction eliminates the need for additional filtering, lowering the cost of operation. Double-conversion technology protects the connected load from sags, swells, harmonics, noise and voltage imbalances without going to battery operation. This UL1778 listed UPS is ideal for a wide range of applications including data centers, broadcast, computer networks, hospitals/medical, education/research facilities, water/wastewater treatment, manufacturing plants as well as food, pharmaceutical, beverage and other processing industries.

This new higher capacity model includes SNMP networking capabilities that allow users to network their UPS with manufacturing and management systems. With SNMP capabilities, FirstLine offers web browser based visual readings, alarm notification, a 48-hour system history, as well as client shutdown software for the most popular operating systems.

The new FirstLine combines power conditioning, outage protection and harmonic correction for higher capacities but still retains its economical price. Now customers with greater capacity needs will benefit from improved efficiency and a lower cost of operation. Further, the small footprint addresses a real customer need, especially for retrofits and electrical upgrades, where floor space is at a premium, and quality power protection is critical.

In addition to the new 37.5 kVA model, FirstLine models are available for 10, 15, 20, 25 and 30 Kva applications with input voltage of 208, 220 and 480 VAC and a range of +10 /- 20 percent (166 to 229VAC). Input frequency is 60 Hz +/-5 percent. Full load walk-in from 25 percent to 100 percent of rated load in 10 seconds.

Introducing a New Product?
Send Your New Product Announcements to Shannon Given, Director of Content, at Shannong@infowebcom.com

Charging & Testing

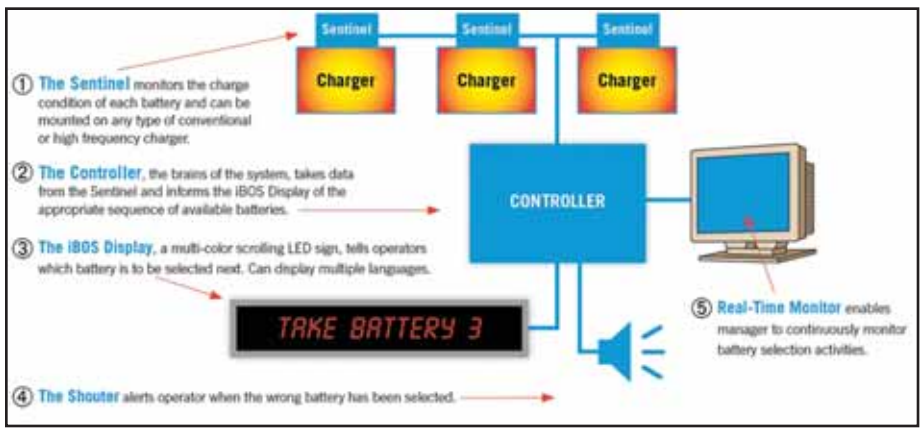
Large Battery Safety Testing with BTC

New Li-ion batteries being developed for vehicles (EV and HEV) as well as for other applications pose a potential hazard, especially in adverse conditions, leading potentially to fire and the release of toxic and corrosive chemicals. Safety testing is best performed under adiabatic conditions as this typically the worst case scenario. HEL has developed a custom Battery Testing Calorimeter (BTC) based on the industry standard "ARC" calorimeter. The BTC is a large scale version of HEL's Phi-TEC adiabatic calorimeter.

Compact but robust, with a range of safety features, both hardware and software based, the BTC is fully software controlled and can be wheeled in and out of test locations.

It's advanced features enable the user to understand what may happen during a worst case scenario arising from mal-operation. Specifically, BTC can provide information such as exotherm 'onset' temperature, heat release (or temperature rise), pressure increase, global reaction kinetics, time to maximum rate (TMR), and SADT (commonly used in storage / transportation studies).

The BTC is designed to test a wide range of battery types, size up to 35 cm by 35 cm. Performance while charging under different conditions, as well as physical damage, can be simulated, allowing for the development of safer batteries with carefully determined operating limits.



Philadelphia Scientific Introduces Real-Time Monitor Enhancement to iBOS Charger Management System

Philadelphia Scientific has introduced the Real-Time Monitor enhancement to the iBOS charger management system. The Real-Time Monitor helps battery room and warehouse managers to utilize their pool of batteries most cost effectively by enabling them to use an on-site computer to continuously monitor battery selection activities.

Improper battery utilization is a common problem in today's battery rooms. Site tests have shown that if battery selection is left to a forklift operator, 30 percent of the batteries will be underutilized and 20 percent will be overused. The result: uneven battery usage, premature battery failure and lost productivity. iBOS ensures proper battery rotation by monitoring every battery in a pool and eliminating operator judgment in battery selection by determining which battery has had the longest cooling time since charging. Once charged, each battery is placed in queue. The iBOS "read and react" Display then tells the operator which battery to take. An audible alarm called the Shouter alerts the operator when the wrong battery is taken.

With iBOS Real-Time Monitor, battery room managers can use an on-site computer to continuously monitor battery selection activities. The charger management system provides information in an easy-to-understand manner, signaling the manager when an alert conditions is triggered.

According to Harold Vanasse, vice president of sales and marketing for Philadelphia Scientific, "Using the iBOS charger management system promotes longer battery run time and life, improves operator productivity, identifies faulty equipment and helps managers decide if there are too many or too few batteries in a pool. The new Real-Time Monitor continuously feeds managers the information they need to accurately monitor battery selection. Combined, the iBOS with Real-Time Monitor represent thousands, even tens of thousands, of dollars in potential savings for the average battery room."

Cutting Edge Digital Battery Diagnostic Tester Hits the Market

Storage Battery Systems features the SBS-IBEX with a technology for emergency power, battery diagnosis and monitoring systems.

The SBS-IBEX is a compact and light weight tester for easy on-the road measurements. It allows our users to diagnose the aging status of all types of battery cells quickly and safely while utilizing the impedance measuring technology with a floating charge. This hand held tester meets all IEEE Standard Recommendations for stationary applications such as telecommunications back up power, utility switching power, uninterruptible power systems (UPS) and more. The IBEX is a diagnostic tester that measure the accurate internal impedance, strap resistance, conductance, voltage and temperature while utilizing a ripple-removing algorithm within three seconds during the floating charge.

Proprietary technology allows the IBEX to accurately calculate the invert value of conductance while utilizing IBEX's own topology to maintain reading accuracy. The data is saved automatically through contact probes on the battery posts allowing measurement of numerous cells quickly. Equipped with an advanced technology, Exmons Pro 2005 Diagnostic Software has a user friendly data base management.

ACT D4000 Universal Battery Tester

Take the hassle out of testing multiple battery types with the new ACT D4000 Universal Battery Tester by ACT Meters Ltd. Available through security wholesaler ADI, this compact unit allows a wide range of rechargeable battery types, voltages and capacities to be tested all from the one meter.

The ACT D4000 is designed for rechargeable batteries with voltages between 2.4 V and 12 V, with capacities above 4 Ah. Fully automatic and free from complicated settings, the D4000 performs by selecting the correct load to safely discharge 1Ah from the battery in the shortest possible time. Yellow, green and red LEDs flash to confirm test operation and whether a battery is healthy or defective. The D4000 will identify a healthy battery normally between seven to 10 minutes, but will just take one minute to identify a defective battery. A low capacity battery will be identified normally within three minutes. This makes it possible to quickly identify a good battery without having to wait for the full 1 Ah discharge test to be completed.

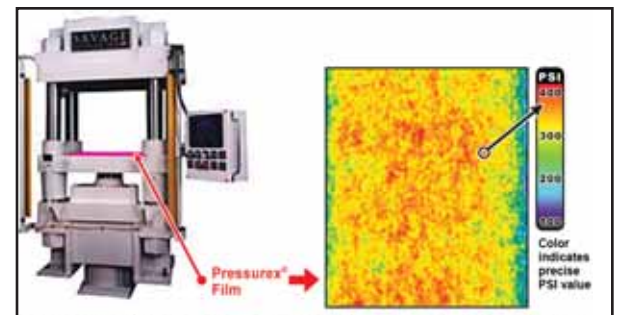
Battery Components

Pressurex Pressure Indicating Sensor Film Minimizes Defects And Improves Quality in Battery Lamination

Pressurexfilm, from Sensor Products, Inc., is an economical, accurate and easy-to-use tool that reveals the distribution and magnitude of surface contact pressure in battery lamination and calendaring presses. Difficult to detect pressure variations across the surface of battery laminators and calendar presses can be easily detected and corrected through use of the sensor film.

When placed between lamination platens or calendar rolls, Pressurex instantaneously and permanently changes color directly proportional to the actual pressure applied. Precise pressure magnitude is then easily determined by comparing the resultant color intensity to a standardized color correlation chart (conceptually similar to using Litmus paper). No training or instrumentation is required.

Pressurex helps to ensure uniform alignment of mating rollers and lamination platens. If the contacting rollers and platens are not parallel, uneven compression could result in delamination during battery discharge or poor contact between the electrodes and their current collectors. Electrodes could also have uneven thicknesses reducing contact area, which is a major problem for cylindrical Li-ion and Li/MnO2 cells and prismatic cells. In addition, uneven contact in heat seal presses could cause leakages in pouch cells.



Pressure Profile Across a Battery Lamination Platen

During calendaring operations, positive and negative electrodes for Li-ion cells and the MnO2 electrode in Li/MnO2 cells are densified using calendering equipment. The electrodes are passed through heavy calender rollers in a continuous process.

Pressurex measures pressures from 2 to 43,200 PSI (0.14 to 3,000 kg/cm2). The pressure-indicating film is very thin (4 mil or 8 mil thick) and can be hand or laser-cut to any size or dimension. It is flexible and conforms to curved surfaces and invasive intolerant environments.

The film is coated on a Mylar sheet and is physically similar to a standard sheet of paper. Pressurex is available in eight pressure ranges.

SigFx, LLC Unveils Intelligent, Safe Battery Management Technology That Doubles Battery Runtimes

SigFx, LLC is introducing an intelligent energy management system called SaFPWR. The SaFPWR energy management system extracts more power from a lithium polymer battery, prolongs the battery cell life and improves safety. The SaFPWR monitors and collects data on the internal and external environments of the battery and their interrelationship. The system also collects data on the use of the device it is serving to maximize the operating efficiency and safety of the device. SaFPWR uses this data to more than double the runtime of the device it serves and virtually eliminate the safety issues present in today's battery market.

Currently, SaFPWR is available for the Apple iPhone, iPod touch and iPod classic. SaFPWR is also available in an external and primary extended runtime battery pack for laptop computers.

New Optical State of Charge Sensor

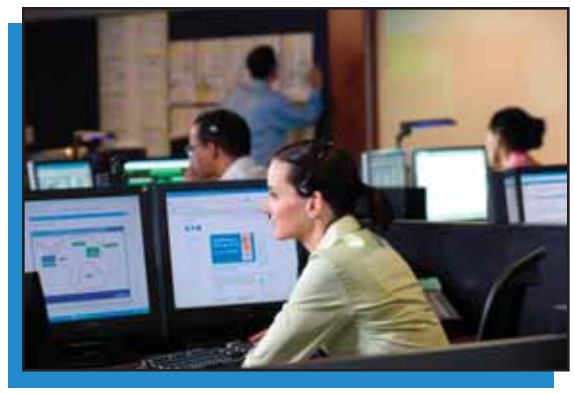
JSA Photonics has introduced an optical state of charge sensor for lead acid and other suitable electrolyte batteries. The patented solution is based on fiber optic sensing technology originally developed at Sandia National Laboratory (SNL) that effectively measures SOC and enables inexpensive, accurate and continuous monitoring of battery capacity. Flexible sensor configurations provide the SOC measurement capability to sealed batteries at manufacture as well as retrofitting of existing wet batteries, providing functional assurance and reduced maintenance costs to the user. The SOC sensor offers additional benefits including cell temperature sensing, enabling tailored charging programs for fast and efficient charging and electrolyte level sensing to detect fault conditions well before they occur. The software, interface control and GUI provides power, easy calibration and continuous monitoring of SOC, temperature and electrolyte levels for one to several thousand batteries for on-site as well as Internet monitoring.

UPS Monitoring:
A Vital Tool for Maximizing Uptime

Robert Sember, UPS Product Line Manager
Eaton Corp.

When it comes to a mission-critical facility's power infrastructure, the adage of 'set it and forget it' doesn't apply, especially when the cost of downtime can run into the thousands and sometimes millions of dollars per second. Considering the financial impact of power disturbances, companies are depending on remote monitoring and diagnostic services to monitor the health of their uninterruptible power systems (UPSs) and batteries to help protect their critical operations. By implementing vigilant oversight of critical power equipment, managers can avert catastrophe and proactively plan for service and maintenance.

Remote monitoring and diagnostic services have emerged as a must-have solution for facility, IT and data center managers who are responsible for critical equipment. Since UPSs serve as the central nervous system of the power infrastructure, knowing the health of UPSs is paramount to achieving high nines of uptime. UPSs and batteries degrade over time due to age, use and environmental conditions, leaving an organization vulnerable to power failure in the event of an emergency. This reality is overlooked in many organizations until it is too late and their UPSs fail. Over the past three years, managers have increasingly utilized these services as they have evolved from basic monitoring to offer analysis of trends in equipment performance and, in some cases, 24-hour live phone support and access to technicians that can make on-site visits when unforeseen power events occur.



Smart Implementation

The process for installing a remote monitoring and diagnostic service is non-invasive and can be performed by either a service technician or the customer. With the correct hardware and software, installation can be completed in 10 minutes or less. Most monitoring systems operate via a direct connection with an off-site server, communicating data about daily conditions and critical events.

Online capabilities lay the foundation for the service to gather and communicate data. Information is e-mailed to the monitoring system's server once daily or upon a critical event, where it is analyzed and stored in a central repository. With some services, a variety of UPS health and status reports can also be e-mailed to pre-designated contacts at the customer's organization, depending on their preferences. Most services provide monitoring for dangerous fluctuations in environmental conditions such as temperature and humidity. Many of the causes for failure of mission critical equipment can be traced back to extreme conditions in the data center environment, even in controlled environments. Imagine your HVAC/CRAC unit going down after-hours or over the weekend; if the equipment is not monitored and has little employee foot traffic the conditions could go unnoticed and the UPS could fail.

Another part of the installation requires the customer's firewall to be configured to allow the Web card in the UPS to transmit e-mail. This allows for one-way communication of data to the remote server for monitoring and for the delivery of critical events and daily "heartbeats." One such service uses a Web card which communicates with the remote monitoring servers utilizing Simple Mail Transport Protocol (SMTP). This protocol offers reliability, pervasiveness and accessibility.

In many organizations, the facilities group is responsible for choosing and implementing a remote monitoring service while the IT group is responsible for granting access to the system. These groups also appreciate the non-invasiveness of most remote monitoring services. All SMTP communication flows from the customer to the vendor only. In most cases facilities and IT managers understand the common goal of having a consistent and reliable backup power supply.

When choosing a monitoring solution, it is best to look for a company that also offers live support and is available to assist with service issues, including guiding a customer through the installation process. Many times, a monitoring service will make a technician available to the customers to assist with installation, troubleshooting or managing critical events.

Similar to the many services that currently offer remote monitoring, one system such as Eaton's eNotify monitors more than 100 UPS and battery operating data trends. It also features monthly monitoring reports and 24x7 access to live support from Customer Reliability Center (CRC) analysts. Eaton has 300 field engineers, support specialists and technicians in North America with 24-hour access to factory design engineers during escalated emergencies. Technical resources can be dispatched immediately to resolve problems that could jeopardize critical operations.

Case in Point

Bexar Metro 9-1-1 Network District needed the ability to monitor UPS units at more than 20 locations in the metropolitan area of San Antonio. This was critical to their work in supporting the area's 9-1-1 call centers. With the eNotify service, Bexar Metro has 24x7 monitoring and onsite support for its UPS network.

"Our IT staff can now check system availability, generate monthly reports and monitor the health of each UPS," said Bill Buchholtz, executive director of Bexar Metro 9-1-1 Network District. "The eNotify service is an efficient way for us to manage and anticipate any critical events, especially when we have our UPSs in multiple locations across a large geographic area."

With any monitoring service, there will most likely be some customer responsibilities to ensure connectivity between the UPS unit and remote monitoring servers. Such responsibilities may include confirming that the Ethernet cable is physically connected to the network identification or Web card, maintaining connectivity to the server (either internal or external) and keeping the monitoring service partner informed of any actions on the customer's end which might affect the unit's availability or the Web card's connectivity. These small tasks are worth the effort to ensure the UPS is proactively being monitored.

Utilizing Health Reports

Perhaps the most popular feature of remote monitoring and diagnostic services are the reports. Built upon data that is gathered and analyzed by the system, reports are tailored for a variety of purposes ranging from daily status e-mails or notification of critical issues to general summaries of equipment performance suitable for internal stakeholders.

Daily "heartbeat" e-mails summarize the status and activities of the UPS and attached

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external sensors based on the information gathered by the network identification or Web card. For example, daily e-mails are sent to analysts that identify the unit in question and includes the day's data as an attachment. In the event that the system does not receive a daily "heartbeat," an e-mail can be automatically sent to the customer letting them know of a possible problem with the unit. These e-mails should undergo a rigorous process to ensure that they are valid before being stored in the database server. Once the data is stored on the server, all current and historical data is checked for anomalies. The rules for detecting anomalies should be defined on a per-model basis to ensure customized, accurate detection. In the event that an anomaly is detected, an analyst can be notified and determine whether the event necessitates further action.

If a potentially critical event is identified, the service deploys an alert based on the customer's designated protocol. The alert may be posted on a Web user interface or may be delivered as a phone call or e-mail to a data center manager. With more comprehensive services, there are approximately 50 events out of 200 that can trigger an event e-mail. Similar to status e-mails, if an event e-mail is triggered it is checked for authenticity by the remote monitoring servers. Out of the 50 possible event e-mails, only 10 may be considered critical events, such as a UPS hardware fault or a UPS battery is completely discharged. Any event e-mail that is deemed critical is sent to the analysts, where they will decide whether the event warrants dispatching a technician to the site.

Another point of consideration when choosing a remote monitoring service is how information is disseminated. Many data center managers prefer a service that generates reports, a very important feature to assist them in proactively managing the health of their equipment in a time-efficient manner. Data center managers are also leveraging monthly reports to concisely relay pertinent information to internal stakeholders, helping them to improve on job performance.

Detailed reports can be generated monthly and reflect the previous month's data per individual unit. These reports reflect data gathered by the system and provide a color-coded reading of the system's overall health (green, yellow or red). The status of the battery is reflected, including how many times the unit went on battery, how long it was on battery and how many times the battery was completely discharged. A Relative Health Index (RHI) score is assigned to the unit and included in the report. This score falls within a range of 0 to 10 and is computed using a weighted average of the individual parametric data RHI values along with battery information. The report also includes a summary of critical event information and a link to the service support history Web page.

Proactive Maintenance: Worth the Effort

Research indicates that regular preventive maintenance (PM), which affords the opportunity to detect and repair potential problems before they become significant and costly, is crucial in order to achieve maximum performance from your equipment. In fact, studies show that routine preventive maintenance appreciably reduces the likelihood that a UPS will succumb to downtime. The 2007 Study of Root Causes of Load Losses compiled by Eaton revealed that customers without preventive maintenance visits were almost four times more likely to experience a UPS failure than those who complete the recommended two preventive maintenance visits per year.

To select the best coverage for your UPS and its application, consider the following questions:

1. What type of UPS service do I need?
   A. Depot Exchange Repair or Replace: You contact the UPS service provider and then ship the UPS to a repair facility. The service provider returns the repaired unit or a refurbished unit to you.
   B. Advance Swap Depot Exchange: You contact the UPS service provider who then ships a refurbished unit to you. The original UPS unit is returned to a repair facility.
   C. On-Site Repair: You contact the UPS service provider and a factory-trained field technician arrives at your site to diagnose and repair electronic or battery-related problems.

Smaller UPS products (below 1,000 VA) generally can be repaired at a depot, while products over 1,000 VA and up to 15 kVA can either be repaired at a depot or serviced on-site. Larger UPSs that are either hardwired (cannot be unplugged) or too heavy to ship can only be serviced via on-site field technicians.

2. Do I buy a support agreement, extended warranty or pay as I go?
   A. Support agreements, or service contracts, usually combine parts and labor coverage (electronics, batteries or both), at least one or more UPS preventive maintenance inspections annually, and a combination of coverage hours and arrival response time. Plans can be tailored to meet most any need. Special features like remote monitoring, battery replacement insurance and spare part kits may also be added.
   B. Extended warranty (or basic warranty) may also be purchased for many UPS products. A warranty commonly covers specified parts and labor such as electronic components for a fixed period of time but will not include 24x7 coverage or arrival response times. Nor will warranties include preventive maintenance, although extra services can be purchased in addition to a warranty extension. The more additional services that are added to a warranty, the closer you are to a support agreement.
   C. Time and Material (T&M) service is a pay-as-you-go approach in which when something breaks the service provider conducts a repair. T&M can be done either via depot repair or on-site, based on the type of product. T&M can be expensive depending on what needs to be repaired. In addition, the uncertainty of knowing when a field technician will arrive can make T&M an unacceptable service solution for some customers. Support agreement (contract) customers always take priority, resulting in T&M response times of up to five days based on the product and location for non-contract customers.

Remember that warranties cover repairs but do not promise when or how fast repairs will be made. Support agreements include repairs, time of repair and the speed of arrival (or advance swap exchange vs. waiting for a returned product). Pay special attention to which items are covered in a warranty or support agreement. Warranties or support agreements for large UPS models usually cover only electronics, with battery coverage available as an optionally purchased item. Twenty percent of customers purchase battery coverage on larger UPS models but most pay as they go.

3. What should be covered?
   A. UPS electronics parts and labor coverage
   B. UPS Batteries Parts and Labor Coverage: Often the leading cause of failure, batteries generally need to be replaced every five years or less. Batteries may need to be replaced more frequently, especially if they are discharged frequently or operate in a warm environment.

4. How long should I plan for a UPS to last and how much should service cost?
   A. Large UPS products usually have a 15 to 20 year life span.
   B. Small UPS products can last 10 or more years, but are often replaced much sooner.
   C. All UPS product life expectancies can be maximized or extended via routine preventive service, part replacements and upgrade/modification kits. Batteries and capacitors can be replaced to rejuvenate a UPS and provide years of reliable power protection.
   D. The total cost of ownership (TCO) varies widely based on the size of UPS, amount and type of batteries, quantity and type of services desired and application. For example, is the UPS frequently discharging its batteries? Very basic warranty coverage may cost five to 10 percent of the product purchase price and a comprehensive, premium support agreement could exceed 35 percent of product purchase price per year.

Another important question is does your monitoring service offer ongoing maintenance? Conducting preventive maintenance ensures that equipment is running properly and can identify potential problems before there is an emergency. This may incorporate scheduled maintenance to upgrade firmware and update configuration settings. This also includes unscheduled maintenance in the event of a critical issue. Look for a service with a process that is structured to allow either the customer or the monitoring party to initiate action to correct any critical issues. Access to technicians who can travel on-site to address issues identified by the system is also important.

The Future: Knowing the Health of the Complete Power Chain

Over the next five years, providers of remote monitoring and diagnostic services will meet their clients' needs by continuing to move toward increasingly automated solutions. While many companies are currently offering monitoring services, 24x7 accessibility to support and technicians is currently limited. The installation process will also continue this trend toward automation as the process for customer installations is simplified. Remote monitoring services will also continue to offer more trend analysis and develop more of a diagnostic capability.

For facilities, IT and data center managers, all aspects of their jobs are strained by increased demands and decreased resources. As power demands and utility costs continue to increase, data center managers are expected to maintain reliable power and security while meeting business objectives and corporate sustainability goals. While the automation of processes including monitoring the health of mission critical equipment will provide some relief, a critical component will be the ability of IT and facilities departments to work together toward common business objectives. It makes sense to focus monitoring capabilities on the UPS because it is the most mission-critical piece of equipment in the data center, but monitoring services will expand in the future to include the health of the complete power chain. In today's environment there is little room for error, which is why more data center managers are turning to remote monitoring and diagnostic services to manage their own time more efficiently and avoid costly downtime.

Bob Sember is a UPS product line manager for Eaton Corp. where his work encompasses battery services, single-phase product services and eNotify Remote Monitoring and Diagnostic Service.

For more information, please visit www.eaton.com/enotify.

Implementing Battery Management Safety Strategy

Jeff Donato, Service Product Manager
Emerson Network Power Liebert Services

In most cases, the ability to keep your critical systems running through power outages and disruptions is dependent on the UPS battery system. Batteries represent a significant part of the cost of the critical power system, and if not properly maintained, they can also be the least reliable and potentially, the most dangerous component in the system.

The current economic downturn is forcing many organizations to review budgets and identify areas that can be trimmed or eliminated. Many companies are also looking at ways to extend the refresh cycle of data center equipment, such as UPS systems. If your company is planning to delay purchasing new UPS systems, special care and attention needs to be given to preventive maintenance and safety issues surrounding the batteries. You may want to also give thought to implementing proactive management strategies designed to optimize battery performance and prevent dangerous situations that could pose a hazard to your facility and employees.

Battery Life Expectancy and Aging

Understanding battery life expectancy and aging is the first step in developing an effective battery management strategy. Batteries are subject to wear and aging faster than most other components of a critical power system. They have a certain life expectancy and, sooner or later, every battery will reach the end of its life. Misunderstanding battery life expectancy is common and stems from confusing battery design life with battery service life.

Battery design life is specified by the manufacturer and takes into account cell design and battery aging under controlled conditions in the manufacturer's laboratory. Battery service life considers how applications, installation designs, real-world operating conditions and maintenance practices impact battery aging, most often lowering life expectancy.

Figure 1 shows estimated design life versus service life for different classes of flooded and VRLA (valve regulated lead acid) batteries. The flooded high discharge rate batteries are typically used in large UPS systems.

	Design Life	Service Life
Long Duration Flooded Batteries	20 years	25+ years
Flooded General Purpose	20 years	20+ years
Flooded High Rate (UPS)	20 years	12+ years
Modular VRLA High Rate	20 years	8 to 12 years
Modular VRLA Medium Rate	20 years	12+ years
Monobloc VRLA High Rate	10 years	4 to 6 years
Monobloc VRLA Medium Rate	10 years	6 to 7 years

Design Life = Cell Design + Manufacturer Operation Conditions
Service Life = Installation Design + Operating Conditions + Maintenance Practices
Warranty Life = MFG Amortizes the cost of the cell. No relationship to Design and Service Life.

Figure 1. Design Life vs. Service Life of flooded VRLA batteries.

The normal battery aging process is caused by mechanical deterioration that results from discharge and recharge of the battery. Whether the batteries supporting a critical power system will age normally toward their defined life cycle or fail prematurely depends on a variety of factors. How batteries are handled, the environment they are in, the quality of the systems used to maintain the batteries and other variables, affect how they age.

In batteries, high ambient temperature and frequent discharges are most commonly responsible for reducing useful life across all types of batteries. Battery aging accelerates dramatically as ambient temperature increases. This is true of batteries in service and in storage. Even under specified temperatures, batteries are designed to provide a limited number of discharge cycles during their expected life. While that number may be adequate in some applications, there are instances where a battery can wear out prematurely.

Battery Inspections

1. Check integrity of battery cabinet (if applicable).
2. Visual inspection of the battery cabinet and/or room to include:
   - Check for NO-OX grease or oil on all connections (if applicable).
   - Check battery jars for proper liquid level (if flooded cells).
   - Check or corrosion on all the terminals and cables.
   - Examine the physical cleanliness of the battery room and jars.
3. Measure and record DC bus ripple voltage (if applicable).
4. Measure and record total battery float voltage.

Proper Preventive Maintenance

The main goal is to keep the system up and running. The safety issues surrounding the batteries are usually addressed when users are properly maintaining their system and making sure the batteries are working. Safety concerns primarily come into play when you neglect the system, are not aware of the expectant battery life and do not conduct proper maintenance.

Proper battery maintenance begins prior to startup. The batteries need to be fully charged, properly installed, physically, electrically and environmentally, and their condition verified in order to minimize the likelihood of costly retests and failed equipment. Proper inspection and testing of the batteries before startup and/or load testing will provide valuable information that can be applied immediately and may serve as a baseline for any testing conducted throughout the service life of the batteries.

Depending on whether your facility is using flooded or VRLA batteries, certain maintenance best practices should be followed. These best practices have been documented in publications IEEE-450 for flooded batteries and the IEEE-1888 for VRLA batteries, and include acceptance testing prior to commissioning, as well as inspections and load testing requirements for all batteries. Figure 2 outlines the accumulative requirements per inspection period.

Battery Full Preventive Maintenance

1. Check integrity of battery cabinet.
2. Visually inspect battery system for: swelling, leaks, loose foreign objects, overheated or corroded cables and connectors, loose connections on batteries, and appropriate product labels related to safety and warning hazards.
3. Clean and neutralize cell tops as required.
4. Tighten all battery terminal connections to their proper specifications.
5. Measure and record DC bus ripple voltage.
6. Measure and record total battery float voltage.
7. Record room ambient temperature.

Recommended Task	FLOODED IEEE 450			VRLA IEEE 1188			
	Monthly	Quarterly	Annually	Monthly	Quarterly	Bi-Annually	Annually
Battery system voltage	●			●			
Charger current and voltage	●			●			
Ambient temperature	●			●			
Visual inspection	●			●			
Electrolyte levels	●						
Pilot cell voltage and specific gravity	●						
Specific gravity all cells			●				
All cell voltages		●				●	
All cell temperatures		10% Only			●		
Cell internal ohmic values			●		●		
Intercell connection resistance			●		UPS		●
Detailed internal visual inspection			●				
AC ripple current and voltage			●				●
Capacity test			5 Years				●

Figure 2. The IEEE Standards address best practices for maintaining flooded and VRLA batteries.

Unfortunately, common practices often replace best practices. Governed by real-world factors, many facility managers are often forced to take into account the cost of performing the recommended IEEE schedule as it relates to the criticality of the application. While following the IEEE schedules is recommended, when everyday pressures mandate otherwise, facility managers are encouraged to consult manufacturer guidelines for recommended maintenance and potential cost-effective options.

Battery Monitoring System

Once a battery is operating properly, it's important to proactively monitor its performance to detect battery failure, optimize useful battery life and reduce maintenance costs and safety concerns.

A predictive battery monitoring system provides valuable data in assessing the true state of health of the battery system. Instead of waiting for an inevitable failure or replacing batteries prematurely to prevent problems, predictive battery monitors

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allows you to continue to utilize the batteries longer and with confidence by knowing the true condition of all critical battery parameters, such as cell voltage, overall string voltage, current and temperature.

The best way to determine a battery's state of health, without discharging it, is to use a monitoring system that measures the internal cell resistance of the battery. As the battery ages and loses capacity, the resistance of a battery cell's internal conduction path increases. A significant increase of the resistance in one module is enough to fail a complete battery string.

Because 40 percent of the resistance in a battery cell is in effect, paralleled with capacitance, DC resistance measurements are more accurate. With AC testing methods, the capacitance tends to mask the resistance increase in that part of the path parallel to it. DC resistance-based testing eliminates the capacitance considerations completely.

The information gained from battery monitoring should be analyzed and used to optimize battery life. For example, VRLA batteries are sensitive to temperature and float voltage settings. A battery monitor can provide precise temperature and cell voltages of the batteries monitored, allowing these conditions to be optimized, thereby utilizing the maximum available life and performance of the battery. Combining monitoring with your maintenance program and aggregating this data with a service partner will provide the maximum level of trending and diagnostics to identify problems before they occur. The best time to install a monitor is during battery replacement when the system is new to ensure proper baseline readings.

Battery Replacement

In addition to implementing proper maintenance practices and monitoring batteries, safely replacing failing batteries will help keep IT systems running to specifications and minimize any risks.

IEEE standards recommend replacing a battery at the time its capacity drops below 80 percent. Based on factors such as age, usage, environment and maintenance, a typical VRLA battery with a 10-year design life may reach 80 percent of rated capacity and need to be replaced within three to five years.

Keep in mind, however, that no more than 20 percent of the batteries in a string can be replaced with new batteries during the normal battery lifetime without substantial risk of failing the entire string. That's because more than a 20 percent mix of old and new batteries can destabilize the string.

Compared to a new battery, the average resistance of the batteries in a string is higher, which means it is taking more current and doing more of the work. When you introduce a new battery with lower resistance improper float characteristics are created within the string. Consequently, the string does not operate as well as it would if the failing battery had been replaced with one of like age/resistance.

An effective practice would be to have enough spares to cover 5 to 10 percent of the batteries in every cabinet, depending on the criticality of the facility, plugged in and housed similarly to the batteries in service. The spare batteries will age simultaneously with the main battery string, making replacement faster and more stable for the critical power supply. While it's impossible to replicate the exact same conditions, replacing a failing battery with one of the same age, even if some variance in the condition of batteries exists, is safer than replacing it with a new battery. However, keep in mind that you cannot extend the expected life of the string, but rather stabilize the string prior to replacement.

Conclusion

When it comes to batteries, the important point to remember is that batteries typically do not fail without a warning. If you implement an effective battery management strategy that includes regular visual inspections, preventive maintenance and integrated monitoring you should catch any issues before they become serious problems.

Only when a greater level of attention is given to the battery can organizations ensure that they can continue to keep business critical system running up to specifications and minimize the risk to business operations, facilities and employees.

Contact Emerson Network Power Liebert Services at www.liebert.com.

Modular Construction of Battery Systems

David White, Senior Member Technical Staff
Southwest Electronic Energy Group

The battery industry may be on the verge of a significant growth cycle in large format Li-Ion battery systems due to expected demand for electric vehicles. Important to this growth is what was once thought of as a detriment of the Li-Ion chemistry: that it requires monitoring and control electronics for safety and for reliability. Engineers are turning this detriment into an advantage by using intelligent electronics to make battery systems that have capabilities that would not be practical, or even possible, without these electronic tools. This article will show how this new battery system technology can be incorporated into products that are not in the high production mainstream but that have the same or even more stringent performance requirements. This new battery system development methodology utilizes battery modules to construct complex battery systems.

Battery Modularity Concept

Battery modularity design methodology is the construction of a complex rechargeable battery system using series and parallel combinations of identical, independent battery modules. Each battery module is a self contained rechargeable battery of a convenient size for on-site construction of multiple battery system applications and for meeting DOT requirements for safety in transport.

The battery modularity design methodology relies on the battery module having a means of internal charge control that allows it to be charged from multiple energy sources such as power supplies, solar panels, fuel cells or combinations of these. A battery system constructed from these modules has the capability of using these charging energy sources to charge the whole battery system while deployed.

Advantages of constructing large battery systems using battery modules include:

1. Extreme flexibility of battery system design
2. Fast development
3. Cost reduced DOT testing
4. Increased safety in handling and shipping
5. Lower assembly costs
6. Lower repair and replacement costs
7. Lower inventory costs
8. Improved time-to-repair and system availability

Battery Module Requirements

Construction of dissimilar battery systems using a multiplicity of same battery modules requires considerable foresight into the battery module design. Following is a list of typical requirements:

1. Fast and easy maintenance
2. Battery module replacement
3. Internal charge control
4. Configurable for distinctly different applications
5. High battery module reliability
6. Programmable architecture
7. Support individual or centralized status, state of health monitoring and remote control
8. Support display of state of health, capacity, charge status, etc.
9. Chemistry agnostic
10. The Key Requirement: A means to balance all cells and all battery modules in the battery system

Why Balancing is the Key Requirement

Modern Li-Ion cell chemistries are remarkably robust in their ability to maintain balance. Never-the-less, field return data on high series count batteries support the need for a robust balancing capability for complex battery systems. For high cell count battery systems battery pack unbalance is the number one reason for pack failure. To understand why consider the following:

1. The likelihood of an imbalance increases with the number of series connected cells
2. A larger battery pack has a greater likelihood of portions of the pack being at different temperatures
3. Pack imbalance can be caused by differential leakage currents external to the cell such as:
   - Differential leakage currents within the pack-protect circuit itself
   - Differences in the insulation resistance between cells
   - Humidity and condensation on the pack-protect circuit board and on the cell insulators
4. Pack imbalance can be caused by inter-module or intra-module capacity differences due to:
   - Different lots of same cell
   - Differences in module age
   - Cell electrolyte leakage, contamination or other damage
5. Replacement of battery modules typically requires a system re-balance due to:
   - The replacement module's state of charge being different from other modules
   - The replacement module's capacity being different from other modules

The resultant requirement is that a robust balancing capability must be designed into the whole battery system. In the instance where the module design concept is utilized, this means intra-module and inter-module balancing.

Example Implementation of Intra-Module and Inter-Module Balancing

Electronic cell balancing is not new. Two common methods are discharge balancing and charge transfer balancing. Discharge balancing is balancing by discharging higher capacity cells until they match the capacity of the lowest capacity cells. Charge transfer balancing is balancing cells by transferring charge from the higher capacity cells into the lowest capacity cells until the cell capacities are equalized. Both methods can theoretically be done at any time and in any battery operating mode. Neither method will reduce the usable capacity of a battery pack from what it was prior to being balanced.

These balancing methods are commonly only described for balancing across a complete, inflexible, battery system using centralized control. There is an unmet need for a balancing method for highly configurable battery systems constructed from independent rechargeable battery modules. The following two methods, developed by Southwest Electronic Energy Group, meet this need.

Zener Diode Module Balancing

A simplified schematic of two, four series, Li-Ion battery modules that utilize Zener diode module balancing is shown in Figure 1. Assumed, but not shown, are the pack-protect circuits associated with each of the modules. The two modules in the figure are unbalanced and are in the process of being charged. The first module has attained full charge status and its charge FET (shown as a simple switch) has opened. The other module is at a lower relative state of charge and has not yet attained full charge status. Charge current is bypassing the fully charged module via the Zener diode and current limiting resistor and is charging the module at the lower state of

Southwest Article Continued on Page 14

charge. The charge current will continue until both modules are balanced at which time the second module's pack-protect circuit will open its charge FETs.

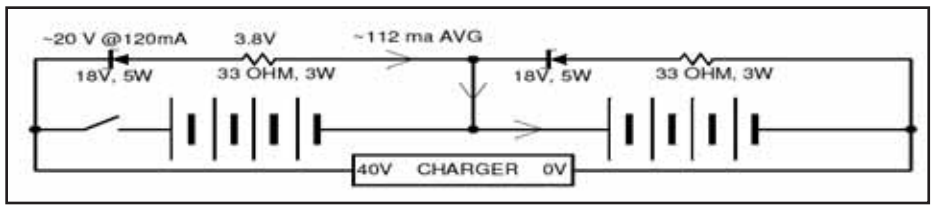

Figure 1. Zener Diode Module Balancing Circuit

Figure 2 illustrates how Zener diode balancing works. Each module in the example has internal charge control. Module 2 is at a higher state of charge than Module 1. At the beginning of the data set, Module 2 is near its end-of-charge cycle and has begun pulse charging, allowing charge current to flow into both modules in a pulsed fashion. When Module 2 is at full charge, it stops pulsing and opens its charge FET. Module 1 completes its charge using the bypass Zener diode current. When Module 1 has reached full charge status it also opens its charge FET. Both modules are now balanced and charge current stops going through the modules. Some small amount of quiescent current will bypass both modules as long as the charging power source is attached.

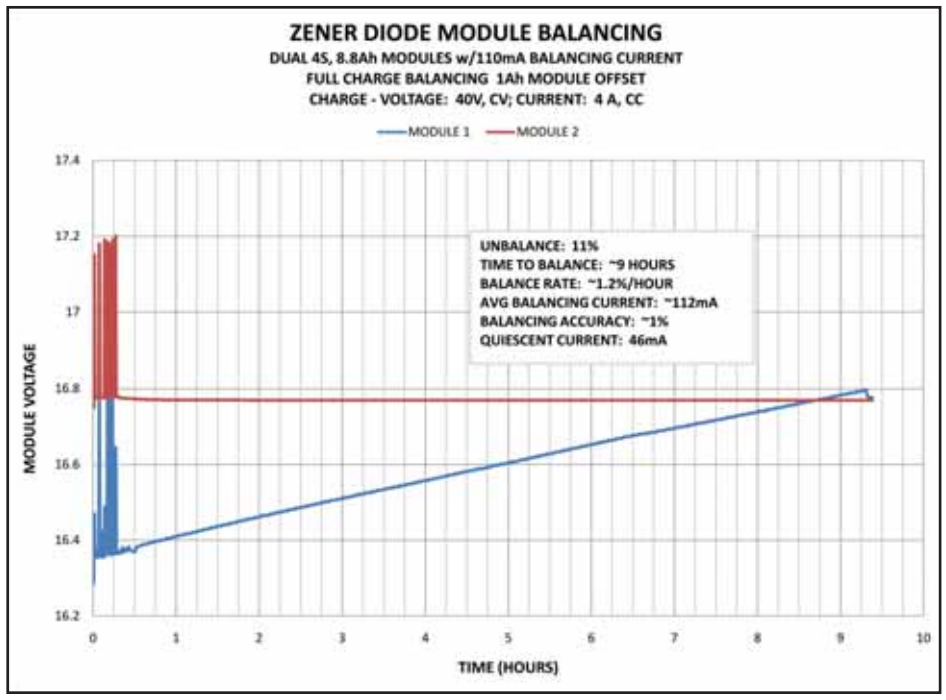

Figure 2. Zener Diode Module Balancing Example

Discharge Module Balancing

A simplified schematic of a four-series battery module that includes the Li-Ion cells and the protect circuit is shown in Figure 3. The circuit in the figure is capable of intra-module and inter-module discharge balancing. The circuit is constructed using off-the-shelf parts including a microprocessor, an AD converter, an analog front end circuit, external balancing switches and external discharge balancing resistors. An 8 amp implementation of the pack-protect circuit in Figure 3 will fit onto a 2.5-inch by 0.75-inch PCA.

As in the previous example, consider a battery system made from two, Figure 3 modules connected in series. Each Figure 3 module is able to balance the cells it is connected to using the external FET switches and the 25 ohm, 3/4W discharge resistors. This is conventional intra-module balancing. What may not be obvious is that each Figure 3 module, under appropriate internal software control, is also capable of inter-module balancing with the other module connected in series with it without there being any control communication between the modules.

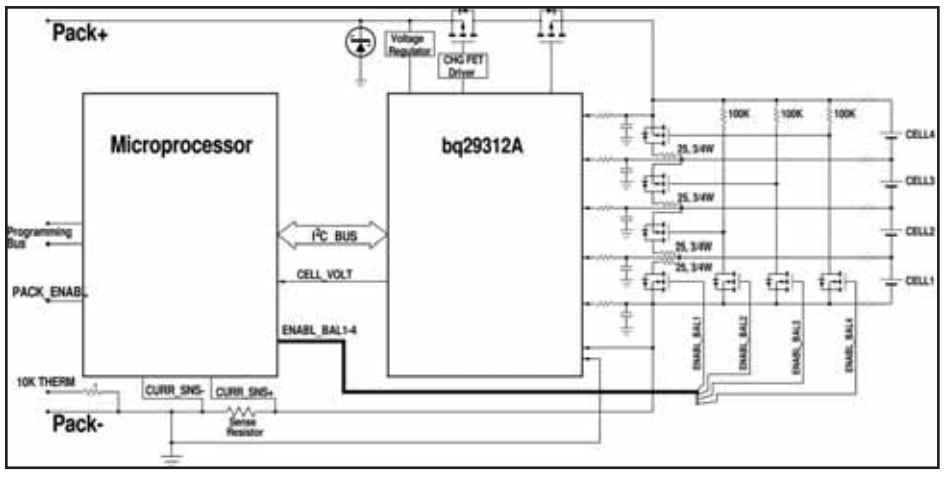

Figure 3. Discharge Module Balancing Circuit

Figure 4 illustrates how discharge module balancing using two, Figure 3 modules connected in series is accomplished. The two modules are programmed for intra-module charge control to 80 percent capacity as might be required in a battery back-up application. There were no control signals connecting these modules; the battery modules' external connections were only PACK+ and PACK-.

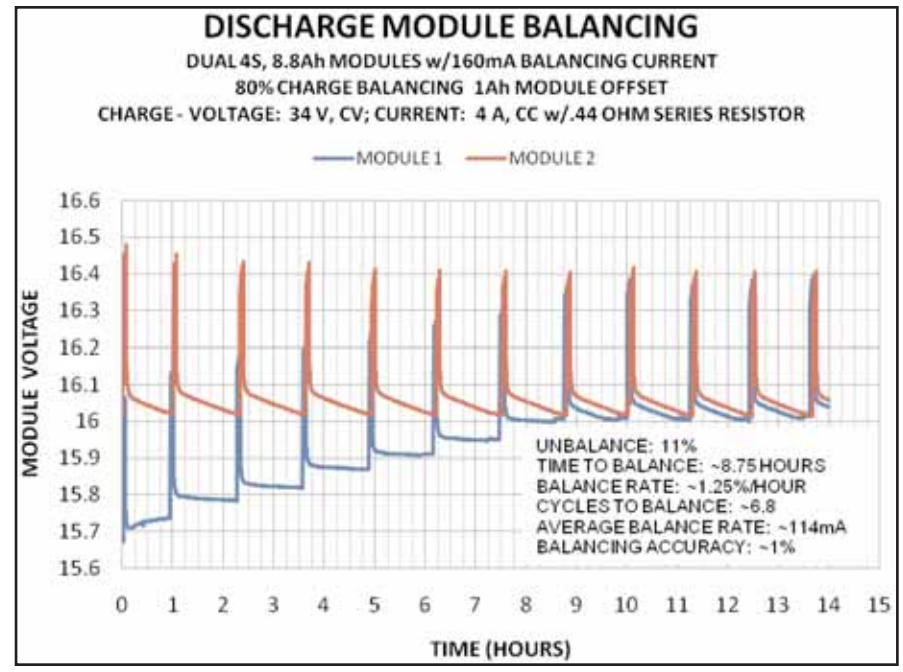

Figure 4. Discharge Module Balancing Example

Prior to being balanced, Module 2 is at a higher state of charge than Module 1: they are unbalanced. A 34-volt current limited power supply is connected across the two modules as a charge source. Module 1 has its charge FETs constantly on but Module 2 is close to being fully charged so it pulses its charge FETs to reduce average charge current. The pulsed charge current from Module 2 charges both Module 2 and Module 1 until Module 2 reaches 83 percent capacity, opens its charge FET, and stops pulse charging. Between charge pulses, Module 2 discharges itself down to 80 percent capacity by enabling all four of its balancing resistors. Module 1 does not discharge itself during this time because it has not reached 83 percent capacity. When Module 2 discharges down to 80 percent capacity it begins pulse charging once again until it again reaches 83 percent capacity and opens its charge FET. Thus, Module 2 charges and discharges itself between 80 percent and 83 percent capacity while Module 1 only charges without discharging.

This continues until Module 1 attains the same 83 percent capacity at which time the two modules become balanced. Once balance is attained, both modules continue to perform 3 percent capacity charge/discharge mini-cycles. Pulse charge current range is approximately 2.2 to 3 amps due to 0.44 ohm resistor in series with the 34 volt charge source. Charging and discharging 3 percent at about 80 percent capacity is not stressful on the cells. Cycle rate is about 0.8 cycles per hour, 19.2 cycles a day, 7,008 cycles a year.

An obvious question is how many of these mini-cycles are required to reduce cell capacity to 80 percent of their initial value? Some NASA studies indicate this number may be in the 10's to 100's of thousands. Thus, it is feasible that continuous mini pulses such as this do not appreciably affect battery module life. Never-the-less, if mini-cycles are objectionable, it is possible to lengthen them or cause them to stop altogether once balance is attained.

Conclusions

Electronic balancing is a requirement for Li-Ion battery systems because the chemistry does not provide for overcharge balancing as do previous rechargeable chemistries. Engineers having to live with this restriction are discovering that the ability to automatically electronically balance all parts of a complex battery system leads to new paradigms in battery system design, use, and maintenance that are only recently becoming evident. Among these are:

1. Applying electronic balancing to other, non Li-Ion, rechargeable chemistries
2. Increased number of series connections in a battery
3. Increased flexibility in modularity and replaceable unit concepts
4. Smarter battery systems
5. More flexible charge control
6. Multiple charger energy sources
7. Potential for multi-energy source hybridization

David White has been designing state-of-the-art computer, seismic and battery systems for more than 38 years. David's practical design experience is in large, high capacity, high reliability computer and system designs used in battery operated, man portable applications that must work in any environment above, on or under the Earth.

For more information, please contact Southwest Electronic Energy Group at www.swe.com.

Computed Tomography Imaging as Applied to Primary Cell Evaluation

John Harmon, Ramesh Godithi
Celina Mikolajczak, Ming Wu
Exponent Failure Analysis Associates

In today's market for portable and increasingly wireless electronic devices, the lithium primary cell has come to fill a niche in applications that do not allow for recharge, and require relatively low rate discharges, small form factors and long lifetimes, in essence for install and forget hardware. Applications include watches, implantable devices (i.e. pace-makers), clocks, smoke detectors (replacements for traditional 9 volt alkaline cells), gas meters, BIOS backup and remote sensing (i.e. fast track sensors for cars). This article will briefly describe how computed tomography imaging can be used as a tool to evaluate the design and structural evolution during discharge of primary batteries without destructive examination.

Cell construction is one of the largest contributing factors to overall cell reliability and quality. Design schematics and drawings, although useful for providing a general overview of cell design and ruggedness, do not reveal how a cell is truly assembled in a manufacturing setting, nor do they reveal how a cell will age during various discharge scenarios or how likely it is to contain a manufacturing defect. Cell disassembly can be used to assess initial construction or cell aging at various discharge states. However, disassembly and examination of lithium primary cells poses a number of challenges including that cell opening must be conducted under an inert atmosphere in a glove box if the lithium metal, or a corrosive and/or volatile cathode material, is to be examined. Such disassembly also requires appropriate engineering and personal protective equipment. In addition, though disassembly will reveal surface features on components, it will not reveal hidden subsurface voids or cracks in the components. Finally, cell opening is by its nature destructive, so it may be difficult or impossible to track the evolution of specific features of interest within a single cell while the cell ages or over the cell lifetime.

Traditional planar X-ray is a powerful and commonly used, non-destructive examination technique. However, a planar X-ray produces a composite image of the entire cell and rarely allows the viewer to observe individual components within the cell. High-resolution X-ray Computed Tomography (CT scanning) allows for the inspection of individual components and features within the cell such as current collectors, active material interfaces (active materials are the metals and materials used for the anode and cathode), cell leads, void spaces, corrosion pitting and cracks without damaging the cell. Thus, CT scanning can be used to assess initial cell construction and to evaluate the condition of various components as the cell ages or is discharged. For example, CT scanning can be used to assess the uniformity of active material reaction/depletion or to identify delamination of cathode material due to non-uniform lattice swelling. In addition, CT scanning can also be used as a failure analysis tool to examine cells that are not performing as expected. Finally, CT scanning can be used to perform 100 percent inspection screens for critical applications where a cell fault cannot be tolerated.

High-resolution X-ray CT is a nondestructive technique for visualizing object interiors. It is currently used to examine a wide range of materials including rock, bone, ceramic, metal and soft tissue. Most people are familiar with the use of CAT scans in medical applications where it is used to distinguish between different materials and provide a three dimensional perspective of an object's interior. High-resolution CT differs from conventional medical CAT-scanning in its ability to resolve details as small as a few tens of microns in size (i.e. less than 0.001 to 0.002 inches), even when imaging objects are composed of high density materials.

In order to produce CT images, multiple X-ray images are taken as the object is rotated around a central rotation axis. These separate perspectives of the object are then used to mathematically determine the relative density of the object at different locations in the plane of interest. This imaging process is then repeated for each desired slice of the object until a stack of images has been produced representing the internal structure of the object. Exponet has used the CT scanning technique to:

- Visualize the anode and cathode interface
- Visualize voids and/or fracturing within the anode and cathode materials
- Monitor the anode active material consumption and the uniformity of consumption at various states of charge
- Monitor swelling of cathode material versus state of charge
- Examine electrode alignment and positioning
- Detect internal cell pitting and corrosion
- Assess overall cell construction quality

To demonstrate the applicability of CT scanning on primary cells, we scanned a variety of cells of different constructions at various states of charge.

Figure 1 and Figure 2 present a CR2050 lithium/manganese dioxide primary coin cell at the fully charged and discharged states respectively. The overall cell construction is clearly visible including the press fit steel exterior, cathode pellet and anode pellet. The steel exterior corresponds to the brighter portions of the image (in CT images, higher density materials appear brightest). The manganese dioxide cathode is the gray region within the cell interior. The apparent gradation change in image density in the manganese dioxide in the CT images is an artifact of the imaging process due to a larger volume fraction of steel from the cell exterior being located toward the image top. Materials with low x-ray absorbance such as the lithium metal anode or void spaces will appear black in a CT image. For instance, in Figures 1 and 2, the lithium metal anode is the black region directly below the cathode.

The interface between the cathode material and anode is clearly visible, and its location was tracked versus the discharge state of the cell. Figure 2 shows the same cell in the nominally discharged state. As would be expected, the lithium has been almost entirely consumed, which is seen as a decrease in the imaged black region within the cell. A concomitant swelling of the cathode matrix was observed due to intercalation of the lithium. Furthermore, fractures that developed within the cathode material due to swelling (dark lines through the cathode material) are shown in Figure 2. Similar fracturing of the cathode material upon cell discharge has been observed in other cells in the discharged state and does not necessarily represent a cell design or manufacturing defect as long as cell performance and safety are not impacted by that fracturing.

Figure 1. CR2050 lithium/manganese dioxide primary cell ~100 percent SOC.

Figure 2. CR2050 discharged lithium/manganese dioxide primary cell ~0 percent SOC.

Figure 3 is a CT image of the internal construction of a CR1/3N lithium/manganese dioxide primary cell at 50 percent state of charge (SOC). The cell has a bobbin construction utilizing wire mesh current collectors. The metallic parts such as the steel can, metallic wire mesh electrodes and center pin appear as bright regions within the image. The cathode material corresponds to the gray regions within the image. The lithium metal corresponds to the black regions adjacent to the cathode material. The sealing surfaces are visible within the figure and appear to indicate a relatively uniform gasket compression with no signs of corrosion. The lithium metal has been consumed unevenly during discharge. This is clearly demonstrated in the image where the

Figure 3. CR1/3N lithium/manganese dioxide primary cell 50 percent SOC.

Exponent continued on page 22

Battery Power 2009

October 20 - 21 • Denver • BatteryPowerOnline.com

Battery Power 2009, an international conference highlighting the latest developments and technologies in the battery industry, will be held October 20th - 21st in Denver, Colo.

This seventh annual event will feature more than 30 presentations on portable, stationary and automotive battery technology, as well as battery manufacturing, materials and research & development. Topics will include new battery designs, emerging technologies, battery materials, power management, charging and testing systems, battery health, as well as the latest market trends affecting the industry.

The conference is designed for OEM design engineers, system engineers, technical and management professionals involved in battery powered products and systems, battery manufacturing, battery technology research and development and power management technology.

Our Commitment to You

Whether this is your first time participating at the Battery Power conferences, or if you have attended in the past, the 2009 event will provide you with the most up-to-date developments and technologies in the battery and power management market.

Monday, October 19th

Pre-Conference Activities

Tour of the National Renewable Energy Laboratory (NREL), presented by NREL

Attendees (limit of 25) will be given a tour of NREL's Battery Thermal Management Lab at the Thermal Test Facility, the Battery Material Research Lab at the Solar Energy Research Facility and Science and Technology Facility, as well as a tour of the Plug-In Hybrid Electric Vehicle and Solar Charging Station.

Lithium-Ion Battery Design Tutorial, presented by Battery Design LLC

This full day course surveys all aspects of lithium-ion battery design ranging from materials and processes, to cells to packs. A thorough overview of the issues involved in life estimation, thermal behavior and abuse tolerance is provided. How to design lithium-ion cells is discussed in detail with an emphasis on comparing different chemistries.

Li-Ion Battery Power Management: Chemistry Characteristics, Charging, Fuel Gauge and Cell Balance Workshop, presented by Texas Instruments

This workshop provides the battery electrical behavior, charging and discharging characteristics, cycle life and safety protections including over-charging, over temperature, over-current and short circuit for Li-Ion and LiFePO4 batteries. This seminar is structured to provide in-depth coverage of the topics in battery powered applications, and is intended for the audience from entry level to intermediate experience level.

Keynote & Featured Presentations

Venture Capital Investor Panel

Venture Capital investment in advanced battery companies is growing, with interest expanding all across the value chain. However, few have a long track record, essential in such a demanding field where a firm grasp of electrochemistry is needed to discern a lab project from a home run. This session will bring together some of the industry's leading VC investors with experience in the battery industry to share their insights, strategies and evaluation process. These investors will share their experience funding fast growing battery companies, and ample time will be made available for the audience to interact with the panel to answer your questions and gain an insight into this keenly important topic.

Skip Maner, Managing Principal
Inverness Graham Investments
Additional Panelists TBA

Battery Projects and Developments in Government Laboratories

This panel discussion will feature three of the country's leading government labs actively involved in fundamental battery research and development. Hear what battery projects they are currently working on and what exciting developments are on the horizon for electronics, renewable energy, automotive and other applications.

Ahmad Pesaran, Principal Engineer
National Renewable Energy Laboratory
George Andrews, Program Manager
Oak Ridge National Laboratory
Kevin Gering, R&D Scientist • Idaho National Lab

Lithium Ion Cell Evaluation – Optimizing Battery Performance for Your Application

Today, Lithium ion batteries are commonly used in many non-consumer applications that include portable medical devices, commercial power tools, military devices, various wireless applications, server backup and industrial products of all types. These applications often have a set of unique requirements that require evaluation to verify performance under their specific conditions. These requirements might include operation outside of the typical temperature ranges, high discharge pulse rates, extreme cycle life, long calendar life in backup applications, fast charging and shallow cycling. This presentation will report on evaluations on Li-ion cells with various chemistries including lithium iron phosphate, as well as demonstrate the differences in lithium ion cylindrical, prismatic and polymer performance.

Chris Turner, Dir. of Battery Technology • Nexergy, Inc.

Basics of the EU-Directive on Batteries: The Legal Scope and its Impacts

This presentation will outline the objectives and most important provisions of the European Union's Battery Directive 2006/66/EC. Attendees will receive an overview of the national implementation status in the 27 EU member states, and the Directive's definition of "producer" and "battery." Learn the details the originating obligations for "producers" (be it manufacturers, distributors, importers or distance sellers), such as registration, reporting, collection and treatment, labeling and other information requirements, ban of certain substances. Finally, the financial and organizational effort for compliance of an affected company is assessed.

Ofira Varga, Environmental Consultant
1WEEE Services

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Tuesday, October 20th

8:00 Welcome and Introductions

8:05 Keynote Presentation: Venture Capital Investor Panel
Skip Maner, Managing Principal • Inverness Graham Investments
Additional Panelists TBA

9:10 Featured Presentation: Lithium Ion Cell Evaluation – Optimizing Battery Performance for Your Application
Chris Turner, Director of Battery Technology • Nexergy, Inc.

10:00 Networking Break

10:45
Ultra Low Voltage, High Efficiency Boost Converter for Battery Charging Applications
Kevin Parmenter, Applications Engineering Manager • Freescale Semiconductor

Fuel Cells and Batteries: Achieving Grid-Like Power for Off-Grid Deployments
Ian Kaye, CTO • UltraCell Corp.

Battery Pack Design to Prevent Cell Damage in Transient Thermal Gradients
Robin Sarah Tichy, Technical Marketing Manager • Micro Power Electronics, Inc.

11:25
Challenges and Solutions for LiFePO4 State Of Charge Indication
Yevgen Barsukov, Sr. Applications Engineer
Texas Instruments, Inc.

Fixing the Frequency with Li-Ion: Demonstration Projects for Frequency Regulation of the Electric Grid
Sam Jaffe, Senior Research Analyst
Energy Insights

Battery Performance and Thermal Management: Cell, Module, Pack Calorimetry Testing
Martyn Ottaway, Managing Director
Thermal Hazard Technology

12:00 Networking Lunch

1:30
Combining Built-In Charge Control and Discharge Balancing to Balance Independent Series Connected Battery Modules
David A. White, Electrical Engineer
Southwest Electronic Energy Group

Battery System Management and Cell Variations
Matthieu Dubarry and Bor Yann Liaw
Hawaii Natural Energy Institute, SOEST

Cradle-to-Grave Clean Li-Ion Batteries
Neil Maguire Vice President, Business Development • Imara Corp.

2:10
Battery Charging a Key to Improving Efficiency of Electric Cars
Morten Schøyen, Chief Marketing Officer
Eltek Valere

Rapid Development of Large Li-Ion Battery Packs Using Off-the-Shelf Battery Management Systems
Davide Andrea, Engineer • Elithion

Challenges to Bringing New Li-Ion Paradigms to High Reliability Markets
Chris Pearson • ABSL Space Products

2:45 Networking Break

3:15
A Hybrid Battery System for Electric Vehicles
David H. Shen, Ph.D., President • NEXcell Battery Co., Ltd.

Diagnostic Analysis, Modeling and Prediction of Capacity Loss In Li-Ion Cells
Kevin L. Gering, PhD, R&D Scientist • Idaho National Lab

Extending the Battery Life Cycle with Ultra Caps
Gene Weaver, VP Sales & Marketing • Renewable Power Systems, Inc.

3:50
Advances in NiZn Technologies for Light Electric and HV Applications
Joe Carcone, Vice President, New Business Development • PowerGenix

Using Adiabatic Calorimetry to Design Inherently Safer Li-Ion Batteries
Peter Ralbovsky, Calorimetry Expert • Netzsch Instruments

Boosting Ultracapacitor Performances with Nanostructured Carbon Electrodes and Environmentally Friendly Ionic Liquid Electrolytes
Wen Lu, Ph.D., Energy Storage Program Manager • ADA Technologies, Inc.

4:30
Next Generation Li-Ion Technology: Untethered and Environmentally Sustainable
Eric Carlson, Director of Technical Sales • Boston-Power

Materials Joining Technologies for Battery Applications
Nitin P. Phadnis, Worldwide Industry Segment Manager • Branson Ultrasonics Corp.

5:00 Cocktail Reception

Wednesday, October 21st

8:00 Keynote Presentation: Battery Projects and Developments in Government Laboratories
Ahmad Pesaran, Principal Engineer
National Renewable Energy Laboratory
George Andrews, Program Manager • Oak Ridge National Laboratory
Kevin Gering, R&D Scientist • Idaho National Laboratory

9:00 Featured Presentation: Basics of the EU-Directive on Batteries: The Legal Scope and its Impacts
Ofira Varga, Environmental Consultant • 1WEEE Services

10:00 Networking Break

10:30
Modular LFP Batteries for Electric Vehicle Applications
James D. Hodge, Ph.D, CTO • K2 Energy Solutions, Inc.

The Development of a Secondary Cylinder Alkaline Zn/MnO2 Battery Separator
Jirong Dong • Shanghai ShiLong Hi-Tech Co., Ltd.

11:10
Large-Sized Li-ion Cell Technology for Energy Storage System
Sunam Lee, Dir. of Marketing and Business Dev. • Samsung SDI America, Inc.

11:50 Networking Lunch

1:00
Pervasive Power: Integrating Energy Storage for Point of Load Delivery
Steve Grady, Vice President of Marketing • Cymbet Corp.

Mechanical Clamping of Battery Packages
John Lippke, Applications Engineer • BAND-IT-IDEX, Inc.

1:40
Impact of Battery Pack Insertion and Removal on System Side Fuel Gauge
Ming Yu, Application Engineer • Texas Instruments, Inc.
Kim Hsu, Technical Marketing Manager • World Peace Industrial Co, Ltd.

Improved Performance in Lithium Primary Batteries in Long-Term High Temperature Operation
Arden P. Johnson, R&D Manager • Electrochem Solutions, Inc.

2:15
A Novel Dynamic Reconfiguration Approach to Improve the Performance Of the Multicell Battery
Jiucai Zhang and Song Ci, PhD., EE • University of Nebraska - Lincoln

Analysis of Battery Metals Supply
David E. Guberman, Mineral Commodity Specialist • US Geological Survey

2:45 Conclusion of Conference

Registration Information

Two Day Pass - *Provides access to both days of the conference. Includes all networking and expo activities and reception.*

(1 person)	(2 people)	(3 people)
$895	$795	$695

Single Day Pass - *Provides access to either one of the individual days of the conference.*
$595

Half Day Pass - *Provides access to half of either one of the individual days of the conference.*
$295

Federal Pass - *Discounted rate for Federal, State, County and local entities, including military.*
$595

Pre Conference Workshops: *Visit www.BatteryPowerOnline.com for pricing information.*

Expo Only Pass - *Provides access to the exhibit area Exhibit Only Pass does NOT include conference CD-ROM, admittance to conference sessions or food/beverage.*
$50

Thermal Management and Technology Symposium Upgrade - *Provides access to both days of the conference and all conference proceedings.*
$150

Ways to Register
By Phone: 800-803-9488
By Web: www.batterypoweronline.com

Exhibitor Spotlight

MEGTEC is a global turnkey supplier of custom coating, drying and solvent recovery solutions for applications such as battery electrodes, photovoltaic cells and battery separators.

MEGTEC has developed a laboratory coating line designed for companies who are involved in the development and testing of lithium ion, lithium sulfur and silver zinc battery coating formulations. MEGTEC's coating line offers the capability of producing 200 mm wide cathode and anode samples at speeds up to 3 meters/min.

MEGTEC's pilot lab line with three-zone dryer is located in De Pere, Wisconsin. Customers can test, develop and improve their processes by evaluating system variables.

MEGTEC Systems Inc.
Contact: Jim Nennig
Phone: 1-800-558-2884
Email: info@megtec.com
Web site: www.megtec.com

Hotel Information

Battery 2009 will be held at the Hyatt Regency Tech Center. A limited number of rooms have been reserved for attendees who make reservations with the Hyatt Regency Tech Center. Mention Webcom Communications to receive a discounted room rate of $175.00 per night. To receive this discount, reservations must be made by September 28th, 2009.

Hyatt Regency Tech Center
7800 East Tufts Avenue • Denver, CO 80237
303-779-1234 • 800-233-1234 • www.hyatt.com

Co-Located Event

Thermal Management & Technology Symposium 2009

Thermal Management and Technology Symposium 2009 will be co-located with Battery Power 2009 and share a combined exhibit hall. For a nominal fee, Battery Power attendees can upgrade their registration pass and get access to the Thermal Management conference and the conference proceedings.

Thermal Management and Technology Symposium 2009 will feature next-generation thermal technology, thermal materials, heat transfer and worldwide technology trends.

The conference is designed for design engineers, system engineers, process engineers, material scientists and R&D managers with organizations in a variety of industries and markets whose products, operations and services depend upon sophisticated and precise control of thermal properties and states. To view the conference program, please visit www.ThermalNews.com.

Yardney and Coda Automotive Announce Plans to Build US-Based Battery Production Facility

Connecticut-based Yardney Technical Products, Inc. and California-based Coda Automotive have entered into a joint venture (Coda Battery Systems LLC) to design, manufacture and sell automotive grade, lithium-ion battery power systems in the US. Coda Battery Systems LLC submitted a proposal under the stimulus grant program to the Department of Energy on May 19 for funding to build manufacturing at a facility in Enfield, Conn. The Coda Battery facility expects to employ 600 US workers in manufacturing positions.

Scheduled for delivery to the California market in the fall of 2010, the four-door, five-passenger, fully-equipped mid-size, all-electric Coda sedan will initially be sold with a battery system from a joint venture between Coda Automotive and Chinese-based Tianjin Lishen Battery Co., one of the largest suppliers of lithium-ion batteries in the world. Coda Battery Systems LLC will begin supplying the power battery system for the Coda sedan as soon as the new US facility can be brought on-line. It is anticipated that Lishen, Coda's battery partner in China, will participate in the US manufacturing joint venture.

"The partnership was a natural fit," said Kevin Czinger, president and CEO, Coda Automotive. "We are eager to apply our respective strengths to facilitate the rapid advancement of an electric vehicle industry built on the vast skills and traditions of US workers. This Connecticut factory and the hundreds of new manufacturing jobs it will create are only the beginning of our long term plans."

"This electric vehicle venture is a major strategic step for Yardney," said Vince Yevoli, president, Yardney. "We have been working on battery technology research specifically for hybrid and electric vehicle applications for years. This is the culmination of all that we have worked towards; building the technology, experience and reputation to be able to produce automotive grade lithium-ion power battery systems," Yevoli said.

EnerDel Awarded $3.3 Million for Safety Research on Auto Lithium-Ion Battery

Advanced lithium-ion automotive battery developer EnerDel has been awarded up to $3.3 million for a cost-share research project under the US Department of Energy (DOE). This will be the largest of a set of new projects announced under DOE's Vehicle Technologies Program, and will focus on the development of innovative technologies to eliminate overcharging in lithium-ion cells.

The program is separate from the Department's Advanced Technology Vehicle Manufacturing loan program and Advanced Battery Manufacturing Initiative grant program, where Ener1 also has applications pending for large-scale expansion of its domestic manufacturing capacity.

"EnerDel is deeply committed to the continuous improvement of advanced lithium-ion automotive battery technology," said EnerDel CEO Ulrik Grape. "This award by the Department of Energy will help us enhance the reliability, safety and performance characteristics of lithium-ion batteries and widen their scope of commercial application."

The project will be conducted jointly with Argonne National Laboratories in Chicago and will focus on a new chemical additive that acts as a "shuttle agent" to effectively cap the voltage of the cell. The additive transports the charge through the cell once the desired voltage is reached. Overcharging cells in pack systems is normally monitored with voltage monitoring circuits. Refining this at the base chemistry level of the cell will vastly improve reliability and overall pack efficiency.

In total, seven projects under this program were awarded by the DOE ranging from $500,000 to $3.3 million and will be conducted over the next three years. All of them will focus on aspects of improving battery material performance or decreasing cost.

Western Lithium Joins USA-Based National Alliance for Advanced Transportation Batteries

Western Lithium Corp. has joined the National Alliance for Advanced Transportation Batteries (NAATBatt). NAATBatt is a not-for-profit cooperative of more than 50 battery developers and materials suppliers including BASF, Bosch, ConocoPhillips, FMC, Rockwood Holdings and Siemens, that intends to help develop the burgeoning North American battery industry by enabling multiple companies using a variety of lithium-ion technologies to manufacture lithium-Ion battery cells.

Jim Greenberger, a spokesperson for NAATBatt said, "We are delighted to welcome Western Lithium as our newest member. A reliable supply of lithium is an essential component in the growth of the electric vehicle market in the United States and we look forward to their input as we help the industry develop."

Jay Chmelauskas, Western Lithium's president, said, "A domestic source of lithium would bring geographic diversity of supply to what is becoming an increasingly important commodity. We are positioning our company to be a building block for the commercial development of lithium-ion batteries for automobiles within North America and globally."

The US produces just 3 percent of the global lithium supply. At present, almost two thirds of the world's lithium comes from three producers in South America. The demand for lithium is expected to increase substantially over the next decade, supported by global consumer adoption of new generation hybrid/electric vehicles powered by lithium-ion batteries.

Western Lithium is developing the Kings Valley, Nev. lithium deposit into a potentially strategic, scalable and reliable source of high quality lithium carbonate. The company is positioning itself as a major US-based supplier to support the rising global demand for lithium carbonate that is expected from the increased use of mobile electronics and hybrid/electric vehicles.

Lithium-Ion Technology will Support Key Functions Onboard DDG 1000 Destroyers

Saft has signed two contracts totaling more than $1 million with DRS Technologies to supply its lithium-ion (Li-ion) energy storage systems for the Integrated Fight Through Power (IFTP) system for the US Navy's DDG 1000 destroyers.

"Given the US Navy's stringent battery requirements, the introduction of our Li-ion technology into the DDG 1000 platform marks a huge milestone for Saft," said Thomas Alcide, Saft Specialty Battery Group general manager. "We are excited to receive these two contracts and the opportunity to further our partnership with the US Navy by positioning ourselves as a trusted and reliable battery supplier."

The two rechargeable Li-ion batteries will support key functions within the IFTP system, which sustains the destroyers' Integrated Power Systems (IPS) and provides the means for conversion and distribution of the ships' service power to various shipboard weapons and sensor systems, as well as various auxiliary systems.

Saft will develop 12 batteries using VL 34P cells for each destroyer with custom electronics, housing and an integrated charger to support the IFTP's Load Center breakers, giving them the ability to shut down electronically, even when there is no power.

Under the second contract, Saft will provide 22 batteries, also based on VL 34P cells, for each ship for the IFTP's Housekeeping Power Supply (HKPS). The batteries will supply onboard back-up power, carrying the destroyers' loads until they can be shut down.

The VL 34P cell was developed to provide the dual performance of power and energy suited for applications that require both high power and long run times. The

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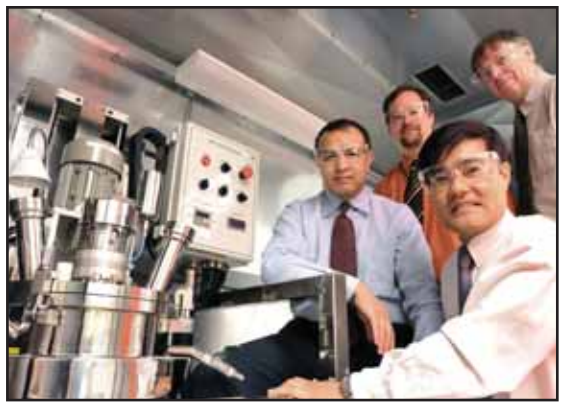
ability to operate at very high temperatures (up to 70°C), while maintaining performance for the duration of its long lifetime, makes this cell well suited for integration into energy storage systems for a wide array of military applications. This technology has also been used in various military hybrid electric vehicle applications to support battery-only operation, silent watch and drive assist.

The DDG 1000 destroyer is the first in a class of the US Navy's multi-mission surface combatants tailored for the littoral, air and sub-surface warfare. It operates as part of a joint maritime fleet, assisting Marine strike forces ashore. The ship's affordable and flexible design, unmatched stealth and precision volume strike make the DDG 1000 an important asset to the US war fighter.

Argonne's Lithium-Ion Battery Technology to be Commercialized by BASF

The US Department of Energy's (DOE) Argonne National Laboratory and BASF have signed a world-wide licensing agreement to mass produce and market Argonne's patented composite cathode materials to manufacturers of advanced lithium-ion batteries. BASF will conduct further lithium-ion battery material application development in its current Beachwood, Ohio facility. Contingent upon winning a DOE grant under Recovery Act - Electric Drive Vehicle Battery and Component Manufacturing Initiative (DE-FOA-0000026), BASF plans to build a cathode material production facilities in Elyria, Ohio.



Argonne National Laboratory battery researchers (from left) Khalil Amine, Chris Johnson, Sun-Ho Kang and Mike Thackeray flank a continuously stirred tank reactor used to produce scaled-up quantities of cathode materials for lithium-ion batteries.

The patented cathode materials licensed to BASF are part of a large and diverse suite of lithium-ion battery inventions and patents developed at Argonne with funding from DOE's Vehicle Technologies Program. The further development and commercialization of the cathode materials will result in advanced batteries that are higher-performing, longer-lasting and safer when compared to the existing technology that has dominated the market for nearly two decades.

"BASF is excited to begin this partnership with Argonne National Laboratory as we look to advance the lithium-ion battery market in North America," said Joseph Breunig, BASF Corp. president of Market and Business Development. "The aim of our application development team in Beachwood, Ohio, along with our funding proposal to DOE for a world class facility in Elyria, Ohio is to make lithium-ion battery use realistic, affordable and widely available. Partnerships like this are exactly the type of public-private investment commitment that will create a more sustainable environment, help move the economy forward, and create new jobs."

"This licensing agreement has the potential to put the United States several steps closer to reaching President Obama's goal of having one million Plug-in Hybrid Electric Vehicles on the road by 2015," said Argonne director Eric Isaacs. "The transfer of Argonne developed battery technology to BASF provides a stellar example of why DOE invests taxpayer dollars into scientific research and development. When federally-funded R&D is commercialized, it enhances our economic competitiveness, energy security and quality of life through innovations in science and technology."

When completed, the proposed BASF facility in Elyria, Ohio is expected to be the largest cathode material production facility in North America. The cathode material licensed from the DOE has been shown to be a material of choice among the largest North American and Asian cell manufacturers that are actively engaged in providing lithium-ion battery solutions to the automotive and other commercial marketplaces. The impact of such a facility is anticipated to be significant as the facility construction and staffing will have a positive economic impact for Ohio and will attract further businesses to North America.

Argonne's composite cathode material employs a unique combination of lithium and manganese rich mixed metal oxides in a revolutionary materials-design approach to extend the operating time between charges, increase the calendar life and improve the inherent safety of lithium-ion cells. Moreover, the enhanced stability of the composite material permits battery systems to charge at higher voltages, which leads to a substantially higher energy storage capacity than currently available material through both the higher voltage and higher capacity per unit weight of active material. BASF intends to commercialize these cathode materials for transportation and other applications.

EnerSys Enhances Lithium-Based Capabilities with Expansion Of Design, Assembly and Sales Operations

EnerSys has enhanced its lithium-based capabilities with the launch of an EnerSys Advanced Systems (EAS) unit in Budapest, Hungary, in addition to an existing EAS unit located in Horsham, Pa., near Philadelphia. These enhancements are in response to the growing demand for lithium-ion batteries.

The new EAS unit in Budapest provides customers with additional resources for the design and assembly of advanced lithium-ion batteries. It also employs a team of engineers for customer assistance in lithium-based applications.

New lithium-based battery products for defense applications have been developed and launched at EAS in Horsham since its acquisition as the former ATK Power Sources Center. In addition, EnerSys' joint venture with Modular Energy Devices, Inc. develops small-format lithium-ion products for customers including those in the telecommunications industry.

EnerSys previously established a marketing alliance with GAIA, a German unit of LTC Corp., to develop large-format lithium-ion products, primarily for defense and industrial applications.

"Our investment in lithium-ion technology demonstrates the commitment to meeting the ever growing, worldwide demand for small- and large-format lithium products," said EnerSys chairman, president and CEO John Craig. "While this technology is more expensive than our existing nickel and lead-acid battery solutions, there are applications where the premium can be justified.

Lead-based battery products continue to dominate EnerSys' sales to industrial and specialty markets, with growth driven in part by its product line of thin plate pure lead (TPPL) batteries, which provides more than 20 percent of improvement in performance over that of existing lead-based products. Recent expansion of EnerSys' product portfolio accommodates the widening and changing demands of the industrial energy storage market. This expansion included the acquisition of GAZ in Zwickau, Germany for nickel-based battery products, as well as the aforementioned investments and alliance for lithium-based battery products.

China Sun Group High-Tech Co. Signs Contracts with Battery Companies to Begin Testing on Eco-Friendly Product

China Sun Group High-Tech Co., which through its wholly-owned subsidiary Dalian Xinyang High-Tech Development Co. Ltd. (DLX) has the second largest cobalt series production capacity in the People's Republic of China (PRC), has entered into contracts with four additional battery production companies to begin testing samples of lithium ion phosphate. A next generation 'green' power source, lithium ion phosphate can be built into batteries that power electric cars, hybrids, scooters and other state-of-the-art electronic devices.

In addition to DLX's four new testing customers, testing by two of DLX's existing customers, Shandong Zaozhuang and Beijing Zhongke, on the natural attenuation rate curve is nearing completion. Early reports indicate that

over the past 45 days, the change of curve has maintained good consistency with a very little decay rate. Shandong Zaozhuang and Beijing Zhongke have expanded their relationship with DLX by entering into memorandums of understanding to continue battery development based on lithium ion phosphate materials supplied by DLX.

"Our customers' involvement in testing and feedback helps to ensure the highest quality standards are meet, if not exceeded. Our goal is to help global manufacturers lower their carbon footprint, increase safety and decrease production costs using the latest technologies and materials such as lithium ion phosphate," said China Sun Group CEO Bin Wang. "In addition to growing our customer base and those performing testing, we continue to receive ongoing support and direction from City Council of Dalian, which should help accelerate our time-to-market lithium ion phosphate."

PCTEST Engineering Laboratory Receives Award to Develop a Smart Thermal Management Platform for Lithium Batteries

PCTEST Engineering Laboratory, Inc. (PCTEST Lab), an independent testing laboratory of consumer electronics and wireless devices, has received the Maryland Industrial Partnerships (MIPS) award for its research on "Smart Thermal Management Platform for Lithium Batteries."

The lithium battery research project will be jointly conducted by PCTEST Lab, led by CTO Dr. Jae Sik Chung, and by The Center for Risk and Reliability at the University of Maryland, led by director, professor Ali Mosleh, PhD and professor Byeng D. Youn, PhD, both from the Department of Mechanical Engineering. The Center for Risk and Reliability focuses primarily on the research and development needs of the industry to understand the fundamental causes of failures or accidents and develop corresponding preventive measures.

"We're looking forward to working with Dr. Youn and Dr. Mosleh of the University of Maryland on the lithium battery research project," said Randy Ortanez, PCTEST Lab president and Maryland Electrical Engineering alumni. "We are eager to partner with the University to develop a Smart Thermal Management (STM) platform and improve the safety and reliability of lithium batteries used in mobile devices. PCTEST Lab is excited about this opportunity to support the continued evolution and safety of lithium battery products."

Lithium-Ion Batteries Hit the Streets In Volvo Demonstration Fleet

Volvo Car Corp. has chosen advanced, American-made lithium-ion battery systems designed and produced by Ener1, Inc. to power a pair of plug-in hybrid V70 demonstration cars being put through their paces across Europe this fall as part of a rigorous development program leading up to the planned 2012 commercial launch of a production plug-in model. The project is a joint venture between Volvo and Vattenfall, one of Europe's largest electric utility companies and a proponent of electric vehicle infrastructure build-out.

With a single charge from an ordinary household socket, the cars can run up to 31 miles (50 kilometers) using only battery electric power, more than meeting average daily commuting needs for the vast majority of drivers. Beyond the electric-only range, a highly fuel-efficient diesel engine kicks seamlessly in to power the vehicle without interruption.

"These cars and the battery systems constitute a tremendous engineering achievement and a major step forward in the commercial evolution of electric drivetrain technology," said Ener1 CEO Charles Gassenheimer. "Volvo is every bit as demanding as you would expect. They approached this program with the same relentless passion for safety, quality and reliability that made them famous. You can't ask for a better performance measure than that."

Made by Ener1's manufacturing arm, EnerDel, the batteries were custom built for this real world test program, to be operated in one of the most advanced automotive and utility partnerships in the industry. A standard production car was deliberately chosen as the platform in order to prove broad applicability of the technology in otherwise conventional automobiles. The diesel engine will eventually run on renewable biodiesel as well as standard blends.

The cars will be used to gather information and experience about the driving habits and performance expectations of everyday motorists using the new technology, as well as their actual charging needs. Vattenfall will test different concepts for high-speed home charging, as well as charging stations in public places, where owners pay to fuel with electricity instead of liquid fossil fuels.

The partnership between Volvo and Vattenfall began in January, 2007. With the current project, both companies say cooperation is now being taken to the next level. The goal is to produce plug-in hybrid vehicles and introducing them on the market as early as 2012.

Quallion Selects Palmdale, Calif. for New Li-Ion Battery Manufacturing Facility

Quallion LLC has selected Palmdale, Calif., as the location for its new battery manufacturing plant. More than $10.6 million in incentives has been offered to Quallion by the City of Palmdale for the development of its new facility. Proposed incentives include tax credits, fee waivers and the sale of 9.65 acres of land in the Fairway Business Park for the price of $1. The City of Palmdale's proposal further supports Quallion's application for funding to build this plant under the US Department of Energy's (DOE) Recovery Act - Electric Drive Vehicle Battery and Component Manufacturing Initiative.

The announcement follows the endorsement of California's Congressional Delegation and the California Energy Commission's announcement that it will provide up to $9 million in cost sharing for Quallion's new manufacturing facility if the company receives a funding award from the DOE.

If its DOE and California Energy Commission bids are granted, Quallion will begin construction of its new lithium ion battery manufacturing facility immediately, with the facility slated to be complete in 2012. More than 400 construction jobs will be created in Palmdale and more than 2,350 long-term skilled manufacturing and installation jobs will be created in California and across the country. Quallion's plant will significantly increase America's influence in the Asian dominated lithium ion battery industry and will help to renew America's manufacturing job market.

Quallion's proposed lithium ion battery facility will directly support President Obama's goal to have one million plug-in hybrid cars on the road by 2015. The new plant will produce zero emission advanced lithium ion batteries for automobiles as well as batteries that replace engine idling as a stationary power source for heavy duty trucks. Anti-idling laws, which forbid the use of engine idling in a stationary truck to power electrical systems that run air conditioning and heating,

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exist in 24 states and the District of Columbia. The state of California has some of the most rigorous laws, which have a minimum fine of $300 for idling, up to $10,000. Additionally, according to the US Environmental Protection Agency, truck idling results in the emission of 11 million tons of CO_2 and the DOE estimates that engine idling consumes 3.2 billion gallons of diesel fuel annually. With the DOE funding Quallion will be able to deliver a clean energy solution that enables the 2.54 million heavy trucks on American roads to comply with the growing number of anti-idling laws across the US, eliminate unnecessary pollution, and significantly reduce America's consumption of fossil fuels.

Quallion currently produces high volume medical and military batteries as well as custom-designed aerospace batteries. Cell designs range from the world's smallest conventional lithium ion cell (a cylindrical 1.8 mAh cell) for medical implants to large 15 Ah and 72 Ah prismatic cells. Quallion also has extensive experience with the commercialization of its module type battery configurations using its proprietary Matrix technology that will enable scalable battery designs that can be quickly and cost effectively reconfigured for use in a variety of vehicles from heavy duty trucks to passenger cars.

Saft Lithium-Ion Technology Launches with MEASAT-3a Communications Satellite

Built by Orbital Sciences Corp. and powered by Saft's lithium-ion (Li-ion) technology, the MEASAT-3a successfully launched into space on Monday, June 22, 2009, from a Land Launch rocket at the Baikonur Cosmodrome, Kazakhstan launch site. The MEASAT-3a contained two of Saft's VES 140 batteries onboard, for a total of 72 VES 140 cells. This launch makes a total of 33 spacecraft in orbit today using Saft Li-ion battery technology.

"Saft's contribution to the MEASAT-3a satellite strengthens our longstanding partnership with Orbital and reinforces Saft's reputation as a trusted and reliable supplier for the space industry," said Thomas Alcide, general manager of Saft's Special Battery Group. "With the launch of MEASAT-3a, Saft Li-ion battery technology is now represented in a total of 33 spacecraft currently in orbit. This further adds to our growing heritage of Li-ion batteries in space."

Saft's rechargeable Li-ion batteries power the MEASAT-3a during two eclipse seasons per year when the spacecraft is blocked from the sun, resulting in significant energy and weight savings for the satellite. By substantially decreasing the weight, the MEASAT-3a can dedicate more of its crucial mass to the payload, creating a more powerful satellite.

In addition to the MEASAT-3a, Saft has provided batteries for several Orbital-built satellites, including the Optus D3, which is scheduled to launch later this year, and both the Optus D1 and Optus D2 satellites that launched in 2006 and 2007, respectively. Saft also supplied its Li-ion technology for Orbital's Horizons-2 and THOR 5 satellites, both launched in 2008. Orbital's KOREASAT 6 is currently being manufactured with Saft Li-ion batteries onboard and is scheduled for launch in 2010.

International Battery Submits Proposal to Department of Energy on the Company`s Environmentally-Friendly Manufacturing Process

International Battery (IB), a US manufacturer, designer and developer of large-format lithium-ion rechargeable cells and batteries, has submitted an application for a grant from the US Department of Energy (DOE) under the Recovery Act – Electric Drive Vehicle Battery and Component Manufacturing Initiative. International Battery's proposal – entitled 'Project American Lithium' – provides comprehensive details on how it plans to significantly expand its existing, US-based manufacturing capability.

"DOE is looking to stimulate an American manufacturing renaissance to supply next generation lithium batteries for emerging electric and plug-in-hybrid vehicles. International Battery has already built a unique small factory in America and is shovel ready for expansion," said International Battery Chairman, Mark Mills. "The company's expansion plans can create hundreds of jobs and world-class large lithium batteries."

The company's manufacturing process is inherently green. IB batteries are fabricated using a water-based process instead of the common use of large quantities of organic solvent chemicals. IB's aqueous process is not only environmentally friendly, and worker-friendly, but also permits lower costs.

According to International Battery's CEO, Ake Almgren, "International Battery is one of a handful of lithium battery manufacturers able to fabricate truly large-format lithium battery cells. The company's individual cells are ten to 50 times larger than those commonly labeled "large format" today. Storing vehicle-vehicle scale and even more utility-scale quantities of electricity requires thousands of typical "large" lithium cells, but radically fewer of our battery cells. Employing fewer cells to store the same quantity of energy lowers the cost of integrated battery systems and improves reliability and performance."

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lithium metal has an uneven interface with the cathode active material. Additionally, voids and fractures are evident throughout the cell. The voids are coincident with the current collector mesh. Fractures of the cathode active material appear to propagate outwards from those voids along the cathode active material current collector interface. This observation coupled with isolated voids adjacent to the current collector tends to indicate void formation occurs first followed by fracturing of the cathode active material matrix as intercalation of the lithium into the manganese dioxide progresses during discharge.

The construction of a 9 volt lithium/manganese dioxide primary battery at 25 percent SOC is shown in Figure 4. There are three individual cells in a series within the battery. Each individual cell consists of a spiral wrap of electrodes with three sharp bends to create a four layer structure. The cathode material is supported by a wire mesh current collector. The lithium metal appears to be attached to one side of a solid metallic current collector wrapped around the cathode corresponding to the two thin lines within the black regions in the cell interiors. Along the second internal electrode bend for each cell, there appears to be a gap between the anode and cathode where one layer of the anode material has been bunched up. As noted previously the cathode material has swollen due to intercalation of the lithium. Furthermore, the cell swelling is relatively even. However, along the electrode bends near the bunched anode material, the cathode swelling exhibits some non-uniformity.

Figure 5 shows a cross sectional image of a 9 volt alkaline zinc/manganese dioxide cell. There are six cells in series in alternating orientations within the battery (this cross section shows three of the cells). The powdered structure of the zinc is clearly visible within the image. It is also apparent that the distribution of zinc is not uniform throughout the cells. There are irregularities along the surface as well as voids within the zinc powder. Other features that are clearly illustrated include cathode pin alignment, cell wall uniformity/integrity and distribution of anode and cathode active materials.

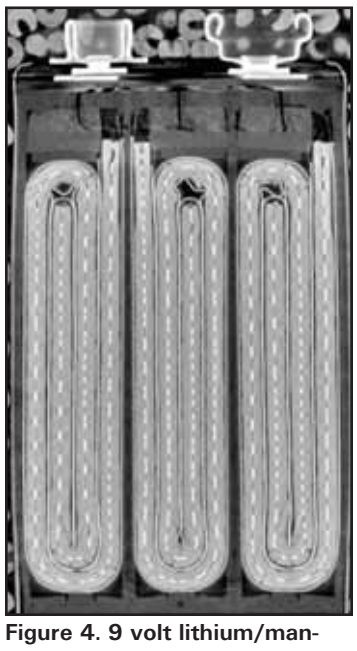

Figure 4. 9 volt lithium/manganese dioxide primary cell 25 percent SOC.

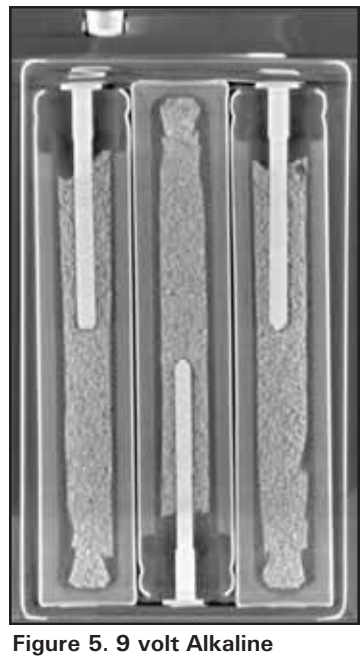

Figure 5. 9 volt Alkaline zinc/manganese dioxide primary cell 100 percent SOC.

Conclusions

Cell construction is one of the largest contributing factors to overall cell safety and reliability. Traditionally, evaluation of cell construction has involved the use of planar X-ray imaging along with cell disassembly as complimentary techniques. Planar X-ray imaging provides a composite view of the cell, but it is difficult to evaluate individual components within the cell.

Cell disassembly is complicated for some primary cells due to the reactive and volatile nature of materials within them necessitating disassembly under an inert atmosphere and thus complicating traditional methods of cell assessment. In addition, cell disassembly will not reveal features within cell components such as voids or cracks. High-resolution X-ray Computed Tomography offers a powerful non-destructive approach for investigating cell internal construction capable of resolving individual components and interfaces without the need to conduct destructive cell disassemblies. This technique is applicable to most commercially available cells including: lithium primary cells, lithium ion cells, alkaline cells and rechargeable alkaline cells.

John Harmon, Ph.D., P.E. is an engineer with Exponent's Mechanical Engineering and Materials/Metallurgy practice. Since joining Exponent, Dr. Harmon has worked on the characterization and failure analysis of batteries for corporations and government agencies. Dr. Harmon's primary research interests include reliability assessment and failure analysis of batteries.

Contact John Harmon at 650-688-7064 or jharmon@exponent.com.

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Calendar of Events

August
- *16-20* - **APCO**, Las Vegas, Nev.

September
- *30-Oct 2* - **Batteries 2009**, Cannes Mandelieu, France

October
- *20-21* - **Battery Power 2009**, Denver, Colo.
- *20-21* - **Thermal Management & Technology Symposium** (co-located with Battery Power 2009), Denver, Colo.
- *29-30* - **Remote Conference & Expo**, San Antonio, Texas

November
- *12-13* - **5th Lithium Mobile Power**, Albuquerque, NM
- *30- Dec 4* - **MRS Fall**, Boston, Mass.

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