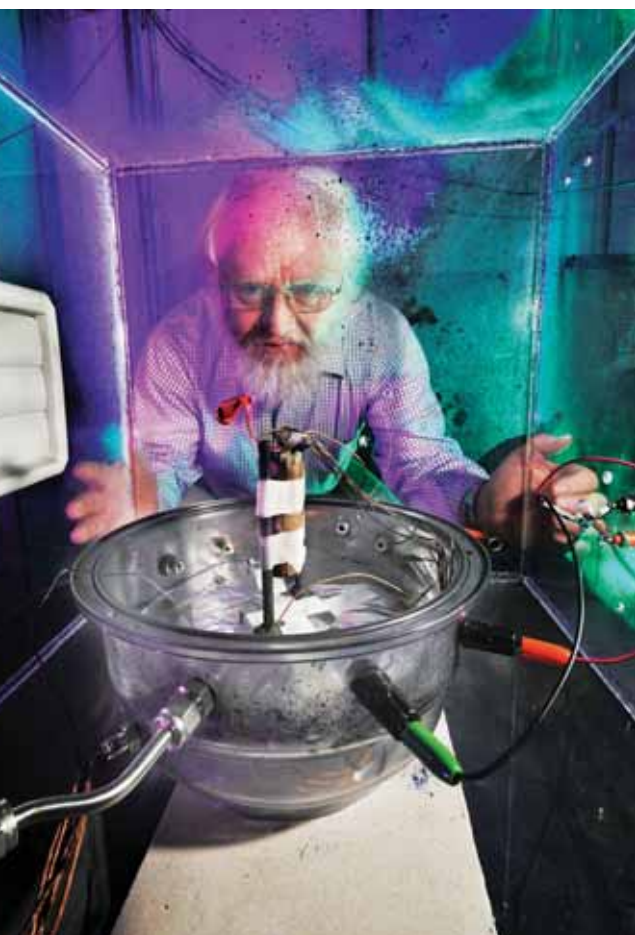


BATTERY POWER PRODUCTS & TECHNOLOGY

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

Sandia Researchers Damage Batteries to See How Much Abuse They Can Take



Sandia researcher Peter Roth prepares to blow up a battery to see how robust it is. The work is part of the DOE-funded FreedomCAR program.

Researchers in the Power Sources R&D group at Sandia National Laboratories have been driving nails into batteries, heating them to extreme temperatures, overcharging them and putting them into some of the most adverse conditions possible to see how much abuse they can take before they blow up. For certain types of lithium-ion batteries the answer is a lot.

The research is part of the DOE-funded FreedomCAR program that is looking at lithium-ion batteries to be part of hybrid electric-gasoline powered vehicles and eventually plug-in hybrids.

Current hybrid vehicles run on gasoline and use nickel-metal hydride batteries as the energy storage device for the electric motor. The intent of the battery portion of the FreedomCAR program is to replace the older type batteries with safe lithium-ion batteries that have six times the energy density of lead-acid batteries and two to three times the energy density of nickel-metal hydride batteries.

"Lithium-ion batteries, generally found in laptop computers and power tools, have greatly improved over the past few years," said Peter Roth, lead researcher for Sandia's FreedomCAR battery efforts. "In fact, they have improved so much that we expect to see them in hybrids later this year and possibly even in short-range plug-in hybrids within two years."

He notes the battery industry has made great strides in manufacturing safe, long-lasting, and affordable batteries. Sandia has played a role in assuring that the lithium-ion batteries are indeed safe and can operate for long periods of time. Sandia is a National Nuclear Security Administration (NNSA) laboratory.

One way Sandia researchers have helped determine how safe and long-lasting batteries are is by testing them in adverse situations to determine when and how they can fail or leak their electrolyte.

The Sandia research group obtains batteries and battery materials from research laboratories, like Argonne National Laboratory, and companies that manufacture and sell batteries. They then study the stability of the materials, their flame-retardant performance, high-temperature integrity of separators between the cathode and anode, and general thermophysical properties.

Story continued on page 20

An Integrated Overvoltage Protection Controller Dedicated to USB Charging Protection in Portable and Consumer Devices

ON Semiconductor has introduced the NCP361, an integrated overvoltage protector dedicated to USB charging applications for portable and consumer devices, such as cell phones, MP3 players, set top boxes and computers.

The NCP361 uses an internal P-channel FET, making the need for an external device unnecessary and thus reducing the system cost and the printed circuit board (PCB) area of the application board. If overvoltage from a wall adapter occurs, causing the input voltage to exceed the overvoltage threshold, the NCP361 instantaneously disconnects the output from the input to protect the downstream system for optimal protection. The NCP361 offers lower quiescent current than competitive ICs and very low current consumption at 20 microamps (uA).

For added protection, the NCP361 features overcurrent protection at 750 milliamps (typical). It has a negative-going flag output that alerts the system that a fault has occurred. The enable pin allows this overvoltage protection (OVP) device to be forced to an off-state. It also offers protection of VBUS up to +20 V, a more precise voltage threshold than discrete zener-based devices.



INSIDE

Battery Power 2008
Conference Preview p 8

Key Considerations in Battery
Charger Design p 14

Taking Charge of Counterfeits
p 16

Going Green Boost Profits:
A Win-Win Paradigm Shift p 17

PRODUCTS & SERVICES



New Batteries
On the Market p 3

Charging & Testing p 4



Integrated Circuits &
Semiconductors p 6

Power Conversion p 11

Power Supplies p 12

Battery Components p 13

DEPARTMENTS

Industry News p 18

Calendar of Events p 22

Marketplace p 22

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QUALLION

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Since 1998, Quallion has delivered custom battery solutions for demanding applications. From medical implants to high voltage power supplies, Quallion leads the Lithium ion battery industry in safety, reliability and performance. Drawing upon its unique ties to the Japanese Lithium ion battery market, Quallion now offers new battery solutions to the Heavy Duty Truck Market. Enabling technologies such as the Matrix™ Battery Design, Zero-Volt™ capability and SaFE-LYTE™ offer proven battery solutions that can pass the most aggressive test conditions, including full crush and constant overcharge.

Quallion's Matrix™ Battery System was designed specifically for the vehicle market. The concept is based on matrix arrays of 18650 Li ion cells arranged in series to establish voltage, and strings of cells configured in parallel to establish capacity. The advantage of this approach is nominal use of control electronics and cell redundancy for efficient increases in reliability and survivability. Utilization of commercial grade 18650 cells offers the greatest cost effective solution and the highest variability of chemistry configuration as the cells are interchangeable in the Matrix™.

Quallion was founded by biotechnology entrepreneur and philanthropist Alfred E. Mann and Dr. Hisashi Tsukamoto.



(Top) Quallion's new 48.8V Matrix™ Module (4.2kg) comes in 7.5Ah, 9.5Ah and 12.5Ah configurations.

(Above) This 72Ah matrix-design pack offers as a lead-acid replacement for military applications for high power or high energy.

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New Batteries on the Market

PowerGenix Targets Toxic Battery Market With New Line of Rechargeables



PowerGenix, a manufacturer of safe, non-toxic, rechargeable nickel-zinc (NiZn) batteries, has met the European Union's requirements for the Reduction of Hazardous Substances (RoHS), as well as the 2006 Battery Directive. PowerGenix's line of rechargeables serve as high-cycle, high-power replacements for existing sealed rechargeable battery technologies including nickel-cadmium, which is being phased out by manufacturers and retailers in North America, the EU and Asia due to toxicity concerns.

The RoHS directive bans new electrical and electronic equipment containing more than agreed levels of toxic heavy metals such as lead, cadmium, mercury and hexavalent chromium from the EU market. In parallel, the Battery Directive places even more aggressive restrictions on the use of cadmium and mercury. The general RoHS directive became mandatory in the EU during 2006 and is being adopted in California and is under consideration in parts of Asia.

PowerGenix's batteries contain no lead, cadmium or mercury, common additives for electrode stabilization, presenting a cleaner environmental alternative to lead-acid and nickel-cadmium batteries. In addition to being non-toxic and inexpensive, nickel and zinc also allow for repeated recycling while still maintaining their physical properties and performance.

During lab testing at an independent analytical laboratory, PowerGenix's battery cells were separated into multiple samples. Results showed that all components are well below concentrations required for compliance with both RoHS and the EU Battery Directive.

Power Air Introduces ZPAC 40 Zinc Air Powerpack

Power Air Corp. has introduced its first commercial product, the ZPAC 40 Zinc Air Powerpack. The ZPAC 40 provides the equivalent energy to 40 AA alkaline batteries, in a lightweight, compact, recyclable "CellPAC" that fits into a shirt pocket.

The ZPAC 40 can be used anywhere, anytime, to provide safe, personal portable power without the need of an electrical outlet. It provides extra runtime for travel, emergency, remote and recharging power applications by supplying energy via a mini-USB port. Adaptors are available to connect to most devices that do not have mini-USB ports. The company expects to begin shipments in October.



Lithium Technology Corp. to Launch Advanced New Product Line

Lithium Technology Corp. (LTC) has launched its new product line of high energy density lithium iron phosphate (LiFePO4) cells, the largest cells of their kind in the world. This product line is aimed at answering the need of the electrical vehicle (EV) and the plug in hybrid vehicle (PHEV) markets.

The company's new product line offers cells ranging from 8 Ah to 40 Ah, which joins the existing high power line that offers cells ranging from 6 Ah to 35 Ah. The company's com-



plete portfolio of products includes various cell chemistries and large batteries.

LTC's large format technology allows for the development of safer battery systems with a lower number of cells. The weight of the battery is decreased while performance and safety monitoring capabilities are increased. The battery management system (BMS) precisely monitors fewer cells, keeping them in balance for best performance and preventing damage to the battery due to over voltage, under voltage, over temperature and short circuit.

EnerSys UPS Solutions with DataSafe 16 Volt Front-Terminal UPS Batteries

EnerSys has introduced the first 16 V front-terminal battery for UPS markets. The DataSafe 16 V battery provides more power in less space, easier access and cost benefits.

The DataSafe 16 V UPS battery is available in two sizes: 500 watts per cell (WPC) and 925 WPC. DataSafe 16 V front-terminated batteries require 44 square feet to support a typical 750 kVA UPS system with a full 15 minutes of run time. The VRLA



batteries used for UPS applications are designed to back-up the primary power system, typically supplying power for 15 minutes until the backup generator is fully operational. Until now, these batteries were limited to 12 V batteries.

The DataSafe 16 V batteries require 20 percent less space and scale easily to large capacity systems, minimizing the number of strings needed for larger UPS systems thereby reducing costs. The DataSafe 16 V battery fits within many existing cabinet designs, eliminating additional expenses for costly slide-out trays or to upgrade from 12 V batteries.

With complete front access and up to 50 percent fewer connections, DataSafe 16 V batteries offer more simplified installation, access and maintenance than top-terminated 12 V batteries. Additionally, less complicated wiring helps reduce costs.

New Environmentally Friendly Thin-Film Batteries Provide "Green" Performance

Cymbet Corp.'s new EnerChip family of thin-film battery devices offers something unique in battery technology: environmentally friendly, "green" performance.

Environmental friendliness is a key EnerChip attribute, since the product is designed to eliminate battery replacement and last the life of the device it powers. As a solid-state device, the EnerChip is lead-free and contains no hazardous materials, flammable solvents or liquids that can harm the user or the environment, therefore eliminating or reducing some end-of-life product costs.

The EnerChip's small form factor and highly rechargeable, solid-state, thin-film advancements can be economically and reliably integrated as an embedded device or as a surface-mounted component. Cymbet's EnerChip family is well suited for applications where back-up power is needed to maintain the settings of microcontroller memories, real-time-clocks and SRAM during power loss or power failures.

All EnerChip products can be lead-free reflow soldered (260°C) using automated high-speed assembly processes, significantly reducing assembly cost. The devices offer a fast recharge time (under 30 minutes to 80 percent), are capable of greater than 5,000 charge/discharge cycles and do not suffer from the self-discharge limitations associated with super capacitors or shelf-life limitations common to chemical batteries. Currently, product is available in capacities of 12, 50 and 85 uAh.

If you are interested in new battery technology and materials, you'll want to check out

Battery Power 2008, September 4-5, in New Orleans.

The preliminary brochure is available online at www.BatteryPowerOnline.com



New Battery Charger for Handheld Barcode Imagers Mounts to Wall or Countertop

Pepperl+Fuchs has introduced the ODZ-MAH-charger, a battery charger designed specifically for use with GRIP2 and GRIP3 model barcode reader handles. The charger is easily mounted to a wall or countertop, provides LED indication of the battery charge status and is available with an optional Bluetooth modem.

This battery charger has a footprint of 9.125 inches by 3.4 inches by 2 inches, and weighs 4.8 oz. It provides a charge time of approximately three hours for barcode readers using GRIP2 handles, and six hours for barcode readers using GRIP 3 handles. A 5 VDC power supply is included.

Testing System for Hybrid Electrical Vehicle Battery Packs

Arbin's HVBT, bundled with MITS-Net control software, delivers advanced tools to aid in the research and development of electric and hybrid electric vehicle battery packs.

Each main channel is completely isolated, which enables the system to run tests on each cell in a battery pack independently. Users can now get capacity values from charge/discharge tests, balance cells to a desired level, and run other diagnostic tests on individual cells within the pack without having to disassemble the battery.

HVBT features Arbin's MITS-Net Control software. MITS-Net unleashes the full potential of HVBT by providing several built in control types: constant current, C-rate, load and power, current ramp and staircase and CCCV. Temperature sensor inputs can also be used to measure and record temperature data, as well as manipulate test schedules. MITS-Net has a built-in safety net to ensure system reliability and safety for both the battery pack and the machine. Arbin's MITS-Net software also includes a data conversion macro allowing users to export their data.

SBT8050 Battery Life Test System for High Power Battery Modules and Packs

The SBT8050 is a 12-channel battery tester from PEC, that is well suited for testing and evaluating HEV as well as industrial battery modules and packs. The equipment is designed for both laboratory and production scale applications including formation and ranking.

By adding more test channels to the master controller and more test systems to the same network, the number of channels can easily be expanded.

Preparing a test can be done off-line on an existing desktop PC, running PEC's LifeTest application. The end user can configure the specific test by filling out the event table with the individual cycle steps. For complex or HEV cycles, the software allows a direct import to the events through a preformatted CSV file.

The system supports current, voltage, power and resistive based loads, with a minimum pulsing width of 1 msec. The SBT8050 system will give ultra fast switching capabilities between charging and discharging modes, guaranteeing the accuracy needed.

Every channel is independent, microprocessor-controlled and features a dynamic electronic load to obtain very high accuracy, reliability and flexibility. Using a CANbus or SMBus interface the unit can communicate with the battery module or pack to obtain additional data, such as the individual cell voltages and temperatures.

The power MOSFETS are mounted on a central liquid cooled heatsink that will evacuate the discharging heat to a central heat exchanger. This heat exchanger is either built into the rack or can be mounted outdoors. In large installations, energy recuperation can be considered as well.



EnerSys Charges Ahead with EnForcer Line of Battery Chargers

EnerSys has renamed their entire line of motive power chargers, EnForcer chargers. At the top of the EnForcer line is the high frequency (HF) charger. The EnForcer HF delivers a minimum of 95 percent power factor and a high efficiency rating of over 90 percent to save power and money. Because EnForcer HF chargers can automatically deliver and adjust charge rates based on the constant diagnosis of the battery, the EnForcer HF charger can manage the battery's heat and over-charge. This means longer battery life and less battery maintenance requirements.

The EnerSys EnForcer charger line also encompasses traditional charger technologies like the SCR, ferroresonant and a SCR/ferroresonant combination chargers. Well suited for light to heavy applications, the EnForcer SCR charger offers precise control of output current in order to deliver a complete charge. The SCR control also allows the user to select the time and day of the week for equalization charges required to optimize battery life, making the EnForcer SCR charger truly automatic. The EnForcer SCR can be used in an opportunity charging mode, which can reduce or even eliminate battery changes in multi-shift operations.

The EnForcer Ferro charger is a fully automatic, ferroresonant charger known for consistent performance. The EnForcer Ferro provides battery protection through voltage mismatch protection, manual low-voltage over-ride, overload protection and reverse polarity protection. This charger is fully automatic and will provide the required weekly equalization charge without user intervention.

EnForcer Hybrid chargers offer a unique combination of the SCR charger technology with the efficiency of ferroresonant chargers which ensures a complete recharge under virtually all operating conditions. These chargers are designed for complete recharges of both standard and high-gravity batteries in both hot and cold environments for greater battery performance, longer battery life and higher productivity. The EnForcer Hybrid is also very energy efficient, providing operational savings.

Tystor AB's New Series of Watertight Lead Acid Battery Chargers

The new Tystor WP series starts with a 12 V/20 A, 18 V/10 A and 24 V/10 A charger. It is watertight, power saving and accepts a worldwide input of 100 to 240 VAC.

The chargers are built in a robust aluminum box. The chargers feature a seven-step charging algorithm supported by a built-in microprocessor in cooperation with an external temperature sensor and fully compensated for voltage drops of output cable.

Additionally, the chargers come with an output connector for an external indicator panel, energy meter or alert information. By switch selectable functions for normal charge, record charge or as a stand alone supply.

BATTERY POWER PRODUCTS & TECHNOLOGY ANNUAL RESOURCE GUIDE

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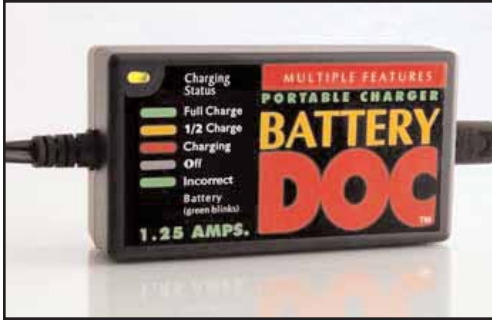
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Charging & Testing

Wirthco Engineering, Inc. Introduces Battery Doc Sport Portable Battery Chargers/Maintainers



WirthCo Engineering, Inc. has introduced the Battery Doc Sport portable battery chargers/maintainers. The Battery Doc Sport is a 1.25 amp portable electronic switching charger that safely charges and maintains lead acid or gel-cell 12 volt batteries for peak operating conditions.

The Sport has reverse polarity and short circuit protection, two charging-current settings and a three-color LED charge indicator. Battery clips, motor-

cycle plugs and lighter adapters fit in the Battery Doc E-Z Use universal connector terminal, standard on each Battery Doc product. It also comes with its own carrying case.

The Battery Doc Sport is a UL 1950, cUL, TUV and CE-listed portable multiple-feature charger that is well suited for 12 volt automotive, off-road, marine, commercial, agricultural and industrial lead acid or gel-cell 12 volt batteries.

ViaSensor BA-1000 Battery Electrode Health Analyzer

The ViaSensor Battery Electrode Health Analyzer (BA-1000) is the first instrument of its kind that can measure entropy and enthalpy in an electrochemical cell. The ViaSensor BA-1000 is based on the electro thermal measurement system (ETMS).

The voltage of a half-cell or a battery at rest, known as open circuit voltage (OCV), is measured as a function of temperature. The equilibrium open-circuit voltage is the difference in chemical potential of lithium atoms in the anode and in the cathode. By making measurements at different temperatures, the enthalpy and entropy contributions to the free energy of intercalation can be determined independently as functions of the lithium concentration or the state of charge.

The BA-1000 is designed to study Li-ion and other battery chemistries in small form factors such as coin cells or small laminated sheet type cells. Future models will incorporate other battery form factors and sizes.

The ViaSensor BA-1000 battery analyzer is an accurate alternative to other sometimes difficult and expensive techniques such as X-ray diffraction, neutron diffraction and calorimetry. The BA-1000, with its very small footprint will save much needed laboratory space, technique-specific expertise and money.



Aeroflex Plainview Introduces a Battery Electronic Unit Family

Aeroflex Plainview has released their Battery Electronic Unit (BEU) family of lithium-ion (Li-Ion) cell balancing products. Aeroflex's BEUs promote and facilitate the safe use of large Li-Ion batteries on spacecraft and aircraft missions of greater than 20 years. Employing DC/DC converter technology inte-

grated with Aeroflex's legacy RadHard MIL-STD-1553 databus and ASIC solutions allows Aeroflex to deliver a low mass, energy conservative sub-system that is well suited for satellite programs that desire the benefits of Li-Ion technology.

The four Aeroflex BEU products all offer cell balancing to within ± 5.0 mV, cell voltage monitoring accuracy ± 10 mV, total battery voltage monitoring accuracy ± 0.3 percent of full scale, MIL-STD-1553B telemetry and discrete output lines for critical signaling.

Aeroflex is already planning an addition to the BEU family and will be offering solutions to support eight cell battery applications. Evaluation boards will be announced in the second quarter of 2008.

Battery Power Products & Technology Magazine is now available electronically! Download this issue of Battery Power at www.BatteryPowerOnline.com.

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Stand-Alone, Multicell Li+ Battery Fuel Gauge to Integrate LED Drivers and a Pushbutton Input

Maxim Integrated Products has introduced the DS2788, a stand-alone fuel gauge to integrate LED drivers and a pushbutton input for multiple Li+ cells into a single IC. Designed for the tight space of a battery pack, it is packaged in a lead-free 14-pin TSSOP. The DS2788 is well suited for displaying the remaining battery capacity of power tools, ebikes, portable household appliances and ultra-mobile PCs.

The DS2788 reports a battery pack's remaining capacity in both "mAh remaining" and "percentage of full" to the host system, and it displays the results using either four or all five of its integrated LED driver outputs. Capable of directly sinking current, each LED driver pin requires a single resistor to set its current in the LED display, thus reducing board space and system cost. A programmable I/O pin that can be configured as a debounced-pushbutton input enables the LED display.

To reduce the need for software development and shorten time-to-market, the DS2788 utilizes an embedded fuel gauge algorithm to calculate remaining capacity based on precision coulomb count, discharge rate, temperature and cell characteristics, along with precision battery-current and voltage measurements. The fuel gauge accurately monitors battery packs with multiple Li+ cells by allowing internal gain calibration of an external voltage-divider that feeds the battery-voltage-measurement input. To conserve battery power, a pin for driving external FET switches enables the voltage-divider only during voltage measurement. An estimate of the battery pack's capacity is communicated to the host over a 1-wire interface, which reduces the number of necessary contacts between the pack and the host to as few as three.

Additionally, the DS2788 provides 16 bytes of EEPROM for the exclusive use of the host system and/or pack manufacturer. This EEPROM can be used to facilitate battery lot and date tracking, as well as for the nonvolatile storage of system or battery-usage statistics. A unique, factory-programmed 64-bit ROM ID assures that no two DS2788s are alike and enables absolute battery-pack traceability. Prices start at \$2.72 (1,000-up, FOB USA).

TI Expands Battery Fuel Gauge Family for Smart Phones and Mobile Internet Devices

Texas Instruments, Inc. (TI) has introduced two new battery fuel gauge devices with integrated low-dropout regulators (LDOs) for smart phones, mobile Internet devices and media players with embedded or removable batteries. The new system-side and battery pack-side fuel gauges build on TI's family of integrated circuits (ICs) that predict battery life with 99 percent accuracy to extend run-time, protect data and provide a better user experience.

The bq27510 system-side battery fuel gauge with Impedance Track technology incorporates a LDO and can be powered directly from the battery cell with less external circuitry, regardless of system voltage. In addition to simplifying design of the fuel gauge into the host system, it accurately measures remaining capacity data from a

device's single-cell Li-Ion battery to predict remaining battery capacity under all conditions, even as a battery ages.

In addition to the system-side battery fuel gauges, TI's new bq27540 device resides directly on the embedded or removable battery pack to intelligently manage available power that resides in the battery. The bq27540 will support SDQ, HDQ and I2C communication protocols to allow the system to read important information from the battery.

Accurate fuel gauging helps systems intelligently manage available power, alert the user of system operating-time and extend the run-time of the system as far as possible. Mobile application processors, such as TI's OMAP 3 platform with SmartReflex power and performance technologies, rely on accurate battery data to better optimize the mobile device's complete power operating system. As with the bq27500, the bq27510 and bq27540 provide an accurate reserve energy warning, which allows a system to save data to non-volatile memory before the system shuts down, so work is not lost when a battery runs to empty.



Atmel Introduces AVR MCUs with Unique Combination of USB, Battery Charging and Analog Features

Atmel Corp. has announced a new AVR microcontrollers combining USB controller and high performance analog features. The ATmega16U4 and ATmega32U4

reduce system cost in battery powered devices such as gaming accessories.

Battery powered devices can take advantage of being connected to a USB port to recharge. However, modern batteries require sophisticated algorithms to accelerate and optimize charging, while USB brings further constraints on the battery charging since it is



limited both in the voltage and the maximum current it can provide. The new AVR devices allow optimized battery charging combined with USB functions. The analog to digital converter can be used to sense motion or pressure in the end application and the high-speed PWM is well suited for low cost motor control.

Gaming peripherals, such as sophisticated joysticks also require a number of analog to digital conversion channels and several PWM channels to drive force-feedback motors. The new devices have a rich feature set that address those needs and optimize the global system cost. This includes a 10-bit ADC with 12 channels; a built-in temperature sensor allowing compensating thermal effects on analog performance; a programmable gain x1, x10, x40 and x200 giving more flexibility to measure differential voltages for current monitoring. A high-speed timer with three PWM channels with complementary outputs and programmable dead-times allows 8-bit resolution PWM with a frequency of 500 kHz, up to 11-bit resolution PWM with a frequency over 60 kHz.

A hardware flow control on the USART eases the connection to other devices when bridging with USB at high baud rates. Digital inputs with TTL thresholds ease interface with 3 V devices in mixed 5/3 V applications. An on-chip 3.3 V regulator can deliver up to 50 mA and supply external devices in USB powered applications. Jitter and accuracy of the on-chip 8 MHz calibrated RC oscillator can support serial communication without crystal. All devices include a hardware multiplier, one USART, one SPI, one TWI, two 8-bit and two 16-bit timers with PWM and 26 programmable I/Os.

Three New Power Management ICs Can be Factory Customized to Support Hundreds of Application Specific Configurations for Ultra-Mobile Devices

While lithium-ion (Li-Ion) batteries offer many advantages for portable consumer electronics, they require extremely accurate charging current and output voltages to optimize battery life and performance. To address this need, Freescale Semiconductor has introduced a family of Li-Ion battery charger ICs designed to provide high performance and accuracy, as well as enhanced configuration flexibility.

Batteries in Action

Electrochem Powers GPS Tracking for Iditarod Trail Sled Dog Race

Electrochem's lithium battery solution was chosen to power satellite tracking technology for the racing teams in the famous Iditarod Trail Sled Dog Race. The manufacturer of the tracking device, IonEarth LLC, selected Electrochem under a 10-year agreement with Iditarod to ensure power to the bi-directional GPS tracking devices, which will permit organizers, volunteers, media and fans to follow the movement of equipped mushers in real-time throughout the race.

Electrochem's BCX C-size battery solution is expected to perform in some of the most brutal conditions on earth, including a course that weaves through woodlands, rivers, mountains, tundra and coast, in temperatures down to -50°F and severe winds and snow. The race course from Anchorage to Nome covers 1,150 miles in 10 to 17 days and as such is tagged the "Last Great Race on Earth".

"Electrochem's high performance lithium batteries were especially chosen for their extended operation in very cold weather," said Jerry Miller of IonEarth. "The devices will transmit critical information including position, speed, heading, altitude and temperature through the Iridium satellite network to a central server every 15 minutes. The battery's well-known quality and reliability makes certain this operation takes place."

The devices were rolled out to 20 of the competing sleds this year when the race began March 1st, with full roll-out expected in 2009.

"The battery solution from Electrochem is a critical component of this system for Iditarod," said Stan Hooley, executive director of the Iditarod Trail Committee. "This will be the first time we have deployed satellite tracking devices and Electrochem is the battery of choice trusted to power them."

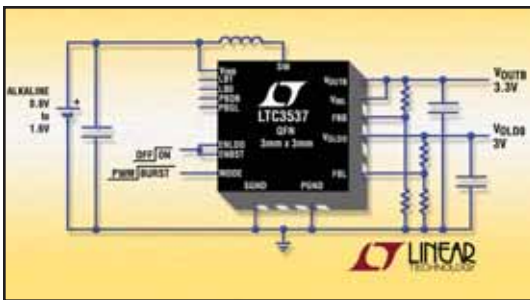


Freescall's MC34671, MC34673 and MC34674 single-input autonomous battery charger ICs offer output voltage accuracy of ± 0.4 percent over temperature and charging current accuracy of ± 5 percent over temperature. The ICs can be customized to create hundreds of configurations to address a wide range of portable and ultra-mobile device needs. A designer can select features and specifications, such as pin-out, feature set, charging parameters and LED indication, and Freescall can deliver customized charger ICs by programming them at the end of the manufacturing process.

The programming flexibility of the Li-Ion battery charger devices enables Freescall to create highly tailored charger ICs for specific application requirements. Target applications for Freescall's battery charger IC family include cell phones, personal media players, navigation systems, digital still cameras, as well as travel chargers for these devices.

Built using Freescall's advanced SMARTMOS process technology, the battery charger ICs are designed to deliver up to 1.2 A of charge current to single cell Li-Ion or Li-polymer batteries. The battery charger input voltage can come from an AC adapter or a USB port power source. The high input voltage capability (up to 28 V) is designed to eliminate the need for an external input over-voltage protection circuit required in handheld devices, which helps reduce system cost and board space.

To provide developers with smaller, lighter charger IC products for space-constrained portable designs, each battery charger IC comes in a low-profile 2 mm by 3 mm by 0.65 mm ultra-thin dual flat no-lead (UDFN) thermally enhanced package.



600 mA, 2.2 MHz Synchronous Boost Regulator with Output Disconnect and LDO

Linear Technology Corp. has unveiled the LTC3537, a 2.2 MHz, current mode synchronous boost DC/DC converter with integrated output disconnects plus an LDO. The LTC3537's boost converter's internal 600 mA switches can deliver output voltages as high as 5.25 V from an input voltage range of 0.68 V at start-up (0.5 V when running) to 5 V, making it well suited for Li-Ion/polymer or single/multicell alkaline/NiMH applications. The LTC3537 can deliver up to 100 mA of continuous output current (at 3.3 V) from a single alkaline cell or 300 mA from a dual cell input. Synchronous rectification enables efficiencies of up to 94 percent while a 2.2 MHz switching frequency minimizes the total solution footprint.

The second channel, a 100 mA LDO, has an input range of 1.8 V to 5.5 V and can deliver outputs as low as 0.6 V. It can be driven by either the input voltage source or the boost converter's output, providing design flexibility. The LDO channel's 100 mV dropout voltage and 24 db ripple rejection offer a compact and low noise secondary output.

With both channels in operation; the Burst Mode operation or the Boost Channel lowers quiescent current to 30 μ A, providing extended battery run-time in handheld applications. For lower noise operation, the Burst Mode feature can be disabled. Other features include Power Good indicators for both channels, a low battery comparator and thermal overload protection. The combination of its high switching frequency and 3 mm by 3 mm QFN package provides a very compact solution for dual rail handheld applications.

Littelfuse Silicon Diode Array Improves Communication Line Protection from ESD and Other Overvoltage Threats

Littelfuse, Inc. has expanded its SP72x series of SCR diode arrays for electrostatic discharge (ESD) and other overvoltage protection of telecom and datacom interface circuits. The SP725 is particularly well suited for protection of micro-processor/logic inputs, data bus lines, analog device inputs and many other voltage clamp applications.

The thyristor-based design of the SP725 silicon diode array utilizes two bipolar SCR/diode structures to protect each of the four inputs (typically external signal or bus lines). Its operation is similar to what is known as a steering diode, but it has lower capacitance and leakage current for a given impulse rating. This means less chance of communication signal distortion. Each SCR structure is triggered on by any current that biases the SCR into conduction against the supply rails. These internally

Integrated Circuits and Semiconductors continued on page 10



Hi-MECHA



Stacking Machine



Sealing Machine

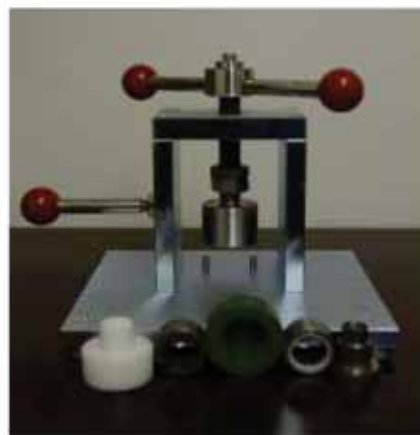


Forming Machine

Hohsen



Manual Crimper



Coin Cell Disassembler

Pred Materials Offers a Line of Products for Battery Manufacturers

- Production equipment from lab to pre-production scale
- Hand tools
- Coin cell parts
- Foils and chemicals

Pred Materials and Hohsen Corporation are pleased to announce the availability of pre-production battery manufacturing equipment from Hi-Mecha of Japan. These include the featured Stacking, Sealing, and Forming machines above. All Hi-Mecha equipment so far has been customized for each manufacturer's needs. Some standardized machines will soon be available.

In addition to these large-scale systems from Hi-Mecha, we are pleased to present these manual tools:

- * our Manual Coin Cell Crimper, available for our standard coin sizes (2016, 2025, 2032, 2320)
- * our new Coin Cell Disassembler which allows for dismantling a coin, doing minimal damage to internal elements, is newly available for sizes 2016, 2025 and 2032.

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email: steve@predmaterials.com

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BATTERY POWER 2008

September 4-5
New Orleans, La.

Battery Power 2008, an international conference highlighting the latest developments and technologies in the battery industry, will be held September 4-5 in New Orleans, La., in the heart of the French Quarter.

This sixth annual event will feature more than 40 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, circuit protection, charging and testing systems, battery health, as well as the latest market trends affecting the industry.

The conference is designed for battery manufacturers, distributors, OEMs, design engineers and power integrators to learn the latest capabilities, design issues, trends and market forecasts in batteries and battery-powered products and systems.

Pre-Conference Events - September 3rd

Workshops

Li-Ion Battery Safety, Maintenance, Charging and Fuel Gauging, Texas Instruments

1:00 pm - 5:00 pm

The workshop will start by covering Li-Ion battery characteristics including self-discharge, useable capacity and battery impedance, Li-Ion battery cell safety and UL testing and Li-Ion battery safety requirements. Basic battery maintenance and transportation will be discussed, as well as Li-Ion battery pack electronics safety and design. Attendees will also learn about front-end safety and power path management charging, which allows to charge the battery while powering the system simultaneously.

Developing Flexible Linear and Switching Charger Designs, Microchip Technology, Inc.

1:00 pm - 5:00 pm

When designing battery systems for portable applications, topology selection and feature set can make or break the success of new products. This four-hour seminar will explain the development of flexible linear and switching charger designs. Embedded charger design and the advantages of certain topologies over others will be discussed, in light of how to meet the many new global standards of today.

Habitat for Humanity

7:30 am - 3:15 pm

Join Battery Power 2008, Battery Power Magazine and the New Orleans Area Habitat for Humanity to help build a house. New Orleans Area Habitat for Humanity (NOAHH) is leading an unprecedented rebuilding effort, as the largest homebuilder in New Orleans. In 2008, NOAHH plans on building hundreds of new homes in Orleans, Jefferson, St. Bernard and Plaquemines Parishes. No Experience Necessary! Battery Power 2008 will arrange transportation from the Astor Crowne Plaza hotel to and from the work site and lunch.

Register Early and Save \$\$\$

Register by May 9th for a reduced rate of \$795, that is a savings of \$500! Battery Power 2008 also offers team discounts. Register two attendees and \$100 is automatically deducted from each attendee's registration fee; register three or more attendees and \$200 is automatically deducted from each attendee's registration fee. Government and military discounts are also available.

Register online at www.batterypoweronline.com/bp08_reg.php

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Benefits of Attending:

- Optimize your system performance and dependability
- Assure compliance with latest safety requirements and best practices
- Discuss your specific system needs with technology experts
- Improve system longevity and power delivery
- Maximize return on battery technology system investment
- Find out the latest market, pricing and manufacturing trends worldwide

Who Needs to Attend:

- CEOs interested in leaning the latest investment and market trends
- OEM design engineers of electronic products and battery powered systems
- Developers and integrators of battery products and systems
- System engineers of standby, backup and UPS
- System integrators, vendors, distributors
- Manufacturers of batteries and battery packs
- IC and chipset providers
- Manufacturers of charging, monitoring and testing equipment
- System engineers of electric vehicles
- Product managers seeking new applications and partnering opportunities
- Charging and testing system component providers
- Specialized energy materials suppliers
- Battery component providers

Hotel Information

Battery Power 2008 will be held at the Astor Crowne Plaza located in the heart of the French Quarter. A special room rate of \$169 is available for Battery Power 2008 attendees. Be sure to reserve your room by August 13, 2008, to receive this special rate. Be sure to mention Webcom Communications when reserving.

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Preliminary Program

Market Trends – Markets, Technologies and Major Players

Increasing demand on energy and energy efficiency continues to drive battery technology innovations in many markets. Hear an overview of key markets, leading technologies and major players in new and improved battery technologies. Critical technology and market barriers will be discussed in each of the three areas, and a review of corporate, private and government investments in various battery technologies will also be included.

Ying Wu, Ph.D., Senior Analyst, Lux Research, Inc.

Venture Capitalist Investor Panel

This exciting session brings together some of the industry's leading VC investors to provide the audience with their insight and a chance to interact with some of the most knowledgeable investors in the market today. Leading investors are funding fast growing battery companies and here you will find out about their investment criteria and how they go about making investments.

Richard Baxter, Ardour Capital Investments, LLC

William Lese, Braemar Energy Ventures, James Kim, CMEA Ventures

Matt Jones, Nth Power, Mark Cox, New Energy Fund, LP

International Regulatory Issues

International regulatory requirements impact the design, cost and time-to market of cells and batteries. This presentation will focus on the worldwide regulatory certification of cells and batteries used in the portable consumer market. Discover the legal and market driven requirements in North America, Europe, Asia and other regions.

Jody Leber, Program Manager, Motorola Product Testing Services

Lithium Ion Cell Evaluation – Going Beyond the Manufacturer's Data Sheets

A cell manufacturer's data sheets typically give the performance of cells under conditions that encompass the majority of usage conditions that are a reflection of their customer base. This presentation will show the performance for a variety of lithium ion cells highlighting those that can deliver under unusual conditions.

Chris Turner, Director of Battery Technology, Nexergy, Inc.

Understanding Battery Pack Performance Issues

Most portable devices, electric hybrid vehicles, and energy storage applications require proper configurations of battery packs. Besides typical cell operating and performance issues, there are additional issues related to pack operation. In this presentation, we will discuss how to establish cell baseline behavior via testing and characterization, which is used to model cell performance. We will then discuss how cells in a batch can be characterized to assist us understand their variations and develop criteria to select cells for pack assembly.

*Matthieu Dubarry, Electrochemical Power Systems Lab
Hawaii Natural Energy Institute*

Technology to Prevent Counterfeiting in the Battery Industry

The worldwide battery industry is struggling to fend off the growing threat of counterfeits, an epidemic that contributes to an estimated \$500 billion in global trade. Kodak discusses this worldwide problem and the various needs of brand owners and battery manufacturers, and the high-tech solutions that are being deployed to prevent the rising tide of dangerous fakes.

Steven J. Powell, General Manager and Director, Security Solutions, Eastman Kodak Company

Valuable Lessons Learned from Controlled Battery Testing

Controlled laboratory testing can tell us about the suitability of a battery and its related subsystems for an intended environment. This presentation will give an overview of military and commercial compliance standards. This will be followed by a summary of qualification and reliability test methodologies used to validate the design, construction and manufacturing of batteries and subsystems.

*Gary Rohlke, Product Test Sales Manager,
Sypris Test & Measurement*

Optical State of Charge Sensing

*Joseph S. Accetta, Founder,
JSA Photonics Inc.*

Battery Pack Electronic Design for Lithium Based Products

*Michael Coletta, Principal Engineer,
Intersil*

How to Design System-Side Fuel Gauge For Portable Devices

*Jinrong Qian, Applications Manager,
Texas Instruments*

Charging Systems For High-Power Cells

*David Nierescher, CTO,
Micro Power Electronics*

Intelligent Battery Charging Technology

*John James, President and CEO,
GEM Power, LLC*

Fuel Cell Integration Into a Battery Electric Utility Vehicle

*Mark Anderson, Senior R&D Engineer,
Toro*

Evaluation of Atmospheric Plasma Surface Modification for Continuous Processing of Flexible Battery Components

*Rory A. Wolf, Vice President
Business Development,
Enercon Industries Corp.*

Implementing Charging Algorithms in Firmware

*Keith Curtis, Technical Staff Engineer,
Microchip Technology, Inc.*

Dual Mode Converter Maintains Output Regulation over Wide Input Range

*Robert Bell, Applications Engineering Manager,
National Semiconductor*

Performance Improvements of Electric Vehicle Battery Packs with Active Equalization

*Brian Kuhn, Founder and Senior Engineer,
SmartSpark Energy Systems*

Performance Comparison of Lithium Primary Batteries for High Temperature Operation

*Arden P. Johnson, R&D Manager,
Electrochem Commercial Power*

Domestic Manufacturing of Lithium Ion Cells

*Tibor Kalnoki-Kis, General Manager
Electro Energy, Inc.*

Cathode Materials for Lithium Ion Batteries

*Dr. Stefan Malcus, Manager
International Technology,
Toda Kogyo Europe GmbH*

Battery Charger Efficiency Standards and Strategies for Improvement

Pressure for efficient use of increasingly limited electric power resources together with ever increasing use of portable, battery operated electronic devices, has prompted interest by both users and government agencies in battery charger efficiency. This paper explores the existing and in-development battery efficiency standards and relates these to various battery charger design topologies. It presents methods for analyzing conversion efficiency and strategies for improvement.

*David Gunderson, Sr. Electronics Engineer,
Micro Power Electronics, Inc.*

Extended Run Backup Power for Critical Communications Networks – Battery/Fuel Cell Combinations

In combination with batteries, fuel cell technology can be used to improve reliability and significantly extend run times at mission critical sites when compared to battery-only configurations. As fuel cell technologies advance, more solutions are developed to combat power outages. Proton Exchange Membrane (PEM) fuel cell systems offer a compelling value proposition to telecommunications carriers and others who require highly reliable critical backup and remote power solutions.

Bill Shank, Vice President of North American Sales, IdaTech

High Rate Ni-MH Battery for Hybrid Electric Vehicle

Ni-MH battery can be used for electric vehicle applications but due to the high cost of Nickel and less energy density than the lithium ion battery therefore Ni-MH battery becomes a less possibility candidate for the EV use. This presentation concentrates on the cell design and manufacturing of the high rate Ni-MH cell for various electric vehicle batteries. The multi-cell battery design and testing results of Ni-MH electric vehicle battery will be presented.

David H. Shen, Ph.D., NEXcell Battery Co., Ltd.

New Safety Constraints of the Lithium Battery Charge

Following the new high rate requirement from portable devices manufacturers to decrease constant current charge sequence, new systems must be developed to guarantee a good safety level, despite the increasing diversity of the wall adapter performance. At the same time, a new requirement to supply external accessory from a lithium battery pack increases the difficulty to guarantee the same charge and discharge safety level. We will make an application comparison between the previous and the new generations of charge and discharge systems, taking into consideration these new safety requirements.

Bernard Remaury, Application Engineer, ON, Semiconductor

Advances in Characterization Techniques for Understanding Degradation and Failure Modes in Lithium-Ion Cells

A novel cross-sectioning technique has been developed that enables direct imaging and characterization of degradation mechanisms inside lithium-ion cells. Unlike conventional techniques that require harvesting of materials from a cell, this cross-sectioning technique preserves the electrode structure and the spatial relationship between the various components in the electrodes.

Quinn C. Horn, Managing Engineer, Exponent, Inc.

Key Roles of Carbon Materials in Power Sources

Carbon materials are essential component in the modern portable and stationary power sources. Chemical inertia and electric conductivity of carbon materials support their extensive use as conductive additive in most primary and rechargeable battery chemistries. Their properties and roles will be reviewed and discussed, and trends in development of new carbon materials will be emphasized.

*Jean-Yves Huot, PhD, Product Manager - Mobile Energy,
Timcal Graphite and Carbon*

More than 25 sessions have already been announced!

For a complete list and description of the presentations, please visit www.batterypoweronline.com/bp08_program.htm

triggered SCRs offer improved impulse protection compared to conventional diode offerings, and will serve a broad-range of applications.

Transients are diverted around the SP725 silicon diode array input lines to the power supply rails (or ground). Once the discharge current falls below the forward bias levels, the device stops conducting and returns the input lines to their previous condition. This design can protect up to 30 V and will protect at around one volt beyond the supply rail voltage (V^+ or V^-). The closest competing device protects at its breakdown voltage of 18 V.

A significant result of the SP725's broad voltage range is the ability of manufacturers to use it in different products employing different rail voltages. By comparison, Zener diode protectors can only be used on rails up to their standoff voltage, so different protectors are needed for different rail voltages (for example, 3.3 V, 5 V, 12 V, etc.). Thus, the SP725 silicon diode array can help reduce manufacturers' component inventories and simplify their purchasing supply lines.

The SP725 series silicon diode array circuit protection device is available in an 8-lead, narrow body SOIC package, which can be supplied in tape and reel assemblies. It is RoHS compliant and fully lead-free, in contrast to competitive units that still use lead solder for attachment of the IC to heat dissipaters. The SP725 also meets the test requirements of IEC 61000-4-2 for 8 kV direct discharge and 15 kV air discharge. It also meets the requirements of MIL-STD-3015.7 for 25 kV testing.

New Chip Scale Packaging for AnalogicTech Converters Offers Portable Systems Designers Major Space Savings

Advanced Analogic Technologies, Inc. has released the availability of Chip Scale Packages (CSPs) for its AAT1149 and AAT1171 DC/DC converters. By eliminating bond wires, the new CSP option offers a dramatic reduction in footprint. The new packaging option also reduces stray inductance, capacitance and resistance and therefore noise, compared to traditional packaging with bond wires.



The space savings offered by the new CSP options are dramatic. The AAT1149 was originally introduced in a 2 mm by 2.1 mm 8-pin SC70JW package. At 1.235 mm by 0.91 mm, the new CSP option reduces the required PCB footprint by 73 per-



cent. Similarly, the AAT1171, originally introduced in a 3 mm by 3 mm 12-pin TDFN package, is now available in a CSP which, at 1.5 mm by 2.2 mm, reduces the required PCB footprint by 64 percent, when compared to the original package.

Targeted at meeting tight portable design space requirements, the AAT1149 step-down converter delivers up to 400 mA of load current from a 2.7 V to 5.5 V input while operating with low profile, 1 mm high 0603 inductors. Output voltage is programmable via external feedback resistors from 1.0 V to V_{IN} . The device attains up to a high 98 percent efficiency. No load quiescent current is 45 μ A.

The AAT1171 is a dynamic voltage-scaling DC/DC converter optimized to support power amplifiers (PAs) in WCDMA and CDMA handsets. Operating across a wide 2.7 to 5.5 V input voltage range, the device delivers up to 600 mA of continuous load current. The converter optimizes PA efficiency at both low and high transmit levels by supplying a variable output voltage of 0.6 to 3.6 V. No load quiescent current is only 45 μ A. Using an AAT1171 step-down converter can result in a 60 percent power savings when compared to connecting the PA directly to the system battery and thereby dramatically increase the talk-time of the mobile handset.

Both the AAT1149 and AAT1171 are qualified across the -40°C to 85°C temperature range. In a CSP the AAT1149 sells for \$0.87 in 1,000 quantities and the AAT1171 sells for \$1.31 in 1,000 quantities.

TI Introduces USB Power Management Switches with Adjustable Current Limit

Texas Instruments, Inc. (TI) has introduced power distribution switches with an integrated FET that can be set to support a 100 mA to 1.1 A current limit range for a standard USB port or other applications requiring a current limited switch. The power management integrated circuit (IC) efficiently protects an input voltage supply against potential short-circuit conditions that may occur when using a USB connection in a mobile phone, notebook computer, LCD TV, set-top box, gaming system or IP phone.

TI's TPS2550 and TPS2551 power switches incorporate an 85-milliohm, N-channel MOSFET in a 2 mm by 2 mm SON or a SOT-23 6-pin package. The devices operate from a wide 2.5 V to 6.5 V input and minimize current surges during heavy capacitance loads by controlling rise and fall times.

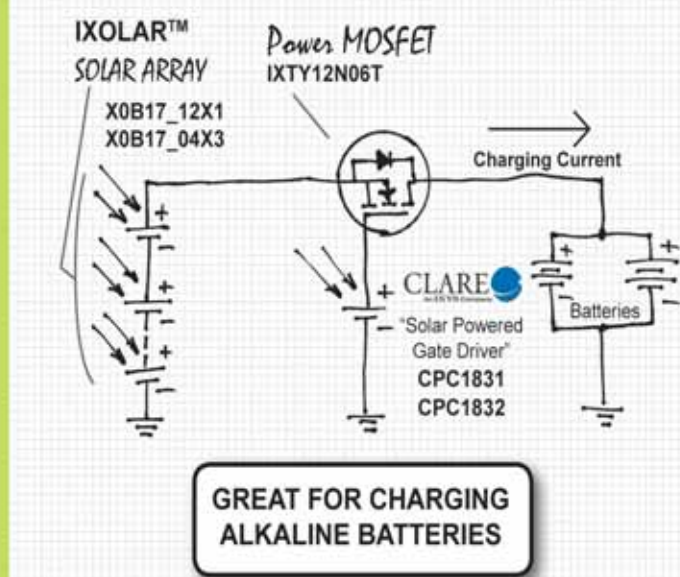
The TPS2550 and TPS2551 offer several protection features. The devices' 2 microsecond (μ S) over-current response limits the output current to a safe level by switching into a constant-current mode when the output load exceeds the current-limit threshold or a short circuit is present. The devices also feature an internal reverse-voltage blocking function to disable the power switch in case the output voltage is driven higher than the input voltage to protect the application's system on the input side of the switch. In addition, a /FAULT logic output asserts at low condition during over-current and reverse-voltage conditions.

The TPS2550 and TPS2551 are part of TI's portfolio of analog power switches including single, dual, triple and quadruple devices that support typical on-resistance ranging from 33 milliohms to 100 milliohm. TI offers USB power switches with fixed current limits from 100 mA to 2 A, in various package options, including SOT-23, MSOP, SOIC and SON with selectable Enable polarities. In the notebook computer market, TI provides a complete portfolio of power switches, including the TPS2231 that supports an ExpressCard interface power slot, the TPS2051B for the memory card slot, and a full portfolio of USB power products.



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Power Conversion



Vicor Adds New 24 Volt Input Series

The Brick Business Unit of Vicor Corp. has added a new 24 V input series for both the VI-J00 and VI-200 families of DC-DC converters. With a wide input range of 10 to 36 V, the modules are targeted for applications operating from 12 V or 24 V inputs, which are typical for battery systems in vehicles. The low-noise ZCS topology reduces the design effort and filtering costs required for power converters to meet agency-conducted emissions requirements.

The new 24 VDC VI-200 series models offer 16 different output voltages ranging from 3.3 V to 48 V with a maximum power of 75 W, and four different environmental grades. Packaging options include a flangeless model (SlimMod), a flangeless model with an integral heat sink (FinMod), and a chassis mount housing with screw/lug wiring interface (BusMod). The modules,

which are optionally available in RoHS compliant models, are a compact 4.6 by 2.2 by 0.5 inches size.

The new 24 VDC VI-J00 series models offer 16 different output voltages ranging from 3.3 V to 48 V with a maximum power of 50 W, and four different environmental grades. Packaging options include a flangeless model (SlimMod), a flangeless model with an integral heat sink (FinMod), and a chassis mount housing with screw/lug wiring interface (BusMod). The modules, which are optionally available in RoHS compliant models, are a compact 2.28 by 2.4 by 0.5 inches in size.

Pricing for the 24 VDC input VI-J00 or VI-200 models ranges from as low as \$89 (5 V, 50 W, E Grade) in 100-piece quantities.

Load Share Series Offer Unique Plug and Play for DC/DC Converters

Calex Mfg. Co., Inc. has released the Load Share series of modules that provide a unique "plug and play" solution for paralleling multiple DC/DC converters. For those who have attempted to parallel DC/DC converters, it is not a simple task. Simply running the output traces in parallel on your pcb generally will result in one DC/DC converter attempting to supply the majority of the output current thus resulting in an overload condition. Due to component tolerances and production variances, the start-up profiles for the same model DC/DC converter may vary. If one converter starts into a full load condition in a parallel circuit prior to the other DC/DC converter module(s)

this may result in an over-current condition resulting in system failure.

No external circuitry is required with any of the the Calex Load Share models. There are six models in the series covering 3.3 to 48 volt nominal input

voltages. Maximum output current is 60 A. All models achieve 99 percent efficiency typically and utilize aluminum substrate technology for thermal management.

The Load Share series utilizes "active load sharing" with low-side sensing resulting in very accurate load sharing with minimal load regulation issues. The low-side sensing in combination with the differential load share bus communication technology designed into the Load Share module results in a very high level of noise immunity. The Load Share modules also utilize the sense point as the point of regulation, which gives the designer the ability to use the DC/DC converter trim function in the system design.

The Load Share models are housed in a 1/4 brick package measuring 2.28 inches by 1.45 inches by 0.50 inches. The baseplate operating temperature is -40°C to 100°C. Lead time for the Load Share modules is six to eight weeks ARO.



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- 1) faster balancing;
- 2) does not reduce pack shelf life;
- 3) mission critical packs are always in balance, continuously ready to use at maximum capacity;
- 4) can balance high capacity packs; and
- 5) built in charge regulation for missions that use solar panels, fuel cells, or power supplies as a source of charge energy.

**U.S. Patent 7,279,867 Method for Balancing Cells or Groups of Cells in a Battery Pack*






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From outer space to under the sea to five miles beneath our planet's land surface, SWE designs and assembles high reliability, customer-specific battery packs and chargers.

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AMETEK produces more alloy variations through proprietary roll compacted powder metallurgy than any other manufacturer in the world. Our PM technology delivers cost savings, greater design flexibility, larger material selection and better net shape capability.

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Lambda Offers 20 Watt Addition to Its PCB Mountable AC-DC Power Supplies

Lambda has unveiled its latest series of compact pcb-mountable 20 watt AC-DC power supplies. The single output ZPSA20 series accepts a wide input voltage range, has a low profile (0.79 inch) and industry standard footprint (2 inches by 3.5 inches), making it well suited for applications such as computer peripherals, datacom, telecom and test and measurement equipment.



These 20 watt pcb-mountable supplies are available with the most popular output voltages including 3.3 V, 5 V, 9 V, 12 V, 15 V or 24 VDC. The outputs are floating so they can be used as either a positive

or negative polarity. Typical efficiencies are up to 82 percent. These models are rated for operation in a convection cooled environment from 0°C up to 70°C with derating. A green LED is provided as an indicator that the power supply is on. Other standard features include overvoltage and short-circuit protection.

Accepting a wide input voltage range of 85 to 264 VAC, the ZPSA20 series is ready for use globally with no further configuration or input selection. Its industry standard footprint makes it well suited as a drop-in replacement for existing supplies, while its low profile means that it can be installed in the most compact of applications. The ZPSA20 series is available now with prices starting at \$12.50 each in 1,000 piece quantities.

TDI Dynaload Launches New XBL Series of Electronic Loads

Transistor Devices, Inc. has add the XBL series of electronic loads to its product line. The XBL series offers 800, 2,000, 4,000 and 6,000 watt models with built in Ethernet, GPIB and RS232 programming capabilities. With its digital control technology, the XBL series provides increased reliability and performance

making it well suited for testing power supplies, batteries, fuel cells and DC power sources. Higher power models incorporate variable speed forced air cooling to assure a quiet environment.

Features include constant current, resistance, power and voltage operation modes; 16 bit digital control offering improved accuracy and performance and closed case calibration minimizing downtime and metrology cost.



Cherokee International Touts CAR2512 1U Front End/Rectifier With Ultra-High Efficiency at Light Loads

Cherokee International has introduced its 2,500 watt CAR2512 front end intended for low profile, 12 volt (V) distributed power architecture applications, such as high-performance enterprise and service-provider switches and routers, mid- to high-end servers and storage equipment. Packaged in a small, 1U-high footprint and measuring 1.65 by 4 by 14.88 inches, the CAR2512 hits an ultra-high power density of 25 watts (W) per cubic inch. The CAR2512 delivers 208 amps (A), supporting 12 V bus architectures that power point-of-load (POL) converters. As a standout feature, the CAR2512 can achieve 90 percent efficiency at just 20 percent of load, with a peak efficiency of 91.5 percent, enabling it to surpass today's application-orientated efficiency standards.

The small form factor is well suited for space-constrained applications where system real estate is at a premium. Up to four units can be mounted side-by-side to deliver 10,000 watts of power in 1U height. Protection features on the rectifier include input over and under voltage, output over voltage, over temperature and over current. In addition, a microprocessor-based design allows for automatic fan speed control, which is well suited for optimizing noise levels of sensitive office-environment applications. This model is also available with full I2C communications, providing intelligent monitoring and control of critical parameters. The CAR2512 is priced at \$395 in OEM quantities.

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Battery Components

Telect's New Heavy Duty Battery Rack Addresses Increasing Need for Reliable Backup Power Solutions in Networks

Telect, Inc. a supplier of power and connectivity solutions for the communications industry, has released a battery rack to tackle communications service providers' requirements for versatile, durable and reliable backup power solutions in central office, wireless and remote site applications.

The new rack, engineered to withstand earthquakes in Zone 4 Seismic areas, accommodates batteries manufactured by all major manufacturers, offering users the versatility to meet the requirements of several backup power and other battery applications with a single solution. Each rack includes five shelves, which typically hold up to four batteries each, for a total of 20 batteries in a single standard-sized rack (7 feet high by 23 inches wide).

Each rack is tested and certified to stringent Zone 4 Seismic ratings, providing a robust solution for earthquake-prone areas and ensuring performance in nearly all situations. By accommodating a variety of battery types, users can incorporate different brands of batteries in a single rack design, thereby streamlining purchasing and increasing confidence in overall performance.

Telect provides the new Indoor Seismic battery rack as a standalone unit or with batteries pre-installed and integrated into a ready-to-deploy solution.

The new battery rack joins Telect's comprehensive line of equipment rack products, which includes unequal flange racks, network bays, channel racks and global seismic frames, along with all standard accessories and hardware. Telect also engineers integrated, ready-to-deploy connectivity and power solutions in equipment racks or enclosures.

Tailored Battery Separator Films to Improve Performance of Lithium-Ion Batteries in Hybrid and Electric Vehicles

ExxonMobil Chemical has introduced a new film technology platform for hybrid and electric vehicle batteries. ExxonMobil Chemical and ExxonMobil's Japanese affiliate, Tonen Chemical, have developed new battery separator films that are expect-

ed to significantly enhance the power, safety and reliability of lithium-ion batteries used in hybrid and electric vehicles. As a result, the new film technologies have the potential to improve the energy efficiency and affordability of the next wave of lower-emission vehicles. Building off the new technology platform, ExxonMobil Chemical can adapt to emerging market needs by providing tailored film grades to meet specific battery maker or original equipment manufacturer requirements.

The new battery separator films are produced using a proprietary wet, bi-orientation manufacturing process that results in fine, highly uniform pores. The films are co-extruded using specially tailored, high heat-resistant polymers. By leveraging ExxonMobil Chemical's technology and polymer expertise to meet very specific hybrid and electric vehicle requirements, the new battery separator films exhibit a unique combination of properties including enhanced permeability, higher meltdown temperature and melt integrity, while maintaining quick shutdown performance and mechanical strength. The higher meltdown temperature significantly increases the film's thermal safety margin.


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Key Considerations in Battery Charger Design

Charles Coles, Senior Applications Engineering Manager

Dave Brown, Senior Applications Engineering Manager

Advanced Analogic Technologies, Inc.

The rapidly expanding feature sets on today's portable electronics products are placing a rising premium on the capabilities of the battery charger function. As designers add new capabilities such as Bluetooth connectivity, higher resolution displays and GPS, the ability of the system power source to deliver as much power as possible for as long as possible and recharge as quickly as possible becomes all the more important to users. Invariably designers must select a charger IC that meets their stringent system requirements for footprint, heat dissipation and cost. But at the same time they must recognize the importance that battery life and recharge time plays in users' perceptions of a product and constantly evaluate the implications of trading off those key selection criteria against better battery performance.

Fortunately designers can select from an increasingly diverse array of battery charger ICs today to meet their specific system needs. Generally, the latest devices offer ever higher levels of power density and a wider array of functions in extremely compact packages. Many of today's charger ICs, for example, integrate a charging device, reverse blocking and current sensing circuits in a single package. To meet the tight space confines of portable and handheld devices, some of these devices occupy less than 10 mm² of board space.

Lithium-ion chargers use a three-step process to safely and efficiently charge a lithium-ion cell. The process begins with a limited current pre-charge or trickle charge mode during the period when the battery is heavily discharged. This mode avoids charging the battery at a high rate when the battery resistance is lowest and, in the process, minimizes heat dissipation. Once the battery reaches a pre-defined voltage, the charger switches to a fast charge constant current mode where the charge current increases to the full rated charge current.

A charge current is selected that will give the maximum discharge capacity over the life of the battery without an excessive charge time. This mode continues until the battery charge level reaches a second voltage threshold near the full charge level. At this point the charger enters into a constant voltage mode in which the battery voltage is kept constant allowing the charge current to gradually level off. This final charge mode is critical for topping off the battery charge. It maximizes the portion of the charging battery voltage that is actually stored charge and not related to the battery ESR multiplied times the fast charge current. It also charges the battery to an accurate voltage level that is optimum for battery longevity. See figure 1 for a typical lithium-ion charge profile.

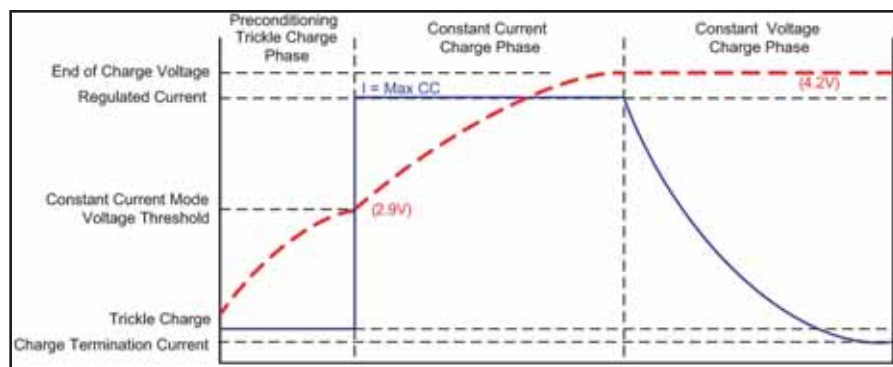


Figure 1. Typical Lithium-Ion Charge Profile

The battery charger ICs available today offer a wide variety of features to ensure battery safety and system reliability during this charging process. All charger ICs feature some sort of thermal management system to either shut off the charger when heat builds up or intelligently manage the temperature of the die by reducing the charge rate as temperature rises. It is important to note that these functions differ widely. Some of the newer devices on the market now offer intelligent digital thermal loops that automatically track and reduce the charge current as ambient temperature rises. This process automatically continues until the temperature stops rising. If the ambient temperature continues to rise past a pre-defined limit, the charger shuts down. These "intelligent" feedback mechanisms shorten the charge cycle by maintaining charge current at the highest level available short of thermal shutdown.

Many chargers also offer an input under voltage charge suspend function that tracks the input voltage versus the battery voltage and automatically terminates the charger when the charge voltage reaches a point where it can no longer continue charging the battery. Over voltage protection protects the battery by constantly tracking the output voltage and ensuring it does not exceed the maximum charge voltage by a pre-set margin.

Some sort of resume charging function is also common. This feature allows the user to disengage the portable device from the charger before the charge cycle is complete and then later reattach the charger and automatically resume charging at the appropriate level. It is important to note that lower cost chargers that don't offer this

capability instead offer a simple enable pin that can be used to manually recycle the part to start the battery recharge cycle.

Most charger ICs also feature status monitor outputs capable of driving external LEDs to indicate charge status. Some also offer a battery charge timer that helps protect the battery and system by terminating charge if a user-programmable charge time is exceeded.

System Power Functions

As handset and other portable product designers squeeze what often seems like an endless array of new functions into their platforms, board space has become increasingly scarce. Power management IC developers are attempting to address this problem by folding a growing number of system power functions into the same IC responsible for the battery charger function. As a result, a growing number of battery charger ICs on the market today now offer integrated DC/DC converters to drive the system microcontroller, memory, a hard disk drive or other I/O and one or more low dropout voltage regulators (LDOs) to power noise sensitive RF circuits.

Typically the DC/DC converters on these integrated power management devices are designed to step-down the average 3.6 V output available from a lithium-ion battery to the lower 1.8 V or 2.5 V voltages required for most microcontrollers. Efficiency is an especially important consideration in these power functions. An inefficient DC/DC converter can have a major impact on the runtime of the battery. Many converters offer excellent efficiency at high loads, but their efficiency drops dramatically under 100 mA. Given the large amount of time portable devices run in standby mode, it is important to carefully consider the converters efficiency across all load ranges. Some DC/DC converters in this class of devices do a better job of maximizing load efficiency across the entire load range by operating in both fixed switching frequency and variable switching frequency modes. Switching frequency is important for size considerations as well. Converters that operate at higher switching frequencies require smaller and lower profile external components. That, in turn, can help the system designer build smaller, thinner portable products.

RF and audio circuits require a high degree of isolation and a low noise power source to prevent the propagation of noise. LDOs offer far lower efficiency than a DC/DC converter, but their low noise characteristics make them well suited for applications such as the microphone pickup circuit in a Bluetooth headset. Look for LDOs that offer fast transient response, support fast startup and are compatible with lower cost, low-ESR ceramic capacitors.

Multiple Power Sources

One of the more difficult challenges charger IC designers face is the desire by users to charge their battery from a growing variety of power sources. Users are no longer satisfied charging their portable device from an AC source. They want to charge their cell phone, MP3 player or PDA while traveling in the car, on a plane or on a train. Oftentimes the most accessible power source available is the USB port of some other electronics device. Widely available on most laptops and computer peripherals, USB ports support bidirectional data transfer as well as power and ground and allow users to simultaneously recharge a battery and update data, audio and video files. As a result many vendors now offer dual path charger ICs that support charging from both AC and USB sources.

But adding this capability to a charger IC significantly complicates its design. USB ports are not universal in design. Passive USB ports often found on network and computer peripherals only supply 100 mA of current. USB ports on most notebook computers, on the other hand, typically supply a 5 V source with up to 500 mA. The difference can have a dramatic impact on charge time. Moreover, the level of power available from a USB port can change dynamically as the host system draws power for other functions. Attempts to charge at more than 500 mA can cause the port voltage to sag and drive the USB host to shut down the USB port and terminate charging.

Many charger ICs provide protection from port shutdown with a binary "all-or-nothing" scheme. Typically the charger will blindly attempt to charge at the highest current rate possible and, once a fault condition occurs, shut down immediately. This approach is particularly problematic in hot climates where overheating of the charger IC is most likely to occur at the maximum charging rate. Attempts to restart the charging process after over-temperature shutdown can damage the battery cell through incomplete electrochemical reactions that can occur when repeatedly initiating and terminating the charging process. It also extends the charging cycle. In addition, most of these devices only indicate their charging status through indicator lights. They don't provide direct communication with the baseband or applications processor that would allow the introduction of more intelligent charge control mechanisms.

To avoid overloading the USB port and continue the charging process, one ideally wants a charger that automatically reduces charge current when the system is drawing power for other functions. Some chargers address this problem by offering two constant current charge levels, one high and one low, either preset at the factory or user-programmable via two external set resistors. In this case, the charger IC will charge at the maximum or "high" current level of 500 mA when the USB port can support it,

and then switch to the second "low" setting, usually 100 mA, when power draws on the system limit the availability of power via the USB port. This ensures USB port integrity under most conditions and maintains the battery charge cycle at either of the two levels.

This two-tier approach brings with it two liabilities, however. First, it requires the addition of a fairly complex and time-consuming hardware and software feedback mechanism between the charger and the system microcontroller to track and control charge level relative to the changing status of the USB port. Perhaps more importantly, however, it does not maximize efficiency of the battery charge cycle. By resorting to an arbitrary 100 mA low charge level when power availability is limited, this strategy fails in some conditions to use all of the power available from the USB port. As an example, if the USB port can supply 200 mA but the charger IC switches to its lower charge level of 100 mA to protect the port, it will take twice as long to charge a 500 mA-hour battery than it would if it had accessed the full 200 mA current available.

To address this limitation, some charger IC developers have begun exploring the use of more sophisticated feedback mechanisms to more efficiently manage charge current from a USB port. The goal is to be able to charge the battery at the maximum rate possible without overloading the power source by dynamically adjusting the charge current as input conditions change. Ideally, this control scheme will allow the user to charge at the maximum rate possible without overheating the charger IC by adjusting the charging current as ambient temperature conditions change.

These new "intelligent" schemes typically feature a mechanism that allows the charger IC to communicate the charging and thermal conditions of the battery to the host processor. They also allow the host processor to dynamically alter the charge current level as the battery's electrical and environmental conditions change. For example, when the IC becomes too hot or the input voltage begins to sag, which indicates the power source is becoming overloaded, this control mechanism immediately reduces the charge current by a preset amount to avoid a fault condition. Ideally, this control loop can then step up or back down the charge current in discrete steps until an equilibrium level is reached. These algorithm-based functions allow users to charge the battery at the maximum charge current available while keeping the USB port regulated. Most importantly, by constantly tracking conditions and adjusting charge current, they maximize charge efficiency and shorten the battery charging cycle (see figure 2).

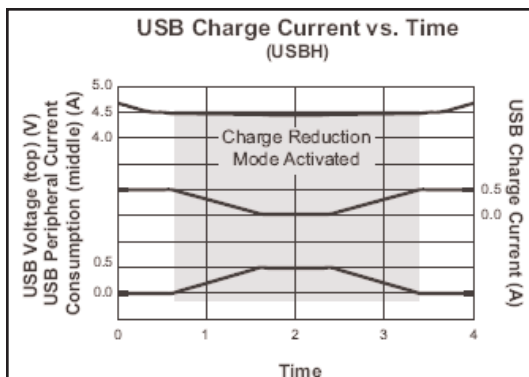


Figure 2. USB Charge Current Reduction for AAT3670

Higher Powered Applications

With portable system designers continually expanding the functionality of their systems, many are moving from single- to dual lithium-ion battery cells connected in series to support the increased power requirements of these feature sets. An increasing number of high-end handsets, portable media players, single-lens-

reflex (SLR) cameras and other devices now require two battery cells to support their high levels of performance. While traditional single-cell portable devices require 4.2 V to charge a single cell, these dual-cell powered devices require between 8.4 V and 8.8 V input to charge.

In the past designers have typically used discrete charger ICs to address this higher-end segment of the market. But recently power management IC manufacturers have introduced new battery charger ICs specifically targeted for this application segment. By supporting input voltages between 4 V and 8.8 V, these charger ICs can be used with both single and dual-cell powered systems. Some support voltages significantly higher to give designers the freedom to use lower-cost unregulated adapters.

Thermal management is particularly crucial at these higher power levels. Accordingly, it is important that designers look for charger ICs in this class of devices

that feature an intelligent thermal feedback mechanism that maintains battery charging current by constantly measuring die temperature and modifying the fast charge current to compensate for thermal conditions.

Conclusion

Battery life remains a key differentiator in portable system design. Users demand portable products that can deliver longer battery life and shorter recharge times. By carefully considering the various functions and features in today's battery charger ICs and identifying the best fit for their application, designers can reduce charge time, maximize battery discharge capacity, number of recharge cycles, and ensure system reliability and customer safety.

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Taking Charge of Counterfeits

Steven J. Powell, General Manager, Security Solutions Group
Eastman Kodak Company

A product recall due to injury; it's every company's worst nightmare. Nothing can erode a brand or reputation more quickly than a national story about a product causing harm to a consumer and the effects can last years and cost millions. One national incident forced a leading company to recall 50,000 of its cellular phones that it determined had fake batteries with fraudulent labels. The recall involved 18 reports of injuries or property damage, including a teenager whose phone exploded in his pocket, and a woman who was in a car accident after her handset blew up.

Horror stories like these are what motivates companies to spend billions of dollars ensuring that their products are of the highest quality. Procuring top of the line materials, standardizing and refining design and manufacturing processes, testing products for quality and performance, all of these steps are scrutinized at every level to make certain that each product is free from risk and that it well represents the company's brand.

The trouble is, none of these safeguards seem to discourage counterfeiters. The problem of counterfeiting is global and it is epidemic. By some estimates, as much as 10 percent, or \$700 billion dollars of product traded globally is counterfeit. Virtually every product of any value is counterfeited, and unfortunately, many of these are high consequence products. To put it bluntly, products that can hurt or kill people. Some of the most dangerous fakes include pharmaceuticals, auto parts and electrical and electronic components. Legitimate products of this type are highly regulated by federal standards, and when counterfeited, have the potential to cause severe injury and even death to unwitting consumers. At a minimum, consumers are likely to encounter subpar product performance, resulting in negative brand perception and a loss of brand loyalty.

Stories of consumers being harmed or products being destroyed by counterfeit batteries are prevalent, and that's because batteries are among some of the world's most replicated products. The US Customs and Border Patrol

names batteries as one of their top ten seized counterfeits. Many battery fakes lack safety features like adequate venting and protective circuitry that leave them subject to overheating and explosions, such as those leading to costly recalls for major brands and companies. Lithium-ion is particularly susceptible to danger if it is not manufactured to proper specifications, as lithium is more volatile than other battery components. Beyond the immediate danger to consumers, counterfeit batteries can also cause long term harm to the environment. Battery counterfeiters typically cut costs by using mercury in the cells, which eventually causes irreparable damage to the ecosystem.

Counterfeiters exploit even the world's top battery brands. Major global corporations publicly acknowledged that they seize and destroy millions of fakes every year. Many handheld product manufacturers have warnings on their Web sites about the perils of counterfeit batteries. Businesses and global brands need a specific security solution in place that combats counterfeiting; one that can be implemented with minimal cost and disruption to manufacturing processes. Without a strong anticounterfeiting strategy, any company is vulnerable to lost revenue, brand and reputation erosion, litigation and product recalls.

As the problem escalates, the number of security options available to manufacturers increases. Today, they include:

- Overt solutions that are visible to the eye. Examples include holographic stickers and markers or micrographics.
- Semi-covert securities that require simple devices to detect, including barcodes.
- Covert options that require more sophisticated devices to detect, including RFID and embedded particle detection.
- Forensic tags that require intricate analytical tools, such as chemical markers.

All of these options are useful, and in fact it is sensible to deploy a layered approach that combines overt with covert features. An overt security feature can facilitate a quick authentication check at the store shelf and helps communicate to the consumer (and the counterfeiters) that the brand owner is serious about brand protection. Covert and forensic layers are important for secondary validation, especially in cases of product liability or litigation.

In the case of its Li-Ion batteries, Kodak saw an opportunity to aggressively thwart the danger of fakes. Through its knowledge of digital imaging and material science, Kodak developed its covert Kodak Traceless System for anticounterfeiting and will be using it to deter counterfeiters from knocking off their Li-Ion batteries, further protecting customers from harm.

The Kodak Traceless System is a technology that employs invisible marker materials that can be added to some component of the product or packaging. It is highly flexible and can be used for many products, but in the case of batteries, the markers can be in the ink on the battery label, ink or varnish on the package card; in the plastic "bubble" on the package, or in the barcode label on the battery. The material is present in ultra low concentrations, so it has no impact on the host material or the normal printing, production or manufacturing processes, and it is invisible to standard analytical methods. The markers are only detectable with the Kodak Traceless reader, making for a completely undetectable security system that is virtually impossible to replicate.

Because the Traceless System can be customized and is flexible enough to be implemented at multiple stages in the manufacturing process, the system can be used from the pallet to the product to detect counterfeits at several different points throughout the supply chain. Products can be spot checked at distribution and retail chains so that fakes are spotted closer to the source for easier tracing. The system can also be used to conduct sting operations at the manufacturing plant. What's more, the Traceless System adds value through its ability to serve as evidence and collateral in settling warranty claims, make recalls easier and more efficient to manage and help defend against liability claims.

An anticounterfeiting system requires an investment, to be sure. However, the benefits of adopting such counter measures, especially for high consequence products like batteries, more than justify the investment. The ability to protect revenues against lost sales, guard against brand erosion from public damage claims, protect against false liability claims, more efficiently handle warranties and possible recalls, increase consumer confidence and deter counterfeiting can do more than ward off bad publicity; it can save money, conserve reputation and provide an edge that can be used to differentiate a company from its competition in the minds of consumers and retailers. Most importantly, it can give consumers a feeling of safety and security that leads to repeat purchase and brand loyalty.

In today's global economy, a recall or liability case can cost a manufacturer millions of dollars in lost revenue and lost confidence. A minimal investment in an easy to employ anticounterfeiting system provides protection and piece of mind that is impossible to put a price on.

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Going Green Boost Profits: A Win-Win Paradigm Shift

Anu Cherian, Industry Analyst
Frost & Sullivan

The world is spinning around the "Go Green" mantra. North America and several European countries are major pioneers of this green era. By aggressively pursuing new technology and new funding for technology development, these regions are sure to provide the bulk of green innovation in the near future. With the current concern over global climate change, both economic and political forces combine to form a perfect environment for green initiatives. For most companies; however, there is an even stronger reason beyond theories of a changing world: increased profits.

When one talks about energy, what instantly comes to mind is oil and natural gas. Whether you believe the doom and gloom about carbon-based fuels, two things are reality, the sources are finite and demand is increasing. These realities are compounded by commercialization within the Third World. The sources of alternative energy are not new. The main issue facing the marketplace is methods of storing different forms of energy that cannot be stockpiled like oil or natural gas. For end users, this is a source of great dissatisfaction.

It is within this mesh of factors that companies within the alternative energy market have a window of opportunity. Cutting edge technologies have more access to a mature market than ever before, despite their higher initial cost and their relative newness to the marketplace.

Alternative Energy Storage

The need for new storage methods for alternative energy has led to a rapid advance in many products, ultracapacitors in particular, flywheels and fuel cells. The industrial market has been keen to adopt ultracapacitors and flywheels due to their high reliability and power density for short-term applications.

Ultracapacitor

The ultracapacitor, also known as the supercapacitor in some parts of the world, is an energy storage device where the energy is stored in an electric field between a pair of conductors on which equal but opposite charges have been placed. Ultracapacitors are composed of various kinds of carbon composites and carbon nano-composites. All companies hold proprietary patented technology to safeguard their innovations in materials used for the electrodes of the ultracapacitor.

Transportation Market

The transportation market currently utilizes several units of ultracapacitors due to their high power density. Typically, ultracapacitors in this market are designed in modular packs to complement the role of the accelerating, decelerating and starting function of the battery in a vehicle. This type of usage reduces wear on the batteries already in use and decreases fuel consumption. In today's high cost fuel market, this is a particularly important driving factor. At present, ultracapacitors have a strong market within the field of hybrid vehicles.

Industrial Market

Within the industrial market, various companies are forging ahead with plans to integrate ultracapacitors into their UPS products. Batteries have typically been the main source of backup power, supplying energy until emergency generators have come online. The reliability of generators is such that unless they start within the first five to 15 seconds after a power disruption, they probably will

not start at all. Today's ultracapacitors can meet this demand window with lower total cost of ownership, and, at the same time be used for power conditioning applications. This indicates immense market potential for this application. There are also other applications within the industrial market such as wind power blade systems, among others.

Consumer Electronics Market

The consumer market on the other hand has progressed significantly and has diversified its application capabilities. For example, it is used to create a brighter flash in digital cameras and mobile phones, while for PDAs and smart-phone applications, ultracapacitors cater to the specific power needs for more complex functions and features and are termed 'power hungry' applications. A decline in price is a factor that is essential to the dynamics of any market, and in the ultracapacitor market, it is still gradually decreasing. Continued price reductions will significantly enhance the commercial viability of ultracapacitors.

When some of the technical insufficiencies of the ultracapacitor are overcome, the ultracapacitor will certainly span out to be an ideal alternative to battery technology.

Flywheel

The flywheel is defined as a heavy wheel attached to a shaft with most of its weight concentrated at the circumference. It stores energy as the speed increases and releases energy as the speed decreases. Typically made of steel, the flywheel has not really advanced in its design but has certainly taken great strides in expanding its horizon of applications. Even though it is not the newest technology, continued improvement has created new avenues for flywheel adoption. Within the past decade, its use in energy storage has been leveraged to benefit power quality and energy recycling applications.

Power Quality

The power quality market is currently considered to be the most reasonable potential market for the flywheel. Manufacturers who specialize in flywheel energy storage deliver a product at an extremely high initial

cost. Their value proposition lies in minimal maintenance and greater longevity. Contrast this with the high maintenance and short longevity of batteries, and a unique market opportunity emerges. The decrease in maintenance and replacement costs helps companies that adopt flywheel technology to conserve resource and increase their bottom line.

Energy Recycling

This application is interesting as it simply utilizes the heavy flywheel to capture energy that is typically wasted. A simple example of this is rail applications where the rotating flywheel stores the energy produced during braking for 15 to 17 seconds and then dissipates it to accelerate the train into motion. This application dramatically reduces the fuel needed to operate a train, since acceleration is a big component of fuel consumption. This idea of recycling is so alluring; the use of flywheels is even being explored for the operation of shipyard cranes.

Conclusion

Regardless of one's position in the climate change debate, the new technologies that have emerged allow forward thinking companies to reduce consumption and increase their long-term bottom line. From a corporate perspective, this should be considered the proverbial "Win-Win" situation. While boosting shareholder value, companies can market themselves truthfully as "green companies" because of the immense potential to conserve oil and gas on so many levels. Future technological improvements will only enhance the value proposition of these paradigm changing applications.

Anu Elizabeth Cherian is an Industry Analyst with Frost & Sullivan's North American Energy & Power Systems practice. She focuses on monitoring and analyzing emerging trends, technologies, and market dynamics in the energy storage, alternative energy, power supplies, and power quality industries worldwide.

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HOPPECKE POWER FROM INNOVATION

New Battery Technology Advances Wind Energy Generation Reliability

Lithium Technology Corp. (LTC), will market an advanced lithium-ion battery for pitch control systems of wind generators, a rapidly growing global alternative energy source. The ultra-high power battery, developed in conjunction with Harting Technology Group for a 2.5 megawatt (MW) class wind power generator was successfully tested in a wind park in Germany. In just the first two months of this year, LTC has received orders for 12 wind power generator projects.

LTC's subsidiary GAIA Akkumulatorwerke (GAIA) teamed up with Harting to design the 648 Wh battery consisting of 24 of LTC's 7.5 Ah cells. The companies have agreed on a non-exclusive joint marketing effort to supply the innovative back-up system to the wind power industry.

"The development of this battery and our relationship with Harting is a significant step for



LTC entering the renewable energy market," said Dr. Klaus Brandt, CEO of LTC. "We anticipate this to be a fast growing and potentially large market for lithium-ion batteries, not only for emergency power but also for energy storage overall, which is key to expanding the use of renewable energy."

LTC will develop and manufacture the lithium-ion cells and supply the battery management system, which will be assembled by Harting using its unique connector technology. Harting will also be responsible for marketing, sales, integration into the wind generator's electrical systems and after sales service.

For maximum efficiency and safety, wind generators rely on a continuous adjustment of the pitch of the turbine blade to the wind conditions. In case of a power grid failure or strong winds, the battery ensures that the blades safely return to a neutral position to avoid turbine damage.

Successful testing and implementation have proven improved performance of the new LTC/Harting battery, which is placed at the base of each of the three blades of the 2.5 MW turbine and subjected to continuous rotation, vibration and extreme temperatures. The next stage of product development will be a system for a 5 MW class wind power generator. Presently, 21 of the LTC/Harting batteries are in service in wind parks in Germany one of the countries leading the effort to use wind energy to replace fossil fuels in the generation of electrical power.

C&D Technologies Selected to Supply Back Up Power for the Olympic Stadium in Beijing

C&D Technologies, Inc. will be supplying back up power to the new Olympic Stadium in Beijing, China, officially known as the Beijing National Stadium, the centerpiece of the upcoming 2008 Summer Olympic Games. C&D Technologies will supply batteries from its new manufacturing plant in Shanghai, China.

The 91,000 seat Olympic stadium will host the opening and closing of the 29th Olympiad, as well as track and field, soccer and other events. In addition to its stunning appearance, the stadium is known for its extensive use of renewable energy and other conservation systems that will minimize impact on the local environment.

"C&D Technologies' quality and technology reputation in China was instrumental in the decision to use C&D batteries to provide back up power for an event that will be watched around the world when the Beijing Olympics opening ceremony takes place on August 8, 2008," said Dr. Jeffrey Graves, president and CEO of C&D Technologies. "We are very proud to be a supplier of critical back-up power for the Beijing National Stadium and of our new manufacturing plant in China that will produce the product."



Continental Launches Production of Lithium-Ion Battery

The international automotive supplier Continental will launch first-time volume production of a high-performance lithium-ion battery for hybrid vehicles at the end of 2008. It will be used in the Mercedes S 400 BlueHybrid.

"This marks an important breakthrough for Continental as supplier of battery systems. In the next few years we will be launching production of further lithium-ion energy storage devices for mild- and full-hybrid and electric-powered vehicles," says Continental executive board member Dr. Karl-Thomas Neumann.

"Lithium-ion technology is viewed as the key to the success of the hybrid and electric drive

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systems in motor vehicles. Lithium-ion batteries have a higher energy density, and thus a wider range, than those based on conventional nickel metal hybrid technology. The power output of the battery determines the overall performance of the vehicle as well as the potential for lower emissions and for possible fuel savings. In so far it also has a significant role to play in reducing CO₂," said Dieter Rogge, head of Continental's Powertrain division, which has developed and will supply ultramodern and innovative technology.

Aside from the lithium-ion battery, Continental also supplies the inverter and the DC/DC converter for the Mercedes S 400 BlueHybrid. The inverter controls the flow of energy between the electric motor and the hybrid battery. The DC/DC converter is the link between the hybrid battery and the vehicle's standard electric system and thus makes possible the elimination of the conventional generator.

ON Semiconductor Completes Merger of AMIS Holdings, Inc.

ON Semiconductor Corp. has completed its acquisition of AMIS Holdings, Inc. in a stock-for-stock merger. Under the terms of the merger agreement, holders of AMIS will generally receive 1.15 shares of ON Semiconductor common stock for each share of AMIS common stock they own. ON Semiconductor will issue a total of approximately 103 million shares of common stock on a fully diluted basis to complete the transaction. Former AMIS stockholders now own approximately 26 percent of ON Semiconductor. At closing, ON Semiconductor repaid AMIS's senior bank facility with cash on hand from both companies.

Exide Technologies Supplying Batteries for Next-Generation Toyota Corolla and Matrix Vehicles

Exide Technologies has announced a new supply agreement with Toyota Motor Engineering and Manufacturing North America. The company has begun shipping lead-acid starting batteries for the next generation of Toyota Corolla and Matrix passenger vehicles assembled at Toyota Motor Manufacturing Canada (TMMC) in Cambridge, Ontario.

According to the terms of the supply agreement, Exide will provide TMMC up to 244,000 group size 24 and 35 starting batteries annually for the Canada-produced passenger vehicles. The batteries are manufactured at Exide's Bristol, Tennessee facility and shipped from Exide's distribution center in Mississauga, Canada.

"Our new supply agreement with Toyota continues a productive, 20-year relationship between Exide Technologies and Toyota Motor Engineering and Manufacturing North America," said Bruce Cole, president of the Transportation-Americas business division for Exide Technologies. "Exide's strong, expanding alliance with this respected customer is a result of our drive to achieve continuous improvement in both operational processes and product quality."

Exide currently supplies Toyota with batteries for its North American-produced Camry and Avalon cars, Tundra trucks and Sequoia sport-utility vehicles.

Ultra-Thin Flexible Battery and High Contrast Durable Display Fuel Industry Growth

Solicore, a producer of ultra-thin flexible lithium polymer batteries, is driving market demand for powered cards with long-term partner SmartDisplayer. A producer of flexible electronic paper display technology solutions,

SmartDisplayer provides powered card manufacturers high contrast, color enhanced, ultra-low power electronic paper display modules. The collaboration between the two companies produces flexible, thin and safe embedded solutions to address the needs of platform providers and OEMs on a global scale.

Taiwan-based SmartDisplayer is strategically centered in East Asia, allowing the company to facilitate the fast forming supply chain while capitalizing on the tremendous market growth experienced in the region. The technology has also set the standard for ongoing display durability while maintaining a flexible solution complemented by the design features of Flexion batteries.

Recently, SmartDisplayer and Solicore have entered into several strategic ventures to address the burgeoning market for powered one time password (OTP) cards. SmartDisplayer's extensive knowledge of this segment empowers them to drive adoption of Flexion batteries


within their customer base.

"Internationally, powered display cards have become one of Solicore's core areas of concentration in the embedded powered solutions market," says Solicore CEO David Corey. "SmartDisplayer has fueled the advancement of powered card technology, further expanding the demand for Solicore's Flexion batteries."

Valence Technology Embarks Upon Manufacturing Expansion to Meet Anticipated Demand for its Lithium Phosphate Battery Packs

Valence Technology, Inc. plans to increase the company's manufacturing capacity to meet anticipated demand for its Lithium Phosphate energy storage systems. By March 31, 2009, Valence plans to have in

Industry News continued on page 20



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place an expanded manufacturing capacity of \$35 million to \$50 million per quarter to support anticipated product sales. As the company's manufacturing capacity expands, Valence believes it can achieve gross margins of approximately 30 percent of revenue with operating profit from 17 percent to 20 percent of revenue.

Valence recently announced it had secured an agreement with Tanfield Group Plc that will result in the purchase of up to \$70 million of product during the first phase of the contract to power zero emission, all-electric commercial delivery vehicles. The Valence battery systems are being installed in vans and trucks produced by Tanfield's UK-based trading division, Smith Electric Vehicles.

"Increasing our capacity to manufacture additional battery systems will assure we have the capability to fulfill the anticipated demand we believe to be building in our sales pipeline," said Robert L. Kanode, CEO and president of Valence Technology. "And, with operational full service

fulfillment centers in Europe, North America and China we are ready to provide the service and support our customers need."

GE Invests in Electric Vehicle Producer Think and Battery Manufacturer A123Systems to Commercialize Electric Car

GE is ramping up its efforts to enable global electrification of transportation by investing in Norwegian electric car manufacturer Think, which recently unveiled a five-seat crossover concept car. To power its vehicles, Think has signed a commercial supply agreement with lithium-ion battery manufacturer A123Systems. GE is in a unique position to help both companies commercialize technology to make electric transportation practical and affordable.

Think recently unveiled a new platform concept for larger electric vehicles: the crossover TH!NK Ox is an electric five-seat car close to the size of a sport utility vehicle but

Sandia continued from the cover

"We look at fundamental chemistry, wanting to discover the kinds of gases they emit when they are heated and explode," Roth said. "We also build smaller prototype batteries that once we get the chemistry right may eventually be built full size to go into vehicles."



Roth said that some of the newer batteries, like the new lithium/iron phosphate ones used in handheld power tools, are extremely resilient and less reactive when subjected to extreme conditions, unlike other types of batteries.

These are the type of batteries the FreedomCAR program is seeking, particularly for plug-in hybrid electric vehicles (PHEV). A PHEV is a regular hybrid that operates both on gas and a battery but has an extension cord. It can be filled with gas at the gas station and also can be plugged into any 120-volt outlet for all-electric driving. It's almost like having a second fuel tank that is used first — only it is filled up at home.

Industry experts predict that plug-ins that can run 10 miles on all electric are two to three years away while plug-ins that can run 40 miles on all electric are three to four years away.



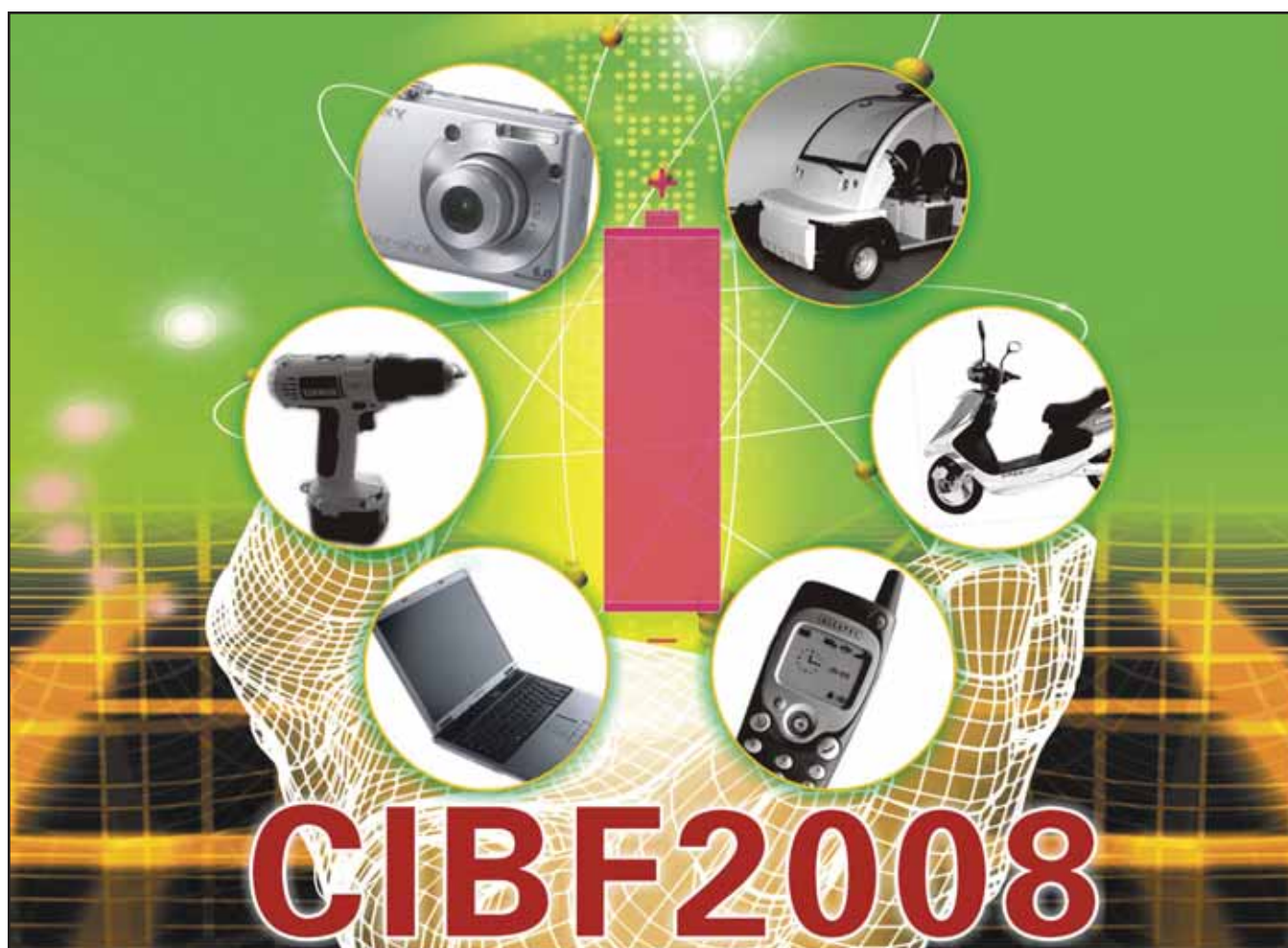
Sandia researchers are testing batteries to see how much abuse they can take. Here's an example of what the work looks like.

Plug-in hybrids make it essential that batteries be completely safe since they will be sitting in people's garages while they recharge.

Lithium-ion batteries that will go into vehicles will be similar to computer laptop batteries. One main difference is there will be "a lot of them," Roth says.

The first hybrids using lithium-ion batteries will be on the market later this year. Mercedes-Benz has announced that it will soon launch the S400 BlueHybrid. After that, it will launch the S300 Bluetec Hybrid, a diesel car that is combined with a lithium-ion battery. Also, General Motors plans to introduce a 40-mile plug-in hybrid with lithium-ion batteries in 2010.

Send R&D articles to Shannon Given,
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lighter and more aerodynamic. The company has also launched to the market the TH!NK City, a plug-in electric car with over 100 miles range.

The commercial supply agreement with A123Systems provides Think with patented Nanophosphate lithium-ion batteries for the TH!NK City, now in production at the company's factory in Norway. Think is delivering its first cars

in Norway, with international sales to follow later in the year.

A123 is now drawing on the research and technology development expertise of GE Global Research in Niskayuna, New York. The joint research will support A123's battery development, including batteries for Think's vehicles.

GE Energy Financial Services has invested in A123Systems to help the company roll out batteries for Think. GE is now A123's largest cash investor, having put more than \$20 million into the company. In addition, GE disclosed it has invested \$4 million in Think Global, the Norwegian holding company that makes the electric cars. The investments were made by GE Energy Financial Services' recently expanded seven-member venture capital group. That group has invested nearly \$100 million in 12 companies during the last 18 months.

GE's research includes a \$5.6 million US Energy Department contract to develop smaller, lower cost, higher performing hybrid drivetrain motors for hybrid electric vehicles. In addition, GE is working on a \$1.2 million project to develop advanced high temperature, high energy density capacitors. GE researchers are also engaged in a US \$13 million project with the US Federal Transit Administration and other industrial partners to build a prototype light-weight, battery-dominant zero emissions hybrid fuel cell bus.

Xcel Energy Launches Wind-to-Battery Project

Xcel Energy will soon begin testing a cutting-edge technology to store wind energy in batteries. It will be the first use of the technology in the US for direct wind energy storage.

Integrating variable wind and solar power production with the needs of the power grid is an ongoing issue for the utility industry. Xcel Energy will begin testing a one-megawatt battery-storage technology to demonstrate its ability to store wind energy and move it to the electricity grid when needed. Fully charged, the battery could power 500 homes for more than seven hours.

"Energy storage is key to expanding the use of renewable energy," said Dick Kelly, Xcel Energy chairman, president and CEO. "This technology has the potential to reduce the impact caused by the variability and limited predictability of wind energy generation. As the nation's leader in distributing wind energy, this will be very important to both us and our customers."

Xcel Energy has signed a contract to purchase a battery from NGK Insulators Ltd. that will be an integral part of a project. The sodium-sulfur battery is commercially available and versions of this technology are already being used in Japan and in a few US applications, but this is the first US application of the battery as a direct wind energy storage device.

The 20 50-kilowatt battery modules will be roughly the size of two semi trailers and weigh approximately 80 tons. They will be able to store about 7.2 megawatt-hours of electricity, with a charge/discharge capacity of one megawatt. When the wind blows, the batteries are charged. When



the wind calms down, the batteries supplement the power flow.

The project will take place in Luverne, Minn., about 30 miles east of Sioux Falls, S.D., with the battery installation beginning this spring adjacent and connected to a nearby 11-megawatt wind farm owned by Minwind Energy, LLC. S&C Electric Company will install the battery and all associated interconnection components. The battery is expected to go on-line in October 2008.

Partners in the project with Xcel Energy include the University of Minnesota, the National Renewable Energy Laboratory, the Great Plains Institute and Minwind Energy, LLC. Xcel Energy is testing emerging technology and energy storage devices as part of its overall Smart Grid strategy, which modernizes and upgrades the grid to allow for easier integration of renewable energy sources.

Xcel Energy is a major US electricity and natural gas company with regulated operations in eight Western and Midwestern states. Xcel Energy provides a comprehensive portfolio of energy-related products and services to 3.3 million electricity customers and 1.8 million natural gas customers through its regulated operating companies.

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Calendar of Events

May

- 4-7 - UTC, Orlando, Fla.
- 5-7 - BATTCON 2008, Marco Island, Fla.
- 6-8 - EDS 2008, Las Vegas, Nev.
- 12-16 - The 8th International Advanced Automotive Battery and Ultracapacitor Conference, Tampa, Fla.
- 18-23 - Electrochemical Society Spring, Phoenix, Ariz.

June

- 9-12 - 7th International Lead Acid Batteries Conference (LABAT), Varna, Bulgaria
- 16-19 - NXTcomm, Las Vegas.
- 24-27 - CableTec Expo, Philadelphia, Pa.

July

- 7-10 - 43rd Power Sources Conference, Philadelphia, Pa.
- 14-16 - Advanced Capacitors World Summit 2008, San Diego, Calif.

September

- 4-5 - Battery Power 2008, New Orleans, La. Contact Webcom Communications at 720-528-3770 or at www.BatteryPowerOnline.com
- 14-18 - Intelec 2008, San Diego, Calif.
- 23-26 - 11th European Lead Battery Conference, Warsaw, Poland

October

- 8-10 - Batteries 2008, French Riviera

November

- 5-6 - Remote 2008 Conference & Expo, Atlanta, Ga.

December

- 1-5, MRS Fall, Boston, Mass.

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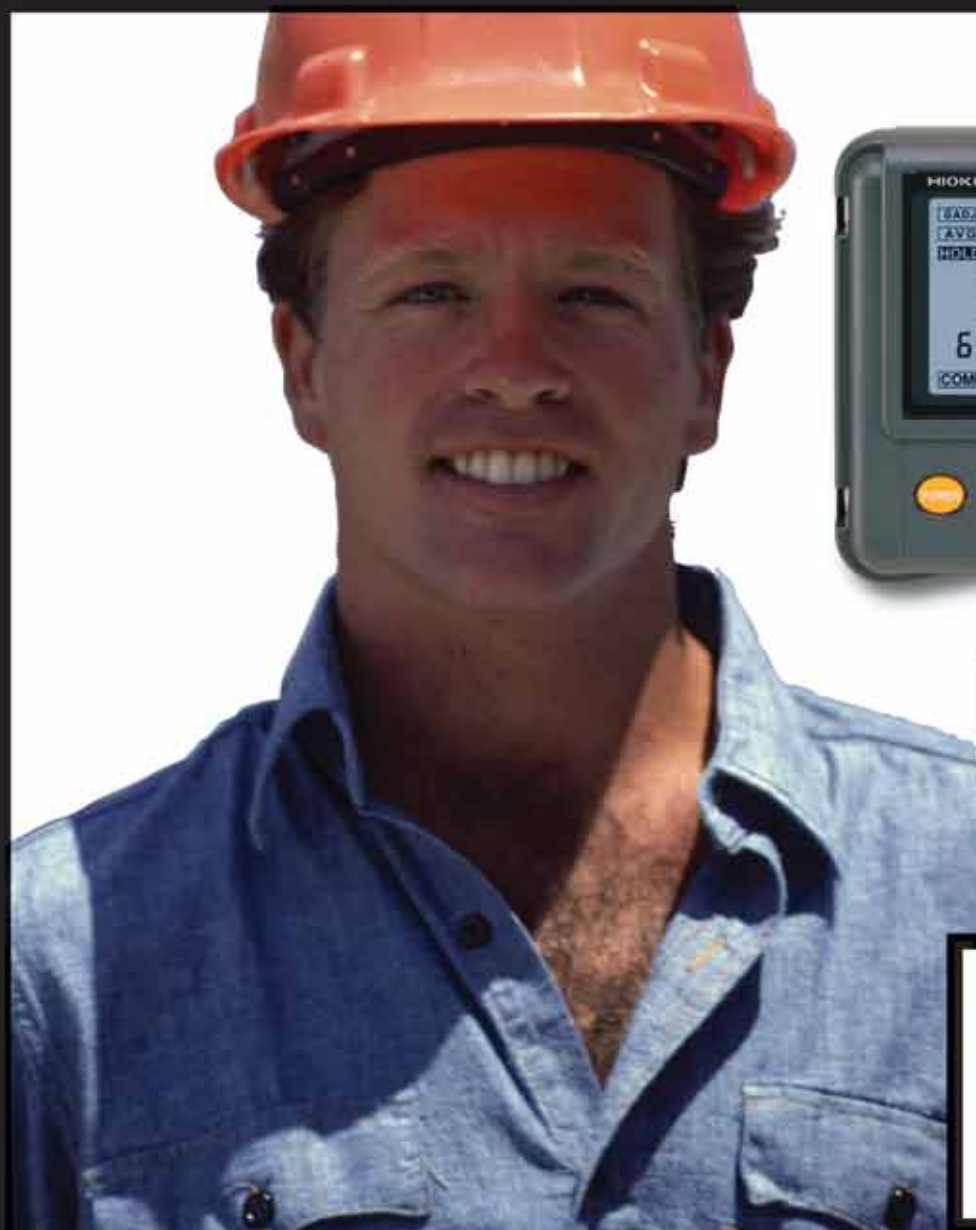
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