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January/February 2011

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Volume 15, Issue 1

# **Key to Optimal Battery**

Real-Time, Remote Monitoring



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A Macro Opportunity In Micro-Hybrids

**2011 Industry Outlook** 

**Battery Charging Safety Requirements** Aren't One-Size-Fits-All Solutions

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# **EDITOR'S CHOICE**

# **Siemens Adds Electric Vehicle Charging Stations to Its Smart Grid Solutions**

Siemens Energy, Inc. has launched its new product line of EV charging stations, which includes solutions for residential, public and commercial applications including integra-

tion into the Smart Grid. Siemens' portfolio of EV charging stations offer safe, highly reliable plug-in EV charging for electric vehicle manufacturers, municipalities, corporations, fleets, utilities and residential customers. The easy-to-use stations provide multiple power options, integrated aesthetics and ergonomics with ruggedized construction.

Siemens' UL listed electric vehicle supply equipment (EVSE) line includes wall-mountable, community multi-level and community multi-level II models. The



company's wall-mountable charging station is a 7.2-kW single-output station designed for residential and light commercial applications. Siemens' public outdoor charging stations will be available in single Level II and multi-level designs. The multi-level charging sta-



tions incorporate a dual power output configuration, allowing both Level I and Level II outputs to deliver energy simultaneously. Siemens' EV charging stations will offer Coulomb Technologies' ChargePoint Network. The ChargePoint Network is an advanced software system that is open to all drivers of plug-in vehicles. Advanced features of the network include: 24/7 driver assistance, the ability to locate a charging station from any smart phone, the ability to detect charging station availability from a smart phone or Google Maps, EV trip mapping and driver billing. Further, the ChargePoint Network provides Siemens charging station owners remote management, flexible billing, fleet management, maintenance and other on-demand software applications. Each unit is equipped with an ANSI C12 communications

compliant meter. By incorporating connectivity options, metering capabilities and an open architecture, Siemens' EV charging stations can be integrated into the rapidly evolving Smart Grid.

In addition to the charging stations, Siemens provides integration of EVs into the utility grid with advanced metering infrastructure (AMI), load shifting through demand response (DR) programs and the addition of generation capacity to handle widespread EV adoption, giving consumers options while avoiding service disruptions.

North America is expected to lead global PEV adoption between 2010 to 2013, primarily due to the Corporate Average Fuel Economy (CAFE) program, which mandates fuel efficiency levels across a manufacturer's entire fleet. The standard is set to increase from 27.5 mpg to 35 mpg by 2020, which will achieve almost 90 percent of President Obama's stated goal. Siemens EV charging stations are designed to interface with all new automotive OEM plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) coming to market and will offer high reliability and safe charging for this growing market.

# Advanced Charging Technologies to Top \$34 Billion in 2015, According to ABI Research

Markets for advanced charging technologies (including solar-powered handsets, solar chargers, wireless power units, fuel-cell battery charging products and public charging kiosks), worth about \$1.5 billion in 2010, are forecast by ABI Research to grow at a CAGR of more than 86 percent to exceed \$34 billion in 2015.

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# **EDITOR'S CHOICE**

As people carry and use increasing numbers of portable electronic devices, they have a growing need to charge their batteries on the go. Today's road warriors can tell you it's not always feasible to plug a cellphone handset into a wall outlet or car adapter for a quick charge. That is why a number of vendors are developing and commercializing advanced charging technologies that can top up batteries wirelessly or using solar or wind power, or which provide for a fast download of electricity while waiting for a flight.

Research director Larry Fisher of NextGen, ABI Research's emerging technologies research incubator, said, "With developers about to release advanced charging products in late 2010 and the first half of 2011, the advanced charging revolution is about to take off. In addition, the Wireless Power Consortium's release of the Qi standard for interoperable wireless charging in 2010 has set the stage for portable electronics manufacturers and infrastructure producers such as Panasonic, Philips Electronics, Samsung, LG Electronics and Nokia to incorporate the technology into their products."

Some of these technologies are particularly applicable to users in developing countries. Parts of the Middle East and Africa, for example, do not have access to stable power and cellphone users must travel many miles and pay to charge up. Solar chargers and handsets could make a real difference to the lives of people in such circumstances, even though they're currently being marketed primarily to the eco-conscious in the developed world.

In a new study, "Charging Technologies for Portable Devices", ABI Research presents forecasts for shipments and revenue for each category of advanced charging technology, globally and by major geographic region, to 2015. The report also analyzes the vendor landscape in terms of business models, technology developments and accomplishments to date.

# **NRG Energy Selects AeroVironment to Build the Nation's First Privately-Funded Electric Vehicle** Charging "Ecosystem"

AeroVironment, Inc. (AV) has joined forces with NRG Energy, Inc. to bring the first privately funded, comprehensive electric vehicle (EV) charging "ecosystem" to drivers in America's fourth largest city, Houston, Texas. The ecosystem is an integrated network of products, services and payment plans that helps make EVs practical for drivers. AV is the exclusive provider of home and public charging systems, installation services, energy usage monitoring and payment and subscription solutions in support of the Houston ecosystem, which can be deployed as a practical, integrated model in cities throughout North America.

In addition to supplying, installing and supporting smart home and public overnight and fast charging stations, AV will also provide the integrated data collection, communication and analysis systems that will power NRG's eVgosm network. NRG plans to invest approximately \$10 million in Houston's public charging infrastructure including installing a minimum of 50

high-powered fast charging stations by mid-2011. The eVgo charging network will give Houston's EV drivers ready access to charging stations along major freeways, in key shopping and business districts, at popular retailers, and in multi-family community and workplace parking areas within 25 miles or more of city center.

"This innovative charging ecosystem will make it easier for Houstonians to drive electric vehicles and contribute to a cleaner, more energy independent future for America," said Tim Conver, chairman and CEO, AV. "We are proud to work with NRG and its partners to introduce a comprehensive EV charging solution to Houston, and look forward to bringing this driverfocused model to other cities in Texas and beyond."

AV and NRG have developed a comprehensive charging solution that is well suited for NRG's customers and is designed to make the use of electric vehicles convenient and easy. These innovative solutions include: a Level 2 Home Charging Dock, Level 2 Commercial Charging Station, High Power DC Charging Station, Installation Services and EV Network Services.

### **Batteries Smaller Than a Grain of Salt**

Lithium-ion batteries have become ubiquitous in today's consumer electronics, powering our laptops, phones and iPods. Research funded by DARPA is pushing the limits of this technology and trying to create some of the tiniest batteries on Earth, the largest of which would be no bigger than a grain of sand.

These tiny energy storage devices could one day be used to power the electronics and mechanical components of tiny microto nano-scale devices.

Jane Chang, an engineer at the University of California, Los Angeles, is designing one component of these batteries: the electrolyte that allows charge to flow between electrodes.

"We're trying to achieve the same power densities, the same energy densities as traditional lithium ion batteries, but we need to make the footprint much smaller," said Chang.

To reach this goal, Chang is thinking in three dimensions in collaboration with Bruce Dunn and other researchers at UCLA. She's coating well-ordered micro-pillars or nano-wires, fabricated to maximize the surface-to-volume ratio, and thus the potential energy density, with electrolyte, the conductive material that allows current to flow in a battery.

Using atomic layer deposition, a slow but precise process that allows layers of material only an atom thick to be sprayed on a surface, she has successfully applied the solid electrolyte lithium aluminosilicate to these nanomaterials.

The research is still in its early stages: other components of these 3D microbatteries, such as the electrodes, have also been developed, but they have yet to be assembled and integrated to make a functioning battery.

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# **Real-Time, Remote Monitoring Key to Optimal Battery Performance**

By planning a regular preventive maintenance schedule you can bet-

ter determine your battery health and end-of-life as well as manage your

# Jeff Donato, Service Product Manager

Emerson Network Power Liebert Services

Today, battery maintenance goes well beyond regular preventive maintenance visits. It has evolved to include technological capabilities that monitor the battery remotely 24/7 so you

can track the life of the equipment to more accurately detect and trend battery failure.

As we all know, batteries that are not properly maintained are proven to be one of the leading causes of downtime and safety risk. In fact, about 37 percent of down units are due to battery failure. A single bad cell in a string of batteries could compromise the entire backup system and leave an organization without protection.

In order to maximize the availability and performance of the battery system, facility managers must ensure

battery system integrity through periodic maintenance, while also considering remote monitoring capabilities that can optimize the life of batteries.

replacement schedule.

While new remote monitoring technology provides greater reliability and peace-of-mind, it's still crucial that you have an on-site maintenance program integrated with remote monitoring that includes analysis and diagnostics. However, taking advantage of a real-time, remote-battery diagnostic system integrated into your holistic program provides some added benefits.

Using this 24/7 technology, you or your service provider can review data constantly, using it as a diagnostic tool to look at critical battery parameters. A combination of critical parameters/readings may point to a specific problem or failure mode, providing real-time notification when a problem occurs. With a real-time battery diagnostics system, technicians can also monitor equipment off-site, providing a continuous watch of the battery to assess its true state of health.

A remote monitoring service may include a team of centralized technicians reviewing the information. This typically includes algorithms that allow technicians to be proactive rather than reactive so they can predict cell failures days in advance

and take steps to avoid a malfunction. There's an inherent benefit in having a centralized expert group that can do that type of detailed analysis and proactively react – as they can diagnose, stabilize, alert, dispatch (if need) and alleviate the problem.

Instead of waiting for an inevitable failure or replacing batteries prematurely to prevent problems, battery monitors allow

organizations to continue to utilize their batteries optimization with confidence by knowing the true condition of all critical battery parameters such as cell voltage, internal resistance, cycle history, overall string voltage, current and temperature.

If a power outage occurs, even a single bad cell in a string could compromise an entire backup system and leave a business without protection on their critical loads. In addition to implementing or integrating remote monitoring with onsite maintenance and monitoring batteries, safely replacing failing batteries will help keep IT systems running and minimize the risk of costly downtime to business operations.

# **Benefits of a Real-Time Remote Monitoring System**

While there are best practices backed by IEEE guidelines, due to cost, customers try to find alternative methods to improve availability and save money. If a customer already performs load testing and they add a monitor, it can save them setup costs by not having to set up portable data-logging monitors. If a customer doesn't perform load testing at all, this gives them a diagnostic tool that monitors all critical parameters.

# **Increase Availability**

Batteries represent the least reliable component in the critical power system. They are an electrochemical device that is designed to age and lose capacity over time. Adverse conditions such as over-cycling, aging capacitors and high temperatures have a dramatic effect on batteries by accelerating the aging process.

With real-time, battery remote monitoring, you can ensure maximum reliability of data center equipment by providing sys-



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# **Diagnose A Problem Before It Begins**



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tematic remote inspections, detection and correction of developing failures before they translate into costly downtime.

While you can't extend the life of a battery, you can optimize the lifecycle to make replacement decisions based on data trends and age. Early detection and correction of failing batteries are key to optimizing battery life and maintaining critical continuity of your data center.

# **Optimize Lifecycle to Controls Costs**

A real-time battery monitoring system also helps you control costs because it gives you time to start planning for maintenance/upgrades based on day-to-day diagnosis of the battery. If you notice that the battery is not working to its full potential, you can begin budgeting for future battery replacement costs.

In addition, by having a system that tracks the performance of the battery, you are essentially helping keep the system so it's working at optimal condition. For instance, if you are replacing failed battery cells, you essentially are controlling the elements so the battery works at its best capacity. Sometimes optimization will bring you longer than expected life.

# Handling Your Remote Monitoring **Technology Needs**

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When choosing a remote service provider, seek out a group that offers a comprehensive portfolio of services. Service should be customized to satisfy data center requirements. In addition, a

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remote service provider should have these qualities:

• Ensures Secure Monitored Network Communications: From monitoring individual systems to an entire site, your provider should have a secure, scalable connectivity solution for your entire business. The service partner should know in "realtime" when a connection is lost or if they are connected • Monitors all Critical Equipment: Have one source for all

critical infrastructure monitoring and service escalation. • Easy Installation: The remote monitoring package should be coordinated by remote provider experts, providing an easy-toorder, installed solution that is inclusive of any necessary communication device.

• Targeted Notification and Customized Service Escalation: Ensure your provider has a comprehensive plan to notify the decision makers within your organization or escalate to your customer engineer for problem resolution. Targeted notification and customized service escalation typically common among disaster recovery plans.

• Provides Comprehensive Reports: Monthly alarm summary and health reports keep you informed of mission critical infrastructure, operation and recommended action plan.

While there are many battery services available, the best solution to maximizing battery performance is to utilize an integrated battery monitoring service that combines state-of-the-art battery monitoring technology with proactive maintenance and service response. This type of proactive solution integrates onsite and remote PM activities with practical analysis to identify

problems before they occur.

The reality is that 98 percent of all power outages last less than 10 seconds. Yet, if the batteries in the uninterruptible power supply (UPS) system supporting your critical network fail during that short time, business can spiral into major costs for your business.

In the end, your organization will benefit from a sound remote monitoring system to manage your company's critical continuity plan. With today's heavy reliance on technology and automated systems, disruptions in the data center can have severe impacts on the business. Remote monitoring provides the necessary assurance that your data center will be prepared to ride through and recover from any disaster.

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Battery Power 2011 is currently accepting abstracts for its With more than 400 attendees, the conference provides ninth annual event, September 20-21 in Nashville Tenn. an excellent forum to discuss new developments in tech-The international event will explore the important topics nology, market conditions and end-user requirements that impacting battery power technology from design issues are driving innovation, capabilities and features, applicain battery packs and emerging charging technologies to tion trends and performance improvements. Attendees predicting battery failure and battery hybrid technologies. include top executives, technical managers and engineer-Other topics include cell design and manufacturing, power ing professionals from original equipment manufacturers, management, testing, materials, market trends and endsystem developers and integrators, dealers and compouser requirements for new applications. Presentations will nent providers. cover the portable/mobile, automotive/EV and stationary/ onsite power markets.

Here are some topics we are looking for:

# **Batteries**

- Thin Film Technology
  - Recycling
  - Renewable Systems
- Energy Harvesting Cell/Battery R&D
- Battery Safety Emerging Battery Technology
- Battery/Fuel Cell Hybrid Technology

# Charging, Testing & Monitoring

- Wireless Charging Technology
- Smart Battery Pack Charging Systems
- Avoiding/Predicting Battery Failure
- Monitoring Battery Health
- Capacity Testing
- Battery Evaluation
- State-of-Charge
- Charging Efficiency

For details on submitting an abstract, please visit the Call for Presentations page at www.batterypoweronline.com/bppt-conf11/bp11 papers.php or contact Shannon Given at shannong@infowebcom.com.

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- Regulatory Issues
- Battery Market Trends
- Circuit Topologies Fuel Gauging

# **Battery Components & Materials**

- Emerging Chemistries
- Nanomaterials/Nanotechnology in Batteries
- Development of High Power Materials

# A Macro Opportunity in Micro-Hybrids

Safe

POWERCENIX

# **Richard Brody, VP of Business Development** PowerGenix

With the long-awaited Nissan Leaf and Chevrolet Volt debuting in December, many foresee an electric vehicle (EV) revolution ahead. While enthusiasts claim EVs are finally ready for prime time, skeptics caution the steep economics of the vehicles don't make sense for budget-conscious consumers. Battery cost is a key obstacle hindering widespread EV adoption: a typical EV battery pack accounts for more than half the cost of the vehi-

cle. Despite optimism from government and the auto industry that battery costs will go down as automakers ramp up EV production, many argue that serious battery price reduction will take at least a decade.

Meanwhile new fuel efficiency and carbon emission standards place increased financial pressures on automakers. These standards are based on emissions improvements within reach of existing technology. and encourage the

industry to rely on proven, already-economical technologies to meet emissions targets. Among vehicle electrification technologies, broader hybridization including micro-hybrids, mild hybrids and full hybrids, represents the most cost-effective route to achieving regulatory carbon emission and fuel savings goals. Of those three technologies, micro-hybrids offer the most promise for near-term, low-cost emissions reductions.



# **Micro Hybrids: Meeting Fuel Economy Standards**

Micro-hybrids are traditional gasoline or diesel-powered cars with automatic stop-start technology that stops the engine at a red light and restarts it on green. At a cost below \$500 per ve-

> hicle system, this simple, low-cost advancement is widely considered the lowest hanging fruit for reducing existing vehicles' emissions. Micro-hybrids improve fuel economy up to 15 percent in city driving, providing an immediate and obvious payback to the consumer.

Auto majors, especially those active in the EU and Asia, have gotten the message: by 2015, according to a recent Lux Research study, 37 percent of new passenger vehicles sold throughout the world will be microhybrids. This growth will greatly outpace sales of more expen-

sive hybrid electric and electric vehicles, especially in developing economies.

With this clear market opportunity, auto manufacturers are now deciding which battery technology will best support microhybrids. Rechargeable lead-acid batteries, the old standby to start cars since the time of your grandfather's Oldsmobile, will retain ground in some segments of the micro-hybrid market. But lead-acid batteries are weighed down by performance limitations including limited charge acceptance and short service life, impeding their effectiveness in start-stops systems. Instead, the auto industry requires a high-performance battery alternative to lead-acid that can ensure longevity by enduring thousands of starts and stops over the vehicle lifetime.

# **Driving New Battery Solutions**

In an industry constrained by the limits of the periodic table, disruptive cost and performance gains are rare. Many experts now eye an old technology, rechargeable Nickel-Zinc (NiZn) batteries, for a new role in micro-hybrids.

First introduced by Thomas Edison for use in EVs in the early 20th century, NiZn batteries have reemerged as the best

hope to for high performance and low cost in the micro-hybrid size, further increasing vehicle efficiency. market. NiZn batteries have already proven their promise in the Strict carbon emission standards present an enormous hybrid vehicle market, demonstrating significant performance market opportunity for a spectrum of hybrid and EV technologains in PowerGenix's 10,000-mile Toyota Prius road test. In gies. While EVs will play some role in cleaner transportation, that test, a NiZn battery provided greater power in a battery pack micro-hybrids are a ready-to-roll technology that will improve two-thirds the size and weight, and at 25 percent lower cost, of fuel economy and thrive within today's market realities. In the standard Nickel-Metal Hydride pack. In micro-hybrids, NiZn turn, NiZn batteries are a promising solution for the millions of micro-hybrids soon to hit the road. batteries offer significant performance improvements by overcoming the cycle and calendar life limitations of lead-acid cells. As demonstrated in the chart, replacing a lead-acid battery with Contact PowerGenix at www.powergenix.com. NiZn also results in up to 70 percent reduced battery weight and

Lead-Acid	Niž	Zn
Parameter	Lead-Acid	NiZn
Form Factor	Prismatic	Prismatic
Nominal Voltage	12 V	12.8 V
Nominal Capacity	60 Ah	40 Ah
Pack Energy	720 Wh	512 Wh
Gravimetric Energy Density	35 Wh/kg	69 Wh/kg
Bare Pack Weight	20.6 kg	7.4 kg







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# **Battery Power 2011 Industry Outlook**

# Industry Leaders Share Their Insight on Growth Areas, Driving Factors and What to Watch for in 2011

### **Stéphane Senvarich, Nickel Product Manager** Saft Specialty Battery Group

What do you see as being the largest growth area in the Battery/ Power market in 2011?

I believe the global appetite for personal portable electronic devices will continue to be an area for growth in 2011. The volume of personal electronics that require batteries, such as tablet touch screen computers, laptop computers, mobile phones, e-books and similar net connected products, paired with their short replacement cycle (around 24 months), should secure the demand for advanced battery power for years.

What factors are driving this growth?

A key factor in driving the growth of the battery market is the rapid adoption of personal communications technologies and after the adoption phase, ubiquity and the subsequent consumers' reliance upon them. Can you imagine a single day without your mobile phone, tablet device or computer and subsequent web connection?

What important changes, trends or advancements do you foresee *in 2011?* 

The power industry will see continued advancements in renewable energy storage as the industry focuses on replacing fossil fuels as an energy source. Markets centering on green energy sources, such as solar and wind power, will certainly see growth in 2011.

# What's new for Saft in 2011?

Saft anticipates growth in green energy markets and has developed eco-designed Ni-MH battery technology dedicated to renewable energy applications. In 2011, Saft will introduce a new battery for solar applications that is shaped like a tube for use inside the pole of solar street lights. The tubular design offers cost savings, low maintenance and pre-

vents theft (a problem with lead-acid batteries). Other features include very long life duration and wide operating temperature range, both of which are key advantages over lead-acid technology. Mass production of the new tubular PV module is planned for second quarter 2011.

Also in 2011, Saft is launching two primary lithium batteries designed specifically for demanding high-drain electronic applications. The new generation LSH20 cell offers enhanced autonomy and a long service life for metering and military radio-communications equipment. Saft's Friwo brand M20Ex cells were developed to offer a unique, world-leading level of performance for an intrinsically-safe D-size cell designed for use in potentially explosive atmospheres such as smart gas meters with GPRS communication, petrochem facilities and mining applications.

Saft is a world specialist in the design and manufacture of *high-tech batteries for high performance applications, such as* industrial infrastructure and processes, transportation, space and defense.

### Dan Squiller, CEO *PowerGenix*

The auto industry is seeing unprecedented growth in the electrification of vehicles. While there will be a few high-profile releases this year of new battery-electric and plug-in hybrid vehicles, the more important story will be dramatically stronger sales of micro-hybrids (start/stop) and mild/full hybrids. These hybrids vehicles offer compelling value propositions, enabling automakers to meet government fuel economy and emission requirements while luring consumers with immediate payback. As such, automakers are deciding which battery will best support

this opportunity, opening the market for a high-performance and robust battery that can endure thousands of starts and stops over the vehicle's lifetime.

# POWERGENIX

PowerGenix has developed the first high-power, low-cost *Nickel-Zinc battery for micro-hybrids and mild/full hybrids.* Currently, PowerGenix is in the qualification process with auto OEMs in North America, Europe and Asia.



Matthew Bloss, Applications Engineer, Ultrasonic Joining, David Speth, Senior Engineer, Materials EWI

# What's new for EWI in 2011?



EWI received a DOE grant through the Ohio State University to support

the Center for Excellence in Energy Storage. This will apply substantial funding for screening of various joining technologies for battery tab welding applications. It is

anticipated that this program will be the first of its kind that will evaluate ultrasonic, resistance and laser welding using the same materials and testing criteria for battery tab welding applications without bias toward different processes or equipment. The results of this program will enable battery manufactures to more appropriately select a joining method that is most appropriate for their needs.

# What should our readers keep an eye on for 2011?

2011 will be a very exciting year for both the battery and the automotive industries. There are high expectations for the performance and reliability of PHEVs and EVs, such as the Chevy Volt and Nissan Leaf; it will be interesting to see how the expectations of these vehicles compare with their performance. The success of these products can have a significant impact on the future of PHEVs and the use of large-format battery cells. As these vehicles gain market share, how we use and interact with our transportation will bring infrastructure (fueling), safety and telecommunication changes to positively affect our driving experience.

What do you see as being the largest growth area in the Battery/Power market in 2011 and what are the driving factors for this growth?

The largest growth area for 2011 is expected to be transportation, more specifically, large-format Lithium-Ion batteries and battery modules for Plug-in Electric Hybrid Vehicles (PHEV) and EVs like the Volt. This is being driven by dependence on foreign oil, 'green' initiatives and government funding and incentives.

# *What developments do you foresee in 2011?*

Many of the developments that are anticipated in 2011 are technical, related to battery and battery pack manufacturing. Developments in non-destructive battery tab weld inspection are





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expected due to the necessity of welds and the increased production volumes that are anticipated. Reliability will be a key factor in the acceptance and success of these vehicles. Reliability of the manufacturing processes to make the battery packs and management systems will drive new technologies for process monitoring and real-time control, especially with thousands of welds in a pack assembly.

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# Sally Bament, Vice President of Marketing and **Product Management**

Boston-Power

What important changes, trends or advancements do you foresee in 2011?

Energy storage is the cornerstone of some of the most profound shifts in technology and society that we've seen in our lifetimes, ranging from the electrification of transportation and the reinvention of grid power to truly ubiquitous mobility. The call for new and better-performing batteries to facilitate these historic advancements is happening today. For the battery industry, the biggest challenge may be the explosive growth in mobile power coinciding with the onset of automotive and utility energy storage applications worldwide in 2011 and beyond.

What do you see as being the largest growth area in the Battery/ *Power market in 2011? What factors are driving this growth?* 

While the market focus in transportation has previously been on short-range HEVs to bring some small savings in on-going fuel costs to consumers, over the next several years, we expect that the market focus will shift towards BEVs and PHEVs, as battery technologies continue to improve, automotive manufacturers standardize on large format battery packs, and the recharging in-

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frastructure grows to meet the increasing number of vehicles on the road. At Boston-Power, we have focused our development on high energy batteries that fulfill the end goal of



electric drive: an all-electric car or long range plug-in hybrid car. We believe this segment will be fueled by strong legislation and consumer pull. High energy density and affordability are the two driving parameters to make this market real.

As the EV markets grow, this will place a higher demand on the grid in localized areas. In addition to this, we expect to see increasing demand for renewable energy sources, such as solar and wind, both of which will require some form of energy storage. The combination of these demands, in addition to governmental regulations, will drive the need for cost effective, high energy density lithium-ion battery solutions for utility energy storage applications in the future.

In the portable power space, we see the need for advanced battery technologies increasing dramatically as consumer and business end-users' appetite for more advanced and portable devices grows. In addition to increased runtime, these users will also be looking for smaller, lighter devices, which will lead to the development of smaller and more powerful batteries. The paradigm of replaceable, rechargeable lithium-ion batteries will also shift as it becomes possible, with technologies like those from Boston-Power, to embed battery cells into products that will last as long, if not longer, than the products they power.

Finally, we continue to see more requirements around "green" initiatives, driven by the IT departments of large multi-nationals, as well as organizations in Europe specifically. Many governments also have strict mandates on IT purchases around environmental sustainability and reduced carbon footprint.

# What's new for your company in 2011?

Driven by a data-driven culture and offering an innovative battery platform that has already been introduced and accepted by the leaders of the electronics industry, Boston-Power intends to continue to help build a battery industry to support the most exciting markets of our times. In 2011, you should expect to see our continued momentum in existing and emerging markets where our technology creates a competitive advantage; as well as our continued innovation with new battery cells and battery systems leveraging our advanced lithium-ion battery technology platform.

Boston-Power develops next-generation lithium-ion batteries that are longer lasting, more environmentally sustainable, faster charging and safer for powering end applications ranging from portable electronics to electric transportation and grid energy storage.

### **Tim Hubbard, Director of Operations** Intertek

What do you see as being the largest growth area in the Battery/ Power market in 2011?

Electric Vehicle (EV) development, including mass product introduction and availability, energy storage chemistry evolvement and local/regional grid infrastructure development, will continue to grow in 2011 and beyond.

What factors are driving this growth?

Growth is mainly due to State and Federal government funding, as billions of dollars of stimulus funding was made available over the last 18 months to develop and build an EV industry base. There is a longer-term vision of replacing, or at least complimenting, fossil fuel-powered transportation dependence.

Intertek's expertise in battery & energy storage services ensures What important changes, trends or advancements do you foresee products meet performance, reliability and safety criteria. A in 2011? global leader in testing & certification, Intertek has expanded its global network of laboratories & advisory services.

We foresee growing economies of scale, as multiple EV applications, from a growing list of competitors, become available to the public. This will likely enhance public perception and acceptance of EVs, leading to greater levels of adoption.

# Motor, Drive & Automation Systems

Join hundreds of industry professionals and discover the latest economic trends and technical advancements impacting motor, drive and automation systems. Learn how new technologies are improving performance, energy efficiency and providing cost savings in a variety of applications.

If you are involved in the motor, drive or automation industries or if your products and systems use these technologies, this is a must attend event.

### What's new for your company in 2011?

As a testing and engineering services provider, Intertek will be staying in tune with and participating



in the development of testing methods and requirements for EV and energy storage technologies. We will continue to invest in our testing infrastructure, allowing us to provide the market with global test solutions.

What should our readers keep an eye on for 2011?

Adoption rate and popularity of EV technology. More rapid improvements in range and performance of EV energy storage applications.



# **New Products** • Batteries



# Shorai, Inc. Launches Powersports Batteries Using **Proprietary Lithium Technology**

Shorai, Inc. has launched a lithium-based starter battery for the powersports industry including motorcycles, personal watercraft, snowmobiles and ATV's.

The product utilizes Shorai exclusive, eXtreme-Rate LiFe-PO4 cell technology, LFX. Benefits offered over traditional lead-acid batteries include weight reduction, two to four times the average service life and the ability to hold a charge for up to one year without maintenance.

In addition to the performance enhancements, Shorai LFX batteries offer environmental benefits. Unlike traditional leadacid batteries, Shorai LFX batteries can be disposed of with no toxic effect to landfills.

Shorai LFX use military-spec carbon-plastic composite cases, and are a drop-in replacement for original-equipment lead-acid batteries. Shorai LFX cells are produced in a ISO 9001:2000 certified factory. The batteries are backed by a twoyear limited warranty.

# International Battery Introduces New 24-Volt Lithium-Ion High Energy Storage System

International Battery, a US manufacturer, designer and developer of large-format lithium-ion (Li-Ion) rechargeable cells, batteries and energy storage systems (ESS), has introduced the IBexus, a 24 volt, 4.1 kWh Li-Ion energy storage system



well suited for storage of solar and other renewable energy sources.

The first of the IBexus product family, the new eight-cell 24 V ESS is well suited as an evaluation module for several different projects with rechargeable energy storage requirements, ranging from sustainable home pilot projects to

micro grid load shifting applications. The first commercialized stock keeping unit (SKU) of the IBexus, the IB 24 V 008 ESS, is a 4.1 kilowatt hour system that contains eight 160 Ah Lithium Iron Phosphate cells wired in series. The battery system comes standard with contactor, current shunt and thermal management controls. For easy communication, the system

includes RS232, RS485, CANbus, Modbus or Ethernet communications, a PC graphical user interface (GUI) and data log functionality for communication with International Battery's technical support resources. A comprehensive battery management system (BMS) maximizes cell performance, enhances safety and monitors/balances individual cells. A standard set of output parameters is included for quick delivery, although customized features and output can also be programmed. Other members of the IBexus product family will include 60 Ah cell capacity and 48 V options.

The IBexus unit features robust thermal and cycling performance as well as easy system expandability and comprehensive battery management. Moreover, these Li-Ion cells offer quick charge times, small footprint, lighter weight, improved cycle life and low maintenance.

# Crown Battery Introduces New 12- and 6-Volt Battery **Series for Renewable Energy Systems**

Crown Battery Manufacturing Company has introduced its new Renewal Energy (RE) battery product series, the CRP Monobloc. The series includes nine 12- and 6-volt batteries with capacities from 130 to 525 ampere-hours (100-hour rating). Standard product design features include easy-access multipoint terminals, a built-in fluid level indicator and handles. The CRP Monobloc RE batteries provide significant benefits including longer battery life, increased reliability, higher performance, enhanced flexibility and configurability, lower maintenance, and safe and easy handling. CRP Monobloc batteries are well suited for backup energy storage for grid-connected users and for energy storage in off-grid applications.

Renewable energy systems are harsh environments for batteries. For instance, rapid power draw from current inverters can cause internal battery temperatures to soar to over 3,000°F. These high temperatures increase chemical reactivity, leading to structural deterioration of battery components and ultimately to early battery failure. Extreme weather, hot summers and frigid winters, also shortens battery life. It's easy to see why conventional automotive batteries, heavy-duty golf cart batteries and marine deep-cycle batteries fail quickly when used in RE systems.

The CRP Monobloc series features a heat-sealed case and cover with anchor-molded terminals. PosiWrap, a separator system, protects plates to reduced maintenance, prevent shortcircuiting and mossing, and keep active material bonded to the plate to ensure long battery life. Finally, Crown's Z3 plate geometry offers added performance and service life with its Diamond Z plate architecture, LifePlus lead oxide and inset lug position. Together, these features provide increased reliability and performance, which give grid-connected users a safety net and make everyday living possible for off-grid users.

### **TI Introduces Integrated USB Charging Port Power Switch**

Texas Instruments, Inc. (TI) has introduced a new power management device that integrates a current-limited power switch and a high-bandwidth 2.6 GHz signaling switch optimized for a USB interface. The TPS2540 is the industry's first host-side charging control inte-



grated circuit with an onboard power switch to enable intelligent charging for portable electronics devices that draw power from a USB port.

The TPS2540 supports USB charging modes around the world, including the upcoming Battery Charging 1.2 draft specification, Chinese and European regulatory requirements and proprietary charging modes from leading electronics OEMs. The IC is well suited for USB ports in a wide variety of host applications, such as AC wall adapters, desktop PCs, docking stations and auto charging accessories. TPS2540 is the first device to enable portable devices to charge via a USB port, even when the host system is in standby mode.

The TPS2540 supports a wide range of TI USB 2.0 and 3.0 transceivers. It complements TI's TUSB1310, which is the industry's first discrete SuperSpeed USB transceiver that enables USB 3.0 and USB 2.0 upstream and downstream functionality when used in conjunction with integrated digital cores.

The TPS2540 is available in volume now from TI and its authorized distributors in a 16-pin, 3 mm by 3 mm WQFN package. Suggested resale pricing is \$0.90 in 1,000unit quantities.

# Fairchild Semiconductor's USB-**Compliant, Li-Ion Battery Switching Charger Shortens Charge Time and Reduces Heat**

When charging a single-cell or parallelcell lithium ion (Li-Ion) battery through a USB port or AC/DC adaptor, designers need a solution that provides faster charge times and overcomes the thermal issues associated with the linear charger solutions in use today. To meet this need, Fairchild Semiconductor has developed the FAN5400 family of USB-compliant, Li-Ion switching





# ICs & Semiconductors

chargers with USB On-The-Go (USB-OTG) capabilities.

The FAN5400 family is well suited for single-cell or parallelcell Li-Ion battery charging in devices such as cell phones, smartphones, tablets, wireless broadband hotspots, digital cameras and portable media/game players. As charge currents and battery sizes continue to increase, charging through the USB port or 5 V AC/DC adaptor with a linear charger becomes increasingly inefficient. The FAN5400's switch-mode charger provides up to 94 percent efficiency, which helps with faster charging and lower thermal dissipation.



No system power limit, up to 900KW

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# **New Products** • ICs & Semiconductors



Integrated with the switchmode charger is a 5 V 300 mA boost regulator that uses the same inductor as the charger there-

by reducing external component count. In addition, both the charger and boost circuit switch at 3 MHz minimizing the size and cost of external passive components. Available in a 1.96 by 1.87 mm, 20-bump, 0.4 mm pitch CSP package, the FAN5400 family is the smallest solution on the market that provides both charger and USB-OTG boost functionality.

For flexibility the device's charging parameters and operating modes are programmable through an I2C interface, which operates up to 3.4 Mbps. Maximum charge current of up to 1.25 A ensures fast charging times and high charge voltage accuracy (±0.5 percent at 25°C) allows for more "topping out" of the battery, resulting in longer battery life.

In addition to the standard thermal and short circuit protections, the FAN5400 family can sustain up to 20 VDC on the input in order to protect against unregulated over voltage conditions on the USB port.

# 15 VIN, 2.5 A Synchronous Buck-Boost DC/DC **Converter Features Integrated Power MOSFETs**, 95 **Percent Efficiency and Low Noise Operation**

Linear Technology has announced the LTC3112, a synchronous buck-boost converter that delivers up to 2.5 A of output current from a wide range of power sources including single or multiple cell batteries, super capacitor stacks and wall adapters. Its 2.7 V to 15 V input range and 2.5 V to 14 V output range

provides a regulated output with inputs above, below or equal to the regulated output. The low noise buck-boost topology incorporated in the LTC3112 provides a continuous, jitter-free transition between



buck and boost modes, making it well suited for RF and other noise-sensitive applications that must maintain a low-noise constant output voltage with a variable input power source. In many applications, battery run time is significantly extended over step-down only solutions. The LTC3112's default 750 kHz switching frequency, that can be synchronized to an external 300 KHz to 1.5 MHz clock, and proprietary third generation buckboost PWM circuitry ensure low noise and high efficiency while



minimizing the size of external components. The combination of tiny externals and a 4 mm by 5 mm DFN or TSSOP-20E package provides a compact solution footprint.

LTC3112EDHD is available in a 16-lead 4 mm by 5 mm DFN package and the LTC3112EFE is available in a thermally enhanced 20-lead TSSOP package. Pricing starts at \$4.00 each and \$4.15 each, respectively for 1,000 piece quantities. Industrial grade versions, the LTC3112IDHD and LTC3112IFE, are guaranteed to operate over the -40°C to 125°C operating junction temperature range and are priced at \$4.40 and \$4.57 each, respectively, in 1,000-piece quantities.

# **Tyco Electronics' Resettable Overcurrent Protection Device for Li-Ion Batteries Offers Size and Cost Benefits**

Tyco Electronics has introduced a Metal Hybrid PPTC in end-products. (MHP) technology useful for high-rate-discharge battery ap-The MHP device technology can be configured for various plications at ratings above 30 VDC/30 A, such as cordless power applications, and higher voltage (up to 400 VDC) and hold curtools, e-bikes and back-up power supplies. MHP technology rent (60 A) devices are currently in development. Future design uses a new hybrid circuit protection approach that combines a considerations include battery protection in Li-ion battery packs bimetal protector in parallel with a polymeric positive temperaused in e-scooters and light electric vehicles (LEVs), as well as ture coefficient (PPTC) device. This integrated solution provides standby-power applications and non-battery applications such as resettable overcurrent protection and utilizes the low resistance electric motor protection. of the PPTC device to help prevent arcing in the bimetal protector at higher currents, while also heating the bimetal to keep it open and in a latched position.



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Due to advances in lithium ion (Li-Ion) technology, smaller, lighter weight and higher power Li-Ion batteries can now replace nickel cadmium or lead acid batteries previously used in high-rate-discharge battery applications. This trend has resulted in a rapidly expanding market for high-rate-discharge Li-Ion battery applica-



tions, which, in turn, has created the need for cost-effective, robust circuit protection devices that help ensure battery safety

# **Cadex Electronics Introduces the C8000 Battery** Test System

Cadex Electronics, Inc. has introduced the next generation of the Cadex C8000 advanced battery testing system. The Cadex C8000 delivers the versatility needed to optimize batter-



ies at every stage of product life. Its wideranging capability is well suited for use during initial product design right through to managing batteries in service. The C8000 fea-

tures device simula-

tion functions such as load capture and playback assist initial battery selection, as well as a variety of life cycle testing options that can be used to characterize the battery. Custom programming is available to create specific routines to monitor quality and performance and standard service programs are used for simple and effective battery maintenance.

Additional highlights include control of thermal chambers to test the effects of thermal cycling on battery properties and parallel channel capability to double the power capability by combining two channels into one.

The C8000 demonstrates its versatility with multiple battery interface options, standard programs for lead-acid, nickel and lithium chemistries and standard or custom waveforms, all coupled with powerful BatteryLab PC software that allows advanced data capture and graphic analysis.

# **Duracell Expands Smart Power Portfolio with** Wireless USB Charger

Duracell has introduced the Duracell myGrid USB Charger. The newest addition to its Smart Power portfolio, the Duracell myGrid USB Charger is a lithium-ion rechargeable battery



that gives users the freedom to stay connected without searching for an outlet.

The Duracell myGrid USB Charger provides extra power for more use-time on popular devices. For example, the Duracell myGrid USB Charger can provide at least four hours on smart phones such as the iPhone and latest BlackBerry models, at least 100 hours of reading on e-readers such as the Kindle, at least 30 hours on MP3 players, and at least 10 hours on Bluetooth headsets.

# Industrial-Grade Charge Controller for PV Applications

PV-Systems exposed to extreme weather/environmental conditions have increased risk for damage in the power electron-

ics. In order to assure reliable battery charge control under such conditions, Phocos has developed an encapsulated charge controller (IP68) to prevent corrosion, the CIS.

CIS is an industrial-grade charge controller that is suit-

able for all practical PV applications. High-quality, four-stage PWM-charging is combined with features such as low-voltage disconnect, flexible load timer functions and a multi-LED system status display. CIS is available in two versions: dual load to independently control two loads and output dimming to save energy in lighting applications.

The CIS has no moving parts, switches or buttons. Settings such as battery type, deep discharge thresholds and timers, are made quickly and easily via infrared remote control accessory.

All devices are connected to the controller by supplied lead wires rather than wire terminals. This feature eliminates the risk of damage from external influences (corrosion, dust, water, bugs, chemicals, physical shock) where components make electrical contact to the controller.

The extremely compact aluminum housing even allows for mounting CIS inside street light poles. CIS was developed in accordance with well-established Phocos standards incorporating the latest technology, highest-quality and best possible cost/ performance ratio.

### **Powermat Launches New Product Line**

Powermat, a wireless charging provider, has launched of its second generation line of products. The newest line expands the breadth of Powermat receivers to support more of today's popular Smartphones with thinner, sleeker and more formfitting options.

These new solutions incorporate Powermat's wireless charging technology directly into back doors specific to each device, closely mimicking the manufacturers' original design; in construction, detail and texture. Consumers pop on the receiver once, then drop and charge, with no more plugging and unplugging. The slim new receiver design is achieved by significant miniaturization of Powermat electronic components, reducing their thickness by more than half; from 3.4 mm to 1.6 mm.

Powermat is also ushering in the next phase in wireless charging with its new power-on-the-go series. The on-the-go solutions include the Powermat Portable 2x Rechargeable Mat, which incorporates a built-in 7,200 mAh lithium polymer battery that charges up to two Powermat-enabled devices independently and simultaneously.

### Chassis Mounting Kit for Half Brick DC/DC Converter

Calex Manufacturing Company has released the Calex MS22 Mounting Kit. The MS22 provides a turn-key solution

for prototyping or mounting a DC/DC converter in an enclosure. The MS22 is a cost effective solution that eliminates the need for the end customer to spin a printed circuit board for the converter. The MS22 accommodates Calex half brick DC/DC converters including the Calex 150 Watt HEW se-



ries, which offers a 9 to 36 VDC input range making the units for battery powered 12 volts systems, 24 volt industrial and 28 volt military applications.

The MS22 can be obtained on a stand-alone basis or with a customer specified Calex half brick DC/DC converter mounted on the board. The MS22 includes an input fuse for protection as well as input capacitors for lower input impedance to the DC/ DC converter. The MS22 also includes on-board barrier strips allowing screw terminal connections for all the converter input and output functions. The dimensions of the MS22 are 5.1 inches by 3 inches The height of the board with a half brick convert-



er mounted on it is 1.37 inches. The converter is mounted on the opposite side of the barrier strips to allow easy heatsinking of the half brick converter for thermal management.

# TDI Introduces A 4.1 kW, 28 V Liquid Cooled **DC-DC Converter**

TDI has developed LiquaCore power management technology that employs liquid cooling from a modular and scalable architecture. The technology uses a cold plate to wrap the electronics with cooling liquid in a sealed package that enables efficient management of waste heat at very high power densities. The cooling liquid employed is either water or a mixture of water and ethylene glycol (anti-freeze). By using standard converter modules powered from a typical 370 VDC bus, TDI can quickly configure a high power solution for virtually any application.

As part of their power management technology, TDI Power has developed a 4.1 kW, 28 V liquid cooled DC-DC converter that boasts 93 percent efficiency and has an MTBF of more than 100,000 hours. With a power density exceeding 35 w/in<sup>3</sup>, TDI can create a modular solution for higher power needs up to 50 kW or more. The module is well suited for harsh environment vehicular applications and can be configured with a customized outer chassis to meet virtually any available space claim. By utilizing common mechanical extrusions and mainstream components, the product is well suited for high volume manufacturing.

# **New Products** • Components

# **ProtectION From Performance Plastics - New Solutions for Lithium-Ion Battery Packs**

The Composites Division of Saint-Gobain Performance

Plastics (SGPPL) recently introduced ProtectION, a series of products designed to protect lithiumion cells from hazards that can negatively affect battery performance.

ProtectION high-performance foams, sponges and substrates are available for prismatic and cylindrical Li-Ion battery



packs. These products protect cells from vibration, overheating or other conditions that can compromise cell efficiency, life and operational safety.

"We have been working with industry leaders for approximately two years to optimize these performance solutions for mobile battery packs," said Steven Jette, business development manager for Saint-Gobain. "These products address the critical safety and performance issues we identified, specifically heat dissipation, electrical isolation, pouch cell expansion, external vibration mitigation and environmental sealing."

# **Ioxus Increases Energy Density By 115 Percent with New Hybrid Capacitor**

Ioxus, Inc. has developed a hybrid capacitor, a combination of an ultracapacitor and a lithium-ion battery, with an energy density 115 percent higher than standard electric double-layer capacitors (EDLCs). Its production of a hybrid capacitor makes Ioxus the only US company, and one of only two manufacturers worldwide, offering this technology.

Ioxus hybrid capacitors are similar to lithium-ion batteries, but they retain a cycle life with more than 20,000 charge/discharge cycles possible rather than the hundreds or few thousand delivered by batteries. The hybrid components offer advantages over standard ultracapacitors, as well, which have an energy density of 12.8 Wh/L. The hybrid capacitor offers an enhanced capability of energy storage, providing power to applications more quickly and efficiently.

Ioxus' hybrid capacitor offers benefits to industries beyond lighting, given its temperature range of -25°C to 60°C. At the low end of the range, the hybrid capacitor loses 5 percent of its energy while comparable battery energy loss would by 50 percent or more.



# **TÜV SÜD America Receives Full Recognition from** Ford for EMC-CS-2009

In recent years the popularity of electric bicycles has grown immensely due to a growing awareness of environmental issues which has led more and more people to seek ways to use alter-TÜV SÜD America's Automotive Electromagnetic Comnative means of transportation, as well as the expanded use of patibility (EMC) Laboratory in Plymouth, Mich. has received electric bicycles at rental shops as fun and relaxing recreation in formal recognition from Ford Motor Company to perform testtourist areas. However, with the expanded use comes a growing to the new EMC-CS-2009 specification. With this recogniing need to construct more recharging stations. By using solar tion, TÜV SÜD continues its eleven-year relationship with modules to generate the power for these bicycles Kyocera aims Ford and its suppliers to perform all EMC and electrical tests to provide an economical and ecological solution. within this specification.

In addition to the new Ford specification, the Plymouth EMC

lab is continuing its growth by expanding capabilities and capacity with the addition of a new threemeter semi-anechoic chamber. This expansion is primarily driven to service the large EV and PHEV batteries and electronic systems market. Along with the new chamber, new infrastructure and test equipment have been added specifically to support the testing of very large automotive battery systems.

TÜV SÜD will continue to offer a full range of automotive EMC testing, including General Motors GMW3097 and previous Ford specifications through the Automotive EMC Laboratory Recognition Program (AEMCLRP). Testing to other standards include: Toyota, Honda, Nissan, Hyundai, Fiat, Mercedes, BMW, Volkswagen, Freightliner, Harley-Davidson, SAE, ISO and CISPR.

### **Kyocera Supplying Solar-Powered Recharging Stations for Electric Bicycles**

Kyocera Corp. and its wholly-owned subsidiary Kyocera Communication Systems Co., Ltd. (KCCS) have announced the development of its new Solar Cycle Station, an environmentally friendly solar-powered recharging station for electric-assisted bicycles that uses the company's high performance solar modules.



Kyocera's "Solar Cycle Station" at a municipal building (Shiga, Japan)

The stations utilize solar modules to generate clean energy for recharging the battery of electric bicycles, but are also connected to the regular power grid, via a DC-AC converter, ensuring stable service during cloudy weather and for recharging during the night. Furthermore, the stations are equipped with conventional outlets so that they can be used as a power source in the event of a power outage or emergency.



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# **INDUSTRY NEWS**

# 3<sup>rd</sup> International BATTERY TECH

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# **Examining Practical Solutions For Driving Down The Cost &** Improving The Performance **Of EV Batteries**

Cost-Effectively Increasing Energy Density, Range, Life Cycle And **Safety** To Accelerate The Development Of Commercially Viable Mass Market Electric Vehicles

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Evaluating solutions improving the life cycle, energy density, safety & range of EV Batteries

Determining how material advances in the anode, cathode and separator will contribute to more cost-effective and higher performance EV Batte

kers From 15+ Vehicle OFMs Inclu



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# Lockheed Martin's SMSS Autonomous Vehicle to **Demonstrate Portable Battery Charging for Dismounted Soldiers**

Lockheed Martin's Squad Mission Support System (SMSS) autonomous vehicle is demonstrating its rugged maneuverability while meeting soldiers' needs to recharge batteries in Portable Power Excursion (PPE) tests at Fort Riley, KS.

The Portable Power Excursion test is part of the larger Nett Warrior program, which will use the PPE tests to collect data and form a strategy to help alleviate a soldier's weight burden, while still providing long-lasting, reliable power critical to today's missions.

Lockheed Martin's SMSS vehicle will cycle through three test Companies from the 1st BDE, 1 Infantry Division during the Nett Warrior excursion demonstration.



During that time, SMSS will maneuprovide two kilo-

SMSS has proved itself in mountainous terver with soldiers and rain. Photo courtesy of Lockheed Martin.

watts to four kilowatts of power. With the requisite number of chargers, the SMSS is capable of charging 146 batteries within 10 hours.

In addition to six Soldier battery chargers and a complement of batteries, the SMSS will carry and power a Mobile Network Integration Kit to improve communications from the network to the platoon, as well as transport up to 600 pounds of other soldier gear.

Nett Warrior, managed by the US Army's Product Manager Ground Soldier, is a set of soldier-worn, battle tracking technologies that provide dismounted Soldiers with increased situational awareness, better reaction time and reduced risk of fratricide. Nett Warrior is designed for Infantry Brigade Combat Teams. A Nett Warrior-equipped rifle platoon, along with all of its organic radio power consumers, will consume the power of 140 batteries per day. The collection of batteries required for one 24-hour mission weighs 155 pounds.

# **BASF Breaks Ground on Production Facility for Lithium-Ion Battery Materials**

BASF has broke ground on a \$50 million facility in Elyria, Ohio, to produce advanced cathode materials for lithium-ion batteries that will power the hybrid and full-electric vehicles of the near future. The new BASF production facility in Elyria is being built with the help of a \$24.6 million grant from the DOE under the American Recovery and Reinvestment Act.

BASF is one of only two licensed suppliers of the Argonne National Laboratory's (ANL) patented Nickel-Cobalt-Manganese (NCM) cathode materials, which employ a unique combination of lithium and manganese-rich mixed metal oxides. The

license covers the broadest scope of NCM chemistry that can be used in today's lithium-ion batteries.

As part of its long-term strategy to invest in cathode materials, BASF will continue to further lithium-ion battery application development at its research facilities in Beachwood, Ohio, and Ludwigshafen, Germany.

# **Perpetually Powered DSP Applications Made Possible** With Thinergy

Infinite Power Solutions (IPS) has teamed with Texas Instruments (TI) to create a perpetually-powered digital signal processor (DSP) solution using its solid-state energy storage solutions and ambient energy harvesting technology. This is made possible by the ultra-low power consumption of TI's TMS320C5515 DSP and the ultra-efficient, high-peak current capability and near loss-less energy storage of the IPS Thinergy Micro-Energy Cell (MEC). The Thinergy solid-state MEC101-7S is rapidly and efficiently recharged by solar energy, even with extremely low light conditions, resulting in a perpetually powered DSP-based application for decades of maintenancefree signal processing. The ultra-low power consumption of TI's TMS320C5515 DSP in active and standby modes enables sophisticated DSP computations, taking advantage of the high peak current of Thinergy technology in the most energy-efficient manner. Potential applications include remote audio, very-lowbit-rate video surveillance, seismic monitoring, remote vibration sensing of bridges, buildings and industrial machinery and other innovative applications yet to unfold.

"The combination of our Thinergy MEC and TI's C5515 ultra-low-power DSP has the potential to create DSP solutions that operate autonomously and continuously for the life of the application," said Tim Bradow, IPS' vice president of technical marketing. "This achievement represents a major step forward in enabling ultra-low-power and low-duty-cycle applications requiring significant signal processing capabilities. We are pleased to be a part of this major milestone achievement in DSP technology."

IPS' Thinergy family of MEC products are paper thin, inherently safe, can be recharged countless times and provide a true 'clean' energy storage solution that delivers a lifetime of power to micro-electronic systems without the prohibitive cost of battery replacement, maintenance and recycling. Combining these attributes with an ultra-thin and flexible form factor makes Thinergy MECs well suited for enhancing existing products and enabling innovative new products across a broad spectrum of markets from medical devices to aerospace and consumer electronics.

# Send Industry News Items to Shannon Given, Director of Content, shannong@infowebcom.com

# **Battery Charging Safety Requirements** Aren't One-Size-Fits-All Solutions

### Shadi Hawawini, Applications Engineer George Paparrizos, Product Marketing Director Summit Microelectronics

A number of new industry standards for battery charging have been introduced over the last few years. Most of them attempt to ensure safe operation for both the system and the battery pack, especially when Li+ based battery technologies are utilized. The majority of new portable designs are starting to implement a variety of architectures to adhere to the new standards, primarily driven by end customers and service providers. As system designs become increasingly complex, time-to-market windows become smaller and new technologies hit the market, many of the implementations may result in higher cost, larger footprints or performance compromises. This article introduces some of the new safety standards (IEEE1725, JEITA, JISC8714, etc.) and regulations and discusses implementations, benefits and challenges. Furthermore, it analyzes the pros and cons of several solutions and why fixed implementations are limiting system design by providing one-size-fits-all solutions.

# **New System Design and Battery Trends**

Over the last few years, the typical portable gadget has become as powerful as a small computer, with an increasing level of complexity and power requirements. This trend has led to the adoption of higher battery capacities and more aggressive charging approaches for addressing the inevitable need for more frequent and faster charging. At the same time, safely charging the batteries in such applications has become a major focus during the development of new portable equipment. New designs incorporate many secondary protection features (a large part of the primary protection finds place in the battery pack), and also try to proactively address corner conditions in the field, such as faulty wall adapters, reverse connectors, faulty batteries, mechanical overstress and others. The battery industry has also developed new battery technologies, such as LiFePO4, to address the sensitivity of Li-Ion battery packs in terms of thermal stability (and operation over a wider temperature range) and overall safety under stress conditions (over-voltage, over-current).

# **IEEE1725 Safety Requirements**

The IEEE1725 guidelines were introduced by the IEEE Standards Association Corporate Program in March 2006. This standard for Rechargeable Batteries for Cellular Phones has the goal to allow cellular phone designs to provide the increasing power and complexity required by the consumer, while ensuring robust and reliable operation. Among other items, the IEEE1725 establishes criteria for reliability of rechargeable Li-Ion and Li-Ion Polymer batteries for mobile telephone applications and also

incorporates battery pack electrical and mechanical construction, packaging technologies, pack and cell level charge and discharge controls, and overall system considerations.

As demonstrated in Figure 1, the IEEE1725 looks at the whole "chain" (The System) to proactively address reliability



Figure 1. IEEE1725 Ecosystem



and safety risks. The safety requirements and recommendations primarily apply on the battery pack, the charging subsystem and the application (system) design. One of the main messages of IEEE1725 is the need for redundancy in the entire ecosystem. The integration of many protection features in a battery charger IC for example, such as battery over-voltage monitoring or current limiting, provides an easier, lower-cost way to meet the safety requirements.

### **JEITA Safety Requirements**

While Li-Ion and Li-Polymer are the most popular batteries in portable electronics because of their high energy density and no memory effect, they are also very sensitive to extreme operating conditions, such as low and high temperatures. This is due to the fact that the charging process itself is a chemical reaction that is greatly affected by temperature. To address this weakness, existing system designs suspend charging when the temperature inside the battery pack is outside certain safe limits, as recommended by the battery manufacturers. In a typical application, charging is suspended when the temperature sensed inside the battery pack is lower than approximately 0°C or higher than approximately 45°C. This thermal information is usually available to the system as the output voltage of a thermistor element, which is commonly sensed at one of the battery pack terminals ("T").

In 2007, the Japan Electronics and Information Technology Industries Association (JEITA) released new safety guidelines targeting both the notebook and lower-power handheld devices. This guide describes the design and evaluation of secondary Lithium-Ion battery cells to ensure maximum safety and, like IEEE1725, is also looking at the entire ecosystem (cell, pack, system design). Corresponding research has identified four main causes of thermally uncontrolled state of cells, which are the primary drivers for hazardous events: internal short circuit, overcharging, external short circuit and external heating.

The JEITA guidelines are paying special attention to thermal overstress, and recommend a more conservative charging approach, by which charging voltage and/or charging currents are reduced outside certain thermal limits. So, unlike the traditional battery pack thermal protection requirements (no charging when  $T > T_{HHARD}$  or  $T < T_{LHARD}$ ), JEITA introduces an additional range of operation. When the temperature during the charging process is cold, but still warmer than the extreme condition ( $T_{LHARD}$  <  $T < T_{ISOFT}$ ), charging is still allowed but with a lower charging current or voltage. This operation prevents faster battery degradation and thermal runaway situations. The same principle of reduced charging current and voltage also applies when the temperature during the charging process is hot, but still colder than the extreme condition  $(T_{HSOFT} < T < T_{HHARD})$ .

### **Other Safety Requirements**

In addition to system safety standards, there are many features that can be implemented to provide even more safety redundancy, or to help the system identify a problem, or possible problems. Modern battery charging solutions with integrated

memory for example can continuously monitor battery charger IC operation, which can be invaluable for understanding what is happening in the system, in case of error, or other conditions. The system can then take actions based on the identified error using I2C as a common method of communicating between the applications processor, and peripheral components. There are many methods that support this as follows.

Status interrupt (IRQ) signals can be a helpful tool for a system designer because these can be generated for particular instances such that the applications processor does not have to continually poll the peripheral device. Once the IRQ has been generated, if the battery charger IC has I2C and status registers, the applications processor can perform a read of the status registers, and determine exactly what the error was, and take appropriate actions, as well as discovering the entire status of the battery charger IC.

For a device that has memory, it is very important to have a layer of non-volatile memory, that can be factory programmed for safe settings, and a layer of volatile memory that the system can continually adjust based on various factors including operating temperature, input source and battery capacity. It is also important for such implementation to incorporate a watchdog timer, which ensures the system remains safe if the applications processor somehow locks up. If this occurs, and the watchdog timer is never reset, then the safe non-volatile memory settings should be reloaded to ensure safe operation.

### **Benefits of Configurable Algorithm**

With having a layer of safe settings in non-volatile, it is important to establish what parameters should be configurable to ensure safe operation. One of the more important areas of safety is the float voltage of the battery. Although this is typically 4.20 V for most chemistries, standards like JEITA require the float voltage to be reduced at extreme temperatures. Therefore, having the ability to have the default safe settings programmed with a lower float voltage value is a good idea in case the system hangs up and charging continues. As an example, having the safe settings programmed for a float voltage of 4.00 V will ensure that the battery voltage will never go above this while the system is off, unless the system turns off when the float voltage is above 4.0 V, at which point, the float voltage will be reset to 4.0 V, and charging will automatically stop.

Additionally, starting with a lower charging current or input current setting can ensure safety in two regards. For one, the default current going into the battery will never be larger than the safe allowable current for a given temperature, float voltage, etc. This is similar to programming the safe float voltage to ensure that the battery charging process never overly stresses the battery. Secondly, if an input can be a USB host or hub limited to 100 mA, it may be a good idea to set the default input current limit to 100 mA such that the input is never collapsed, even if the system hangs up.

These parameters are also very valuable to have configurable such that charging can be optimized for a given situation. Charging currents can be increased to reduce charge time,

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# **Calendar of Events**

# January

10-11 - 10X Advanced Battery R&D, Santa Clara, Calif.

24 - 27 - 8th Tactical Power Sources Summit, Arlington, Va.

24-28 - 11<sup>th</sup> International Advanced Automotive Battery Conference and Symposia (AABC), Pasadena, Calif.

# March

14-17-28th International Battery Seminar & Exhibit, Fort Lauderdale, Fla.

22-23 - TREM11, Washington, D.C.

# Mav

1-4 - BCI's 123<sup>rd</sup> Convention and Power Mart Trade Fair, Miami, Fla.

12-15 - Battery Alliance, Bonita Springs, Fla.

16-18 - BATTCON, Orlando, Fla.

# June

6-10 - Advanced Automotive Battery Conference Europe, Mainz, Germany

7-10 - LABT'2011: 8th International Conference on Lead-Acid Batteries, Albena, Bulgaria

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while ensure safe practices are met. Other helpful programmable settings can include float voltage, fast charge currents, battery temperature threshold limits, termination currents and safety timers, among a slew of others. All of these configurable features ensure that any system requirements can be accounted for, and that there is no one for all solution that will require additional components to perform the specific features required. For example, different battery chemistries or manufacturers may have different temperature ranges, so have the option to program the temperature range in the battery charging IC allows for a quasi-custom part, without additional components. Additionally, some designs may need to be more conservative in reducing the float voltage when outside a specified range, so having a programmable float voltage reduction level can also be very convenient.

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Figure 2. Configurable and Easy-to-Use Safety Algorithms

### **Solutions and Implementations**

The benefits of having a configurable charging profile with programmability and I2C communication are immense for simple integration. The SMB328A is an example of this level of integration; consisting of a switch-mode battery charger for low power dissipation, non-volatile and volatile memory for controlling charging parameters on the fly using I2C, status registers for all relevant charging parameters and errors, and integrated safety features that support both JEITA and IEEE1725. The use chip scale packaging (CSP) further provides benefits by reducing the



Figure 3. SMB328A Typical Application

total solution size, consisting of a chip inductor, five capacitors and one resistor. Finally, the SMB328A offers many features for USB compatibility, to make the IC USB friendly including support for USB input current levels (100 mA, 500 mA, USB charger, and suspend currents), as well as support for USB Onthe-go (OTG).

### Summary

Safe battery charging has become a focus point in newer portable designs. Adhering to the new industry standards ensures maximum system and battery reliability, but may introduce new cost and space challenges. New battery charging solutions, such as the SMB328A product, not only incorporate the required functionality to meet the new guidelines, but go a step further by also integrating features that allow charging optimization for specific battery packs and system designs, as well as real-time monitoring of the charging process.

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Shadi Hawawini is an applications engineer at Summit Microelectronics, responsible for customer support and customer design tool development. Mr. Hawawini has authored numerous technical articles and holds a provisional patent in Advanced Battery Charger Algorithms. He holds a BSEE degree from San Jose State University.

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