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DARPA funds neural image processor

By R. Colin Johnson

PROCESSING IMAGES 1,000-TIMES faster using brain-like neural-network chips is the four-year goal of a $5.7 million University of Michigan research project funded by the Defence Advanced Research Project Agency (DARPA).

By using memristors as the neuron’s memory synapses - because they consume zero current when idle - the image-processing neural network also aims to consume 10,000 times less power than today.

Adaptive neural networks learn the features in an image, rather than memorize its pixel values, allowing simpler representations in memory -- for instance, just two features, “round” and “red,” might suffice to determine that a traffic light says stop.

To detect such features, neurons are arrayed to input all the pixels in an image at once, then process them in layers with variable synapses between them - similar to the visual cortex of the brain. Learning an image proceeds by inputting it to the first layer, whereupon the middle layers self-organize an internal representation, with the last layer acting as an array of single feature detectors. In practice, the more an image feature is presented to the neural network during learning, the stronger the synaptic connections that detect that feature will become.

To test slightly different architectures, the University of Michigan researchers, led by professor Wei Lu, are designing two prototypes. The simpler one uses memristors to store the values of its synapses, but uses conventional connections between layers. The more complex architecture mimics the brain more closely by using the memristors themselves to process voltage spikes sent between layers.

In an interview with EE Times, Lu said: Basically there are two approaches that we are developing, one uses small local memristors to store the weights that are calculated using well known learning algorithms, with most of the computations performed in the neuron. The other approach is more dramatic because we use the memristor to do the learning directly in its synapses, which is a riskier approach because you need a large amount of memory and the algorithms are not well known.

Over the last eight years Lu’s group has developed two types of direct-learning algorithms for memristors - timing-based learning and weight-based learning.

“We stimulate the network with images and the network self-adapts allowing its weights to evolve until a single neuron responds to a specific feature of the image, after which we can use the network to determine if a particular feature is present in any image,” said Lu.

Funding for the first year of the project is set at $1.3 million, with new infusions each year during the first phase, which ends in 30 months with a prototype that can extract features from any image. The second phase aims to add a classifier that takes the features detected and recognizes combinations of them as particular objects, such as detecting the difference between a friendly F-15 jet and an adversary’s MiG jet.

Wei Lu is also a cofounder of Crossbar Inc. (Santa Clara, Calif.), which uses migrating silver ions in amorphous silicon to create resistive random access memories (ReRAM). But for his DARPA contract, instead of silver, he is casting his memristors in tungsten oxide, which changes its resistance as oxygen vacancies migrate from one end of the memristor to the other - depending on which way the current is flowing - thus acting as a resistance-based memory element.

All the work is being performed under the DARPA program called Unconventional Processing of Signals for Intelligent Data Exploitation. Lu’s project is titled Sparse Adaptive Local Learning for Sensing and Analytics. His collaborators include fellow professors Zhengya Zhang and Michael Flynn, Los Alamos National Lab scientist Garrett Kenyon, and Portland State University professor Christof Teuscher.

University of Michigan professor Wei Lu is designing a neural network chip that processes images 1000-times faster than conventional computers. (Source: University of Michigan)

The layout of the memristor array (center) acting as the memory-synapses for the learning-neurons. (Source: University of Michigan)
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EU-funded project ManuCloud yields combined OLED and organic photovoltaic panels

By Julien Happich

Funded for three years by the European Union, the project ManuCloud (distributed Cloud product specification and supply chain manufacturing execution infrastructure) presented a demonstrator of a façade module, which combines OLED- and OPV-technology.

The objective of the ManuCloud project was the development of a service-oriented IT environment as basis for the next level of manufacturing networks by enabling production-related inter-enterprise integration down to shop floor level. Industrial relevance was guaranteed by involving industrial partners from the organic photovoltaic, organic lighting and automotive supply industries.

The transition from mass production to personalized, customer-oriented and eco-efficient manufacturing is considered to be a promising approach to improve and secure the competitiveness of the European manufacturing industries in the future, which constitute an important pillar of the European prosperity. One precondition for this transition is the availability of agile IT systems supporting this level of flexibility on the production network layer on the one hand and on the factory and process levels on the other hand.

ManuCloud was setup in 2010 with project partners Heliatek, Fraunhofer COMEDD, Tridonic Dresden and GSS Gebäudesolarsysteme GmbH, with the mission to investigate the production IT-related aspects for this transition. Its aim was to develop and evaluate a suitable IT infrastructure to provide better support for on-demand manufacturing scenarios, taking multiple tiers of the value chain into account.

On this path, the ManuCloud members implemented the vision of a cloud-like architecture concept, providing users with the ability to use the manufacturing capabilities of configurable, virtualized production networks, based on cloud-enabled, federated factories, supported by a set of software-as-a-service applications.

Two seminal technologies have been selected to demonstrate the application context for the ManuCloud concept: the organic photovoltaic (OPV) and the organic LED (OLED) technology. Each of them is driven by specific market needs. Both markets are currently in an early stage. However, market research predicts a multibillion dollar market for these products already in a few years. Due to the unique properties of large-area light generation and energy harvesting, coming with special features like adjustable colours, transparency and a thin and lightweight structure, OLAEOrganic and large area electronic) technologies are expected to generate numerous new applications with a substantial share being customized solutions. The project has setup and evaluated a manufacturing cloud infrastructure for customized organic lighting and solar cell solutions.

Tridonic Dresden defined application scenarios together with the partners based on discussions with potential customers of the manufacturing environment. The demonstrated façade element was identified as one interesting scenario.

The definition of the façade element and the setup of the lamination process including setup and test runs were driven by Tridonic Dresden together with Fraunhofer COMEDD, Heliatek and GSS Gebäudesolarsysteme. The partners developed a process to integrate temperature and pressure sensitive OLED and OPV devices into glass to create an integrated active glass laminate.

The ManuCloud consortium was composed of eight partners from four different EU member states (Austria, Germany, Hungary, United Kingdom). The partners were advanced clean production Information Technology GmbH (acp-IT), Robert Bosch GmbH, Fraunhofer Institute for Manufacturing Engineering and Automation (IPA, consortium leader), Fraunhofer Research Institution for Organics, Materials and Electronic Devices COMEDD, HELIATEK GmbH, Tridonic Dresden (formerly LEDON OLED Lighting GmbH & Co. KG), nxtControl GmbH, Computer and Automation Research Institute of the Hungarian Academy of Sciences, and the University of Strathclyde.
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Phone communication advances with voice on a radio carrier signal

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Miniature SiP for electric vehicles

By Junko Yoshida

IN AN EFFORT TO PLOT further miniaturization of system-in-package solutions, Infineon Technologies, together with 40 research partners in Europe, announced the successful completion of a large-scale research project called ESiP (Efficient Silicon Multi-Chip System-in-Package integration).

The advantages of System-in-Package (SiP) are well known, since SiP allows chip designers to integrate, in one package, different types of chips made by using different production techniques and structure widths. The goal for the ESiP project, however, was set to develop much more compact and reliable SiP solutions than those available today. The research partners, who described it as an entirely new class of SiP, hope to use the miniaturized SiPs for such applications as electric vehicles, industrial, medical equipment and communications technology.

The ESiP research group claims they have developed basic technologies that enable the integration of various types of chips in the smallest volume SiP packages. “For example, customer-specific processors with the latest CMOS technologies, light-emitting diodes and DC-DC converters, MEMS and sensor components and passive components such as miniaturized capacitors and inductors,” they explained.

The researchers believe the newly designed polymer membrane can decrease the cost of alkaline batteries and fuel cells by allowing the replacement of expensive platinum catalysts without sacrificing important aspects of performance.

“We have tried to break this paradigm of trade-offs in materials (by improving) both the stability and the conductivity of this membrane at the same time, and that is what we were able to do with this unique polymeric materials design,” said Michael Hickner, associate professor of materials science and engineering.

In solid-state alkaline fuel cells, anion exchange membranes conduct negative charges between the device’s cathode and anode -- the negative and positive connections of the cell -- to create usable electric power. Most fuel cells currently use membranes that require platinum-based catalysts that are effective but expensive. Hickner’s new polymer is a unique anion exchange membrane, a new type of fuel cell and battery membrane that allows the use of much more cost-efficient non-precious metal catalysts and does not compromise either durability or efficiency like previous anion exchange membranes.

Based on their initial tests, the group predicted that the membranes with long 16-carbon structures in their chemical makeup would provide the best efficiency and durability, as measured respectively by conductivity and long-term stability.

Chao-Yang Wang, William E. Diefenderfer Chair of Mechanical Engineering, and his team then tested each possibility in an operating fuel cell device. Yongjun Leng, a research associate in mechanical and nuclear engineering, measured the fuel cell’s output and lifetime for each material variation.

Despite predictions, the membranes containing shorter 6-carbon structures proved to be much more durable and efficient after 60 hours of continuous operation.

Because the successful membrane was so much more effective than the initial lab studies predicted, researchers are now interested in accounting for the interactions that the membranes experienced while inside the cell.

“We have the fuel cell output — so we have the fuel cell efficiency, the fuel cell life time — but we don’t have the molecular scale information in the fuel cell,” Hickner said. “That’s the next step, trying to figure out how these polymers are working in the fuel cell on a detailed level.”

It’s important to note that the research group investigated not only new production processes for compact SiP solutions, but also new materials for building SiPs. Their efforts led to a number of innovations ranging from the development of materials to manufacturing process and testing methodologies.

While probing the feasibility and reliability of the new production processes, the group discovered that “test procedures commonly used today are no longer sufficient for future SiP solutions.” The research group also developed new test flows, probe stations, and probe adapters for 3D SiP.

Working on what was billed as the largest research project in Europe for SiP, the group faced high expectations in efforts to improve the future of the European microelectronics industry. The group, under Infineon management, had 40 participating microelectronics and research entities from nine European countries.

Funds came from public authorities in all nine countries and the ENIAC Joint Undertaking - a public-private partnership focusing on the development of nanoelectronics in Europe. Among nine nations, Germany -- where Infineon is based - was the largest contributor.

Synthetic polymers lower the cost of alkaline fuel cells

By Julien Happich

BY CREATING SEVERAL VARIATIONS of fuel cell membranes made of synthetic polymers, and studying them under similar conditions, a research team from the University of Park (Pennsylvania) was able to predict the most optimal structure in an active and stable fuel cell.

The researchers believe the newly designed polymer membrane can decrease the cost of alkaline batteries and fuel cells by allowing the replacement of expensive platinum catalysts without sacrificing important aspects of performance.

“We have tried to break this paradigm of trade-offs in materials (by improving) both the stability and the conductivity of this membrane at the same time, and that is what we were able to do with this unique polymeric materials design,” said Michael Hickner, associate professor of materials science and engineering.

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ReRAM startup bets on silver

By Peter Clarke

A RESISTIVE RAM non-volatile memory technology that could be embedded in SoCs and used in multilayered terabyte memory ICs is being brought to market by a well-backed and well-connected startup called Crossbar Inc.

The company, based in Santa Clara, California, has a working array that it claims validates its silver-ion based technology as a replacement for traditional non-volatile memory. This working chip is a CMOS access controller monolithically integrated with a memory array.

George Minassian, CEO of Crossbar, told EE Times that his company’s embedded ReRAM technology will be available in 2014 and could be in the field in products such as micro-controllers in 2015. High-density monolithic memories based on the technology would then follow within a few quarters, he predicted.

Crossbar’s memory technology is one of a number of alternative ReRAM offerings being researched by the industry. Most of these are trying to achieve equivalent or superior performance to NAND flash memory while being able to scale beyond the perceived two-dimensional limit for NAND flash at about 15 nanometers.

Crossbar, founded in 2010, was formed to commercialize a body of memory device research based on metal-ion migration and filament formation within amorphous silicon that was being led by Professor Wei Lu at the University of Michigan. Professor Lu co-founded Crossbar and serves the company as chief technology officer. However, his amorphous silicon cross-point memory research was being nurtured by venture capital company Kleiner Perkins Caufield & Byers (KPCB) for a couple years prior to Crossbar’s formation, according to Minassian.

The company has received $25 million in Series A and B rounds of funding and is backed by venture capital firms Artiman Ventures, KPCB, and Northern Light. Minassian told EE Times that Crossbar plans to demonstrate its memory array prototype at the upcoming Flash Memory Summit Aug. 13 to 15 as a signal that it is ready to begin product development.

According to briefing materials supplied by Crossbar, the memory is based on a silver top electrode over amorphous silicon over a poly-silicon bottom electrode. The principle of operation is that a writing voltage causes silver ions to migrate through the silicon to form a filament that eventually can connect the top and bottom electrodes. A reverse voltage causes the ions to move and break the connection. Lower voltages can be used to “read” the connection as a 1 or 0.

There are some similarities to the programmable metallization cell technology licensed to Adesto Technologies Corp. and others and being brought to market under the term conductive bridging RAM or CBRAM.

Crossbar’s demonstration array is substantial at a size of 1K by 1K, and was fabricated in a commercial wafer fab using a 110-nm minimum geometry, Minassian said. He declined to name the fabricator. However, the company also has experience of making devices at geometries below 30nm and the filaments are thought to be less than 10nm in diameter, Minassian added.

Voltages are modest, all below about 3.5 volts, and scale with geometry, Minassian said. The performance claims for the memory include 20 times faster write, 20 times lower power consumption, and 10 times the endurance of contemporary NAND flash memory. The read latency is about 20ns. The retention and endurance are tunable to a degree but Crossbar is quoting 10 years and 1 million cycles of endurance at sub-10nm geometry.

An inherent blocking diode within the cross-point structure also helps avoid “sneak-path” problems while reading bits and keep the device structure simple and potentially close to the 4F2 theoretical minimum cell size.

Other benefits include its simple construction, which means the memory is inherently capable of layered stacking - and more easily than 3-D flash, which requires a tapered vertical channel. Crossbar reckons that monolithic integration of up to eight memory layers on top of CMOS memory access circuitry should be “easy” and will allow multi-terabyte memory ICs. The company has already designed a memory controller circuit for a triple layer non-volatile memory as part of its development activity.

“We’ve developed the CMOS controller logic and put memory layers on top,” said Minassian. The technology is also capable of multi-level cell configuration whereby multiple resistance points can be set and detected allowing multiple bits to be stored in a single cell.

Crossbar plans to come to market in two phases, Minassian said. Initially, the company wants to license single-layer memory blocks as IP cores through foundries for use as embedded memory. After that, the company will develop stand-alone memories under its own brand, replacing NOR flash in code storage and NAND flash in data storage.

“We are in discussions with foundries. It will take a couple more quarters to get the technology into wafer fabs but I see embedded [memory] in the market in 2015. Meanwhile, it will take two to three years [from mid-2015] to get to stand-alone
memories,” he said.

But the path for the introduction of innovative non-volatile memory is notoriously difficult. There are many similar ReRAM, conductive bridging and other technologies that are being researched but struggling to compete with the incumbent flash memory technology. Phase-change memory was thought to offer similar scaling benefits beyond NAND flash but the R&D phase took more than 40 years, and although it is now in the commercial marketplace and has some reported deployments, it is only made at feature sizes that are larger than mainstream flash memory.

Ron Neale, a memory device expert who has contributed review articles on non-volatile memory to EE Times, raised some areas of concern about the technology. One is the use of silver as an electrode material in the fab. Like copper, unless carefully controlled, silver can have a contaminating effect in a wafer fab. This might inhibit foundries from adopting the technology. In email correspondence with EE Times, Neale said:

Silver is a fast diffuser and in the past it has been shown to have had a detrimental effect on MOS gate oxides. However - although mostly as a BEOL process - a good experience base of the use of silver pastes as conductors in direct contact with silicon is building from the photovoltaic industry.

A second area Neale raised is the blocking diode effect used for matrix isolation which, according to a 2011 PhD thesis out of University of Michigan, while apparently robust was not at that time fully understood. “There are at least a couple of candidate locations in the memory cell for the site of the non-linear matrix-isolating element,” Neale said in email. A third area is the thermal-dependence of the filament creation and maintenance, which Crossbar describes as being “minimal.”

“So far Crossbar appears to have done most things in the right way and this could be the flash-replacement non-volatile memory that finally takes off,” Neale said. “All aspects of the claimed performance of their ReRAMs can be verified in large arrays - but that should also mean the publication of the full details of reliability testing.” he added.

Since its founding in 2010, Crossbar has filed more than 100 patents related to the development and manufacturing of ReRAM with 30 already issued. One of the biggest claims that may yet aid adoption is that the technology is completely CMOS compatible and can be integrated into the back-end-of-line of any standard CMOS wafer fab.
Flow batteries going grid scale

By R. Colin Johnson

CHEAPER AND 10 TIMES the power density of lithium-ion batteries, those are the claims MIT researchers are making about their flow battery design. The Massachusetts Institute of Technology said in a press release that the low-cost, simplified flow battery design aims to satisfy the Department of Energy’s target of less than $100 per kilowatt-hour for mass adoption of grid-scale energy storage for wind farms, solar arrays, and energy-efficient buildings. The key to the cost reduction is the elimination of the ion-exchange membrane in a flow battery. MIT says its system offers “a power density that is an order of magnitude higher than that of many lithium-ion batteries.”

The battery prototype, designed by MIT professors Cullen Buie and Martin Bazant and doctoral candidate William Braff, handles three times as much power per unit volume as even the most advanced rival designs, MIT said. The prototype uses a laminar flow of two liquids pumped through a channel in parallel without mixing. Instead of having ions permeate a membrane to travel between electrodes, the battery uses electrochemical reactions at the electrodes - located at each end of the channel - to charge and discharge as it stores and supplies energy.

An MIT flow battery is designed to simplify the rechargeable technology by eliminating expensive membranes. The lower solid graphite electrode reduces liquid bromine to hydrobromic acid, while hydrogen is oxidized at the upper porous electrode. (Source: MIT)

The battery reactants are liquid bromine and hydrogen; the chemical reaction reduces liquid bromine to hydrobromic acid at a solid graphite electrode while hydrogen is oxidized at a porous graphite electrode. The strong chemical reaction between the hydrogen and bromine enables the battery to store more energy per unit volume than other flow batteries, MIT said. Reversible hydrogen-bromine reactions have been used in other flow batteries, but corrosive properties eventually cause conventional ion-exchange membranes to fail. MIT’s membraneless setup is designed to solve that problem.

Large-scale flow batteries could enable solar and wind systems to store energy as it is produced and then meter it out as it is needed during times of peak demand. The economies of scale are right, too, since liquid bromine and hydrogen fuel are both widely available and relatively inexpensive in large quantities, “with more than 243,000 tons produced each year in the United States.”

The team aims to optimize its design using a model that has already proven itself out for the initial prototype. By modeling with slightly different architectures and chemistries as the design is scaled up to grid-scale dimensions, the team hopes to achieve its long-term goal of $100 per kilowatt-hour.

Battery data without additional wiring

By Christoph Hammerschmidt

WITHIN THEIR ACTIVITIES towards intelligent battery management technologies, a consortium of two commercial companies and two universities is currently developing a data exchange technology which does not require additional data wires within large lithium-ion battery packs - the battery data are transmitted simply across the current paths.

In order to enable more efficient management technologies for the more than 100 cells within a battery pack, the scientists involved in the project IntLion have developed a technique that resembles the known Powerline Transmission, but applies these principles to DC current paths. This would enable battery manufacturers to do away with additional data wires within the battery packs and thus save space and costs. The system makes every single battery cell accessible to the management system, enabling a more precise and efficient battery management. In addition, this approach allows a better use of the energy potential of such a battery pack: if one cell fails to work properly, it can be replaced instead of replacing a group of cells or even the entire battery pack.

In the IntLion project, Robert Bosch GmbH and ProDesign Electronic GmbH collaborate with the Karlsruhe Institute of Technology (KIT) and the Hochschule Hannover. The project is funded within the scope of the electromobility research program by the German federal research ministry.
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Why hydrogen cars are suddenly back in vogue

By Junko Yoshida

LAST JULY, GM AND HONDA announced that they will join forces to develop a common hydrogen powertrain - fuel cells and hydrogen tanks - for fuel cell vehicles. Their goal is to get those new fuel cell cars ready by 2020. Unlike electric vehicles (EVs) which use electric power stored in large lithium-ion packs, hydrogen cars use the electricity source generated by fuel cells in the electro-chemical reaction of hydrogen and air. A fuel-cell car’s only tailpipe emission is water vapour.

Despite this technology’s obvious advantages over EVs (better range, faster fuelling time), the automotive industry has a history of on-again off-again love affairs with fuel cells. Car manufacturers and market analysts tend to blame the slow progress of fuel cell car development on the absence of a network of hydrogen refuelling stations, each estimated to cost $1 million to $2 million. But setting the infrastructure issue aside, why suddenly are we seeing a flurry of renewed hydrogen activity?

Government regulations.
In 2004, when the market research firm ABI Research made a radical downward revision in its forecast for fuel cell cars, the firm’s then director of energy research, Atakan Ozbek, predicted that the industry would not begin real growth without clearer government commitments at both national and local levels. The automotive companies today know that later this decade they must meet much stricter CO₂ regulations set by governments in the United States, Europe, and Japan. Along with the fuel-cell revival, hybrid, plug-in hybrid, and battery-powered vehicles are part of the push to meet the same regulations. Clearly, no company is putting all its eggs in one basket.

Longer distance and faster refuelling time
In revealing the alliance with GM, Honda president Takanobu Ito said, “Among all zero-CO₂ emission technologies, fuel-cell electric vehicles have a definitive advantage with range and refuelling time that is as good as conventional gasoline cars.” Similarly, GM CEO Dan Akerson said in his statement, “We are convinced this is the best way to develop this important technology.” Akerson added that such vehicles can help curb petroleum dependence and underpin sustainable mobility. The two companies also made it clear that they will work together by jointly lobbying for an expanded network of hydrogen fuel stations. Those that exist in the United States are currently clustered mainly in California.

Shared technologies with EVs
Another key element encouraging auto companies to take a second look at fuel-cell cars is that some of the technologies already developed for their battery-electric cars can be shared with fuel-cell cars. Industry experts point out that fuel-cell vehicles share similar electric motors to power the wheels, brakes that capture power when stopping, software, and related electronics. GM and Honda are both considered pioneers in fuel-cell technology, armed with a large number of patents in the field. However, their competitors have already jumped on the fuel-cell bandwagon earlier this year. Toyota Motor Corp. and BMW AG in January set up a fuel-cell production alliance. Daimler AG, Ford Motor Co., and Nissan Motor Co. also in January said they would jointly develop a line of affordable fuel-cell electric cars for sale as early as 2017.

Flexible touch sensor system as thin as 2μm, feather light

By Julien Happich

WITHIN THE FRAMEWORK of the Japan Science and Technology Agency’s (JST) Exploratory Research for Advanced Technology (ERATO) project, researchers have developed what they claim to be the world’s lightest and thinnest flexible touch sensor system.

With a sheet density of only 3g/m² and built on a 1.2μm thin plastic foil, the 48x48mm prototype features an array of 144 sensors and could well be suited for healthcare and medical applications where conformable sensor sheets could minimize patient discomfort. Professor Takao Someya, Associate Professor Tsuyoshi Sekitani, Dr. Martin Kaltenbrunner, University of Tokyo, and their coworkers also believe the sensors could find applications as a form of electronic skin in robotics or prosthetics.

The international research team developed a novel technique to form a high-quality 19nm-thick insulating layer on the rough surface of a 1.2μm-thick polymeric film. In spite of being very thin, the organic transistor ICs exhibited extraordinary robustness. In fact, when deposited on a rugged substrate, the sensors could withstand 233% of tensile strain (stretched up to double their original size) while retaining full functionality. The bend radius of 5 micron means the sheet of sensors can also be squashed up into a ball while retaining its electrical properties.

These extremely thin and practically imperceptible sensors could open up a wide range of new applications in fields ranging from healthcare and biomedicine to welfare.

Source: University of Tokyo
Infineon’s new TO-Leadless package is especially designed for high current applications such as forklift, light electric vehicles, e-fuse, PoL (Point of Load) and telecom where highest efficiency and reliability are required. 300A continuous current can now be handled using just one single part. Furthermore, compared to D²PAK 7pin, the significant smaller package – reduced by 60% – offers a very compact design and a substantial reduction of 30% in the footprint.

**Key features and benefits of the new TO-Leadless package**

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  - Enables improved EMI-performance
  - Lower package losses

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Apple’s iOS7: Too little, too late for automotive market, says expert

By Christoph Hammerschmidt

AT ITS RECENT DEVELOPER conference WWDC, Apple pitched its new operation system iOS7 for automotive deployment. Now Frost & Sullivan expert Krishna Jayaraman got granular on Apple’s system software. Though iOS7 offers significant improvements with regards to the interfaces and better voice control functions for the Siri personal assistant, the announcement came much too late for the automotive market, Jayaraman said.

“In comparison to other players such as Microsoft or Google, Apple’s commitment to the automotive industry remains very much out of focus”, the expert said in a statement. “Apple’s announcements regarding EyesFree and the integration of iOS7 are a predictive, reflexive reaction at best. “Though interesting, iOS for cars simply comes much too late to the market”.

In 2012, Apple announced an “EyesFree” partnership with nine automotive OEMs. This even triggered rumours that this could be the next megatrend for the connected car and that Apple could potentially overthrow the hegemony of traditional tier ones and assume a much bigger role in the connected vehicle of the future. Hitherto only GM, Honda and Mercedes Benz have implemented Apple’s application. Other OEMs continue to focus on the prioritization among Siri and their own native embedded voice processing systems where, among others, Nuance is an important technology provider. So far only GM successfully developed Spark and Sonic which include Siri as a feature. BMW is believed to follow in one of their 2014 models.

“Apple’s announcements do not contain much threat potential for the market of traditional infotainment systems in the car”, says Jayaraman. “While OEMs such as BMW reject this new solution it is ideal for several niche OEMs because they can benefit from such a pre-packaged solution”. In this context it is an advantage that iOS is already a proven and widespread platform in the smartphone market. However, while specific development and design processes as well as app shops focused to the automotive market are available, these offerings are restricted to application fields music, telephony and navigation. Beyond this, the availability of Siri to control smartphones and native vehicle functions would be a huge benefit.

“For OEMs who already have developed and rolled out their infotainment systems, in particular if they contain the integration of smartphones with all their applications and content. The biggest challenge is the alignment of iOS with current OEM developments. Apple needs to find a way to make iOS7 downwards compatible by collaborating with OEM’s aftermarket departments and find a solution which is compatible with older cars.”

Memory magnetization technique offers faster computing and lower power consumption

By Paul Buckley

RESEARCHERS IN ISRAEL have developed a simple magnetization technique which may lead to a new generation of faster, smaller, less expensive and lower power consumption memory technologies.

Memory devices like disk drives, flash drives and RAM are an essential component of our computers, phones, electronic appliances and cars. Yet current memory devices have drawbacks: dynamic RAM memory has to be refreshed periodically, static RAM data is lost when the power is off, flash memory lacks speed, and all existing memory technologies are challenged when it comes to miniaturization.

Prof. Yossi Paltiel and research student Oren Ben-Dor at the Hebrew University of Jerusalem’s Harvey M. Krueger Family Center for Nanoscience and Nanotechnology, together with researchers from the Weizmann Institute of Science, have developed a simple magnetization technique that, by eliminating the need for permanent magnets in memory devices, opens the door to many technological applications.

The research deals with the flow properties of electron charge carriers in memory devices. According to quantum mechanics, in addition to their electrical charge, electrons also have a degree of internal freedom called spin, which gives them their magnetic properties. The new technique, called magnetless spin memory (MSM), drives a current through chiral material and selectively transfers electrons to magnetize nano magnetic layers or nano particles. With this technique, the researchers showed it is possible to create a magnetic-based memory device that does not require a permanent magnet, and which could allow for the miniaturization of memory bits down to a single nanoparticle.

The potential benefits of magnetless spin memory are numerous. The technology has the potential to overcome the limitations of other magnetic-based memory technologies, and could make it possible to create inexpensive, high-density universal memory-on-chip devices that require much less power than existing technologies.

Compatible with integrated circuit manufacturing techniques, it could allow for inexpensive, high density universal memory-on-chip production.

According to the Hebrew University’s Prof. Paltiel, “Now that proof-of-concept devices have been designed and tested, magnetless spin memory has the potential to become the basis of a whole new generation of faster, smaller and less expensive memory technologies.”
Cobalt replacements make solar cells more sustainable

By Paul Buckley

THE JOURNAL CHEMICAL COMMUNICATIONS has published the results of the Cu-Co cells. Dye-sensitized solar cells (DSCs) transform light to electricity. The cells consist of a Semiconductor on which a dye is anchored. The colored complex absorbs light and through an electron transfer process produces electrical current. Electrolytes act as electron transport agents inside the DSCs.

Usually, iodine and iodide serve as an electrolyte. Chemists at the University of Basel have now been able to successfully replace the iodine-based electron transport system in copper-based DSCs by a cobalt compound. Tests showed no loss in performance.

The replacement of iodine increases the sustainability of solar cells. “Iodine is a rare element, only present at a level of 450 parts per billion in the Earth, whereas cobalt is 50 times more abundant,” explained the Project Officer Dr. Biljana Bozic-Weber. The replacement also removes one of the long-term degradation processes in which copper compounds react with the electrolyte to form copper iodide and thus improves the long-term stability of DSCs.

The research group supporting the Basel chemistry professors Ed Constable and Catherine Housecroft is currently working on optimizing the performance of DSCs based on copper complexes. The group had previously shown in 2012 that the rare element ruthenium in solar cells could be replaced by copper derivatives. This is the first report of DSCs, which combine copper-based dyes and cobalt electrolytes and represents a critical step towards the development of stable iodide-free copper solar cells. However, many aspects relating to the efficiency need to be addressed before commercialization can begin in anything other than niche markets.

“In changing any one component of these solar cells, it is necessary to optimize all other parts as a consequence,” said Ed Constable. This is part of a new approach termed ‘Molecular Systems Engineering’ in which all molecular and material components of a system can be integrated and optimized to approach new levels of sophistication in nanoscale machinery. In the publication, the engineering of the electrolyte, the dye and the Semiconductor are all described.

The systems chemistry approach is particularly appropriate for the engineering of inorganic-biological hybrids and is the basis of ongoing collaborations with the ETH Department of Biosystems Engineering in Basel (D-BSSE) and EMPA. A joint proposal by the University of Basel and D-BSSE for a new National Centre of Competence in Research in this area is currently in the final stages of appraisal.

Portable tablet relies on the old analog TV RF frequencies

By Nick Flaherty

RESEARCHERS AT THE JAPANESE NATIONAL Institute of Information and Communications Technology (NICT) developed a frequency converter for the tablet that enables IEEE802.11-based radio communication in TV bands (470-710 MHz).

The Android tablet uses wireless LAN system for radio communication in TV bands with an inquiry in the white-space database developed by NICT. The original 2.4GHz band of a WLAN system is also available and it is possible that the tablet terminal automatically selects the radio communication band according to data traffic.

Due to the explosive growth of mobile portable devices such as smartphones and tablet terminals, communication traffic has been increasing and a frequency resource shortage problem has been aggravating. To solve this problem, the use of TV white spaces is studied and the establishment of radio rules designed for TV white-space operation has been started in the US, the UK and Japan. NICT has contributed to standardization on various radio communication systems using TV white spaces, and has developed stationary prototypes based on the standards.

Although future TV white-space utilization by portable devices will contribute to the further effective use of frequency resources, it is difficult to miniaturize components and circuits for portable devices due to its lower operational frequency than existing WiFi or cellular bands and its relatively wide frequency range of 470-710 MHz. In addition, technology to avoid interference with TV broadcasts is necessary to be implemented in portable devices. On the other hand, propagation characteristic evaluation supposing practical operation is required for the feasibility study on TV white-space utilization. The tablet is based on an off-the-shelf terminal and a frequency converter newly developed by NICT is implemented for using TV white spaces. This tablet terminal can operate in the frequency considered not to interfere with TV broadcasts according to calculation results provided by the white-space database developed by NICT, and can automatically select the optimal frequency according to data traffic, through control by the network manager.
EEMBC’s floating-point benchmark suite targets MCUs and high-end multicore processors

By Julien Happich

FPMARK IS A NEW BENCHMARK suite that tracks the performance of embedded processors with floating-point hardware units (FPU), an increasingly popular and necessary feature to support graphics, audio, motor control, and many other high-end processing tasks. Just announced by the Embedded Microprocessor Benchmark Consortium (EEMBC), FPMark contains single (32-bit) and double (64-bit) precision workloads, as well as a mixture of small to large data sets to support microcontrollers to high-end processors, respectively. The EEMBC FPMark allows users to evaluate FPU performance on the basis of consistent and controlled data, delivering honest, reliable, and unbiased metrics to serve the needs of processor vendors, compiler vendors, and system developers.

Using floating-point (FP) representation enables more accurate calculations of fractional values than fixed-point numbers (integers) because exponents allow the decimal point to shift. Moreover, floating-point math makes numerical computation much easier and many algorithms implemented with floating point take fewer cycles to execute than fixed-point code (assuming similar precision).

To take advantage of this efficiency, many embedded processors include hardware floating-point units (FPUs) to support these higher levels of precision. The EEMBC FPMark Suite uses 10 diverse kernels to generate 53 workloads, each of which self-verify to ensure correct execution of the benchmark.

These workloads are built on the same infrastructure as EEMBC MultiBench, allowing the user to launch multiple contexts and demonstrate multicore scalability, as well as greatly simplifying the effort required to port the benchmarks to bare metal or implementations running Linux.

The kernels in FPMark include a mixture of general-purpose algorithms (such as Fast Fourier Transform, linear algebra, ArcTan, Fourier coefficients, Horner’s method, and Black Scholes) and complex algorithms (such as a neural network routine, a ray tracer, and an enhanced version of Livermore Loops).

Similar to EEMBC CoreMark, certified scores are not required for FPMark, but EEMBC will promote the use of certified scores for members to ensure high-quality results.

Cloud-based wireless ECG achieves CE certification

By Jean-Pierre Joosting

WEB BIOTECHNOLOGY Pte Ltd has achieved CE certification for its ECG monitoring system called the Spyder — the first cloud-based continuous ECG monitor.

The company, based in Singapore, makes an innovative wireless ECG monitoring system meant to replace traditional hospital remote monitoring systems such as the Holter ECG, which are wired recorders. These are bulky and limited to a maximum of 48 hours of monitoring because they cannot be self-administered.

The 48g Spyder employs a leadless sensor, attached directly to the chest and employs a wireless paired smartphone to display the ECG and to transmit signals to a secured cloud server. The inconspicuous sensor allows continuous monitoring for up to three days on a single charge, increasing the sensitivity of detection of abnormal heart rhythms. In trial test in Singapore, patients have worn the system for up to two weeks at a time. For patients, the ability to move about, even travel across borders with the system, is now a reality.

The commonest use of the Spyder system would be in diagnosis of symptoms such as palpitations, where abnormal beats or rhythms may be missed if a shorter period of monitoring is employed. Data is transferred wirelessly to a cloud server where algorithms are employed to screen the data. Physicians can access this data through a secure web-based Interface and analyze rhythms from Spyder units under their purview. Traditional hospital systems require patients to return the recorders first for data to be downloaded but as Spyder transmits ECG continuously, data analysis can begin while the patient still has the Spyder on.

As the cloud-based solution works in any smart-phone data-enabled location, worldwide remote ECG monitoring is now feasible. A patient, for example, can be in London and his physician can access his ECG from Hong Kong! The Spyder ECG is currently available in Singapore and Malaysia and the company is looking to expand its distribution network to Europe and the Asia Pacific.
RFID antennas embedded into fibre composites

By Julien Happich

Researchers from the Fraunhofer Institute for Integrated Circuits IIS have now found a way to embed RFID antennas into fibre composites. As a result, the technology also works with carbon and glass fibres, making them suitable for use into airplane components for closer reporting and tracking during their manufacture.

The fibre composites parts can communicate with skilled workers in their vicinity, providing part number information, but also monitoring the entire manufacturing chain (who has worked on them, what is the next work step).

Measuring only a few square millimetres, an RFID chip transmits the information and details about the component under fabrication.

The challenge at the Fraunhofer Institute for Integrated Circuits IIS in Nuremberg was to develop an RFID transponder whose antenna works reliably on fibre composites. Components such as glass or carbon fibres are both lightweight and robust, and are thus used increasingly in airplane and vehicle production. However, these fibres have a particularly strong influence on frequencies. Until now, their exact behaviour with regard to RFID had not been well understood on the wireless system, and this is why production steps are still documented with a pencil and paper.

“We took a close look at the frequencies relevant to RFID technology: 125 kHz (LF: low frequency), 13.56 MHz (HF: high frequency), and 868 MHz (UHF: ultra high frequency). We measured the extent to which glass and carbon fibres affect the reliability of the transponder,” says Tobias Dräger, an engineer, in describing the work of the IIS team.

The result: while LF, HF, and UHF work well with glass fibres, they showed weaknesses with carbon fibres. The high frequencies in particular compromised the performance of the RFID chip significantly. “Carbon fibres are, similarly to metal, conductive. As a result, they dampen radio signals considerably—especially at 868 MHz,” says Dräger’s colleague Dr. Iker Mayordomo.

But thanks to their relatively large range of up to 15 meters, UHF frequencies are very well suited to applications in logistics and production. In the past, if RFID was used with incompatible materials such as metals, a very expensive transponder was required to reach this level of performance. “The antennas and transponders required make these customized systems very large. At the same time, integrating them into fibre composites is difficult,” says Dräger in discussing the initial situation. Together with partners from the aviation industry and research, his team has successfully developed a transponder that can operate reliably within conducting components, which are also subject to physical stress.

The scientists have designed an ultra-thin antenna that can be embedded in materials underneath a protective glass fibre layer. Together with Schreiner LogiData, a manufacturer of RFID transponders, IIS has already developed the first test series.
High resolution copper ink printing for electronic interconnects

By Dr Pufinji Obene and Dr Ian Clark

PRINTED ELECTRONICS IS an example of additive manufacturing where only materials that are contributing to the final circuit are deposited, offering a simpler, more cost effective and cleaner process with little or no waste. Today, the vast majority of integrated circuit boards are manufactured by applying the functional materials everywhere and then removing by means of a mask or etchant, the areas not required.

The most commonly used material combination for electronic circuits is copper on FR4 laminate and in many cases up to 75% of the copper is etched back off to produce the desired base circuitry. Although further processing steps such as nickel and gold coating are additive in nature, the passive, active and MEMs devices that populate such base boards to produce final integrated electronic circuit devices are also up to 50% subtractive in nature. The adoption of additive manufacturing could potentially save up to 25-50% of material component costs.

The technology of additive manufacturing will enable manufacturers to deposit conducting and insulating fluids including: adhesives, resistors, liquid crystal fluids, metallic inks, nano-inks, semiconductor inks and a wide range of other fluids as well as regular inks, using well known deposition techniques such as screen, inkjet, gravure and electrostatic printing, together with curing systems such as convection oven, infra red and laser sintering. It will also allow passive components: resistors, capacitors, inductors, switches and relays as well as thin film transistors, organic light emitting diodes (OLED) and logic gates.

To date additive processes are used in products when fabrication costs and flexibility outweighs size and performance considerations. Typical uses are in organic and large area electronic applications. Research and development in the field of OLEDs is proceeding rapidly and may lead to future applications in large information displays, automotive dashboards, home and office lighting and flexible displays. Because OLEDs refresh faster than LCDs (almost 1,000 times faster) a device with an OLED display could change information effectively in real time. Video images could be much more realistic and con-stantly updated. The newspaper of the future might be based on an OLED display that refreshes with updated news and like a regular newspaper could be folded up after reading and placed back in the bag, briefcase or backpack. A flexible OLED display is very likely to be the basis of the next generation smart device used for all forms of written communication.

Intrinsiq Materials (IM) of Farnborough, UK, has teamed up with Swindon-based automotive sensor maker Precision Varionic International (PVI) to use nanocopper conductive inks as the interconnect in high precision printed electronic components for a wide range of applications.

PVI is developing a mid to high range production printing system called High Resolution ElectroStatic Ink JET (ESJET) for the printed electronics marketplace. This patented electrostatic printer technology provides both higher resolution (feature size and print channel spacing) and a broader range of ink type compatibility than conventional ink jet technologies. In contrast to current high-resolution inkjet printers based on piezo operation, ESJET has no moving parts. This allows very high print channel density to be achieved since print channels can be arranged over a two dimensional surface, rather than being in a single print channel line. Typical channel spacing in commercial inkjet printing equipment is 50 to 360dpi, whereas with the lab prototype ESJET printer, resolution of 2116 dpi has been demonstrated with current development aimed at achieving up to 10,000 dpi. A typical

Dr Pufinji Obene is Operations Director at Precision Varionic International – www.pvi.co.uk
Dr Ian E Clark is Sales & Marketing Director at Intrinsiq Materials Ltd - www.intrinsiqmaterials.com
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Nanoparticle-based copper inks

Intrinsiq’s copper inks and pastes are formulated using a patented nanoparticle functionalization technology. This allows the production of copper nanoparticles within a controlled structure and proprietary coating that protects the material from oxidation. By using nanoparticles rather than conventional micron particles as the basis for the ink, it is possible to use inkjet (and other) printing techniques and also sinter or cure the ink at much lower temperatures than would otherwise be possible.

After printing, an oxide-free conductive copper track is produced via rapid thermal annealing of the deposited ink. Intrinsiq inks are specifically designed for photonic, or light based, curing in air via high intensity light sources such as flash lamp or laser, including Intrinsiq’s own LAPS laser curing systems, rather than standard oven-curing techniques.

Intrinsiq’s copper inks and pastes are suited for printed electronics, a “non-contact” plasma process is used to produce high purity (>99.99%), well controlled particle size distributions (5-50 nm) with controlled dopants to ppm levels to produce n-type and p-type structures. The high purity nano-particles produced from this process will enable improved semiconductor performance over state of the art technology, with target mobilities greater than 10 cm²/Vs for printable nano-Si.

Combining the expertise and facilities of IML and PVI allow the partnership to offer a range of services with design and development as well as application development for automotive, LED, medical devices, PV, displays and touch screens. It can also provide bespoke manufacturing of prototype and demonstrator circuits and devices such as sensors, RFID antennas and smart tags, etc, as well as the conductive inks and curing systems.
Silver coating of fabric opens up wearable technology

By Nick Flaherty

DEPOSITING SILVER ONTO clothing fibres to create interconnect could open up huge opportunities in wearable electronics. Researchers at the National Physical Laboratory (NPL), led by Dr Chris Hunt, have developed a way to print silver directly onto fibres that allows the interconnect to stretch with the fabric, rather than just screen printing onto a woven surface.

The new technique could make integrating electronics into all types of clothing simple, practical and reliable with many potential applications in sports, health, medicine, consumer electronics and fashion, says Hunt.

“The technique has many potential applications,” he said. “One particularly exciting area is wearable sensors and antennas which could be used for monitoring, for example checking on patients and vulnerable people; data capture and feedback for soldiers in the field; and performance monitoring in sports. It offers particular benefits over the ‘weaving in’ approach, as the conductive pattern is incorporated within the textile, it ensures that sensors are repeatedly positioned in the same location on the body,” he said. This will lead to improved accuracy of the sensor by preventing sensor misplacement.

It also adds a negligible weight and thickness to the clothes and multiple electronic circuits patterns can be placed on a garment in a single setup. As an example, wireless wearable sensors for home monitoring of physiological data of a heart could, for instance, overcome shortcomings of currently available technology such as “Halter monitoring” and significantly improve the diagnosis and treatment of cardiovascular diseases. Another example would be for a patient with a motor disorder such as Parkinson’s disease, where the monitoring of physiological movement could facilitate medication titration as the disease progresses.

Circuits can be easily printed onto many different types of fabric, including wool which is knitted in tight loops. This is a key difference as it means the interconnect can stretch with the material.

The technique involves chemically bonding a nano-silver layer onto individual fibres to a thickness of 20nm. The conductive silver layer fully encapsulates the fibres and has good adhesion and excellent conductivity at 0.188Ω/sq. The 20nm plating is not enough to carry a significant current, but would be used as the base for copper coating to carry more current.

An immediate use for the nanosilver coated fabric is applications such as wound dressings, hygienic clothing and medical applications using the antibacterial properties of silver. For example, it can be used for the fabrication of face masks, surgical gloves and military uniforms where the infection of the wound can have severe effect. The high flexibility of fabric textiles allows them to be employed in the health, leisure and sports industries.

But it is the opportunities in fashion and consumer technology, such as incorporating LED lighting into clothing or having touch-screens on shirt sleeves that is really exciting, says Hunt.

Having successfully shown that the additive technique is viable in the lab, NPL is now looking for funding or collaborators to develop a full printed circuit on a textile, which can be tested for flexibility and robustness, for example by putting it through the wash. Once this has been successfully achieved, the scientists will then look to develop prototypes of practical applications.
**Device cleans MPO/MTP connector end-faces**

Fujikura Europe has released the One-Click Cleaner MPO designed specifically for cleaning MPO/MTP connectors and adapter mounted MPO/MTP connectors which are widely used in data centres and also in some telco operated infrastructures. The new product cleans MPO/MTP connector end-faces which have been exposed to loose contaminants, such as dust and oil from an installer’s fingers. With just one simple action it is able to clean a variety of fibre counts up to 48 fibre MPO/MTP end faces and is capable of providing over 500 cleans per unit. The One-Click Cleaner MPO is now included within a range of tools which are designed and built to clean an array of network connections. It has also been produced to be more ergonomic than the previous design of MPO cleaning tools by Fujikura. The cleaner is compliant with the EU/95/2002/EC directive (RoHS) since it is made of environmentally friendly materials. An adapter/dust cap is also supplied with the product for cleaning MPO/MTP connector plugs as well as the connectors themselves.

Fujikura Europe
www.fujikura.co.uk

**Silica-based optical fibres and hollow silica waveguides**

Polymicro Technologies, a subsidiary of Molex Incorporated, has extended its specialty optical fibre offering with the introduction of FBPI optical fibre and hollow silica wavelength fibre products. Optimised for near infrared (NIR) attenuation and ultraviolet (UV) solarisation resistance to improve transmission over a wider spectral range, the Polymicro silica-based FBPI optical fibre delivers panoramic spectroscopy and sensor analysis. Available in a range of core diameters from 50-600 μm, broad spectrum FBPI optical fibre with a low -OH pure silica core demonstrates significantly reduced content of UV defects and other UV absorption centres. In the near-infrared (NIR) wavelength region to beyond 2100 nm, Polymicro FBPI fibre attenuation is equivalent to standard NIR fibres having a low -OH silica core and F-doped cladding. Comparable to solarisation properties of standard UV optimised high -OH fibres with high radiation resistance, FBPI fibre features UV transmission down to 200nm. Strong and flexible Polymicro hollow silica wavelength fibre for CO2 laser delivery can be optimised for wavelengths in the infrared region from 3-20 μm for a range of applications, including replacement for high cost, heavy, rigid articulated arms in medical and dental laser applications, industrial cutting, and laser printing and marking. Enabling high laser power delivery under 100W, the hollow construction silica simplifies end termination, reduces abrasion and provides a robust buffer in harsh environments. The geometry of the biocompatible fibre can be easily changed to accommodate part customisation. Available with custom buffers, HSW fibre features removable, reusable Poly-Lok Connectors for prototyping.

Molex
www.molex.com

**Electro-optical convertors feature push-pull connector technology**

Harting has developed a new range of fibre-optic transceivers suitable for industrial applications by integrating electro-optical converters in small-form factor (SFF and SFP) packages with PushPull connector technology. The transceivers are based on overmoulded Harting PushPull cable assemblies with LC duplex mating faces, and offer IP 65/67 protection and ease of handling. The easy-to-integrate Push-Pull device side allows fibre-optic devices to be added to existing solutions, such as I/O boxes, camera systems or industrial controllers. The transceiver module can be equipped with any SFF/SFP transceivers, and can be connected to the base plate via Harting har-flex connectors.

Harting
www.harting.com

**Single chip enables DisplayPort, USB and power over a single cable**

Texas Instruments has launched a single chip that delivers audio/video, USB data and power over a single cable between a notebook, ultrabook or tablet PC and a docking station or dongle. DockPort provides a lower cost alternative to proprietary implementations and offers more features than standard USB docking stations. It enables system designers to create smaller, more affordable docking stations that connect and synchronize computers with LCD monitors, dongles, keyboard/mouse, Gigabit Ethernet, storage, audio speakers, DVD/Blu-ray media player and smartphone. The HD3SS2521 controller enables DisplayPort, USB 3.0, USB 2.0 and power over a single interconnecting cable, and provides the control logic and automatic switching required on the cable’s host side and dock side. The HD3SS2521 enables system designers to create smaller, more affordable docking stations that connect and synchronize computers with LCD monitors, dongles, keyboard/mouse, Gigabit Ethernet, storage, audio speakers, DVD/Blu-ray media player and smartphone. A bidirectional 2:1 switch manages DockPort detection, as well as signal and power switching. It enables display, USB, power, and computer docking Interface over a single cable, which allows designers to create smaller, more affordable docking stations. The 5x11mm package reduces board space by one-third and BOM costs by more than 50% compared to competitive implementations that provide data and A/V over a single connector. Power and charging is delivered over the same cable, reducing the number of connections by allowing upstream charging of host-side computers, or downstream powering of one or more dongles. Operating in two-lane mode with USB 3.0 data, the HD3SS2521 supports one monitor with resolutions up to 4K2Kp at 30 frames per second (fps) and 30 bits per pixel (bpp), or multiple monitors with resolutions less than or equal to 1920 by 1200p at 60 fps.

Texas Instruments
www.ti.com
4-channel CAN bus router is freely programmable

Up to now, PEAK System’s PCAN-Router Pro, a 4-channel router for the CAN bus, could only be operated with the provided standard firmware and be configured through Windows software. With the now released development package, users can develop their own firmware in C and C++. The package contains a selection of programming examples which serve as starting points for development. The library for accessing the device’s resources as well as the Yagarto GNU ARM toolchain form the development environment. Using the Windows software PCAN-Flash, once completed the firmware is transferred to the PCAN-Router Pro via CAN by means of the PCAN-Flash software running under Windows. All new devices starting from serial number 100 are programmable. Customers can download the development package from the PEAK-System website for free. Together with the release of the development package for the PCAN-Router Pro, the tool chains for the PCAN-Router and PCAN-RS-232 products were also shifted to Yagarto in order to support current development standards.

Peak System
www.peak-system.com

Interface box connects to CAN and Ethernet

Vector is introducing a compact Ethernet/CAN Interface with USB. Developers in the automotive and aerospace industries will benefit from simultaneous access to CAN networks and Ethernet-based systems such as Broad-R-Reach or AFDX with just one interface. The new VN5610 device can be used in a broad range of tasks from residual bus simulations to Ethernet monitoring and synchronization of Ethernet frames with other bus systems such as CAN. In particular, developers will benefit from highly precise time stamps with a common time base for synchronizing the various systems. The VN5610 bus Interface provides two separate channels for Ethernet and CAN, which enables simultaneous operation of a remaining bus simulation with the CANoe. IP or CANalyzer/IP Vector tools. While two High-Speed CAN channels are available in the CAN section, the Ethernet section supports Broad-R-Reach and standard Ethernet IEEE 802.3 (100BASE-TX or 1000BASE-T). The advantage here is that the user can connect existing standard Ethernet loggers and accessories when used as an Ethernet media converter. In what is known as Ethernet monitoring, the new Interface offers a transparent connection (in/out/monitor) between two nodes with precise time stamps. In the interplay of the new VN5610 with the Vector tools CANoe.AFDX or CANalyzer.AFDX, it is now possible to access the Ethernet-based AFDX® protocol that is widely used in the aerospace industry. The new Interface can also readily handle the new CAN FD standard with its reconfigurable FPGA hardware architecture, and it rounds out the new VN5610 product range.

Vector
www.vector.com/vn5610

M8 shielded connector range targets Ethernet applications

The Binder range of M8 shielded cable connectors has been extended to accommodate cables up to 6 to 8mm so that they can be used with Ethernet cables. Until now, this popular range of connectors could only accommodate cables up to 5.5mm diameter but a new, wider cable gland extends the application area to include industrial Ethernet and other applications requiring larger diameter cables. Protected to IP67 when mated, Binder M8 connectors are available in three and four pole male and female format and have a shielded, nickel-plated brass connector body and gold-plated brass male and bronze female contacts. Termination is via a secure screw clamp and the rated current is 4A. The connectors have a life in excess of 100 mating cycles.

Binder
www.binder-connector.co.uk

Multiple media connector supports up to 32 single connections

Eisele’s MULTILine connectors are available for compressed air, vacuum or fluids, as well as a multiple media version. Electrical connections can also be integrated. Eisele has now extended the product range with the addition of a 32-line connector for maximum flexibility in connecting compressed air and vacuum lines. The 1800 series includes connections for compressed air, vacuum and fluids, ensuring full flow without pressure losses. The practical quick-connectors feature a positioning pin to prevent incorrect connections. Bundling of four to twelve hoses in one plug-in connection facilitates installation considerably. Up to 32 lines with an outer diameter of four millimetres can now be securely connected with only one Interface. In addition, versions with 16 and 22 connections for hoses with an outer diameter of six millimetres are available. Multiple connectors facilitate installation, maintenance and retrofitting of machines, systems and assemblies. The multiple connectors are manufactured from anodised aluminium. The seals are made of fluoro-elastomer (FPM) and are highly resistant to extreme temperatures as well as chemicals. 32-line MULTILine connectors can be used in a temperature range from -20° to +120°C. The permissible working pressure range is from 0.95 to 16 bar. Special stainless steel versions can be used in the food processing industry. Multiple media connectors and connectors for use with fluids open up many flexible areas of application. It is also possible to combine up to eight compressed air hoses with three to 26 electric lines in one interface.

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www.koehler-partner.de
**Fully verified EtherCAT IP is free of upfront licensing fees**

Altera has announced the availability of a fully verified EtherCAT protocol IP for its FPGAs with no upfront licensing fees. This is the latest offering from the collaboration between Altera, the EtherCAT Technology Group (ETG) and Softing Industrial Automation in Germany for a licensing structure that gives developers access to industrial Ethernet protocols with no upfront license fees, no per-unit royalty reporting or protracted negotiations, simplifying the integration of FPGA-based Industrial Ethernet designs. Altera’s Industrial Ethernet solutions implement both the protocol IP and software stack into an FPGA using programmable logic and a soft embedded processor. In this way, a single board with the same Altera FPGA can work with a range of protocols without hardware modifications. The same FPGA can also be used to implement various industrial automation functions, such as sensor interfaces, accelerators and custom control logic in addition to the communication function. Altera’s Industrial Networking Partner Program provides an ecosystem of established networking experts that enable customers to evaluate Industrial Ethernet and fieldbus solutions on a common FPGA-based platform. These partners provide IP, reference designs and design services that meet network communication and FPGA development needs. Altera provides an out-of-the-box Industrial Ethernet solution that includes no up-front license fees, no per-unit royalty reporting and no protracted negotiations. Customers simply download the entire EtherCAT protocol IP including the software stack from Softing. The protocol IP and reference designs are hardware tested on both the Altera Industrial Networking Kit (INK) the Softing FPGA RTEM Cyclone III kit.

Altera
[www.altera.com/industrialethernet](http://www.altera.com/industrialethernet)

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**Fibre-optic cable secures data transmission whilst withstanding fire for 3 hours**

Huber+Suhner announces a key addition to its industry-leading Radox cable family with the introduction of a fibre optic cable designed to provide users across many industries with secure data transmission in a variety of hazardous environments and conditions. Radox fibre optic cables offer high temperature stability, high mechanical and abrasion resistance as well as industry leading fire performance and good fluid resistance. They maintain their form during short-term contact in high temperature conditions (e.g., molten metal splashes or welding sparks) and feature good bend resistance at low temperatures. The cables are halogen free, generate low smoke and emit no corrosive acid and no toxic and corrosive gases. In the event of a fire the cable continues to transmit data for at least 180 minutes (fire test with circuit integrity, according to IEC 60331-25). The Radox brand was developed by the company using its own plastic materials where the material molecules are linked three-dimensionally by electron-beam cross-linking. These highly resilient fibre optic cables fulfill the optical transmission requirements of ISO/IEC 11801 and IEC 60764-3-12. They are also fully compliant to CEN/TS 45545-2 for fire safety in railway applications.

Huber+Suhner
[www.hubersuhner.co.uk](http://www.hubersuhner.co.uk)

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**Bulkhead-mounted industrial connector housing ensures IP 67 protection**

Harting has introduced a bulkhead-mounted version of its Han B industrial connector housing providing improved protection against water ingress up to protection level IP 67. The new housing incorporates a special flange which prevents water from penetrating into the connector, offering ideal protection for the contact points in the housing interior. A circumferential collar also prevents the seal from sliding off inwards or outwards. The use of a stable seal offsets the effect of uneven sections and provides additional protection against water penetration. No extra costs are incurred when the IP 67 bulkhead-mounted housing is installed, as the cut-out corresponds to the dimensions of the existing Han housing portfolio. The new bulkhead-mounted housing is locked with the company’s Han-Easy Lock levers, which allow a high contact pressure level when closed and also provide optimal sealing between the hood and the bottom housing.

Harting
[www.harting.com](http://www.harting.com)

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**Ruggedized hybrid connector targets space sensitive and high vibration applications**

Souriau has released the JDX Hybrid (Mixed Power & Signal) connector family which is a new combination of power and signal being offered within one high density connector solution that minimizes component inventory, reduces complexity, saves space and installation costs. The new JDX Hybrid connector also offers a ruggedized and sealed IP68 solution for high vibration and shock applications. Having waterproof features combined with reliability and quality, the JDX interconnect system is ideal for both outdoor and indoor environments. The JDX mixed power and signal connector offers the ability to integrate 2 to 3 power contacts with 6 to 8 signal contacts in one connector housing. Available in brass or lightweight aluminium with a shell size of 2 and 3 versatile layouts. The JDX Hybrid connector can also be customized to provide a cost effective cable assembly solution to meet your application requirements. Souriau sealed and non-sealed connectors can be used in a variety of markets including instrumentation & measurement, industrial, mil-aero, broadcast entertainment, medical and telecommunications.

Souriau
[www.souriau.com](http://www.souriau.com)
Microchip is the leader in the fast-growing embedded Wi-Fi market, offering innovative, ultra-low-power wireless solutions for monitoring and controlling products over home networks or across the global internet. Our products are used in many applications including sensors, home automation, machine-to-machine control, and asset tracking to name but a few.

**Microchip’s Wi-Fi Portfolio**

Microchip has a broad portfolio of Wi-Fi products including complete, 802.11 b/g modules, certified radio transceivers, and RF chipset solutions that make adding Wi-Fi simple. Our modules have modular radio certifications and include full TCP/IP stacks and networking services, all in a compact, surface mount component to save you development time and testing cost. With UART, SPI slave, general purpose I/O and analog inputs, our modules provide multiple hardware interfaces. In addition to the TCP/UDP protocol, we support all the common networking services including:

- WPS (Wi-Fi Protected Setup)
- Web Server for configuration and general purpose
- FTP (File Transport Protocol)
- HTTP (Hypertext Transfer Protocol)
- Wi-Fi Direct
- DHCP client and server
- DNS (Domain Name Service)
- SSL (Secure Socket Level)
- mDNS (Bonjour/Zero Config)
- SMTP (Simple Mail Transfer Protocol)

Support for additional services and the ability to customize service and stack function are possible with the networking source code provided.

**Key Features**

- Ultra-low-power for battery-powered applications
- Over-the-air firmware upgrade
- Supports SoftAP, Ad hoc, Infrastructure networking modes
- Hardware interfaces: UART and SPI Slave
- Secure Wi-Fi authentication schemes (WEP/WPA/WPA2/Enterprise/EAP)
- Broad range of IP services
- Complete web service support

**Applications**

With full 802.11g over-the-air data rates of 54 mbps and user data throughput up to 5 mbps, these modules are perfect for embedded applications that send files or small amounts of data. The ultra-low, 30–40 mA receive current and multiple sleep modes of 4 µA or lower make battery-powered Wi-Fi applications possible. Embedded Wi-Fi applications include:

- Remote equipment monitoring
- Asset tracking and telemetry
- Security
- Industrial sensors and controls
- Home automation
- Medical devices

**Modular Certifications**

Microchip Wi-Fi modules carry the following modular certifications:

- FCC United States
- IC Industry Canada
- EN European Union
- KC Korea
- NCC Taiwan
- Telec Japan

The Wi-Fi Alliance insures interoperability with other Wi-Fi Alliance certified equipment.
Embedded Wi-Fi Products

Microchip has two series of Wi-Fi modules each targeted at different system architectures. For customers using PIC® microcontrollers and wanting to modify or customize their networking services, the MRF series of products have the stack and services running on a PIC MCU. For customers looking for a quick integration with any microcontroller, the RN series with stack onboard is a drop-in Wi-Fi solution.

RN Wi-Fi Series
- TCP/IP stack on module (no external drivers required)
- Simple ASCII interface
- Works with any microcontroller

MRF Wi-Fi Series
- TCP/IP stack on PIC MCU
- Elegant solution for combined Ethernet and Wi-Fi architectures
- Extendable TCP/IP stack for additional services

Wi-Fi Products

<table>
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<tr>
<th>Product</th>
<th>Sensitivity (dBm)</th>
<th>Power Output (dBm)</th>
<th>Tx. Max. Power Consumption (mA)</th>
<th>Rx Power Consumption (mA)</th>
<th>Sleep*</th>
<th>Interface</th>
<th>Packages</th>
<th>Antenna</th>
<th>Range** (meters)</th>
<th>Operating Temp.</th>
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*Indicates "off" current for sleep column  
**Open air line-of-site

Wi-Fi Development Tools

Microchip offers several MRF and RN development tools for any development environment. The MRF and RN PIcTail™/PIcTail Plus Daughter boards seamlessly add Wi-Fi connectivity to Explorer-based systems. For non-Explorer-based systems, the MRF/RN battery-powered, portable pocket demo quickly and easily adds Wi-Fi connectivity to embedded applications.

Explorer-Based Development Board

<table>
<thead>
<tr>
<th>Series</th>
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<th>RN</th>
<th>MRF</th>
<th>RN</th>
</tr>
</thead>
</table>
| Platform | 8-bit: PICDEM.net2  
16-bit: Explorer 16  
32-bit: PIC32 Starter Kit + I/O Board, Explorer 16 + PIC32 PIM,  
PIC32 Starter Kit + Multimedia Board | 8-bit: PICDEM.net2  
16-bit: Explorer 16  
32-bit: PIC32 Starter Kit + I/O Board, Explorer 16 + PIC32 PIM,  
PIC32 Starter Kit + Multimedia Board | 8-bit: PICDEM.net2  
16-bit: Explorer 16  
32-bit: PIC32 Starter Kit + I/O Board, Explorer 16 + PIC32 PIM,  
PIC32 Starter Kit + Multimedia Board | 8-bit: PICDEM.net2  
16-bit: Explorer 16  
32-bit: PIC32 Starter Kit + I/O Board, Explorer 16 + PIC32 PIM,  
PIC32 Starter Kit + Multimedia Board |
| Module | MRF24WB0MA/MB | MRF24WB0MA/MB | RN131 | RN171 |
| Image | ![MRF24WB0MA/MB Module](image) | ![MRF24WB0MA/MB Module](image) | ![RN131 Daughter Board](image) | ![RN171 Daughter Board](image) |

Pocket Demos

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<td>MRF24WG0MA/MB</td>
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<td>RN131</td>
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<table>
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<tr>
<th>Part #</th>
<th>AC164136-4*</th>
<th>AC164149*</th>
<th>RN131-EK</th>
<th>RN171-EK</th>
</tr>
</thead>
</table>

*The TCP/IP stack and demo applications can be downloaded from www.microchip.com/mla.
Embedded Bluetooth® Products

Microchip’s low-power embedded Bluetooth modules are ideal for easily adding Bluetooth connectivity to applications, including smartphones and other Bluetooth-enabled platforms. Microchip’s Bluetooth modules are complete, fully certified, and simple-to-use Bluetooth solutions that support both data communication and voice/audio communication.

Data Communication

Microchip’s surface mount Bluetooth modules are low-power Bluetooth EDR 2.1 modules with complete onboard stack and simple ASCII interface. The modules work seamlessly with Android™ and iPhone® devices, providing a range of up to 100 meters. Data modules support a number of applications including:

- Cable replacement
- Scanners
- Sensors
- Medical devices
- Asset tracking

Bluetooth Profiles

- SPP  Serial Port Profile
- HID  Human Interface Device
- HCI  Host Controller Interface
- iAP  iPod® Accessory Profile
- DUN  Dial-Up Networking

Voice and Audio Communication

The RN52 is a low-power Bluetooth module capable of voice and audio communication. The RN52 provides an integrated solution for delivering high-quality stereo audio. It combines a Class 2 Bluetooth radio with an embedded DSP processor, controlled and configured by simple ASCII commands and GPIO. It integrates RF, a baseband controller, DSP and a second parallel data channel making it a complete Bluetooth wireless link.

The RN52 supports multiple audio and data profiles including support for codecs such as SBC, aptX®, and AAC. A highly robust solution, it provides both analog and digital audio interfaces. The onboard stack and profiles allow operation with or without an external microcontroller, and firmware loaded on the module is field-upgradeable over USB.

Voice and audio communication via Bluetooth has multiple applications in diverse markets including wireless stereo speakers and headsets, smartphone application streaming, hands-free automotive audio, remote control for media players, and medical devices.

Audio Profiles

- A2DP  Advanced Audio Distribution Profile
- AVRCP  Audio Video Remote Control Profile
- HFP/HSP  Hands Free Profile/Headset Profile
Embedded Bluetooth Products

Key Features
- Fully certified Class 1, Class 2, Bluetooth 2.1 + EDR, and 3.0 modules
- Onboard embedded Bluetooth stack works with or without external microcontroller
- Supports streaming data and voice/audio communication
- Supports Bluetooth data and audio link to Android and iPhone
- HID and Audio profiles on Android and iPhone

Bluetooth Products

<table>
<thead>
<tr>
<th>Part #</th>
<th>Typical Range (meters)</th>
<th>Interface</th>
<th>Output Power (dBm)</th>
<th>Package</th>
<th>Antenna</th>
<th>Size (mm)</th>
<th>Bluetooth</th>
<th>Development Tool</th>
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<td>RN41-I/RM</td>
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<td>+15</td>
<td>Surface mount</td>
<td>Chip</td>
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<td>(Class 2)</td>
<td>UART, USB, IPS™, S/PDIF, GPIO</td>
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<td>Surface mount</td>
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<td>13.5 x 26.0 x 2.7</td>
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<td>UART, USB</td>
<td>+4</td>
<td>Socket (male header)</td>
<td>PCB trace, U.FL</td>
<td>24.4 x 29.9 x 8.0</td>
<td>2.1</td>
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</tbody>
</table>

Smartphone Communication

Microchip’s Bluetooth modules work seamlessly with Android and iPhone smartphones. Audio and voice communication are compatible with iAP devices, however establishing Bluetooth data connections with iAP devices requires a unique discovery/pairing sequence and negotiation with the iOS authentication co-processor. A special ‘APL’ part number allows for iPod Accessory Profile (iAP) bi-directional data connections. They interface directly to the authentication co-processor and manage authentication, reducing engineering effort and simplifying accessory product design.

The diagram below illustrates how the iAP-compatible module provides a direct hardware connection to the authentication co-processor.

Conventional Approach
Customer Implements iAP on Microcontroller

- High-end microcontroller
- Management of iAP in embedded software
- Longer development cycles and learning curve for iAP

Important: All products designed to connect to iPhones, iPods and iPads® including those that incorporate the Microchip Bluetooth APL module, must be approved with Apple’s Made for iPod (MFi) program. Developers of such products should visit Apple’s developer portal at: http://developer.apple.com/ipod to enroll. MFi membership is required to purchase the evaluation kit or modules.
Personal Area Networks: ZigBee® and MiWi™ Protocol

MiWi Wireless Networking Protocol
MiWi Development Environment (MiWi DE) is Microchip’s proprietary wireless solution that supports MiWi Mesh and MiWi P2P. These protocols are perfect for short-range wireless networking applications. The MiWi Development Environment is optimized for:
- Low power
- Low-data-rate
- Cost-sensitive applications

Supported MiWi Protocol Stacks
- MiWi P2P
  - Simple star network
  - Program memory size ~4KB
- MiWi
  - Mesh Network: up to 4 hops and up to 1024 nodes
  - Program memory size ~16KB
- MiWi PRO
  - Up to 8000 nodes in a Mesh Network and 64 hops of routing capability
  - Size ~25 KB

MiWi Wireless Networking Protocol Development Tools
The MiWi Development Environment makes it easy to develop wireless applications which are portable across different Microchip RF transceivers and different wireless protocols, depending on an application’s requirements, without having to change the application firmware.

MiWi Development Environment Stack for 8-, 16- and 32-bit PIC microcontrollers is part of the Microchip Applications Libraries (www.microchip.com/MLA).

ZENA™ Wireless Adapter
- 2.4 GHz
- 868 MHz
- 915 MHz
Can be used as
- MiWi Sniffer
- MiWi Configurator

Wireless Development Studio
- MiWi Sniffer
- MiWi Configurator
www.microchip.com/wds

MiWi Protocol Demonstration Kit
- 2.4 GHz
- 868 MHz
- 915 MHz

8-bit Wireless Development Kit
- 2.4 GHz
- 868 MHz
- 915 MHz
Personal Area Networks: ZigBee and MiWi Protocol

ZigBee Solutions
As a member of the ZigBee Alliance, Microchip offers certified ZigBee Compliant Platform (ZCP) for the ZigBee PRO, ZigBee RF4CE, and ZigBee Residential protocol stacks. The ZCP is a required starting point for customers to develop a ZigBee Compliant Product. The ZCPs ensure interoperability with the ZigBee industry standard.

Key Features
- Royalty-free ZigBee protocol stack and efficient footprint for entire ZigBee protocol
- Source code format, allowing designers to customize their products
- Utilize Microchip’s broad portfolio of compatible PIC microcontrollers

ZigBee Smart Energy Profile (SEP) Suite includes:
- ZigBee Smart Energy Profile Application
- Certified ZigBee PRO Stack supports PIC24 and PIC32 microcontrollers and dsPIC33 DSC families
- ZigBee Cluster Library (ZCL)

IEEE 802.15.4-Based 2.4 GHz Modules: Agency Certified
MRF24J40MA/MB/MC
- Supports Microchip wireless stacks:
  - ZigBee, MiWi Development Environment
- Module features:
  - Integrated PCB antenna/external antenna
  - FCC (U.S.A.), IC (Canada) and ETSI (Europe) certified

ZigBee RF4CE
Microchip offers one of the smallest footprint, lowest sleep current, RF4CE-compliant platforms for consumer electronic and equipment manufacturers. The ZigBee RF4CE stack is a standard-based wireless communication protocol utilizing the 2.4 GHz IEEE 802.15.4 transceiver for remote controls (controller) and audio/visual equipment (target).

SubGHz Modules
MRF89XAM8A: 868 MHz ETSI Compliant
MRF89XAM9A: 915 MHz FCC Certified
- Supports Microchip wireless stack:
  - MiWi Development Environment
- Module features:
  - Integrated PCB antenna
  - Footprint compatible with MRF24J40MA

www.microchip.com/zoom
Support
Microchip is committed to supporting its customers in developing products faster and more efficiently. We maintain a worldwide network of field applications engineers and technical support ready to provide product and system assistance. In addition, the following service areas are available at www.microchip.com:

- **Support link** provides a way to get questions answered fast: [http://support.microchip.com](http://support.microchip.com)
- **Sample link** offers evaluation samples of any Microchip device: [http://sample.microchip.com](http://sample.microchip.com)
- **Forum link** provides access to knowledge base and peer help: [http://forum.microchip.com](http://forum.microchip.com)
- **Buy link** provides locations of Microchip Sales Channel Partners: [www.microchip.com/sales](http://www.microchip.com/sales)

Training
If additional training interests you, then Microchip can help. We continue to expand our technical training options, offering a growing list of courses and in-depth curriculum locally, as well as significant online resources – whenever you want to use them.

- **Technical Training Centers**: [www.microchip.com/training](http://www.microchip.com/training)
- **MASTERs Conferences**: [www.microchip.com/masters](http://www.microchip.com/masters)
- **Worldwide Seminars**: [www.microchip.com/seminars](http://www.microchip.com/seminars)
- **eLearning**: [www.microchip.com/webseminars](http://www.microchip.com/webseminars)
- **Resources from our Distribution and Third Party Partners**: [www.microchip.com/training](http://www.microchip.com/training)

Sales Office Listing

**AMERICAS**

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**ASIA/PACIFIC**

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Single cable for high-speed networking performance and power technology

TE Connectivity has released the Cloudsplitter Connector System which is a single cable solution for powered devices that delivers Cat5e performance and up to 250 W of power over a single cable. The system is RoHS/REACH compliant, designed to meet UL444 and utilizes CM rated cable. The solution is suitable for use in video surveillance over IP networks, intelligent building management, factory automation and wireless network transceivers. The Cloudsplitter SMT cable plug combines eight 26AWG stranded signal conductors and two 18AWG stranded power conductors in shielded or unshielded configurations. The SMT jack is backward compatible and accepts a Cloudsplitter plug or a standard RJ 45 shielded plug. The system’s integrated power contacts provide DC power at 5 A and up to 50 VDC. Two LED lights are included in the jack assembly for standard data transmit and receive indication. The Cloudsplitter connector system’s unitized connection approach combines two connections into a single product to provide a power and data solution for devices.

TE Connectivity
www.te.com

High density PXI large-matrix format products

Pickering Interfaces has expanded its range of 2-A 1-Pole matrices, with releases that include the highest density solutions available in PXI large matrix (BRIC) format. The 40-596, 40-597, and 40-598 are all BRIC 1-pole matrices with 2A current rating, up to 60W hot switch power and 100 VDC/70 VAC voltage rating – depending on the configuration, these products are available in 2-slot, 4-slot, and 8-slot PXI modules. Each model sets new standards in the achievable density of PXI matrices with configurations of 6, 12, and 16 Y Axis connections and maximum X Axis connections of up to 464 (up to 3,072 matrix crosspoints). For the first time matrix sizes have been introduced at Y sizes of 6 and 12 to complement the usual 4, 8 and 16 sizes; giving users further choice of Y axis size and maximising the X axis size for each configuration. User connections are provided by industry standard D-type Connectors and are supported by the comprehensive range of connection solutions also available from Pickering Interfaces. The BRIC product range uses high quality electro-mechanical relays to achieve their 2-A switch rating. The BRIC structure allows the creation of large PXI matrices over multiple slots without the use of expensive external cables. The fully integrated programming Interface represents the matrix as a single entity, easing user programming and reducing the likelihood of user errors.

Pickering Interfaces
www.pickeringtest.com

Hypertac, Sabritec, IDI unite under Smiths Connectors brand

A provider of high performance interconnect solutions, Hypertac has undertaken a comprehensive re-branding initiative that will position the company, along with its two sister companies Sabritec of Irvine, CA and IDI of Kansas City, KS, under the Smiths Connectors banner. Over time, the three distinct and previously independent brands have forged a close-knit working relationship based upon the natural synergies that exist between their respective technologies and business models. The level of cross-selling and interaction between brands has increased to the point where the time has come to make the combined value and power of the three individual brands more visible in the global market place. As such, a single branding architecture has been created that simplifies the relationship among the brands and with the ultimate shareholder, Smiths Group. The logos of Hypertac, Sabritec and IDI technology brands have been redesigned and placed under the unifying logo of Smiths Connectors. The new visual representations appear in all advertising, printed collateral material and on all product documentation. In addition to extending Smiths Connectors’ global presence through the combined brands which provides a far larger suite of interconnect product and service offerings, the re-branding also increases the focus on delivering the most comprehensive solutions available to its worldwide customer base. Listening closely to the voice of the customer and ensuring the highest possible level of customer awareness and sensitivity continues to be a cornerstone of the Smiths Connectors’ business model.

Smiths Connectors
www.smithsconnectors.com

Modular backplane system increases RF content in board-to-board mating

Molex has released a high-performance connector system designed specifically to enable PCB developers to transfer multiple RF signals across boards in a single assembly while taking into consideration space constraints. The RF DIN 1.0/2.3 Modular Backplane System features a unique bracket housing design, which enables an expansion capability of up to 10 ports for increased orthogonal PCB mating flexibility. The modular board-to-board system offers multiple options including a standard four port, 75 Ohm contact version or customizable six, eight and 10 ports with 50 Ohm contacts. The DIN 1.0/2.3 Interface allows up to 1.00 mm of axial engagement tolerance, providing users with increased flexibility when mating orthogonal PCBs. The RF DIN 1.0/2.3 backplane system is the only one on the market capable of increasing board-to-board content for DC to 3 GHz frequency applications making it suitable for CATV, communication systems and high-density radio applications. The Connectors also feature a push-pull coupling design for quick installation and a plastic housing that engages before the RF contact to prevent damage from stubbing.

Molex
www.molex.com
DFT and test for safety-critical automotive ICs

By Steve Pateras

THE GROWING QUANTITY and sophistication of automotive electronics, particularly in safety-critical systems is driving higher quality and reliability requirements than ever. Not shipping defective parts has evolved from important to imperative. To address quality and reliability requirements, automotive IC makers are adopting new quality standards such as ISO 26262 and IEC 61508. Adhering to these standards, in turn, calls for some key updates to traditional design-for-test (DFT) methodologies. Among the updates are two new test methodologies that will become indispensable for safety-critical automotive electronics: cell-aware automatic test pattern generation (ATPG) and hybrid ATPG/logic built-in self-test (BiST).

Cell-aware ATPG

Cell-aware testing replaces traditional fault models, like stuck-at and transition delay, with a new model that develops the fault behavior from a layout-derived, transistor-level defect simulation of cells. Cell-aware ATPG significantly improves the quality of testing of digital circuits over traditional ATPG, with minimal test cost increase – see figure 1.

Why is cell-aware testing needed? Because while traditional fault models find the majority of defects, they can miss defects that occur within cells, which is a problem because that’s where roughly 50% of all defects occur. Also, traditional fault models are abstractions of defects, whereas cell-aware models are based on simulations of actual defects.

Recently published results show the benefits of cell-aware test. A high-volume 350nm automotive IC design achieved an 88 DPM improvement after traditional test patterns had been applied. Typically, those additional defective parts would have been found through subsequent, but significantly more expensive, system-level tests. Further, the cell-aware testing detected parametric (delay) defects that allowed the designers to adjust design margins, thus reducing area and power consumption in the digital logic.

Adding cell-aware testing to the DFT flow isn’t hard. Creating the cell-aware fault model involves a one-time characterization of a technology library. The cell-aware model can then be used on any design that uses that library.

The automated characterization flow performs extraction from layout into a transistor-level netlist with parasitics for each cell in the library.

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Analog simulations then characterize the effects of potential layout-derived short and open defects to generate the cell-aware model. Both single and dual-cycle analog fault simulation is performed in order to detect both static and delay-related defects.
The cell-aware fault models are written in a user-editable file and automatically incorporated into Mentor Graphics’ Tessent TestKompress pattern generation software. DFT engineers can also use that file to define any proprietary fault model that may be needed to improve quality levels for their specific process or application.

Hybrid ATPG and logic BIST

Another way to improve test efficiency and quality is by using a combination of ATPG compression and logic BIST techniques. In this hybrid approach, the on-chip logic used for the compression and the logic to implement the pseudo-random pattern logic BIST are combined and share DFT resources, like scan chains and on-chip clock control. This infrastructure allows any combination of compressed patterns and pseudo-random patterns to be applied.

The hybrid approach gives you several ways to improve test efficiency during manufacturing test. First, you would use the BIST pseudo-random patterns to cover the faults that are easier to detect. You then don’t need to store ATPG patterns on the tester for these faults, which leaves more room on the tester for targeting faults that are more difficult to detect. The hybrid solution can also reduce the total test time for a complex, hierarchical design because each core is equipped with its own hybrid test infrastructure that allows it to be tested independently of other cores. When your cores can be tested independently, they can be tested in parallel, thus reducing overall test time.

For example, consider an IC for an ABS and stability control system that has four cores. If you only used ATPG compression, then the four cores would have to share the available tester pattern application bandwidth. Either the cores could be tested sequentially using all available tester channels, or all cores could be tested in parallel with each core using a subset of the channels. However, if each core has both ATPG compression and logic BIST available, then the test for each core can be divided into two phases—ATPG in one phase and logic BIST in the other. With this separation, the entire chip can be tested in two phases. In the first phase, two cores use ATPG compression and the other two use logic BIST. In the second phase the situation is reversed. The advantage is that in each phase, only two cores are sharing all available tester channels, because logic BIST does not require patterns from the tester. This means the bandwidth to each core is doubled and the test time is reduced by half.

The hybrid ATPG/logic BIST solution plays another critical role in addressing the reliability requirements defined by the ISO 26262 standard—the ability of logic BIST to provide in-system test of the device logic. The in-system capability of logic BIST can be combined with existing memory BIST capabilities to provide in-system test coverage for most, if not all, of the design.

All of the BIST capabilities can generally be accessed through the standard IEEE 1149.1 TAP controller interface, but this dedicated interface is sometimes not accessible in-system. To accommodate in-system access, the TAP controller can be enhanced to also support a generic CPU interface that translates between parallel read/write CPU operations and the serial bit sequences required by the TAP protocol—see figure 2.

Safety-critical automotive ICs need new test methods to meet the quality and reliability requirements of the ISO 26262 and other automotive electronics standards. With cell-aware test and hybrid ATPG/logic BIST, chip makers will be positioned to achieve high-quality test while controlling test costs even as device sizes and complexities continue to grow.
JESD204B vs. Serial LVDS interface considerations for wideband data converters

By George Diniz

THE JESD204A industry standard for serial interfaces was developed to address the problem of interconnecting the newest wideband data converters with other system ICs in an efficient and cost saving manner. The motivation was to standardize an interface that would reduce the number of digital inputs/outputs between data converters and other devices, such as FPGAs (field-programmable gate arrays) and SoCs (systems-on-chip), through the use of a scalable high-speed serial interface.

Trends show that new applications, as well as advances in existing ones, are driving the need for wideband data converters with increasingly higher sampling frequencies and data resolutions. Transmitting data to and from these wideband converters poses a significant design problem as bandwidth limitations of existing I/O technologies force the need for higher pin counts on converter products. Consequently, systems PCB designs have become increasingly more complex in terms of interconnect density. The challenge is routing a large number of high-speed digital signals while managing electrical noise. The ability to offer wideband data converters with GS/s sampling frequencies, using fewer interconnects, simplifies the PCB layout challenges and allows for smaller form factor realization without impacting overall system performance.

Market forces continue to press for more features, functionality, and performance in a given system, driving the need for higher data-handling capacity. The high-speed A/D converter and D/A converter-to-FPGA interface had become a limiting factor in the ability of some system OEMs to meet their next-generation data-intensive demands. The JESD204B serial interface specification was specifically created to help solve this problem by addressing this critical data link. Figures 1 and 2 show typical high-speed converter-to-FPGA interconnect configurations using JESD204A/B.

Choosing between Series LVDS and the JESD204B interface

In order to best select between converter products that use either LVDS or the various versions of the JESD204 serial interface specification, a comparison of the features and capabilities of each interface is useful. A short comparison is provided in table 1. At the SERDES level, a notable difference between LVDS and JeSD204 is the lane data rate, with JeSD204 supporting greater than three times the serial link speed per lane when compared with LVDS. When comparing the high-level functional tomography (CT) scanners, magnetic resonance imaging (MRI), and others generate many channels of data that flow through a data converter to FPGAs or DSPs. Continually increasing I/O counts are driving up the number of components by requiring the use of interposers to match FPGA and converter pin out and increasing PCB complexity. This adds additional cost and complexity to the customer’s system that can be solved by the more efficient JESD204B interface.

Increasingly sophisticated pulse structures on today’s advanced radar receivers are pushing signal bandwidths toward 1 GHz and higher. Latest generation active electronically scaled array (AESA) radar systems may have thousands of elements. High bandwidth SERDES-based serial interfaces are needed to connect the array element data converters to the FPGAs or DSPs that process incoming and generate outgoing data streams.

The applications driving the need for JESD204B

OFDM-based technologies such as LTE used in today’s wireless infrastructure transceivers use DSP blocks implemented on FPGAs or system-on-chip devices driving antenna array elements to generate beams for each individual subscriber’s handset. Each array element can require movement of hundreds of megabytes of data per second between FPGAs and data converters in both transmit or receive modes.

Today’s software defined radios use advanced modulation schemes that can be reconfigured on-the-fly, and rapidly increasing channel bandwidths, to deliver unprecedented wireless data rates. Efficient, low power, low pin count FPGA to data converter interfaces in the antenna path play a critical role in their performance. Software defined radio architectures are integral to the transceiver infrastructure for multicarrier, multimo-
features like multi-device synchronization, deterministic latency and harmonic clocking, JESD204B is the only interface that provides this functionality. Systems requiring wide bandwidth multichannel converters that are sensitive to deterministic latency across all lanes and channels won’t be able to effectively use LVDS or parallel CMOS.

**LVDS overview**

Low-voltage differential signaling (LVDS) is the traditional method of interfacing data converters with FPGAs or DSPs. LVDS was introduced in 1994 with the goal of providing higher bandwidth and lower power dissipation than the existing RS-422 and RS-485 differential transmission standards. LVDS was standardized with the publication of TIA/EIA-644 in 1995. The use of LVDS increased in the late 1990s and the standard was revised with the publication of TIA/EIA-644-A in 2001.

LVDS uses differential signals with low-voltage swings for high-speed data transmission. The transmitter typically drives ±3.5mA with a polarity matching the logic level to be sent through a 100-ohm resistor, generating a ±350mV voltage swing at the receiver. The always-on current is routed in different directions to generate logic ones and zeros. The always-on nature of LVDS helps eliminate simultaneous switching noise spikes and potential electromagnetic interference that sometimes occur when transistors are turned on and off in single-ended technologies. The differential nature of LVDS also provides considerable immunity to common-mode noise sources. The TIA/EIA-644-A standard recommends a maximum data rate of 655 Mbps, although it predicts a possible speed of over 1.9 Gbps for an ideal transmission medium.

The huge increase in the number and speed of data channels between FPGAs or DSPs and data converters, particularly in the applications described earlier has created several issues with the LVDS interface - see figure 3. The bandwidth of a differential LVDS wire is limited to about 1.0 Gbps in the real world. In many current applications, this creates the need for a substantial number of high-bandwidth PCB interconnects, each of which is a potential failure point. The large number of traces also increases PCB complexity or overall form factor, which raises both design and manufacturing costs. In some applications, the data converter interface becomes the limiting factor in achieving the required system performance in bandwidth hungry applications.

**JESD204B overview**

The JESD204 data converter serial interface standard was created by the JEDEC Solid State Technology Association JC-16 Committee on Interface Technology with the goal of providing a higher speed serial interface for data converters to increase bandwidth and reduce the number of digital inputs and outputs between high-speed data converters and other devices. The standard builds on 8b/10b encoding technology developed by IBM that eliminates the need for a frame clock and a data clock, enabling single line pair communications at a much higher speed.

In 2006 JEDEC published the JESD204 specification for a single 3.125-Gbps data lane. The JESD204 interface is self-synchronous, so there is no need to calibrate the length of the PCB wire traces to avoid clock skew. JESD204 leverages the SerDes ports offered on many FPGAs to free up general-purpose I/O. JESD204A, published in 2008, adds support for multiple time-aligned data lanes and lane synchronization. This enhancement makes it possible to use higher bandwidth data converters and multiple synchronized data converter channels and is particularly important for wireless infrastructure transceivers used in cellular base stations. JESD204A also provides multi-device synchronization support which is useful for devices, such as medical imaging systems, that use large numbers of ADCs.

JESD204B, the third revision of the spec, increases the maximum lane rate to 12.5 Gbps. JESD204B also adds deterministic latency, which communicates synchronization status between the receiver and transmitter. Harmonic clocking, also introduced in JESD204B, makes it possible to derive a high-speed data converter clock from a lower-speed input clock with deterministic phasing.

The JESD204B industry serial interface standard reduces the number of digital inputs and outputs between high-speed data converters and FPGAs and other devices. Fewer interconnects simplifies layout and makes it possible to achieve a smaller form factor - see figure 4. These advantages are important for a wide range of high-speed data converter applications such as wireless infrastructure transceivers, software defined radios, medical imaging systems, and radar and secure communications. Analog Devices is an original participating member of the JESD204 standards committee and we have concurrently developed compliant data converter technology and tools along with a comprehensive product roadmap offering.

By providing customers with products that combine our cutting edge data converter technology along with the JESD204A/B interface, we expect to enable customers to solve their system design problems, while taking advantage of this significant interfacing breakthrough.

**Table 1: Comparison between serial LVDS and JESD204 specifications.**

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<td>Yes</td>
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<tr>
<td>Multi-device synchronization</td>
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<td>Deterministic latency</td>
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<td>Harmonic clocking</td>
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**Fig. 3: Challenges in system design and interconnect using parallel CMOS or LVDS.**

**Fig. 4: JESD204 with its high speed serial I/O capability solves the system PCB complexity challenge.**
Advanced verification for fault-free wireless M2M communication

By Franz-Josef Dahmen

M2M (MACHINE-TO-MACHINE) communication brings valuable benefits both to device manufacturers and to end users: remote sensing, monitoring, tracking and data-logging bring a new dimension to the functions of machines in industrial, commercial, military and other market segments, in applications such as automation, vending, smart metering and logistics.

Wireless is the preferred mode of communication for nearly all these applications. Of course, wireless communication supports mobile applications, such as track-and-trace in the logistics sector. But even in fixed devices, wireless connectivity is often preferred because of the low cost of installation, particularly in remote locations, and the ready availability of commercial off-the-shelf communications modules for wireless protocols such as GSM, 3G and LTE (in cellular telephony), as well as ZigBee and WiFi.

With mobile telephone network reception now available almost anywhere in the world, cellular telephony provides the greatest flexibility and coverage for device manufacturers implementing M2M communication (also known as MTC – Machine Type Communications). But in many cases, this will mark a development team’s first engagement with the sometimes perplexing field of radio. And simply bolting a GSM or 3G module on to an existing end product is no guarantee of effective wireless connectivity, no matter how good the module is.

This article shows how modern simulation techniques can be used to verify the performance of an M2M or MTC application during product development, so that manufacturers can be confident it will work faultlessly when it is released into the field.

The components to be tested

A simplified M2M system architecture consists of three elements: the M2M application itself (the host), the communication/wireless network, and the M2M device (normally a modem). The operation and interactions of these three elements determine the reliability of an M2M system.

The operation of the network is, of course, outside the device manufacturer’s control. But the choice of network type is important, because network availability in the expected locations of use is a prerequisite of reliable connectivity. In fact, most countries in the world now have almost total wireless network coverage in some form. The densest coverage is normally through 2G networks, such as the GSM/GPRS networks introduced in the early 90s in Europe and Asia. Beginning in 2000, 3G networks (using WCDMA, CDMA2000 or TD-SCDMA technologies) were built out in parallel to the existing 2G networks. Today, we are seeing the roll-out of 4G LTE networks, which provide an always-on, broadband wireless connection to the internet. 2G networks offer circuit-switched and packet-switched access to the user domain. Of the varieties of 2G technology, GPRS, which offers higher uplink and downlink data rates than GSM, is currently the most widely used for M2M data. For some applications requiring the transfer of only small amounts of data, Short Message Service (SMS) is also sometimes used.

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on the amount of activity taking place in any given cell – and the response of an M2M application when a communication link fails is one of the key parameters to test during product development, as will be shown below.

**Impact of embedding a modem in an end product**

The quickest and simplest approach to M2M system development is to embed an integrated cellular module, an intelligent modem which provides a black box implementation of the physical and protocol layers. Modules from well-known suppliers such as Sierra Wireless, Cinterion and Telit will have been tested and type-approved against test specifications published by 3GPP (3rd Generation Partnership Project – the cellular telephone industry’s standard-setting body).

Certification of compliance with these specifications guarantees that a module conforms to the standard, just like a mobile phone. Before being embedded in an end product, therefore, the module offers highly reliable communications functions.

In an M2M system, however, a module will typically operate alongside additional hardware and software in end products such as programmable logic controllers, electricity meters, credit card terminals and in-vehicle telematics and entertainment units. In addition, a central application environment handles the data flow from the M2M device, and takes decisions based on the type and value of the information it processes.

The way in which the module is embedded in the end product can, then, give rise to communications malfunctions in the real world. It is disastrous if the first evidence of this unreliable behaviour comes when the device has already been released to the field. By developing test scenarios that mimic real-world use cases, and testing the M2M system’s behaviour in these scenarios in a controlled test environment, device manufacturers can, however, uncover and then rectify potential malfunctions before the device goes into production.

In the past, developers used a variety of means to perform functional testing of M2M systems, for example testing prototypes in real live networks, using a conformance test system or developing a dedicated test network.

All three methods, however, suffer from serious drawbacks. Testing in a live network only allows the testing of scenarios that can be found in the locations and at the times the prototype is tested. This makes it hard to repeat specific problematic test scenarios and to drill down into the causes of faulty device or signalling behaviours.

In a conformance test system, the test scenarios are limited to those specified by the 3GPP. These test systems do not facilitate in-depth testing and modification of the scenarios most relevant to any given application. And development of a dedicated test network is extremely expensive and time-consuming.

Fortunately, there is now a better way. Wireless network simulation provides for the testing of an entire M2M system set-up from the early stages of development. A network simulator supports detailed investigation of device and signal behaviour, provides complete freedom to simulate any kind of network protocol and environment, including those not provided by
Typical causes of M2M communications malfunctions

With a cellular network simulator to hand, device developers can use their imagination to devise stress tests for their M2M system and answer some basic questions.

Do handovers work between cells, between networks or between different wireless protocols? What happens to the application’s data when a handover fails?

Does a device connect or re-connect to the network correctly?

Can the device successfully register and authenticate a SIM card?

What is the data throughput when connected? And when performing a handover?

Does the device handle the simultaneous reception of a large number of SMS messages correctly?

How sensitive is the M2M device’s RF reception? In practice, how weak does the signal have to be before it loses its connection to the network?

For engineers with no previous experience of communications testing, it will often not be obvious how to design test routines to implement scenarios such as these. Network simulators therefore feature software tools that abstract the user away from the underlying test system code, and that provide an intuitive graphical user interface (GUI) for configuring and running many kinds of test scenario.

To illustrate the operation of such a GUI, figure 1 shows Anritsu’s SmartStudio, which is built into its MD8475A Network Simulator. SmartStudio provides pre-defined menu options for configuring multiple cells and cellular standards. It starts by requiring the user to choose which radio access technology (for instance, ‘WCDMA to GPRS handover’) should be used in the simulation.

This choice will be based on the cellular standards the M2M device supports. The next step is to set up the desired cell-specific parameters, or simply to select one of the pre-defined standard cell parameters. This can be done quickly and with a minimum of knowledge of cellular technologies. Then the user just has to click the ‘Play’ button, and the network is created and available for testing.

The cell configurations allow the user to reproduce the network settings of any available mobile network in the world. The typical settings are for the mobile network code (MNC) and mobile country code (MCC). For instance, the codes MCC 262 and MNC 02 are used by Vodafone D2 GmbH in Germany.

These settings can be used on the MD8475A to test the ability of an M2M GSM/GPRS device to register with a network and to be authenticated using identification data stored on the device’s SIM card. The instrument logs the stages in this authentication procedure for viewing by the user.

The instrument can also test the device’s ability to register with other networks. For instance, a device that is pre-programmed to work on Vodafone will be configured to register with Vodafone cells where appropriate. But the device might also be capable of registering with cells operated by other network providers.

The instrument can test the device’s cell-registration behaviour in the presence of cells of multiple providers, taking into account the PLMN (Public Land Mobile Network) identifying information, restriction status, and downlink signal level of each cell. It also tests whether the device successfully performs location registration to that cell. The instrument can also perform a cell re-selection test, which is required should a cell change its restriction status or downlink signal level.

The final step in this family of tests is to test the device’s ability to change cells – an action that might be required when a cell’s downlink signal level changes after the initiation of voice or packet connections. This test checks that the mobile device tries to maintain service by re-selecting the optimal cell after comparing downlink signal levels, and moving to the new optimal cell.

Assessing device performance

The select/re-select and handover set of tests is just one among many that can be easily configured and run using a network simulator and software such as SmartStudio. For each test set, the developer must make a judgement about the application’s tolerance of failure, taking into account the end user’s requirements and expectations. In the case of the select and handover tests, for instance, a device should pass every time as these are basic functions in cellular telephony.

A comprehensive wireless network simulator will be able to perform all the tests required to verify the performance and functionality of any M2M application – see figure 2.

Instruments from Anritsu – the MD8470A (for 2G and 3G) or the MD8475A (for 2G, 3G and LTE- figure 3) are able to hide the complexity of the wireless standards, and let the engineer focus on the application itself, delivering a stable test environment and a simple user interface for the set-up of complex scenarios. And integrated tools for monitoring, logging and failure analysis enable the user to quickly identify and analyse problems in the system.
Towards a global product testing scheme

By Jean-Louis Evans

A SINGLE TEST that gives manufacturers access to international markets for their electrical products seems like utopia. However, the IECEE CB Scheme is the world’s first international system for the mutual acceptance of test reports and certificates for electrical and electronic components, equipment and products. This offers a single test that gives manufacturers access to international markets for their electronic products, covering both electrical safety and EMC.

The main objective of the CB Scheme is to facilitate trade by promoting the harmonisation of individual national standards with international ones. This multilateral agreement significantly reduces the need for duplicate testing, is operational in over 50 countries, and is being used by more than 15,000 manufacturers worldwide. It is also widely accepted beyond the countries that formally participate in the scheme.

The National Committee of each member country designates its National Certification Body (NCB) or Bodies, which are responsible for issuing CB Test Certificates. Testing is conducted by CB Test Laboratories (CBTLs) affiliated to the NCBs, and tests are based on the use of international (IEC / CISPR) standards and the resultant CB Test Certificate proves that a product complies with those standards.

Before the CB Scheme, manufacturers’ only option was to have their products tested and certified by many different national testing laboratories/certification bodies. Under the CB scheme they now only have to deal with one CBTL of their choice.

However, many companies, unaware of the CB Scheme, still apply for testing and certificates with multiple certification bodies to gain access to individual export markets. This significantly slows down time to market for new products and also increases development costs, potentially making products more expensive and less competitive.

Jean-Louis Evans, Managing Director at TÜV SÜD Product Service - www.tuev-sued.de, a global product testing and certification organisation, and at its sister company, TÜV SÜD BABT for radio and telecommunications certification.

Visa required?

While the CB scheme helps a product gain individual country approval, it does not completely eliminate the need for additional “in-country” approval or testing, but does get the manufacturer 85 per cent of the way there.

Declared national differences are considered as part of the testing process which helps to ensure that a manufacturer meets all the requirements of their target markets. Such differences include ‘country deviations’, which are national characteristics or practices that cannot be changed, including climatic or electrical earthing conditions. ‘Regulatory Requirements’ also cover the differing restrictions, licenses, and laws imposed by the government or the national authority.

Once the manufacturer has their CB Test Report and Certificate, they can use this to obtain national approvals in many other member countries. The manufacturer is required to submit an application, and may also be required to provide a product sample in the country of destination. However, under the CB scheme reports and certificates can only be rejected with good technical justification.

To summarise, the CB Scheme follows three simple steps:

First, the product is submitted to CBTL for testing in accordance with international standards and the National Deviations of target countries.

The product is then assessed and a CB Test Report and Certificate issued to the client.

Last, the client (or its representative) submits the product, the CB Test Report and the CB Test Certificate to NCBs in target countries to obtain national certification. This confirms that the product conforms to local standards.

As it reduces the need for duplicate testing, the CB Scheme offers obvious advantages, delivering the ability to carry out one test programme to gain access to many international markets, faster and at a lower cost. Relative to the alternative of embarking on the lengthy and expensive approach of conducting multiple tests to satisfy individual country requirements, this is a seamless process and brings international trade a step closer to the utopian ideal of ‘one test, one market’.
TEST & MEASUREMENT

**Source measure instrument comes with capacitive touchscreen**

Keithley Instruments has equipped a benchtop Source Measure Unit (SMU) with a graphical user Interface based on a capacitive touchscreen. The Model 2450 SourceMeter SMU Instrument is the first such instrument that combines intuitive touchscreen and icon-based control with exceptional versatility. With the product, the company expressly addresses the demand of non-electrical engineers involved in Semiconductor and LED development. The Model 2450’s design offers a new way for users to interact with test and measurement instruments. It is based on the company’s “Touch, Test, Invent” design philosophy. This design philosophy reflects recent market changes, including shrinking product design/development cycles and fewer personnel devoted exclusively to test engineering tasks. At the same time, the profile of the typical instrument user has also evolved. In addition to electrical engineers, it now includes a growing number of non-engineers (such as electrochemists, physicists, materials scientists, etc. frequently involved in Semiconductor and LED development) who need fast access to data but sometimes have limited training in electrical measurement. “Quickset” modes speed instrument configuration, and on-screen graphing capabilities quickly turn raw data into usable results. The unit combines the functionality of a power supply, true current source, 6-1/2-digit multimeter, electronic load, and trigger controller in one tightly integrated, half-rack instrument. Keithley Instruments


**Teledyne LeCroy demonstrates 100GHz real-time oscilloscope**

Teledyne LeCroy has demonstrated what the company claims to be the world’s first 100 GHz real-time oscilloscope, by successfully acquiring and displaying live signals at 100 GHz bandwidth and 240 GS/s sample rate. “Reaching 100 GHz real-time Oscilloscope performance is one of many industry milestones achieved by Teledyne LeCroy,” said Tom Reslewic, chief executive officer, Teledyne environmental and electronic measurement instrumentation. “It reveals new phenomena, opens channels for new discoveries and paves the way for vast improvements in the field of high speed measurement.” The demonstration was conducted at the research facilities of Teledyne Scientific Company in Thousand Oaks, Calif. Teledyne LeCroy and Teledyne Scientific also announced today they have completed the design of a jointly developed next-generation indium phosphide (InP) chip and have released the design for fabrication at Teledyne Scientific’s InP foundry. The jointly developed chip is the first device in an expansive chip set planned for future generations of high speed oscilloscopes. Teledyne acquired LeCroy Corporation in August 2012 and has pursued synergies related to the development of ultra-high speed oscilloscopes. Teledyne LeCroy


High-speed 26.5 GHz EMI receiver for standard-compliant EMC testing

Rohde & Schwarz has expanded its R&S ESR family by adding a model for up to 26.5 GHz. This means that high measurement speeds and comprehensive diagnostic tools are now also available for EMC certification testing in line with the FCC standard and measurements in line with military standards. The R&S ESR26 EMI test receiver covers the frequency range from 10 Hz to 26.5 GHz. The instrument performs conducted or radiated certification measurements in line with commercial standards such as EN, CISPR and FCC as well as military standards. The North American FCC standard and the CISPR standard both specify EMI measurements up to 18 GHz. With its broadband architecture, the R&S ESR26 performs standard-compliant disturbance measurements up to 6000 times faster than other testers. EMI measurements that took hours in the past can now be completed in just seconds. The instrument also offers comprehensive diagnostic tools to support design engineers. The persistence mode allows users to clearly differentiate between pulse and continuous disturbances. Rohde & Schwarz

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Teledyne LeCroy demonstrates 100GHz real-time oscilloscope
True RMS self-powered AC voltmeter fits 30.5mm panel cut-out

Murata’s DMR20-1-ACV is a self-powered four-digit bright LED voltmeter that can measure the true RMS value of its input from 85 to 264 VAC to within 0.1 V resolution. Designed to be completely self-contained, the low cost two-wire voltmeter requires no additional components or connections apart from the AC voltage it is measuring. It is capable of accurately measuring quasi-sine AC source such as modified, modified 2-step and modified 3-step sine wave in addition to conventional sine, triangle and square wave inputs. The voltmeter fits an industry standard “oiltight” 30 and 30.5 mm round panel cut-out. The 7.6mm four-digit LED display is housed in a rugged round polycarbonate case that provides protection against dust, moisture, vibration and shock. It is supplied with an EPDM rubber gasket and plastic hex nut that aid protection to IP67 / NEMA6 specification for water ingress. The DMR20-1-ACV consumes a maximum of 30mA when used at 250VAC/60Hz.

Murata Europe
www.murata.eu

Vector Software adds software test support for Green Hills’ Multicore OSs

The VectorCAST software test platform now supports Symmetric Multiprocessing, Asymmetrical Multiprocessing, and Time-Variant Unified Multiprocessing under Multicore RTOSs from Green Hills Software. The multiprocessing support applies to the entire family of green hills’ OS, from the standard Integrity to Integrity-178b and Integrity-178 tuMP.

Vector Software
www.vectorcast.com

Digital attenuators offer 50 Ohm RF steps

Vaunix Technology has added an attenuation profile feature to its LDA series attenuators. The attenuation profile is user programmable with the capability to simulate various real-world fading conditions. The LDA series of Lab Brick Digital Attenuators includes 50 Ohm RF step attenuators with calibrated operation up to 6GHz. These units connect to a USB port for control and power and require no additional DC supply voltage. They are easily programmable for fixed attenuation or swept attenuation ramps directly from the included GUI. Lab Brick Digital Attenuator API DLL and LabVIEW-compatible drivers are also available for custom programming applications.

Vaunix Technology
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Digital radio test set with a very low phase noise

Aeroflex’ 3920B digital radio test set is aimed at analogue AM and FM, digital P25, P25 Phase II, DMR, NXDN, dPMR, TETRA and TEDS technologies. The 3920B features a new low phase noise RF signal generator in addition to the already advanced functionality available on the Aeroflex 3900 Series Radio Test Sets. The unit is the direct replacement for all versions of the Aeroflex 3900 Series, including the 3901, the 3902, and the 3920. It features a new low phase noise RF signal generator providing enhanced spectral purity with SSB phase noise specified at -110 dBc/Hz at 10 kHz offset. This level of performance is achieved at an offset from the carrier that is significantly less than the industry standard for this type of specification, which is typically 20 kHz. The ability of the 3920B to achieve such low phase noise specifications close to the carrier makes the 3920B suitable for today’s digital narrowband or analogue receiver testing where narrowband phase noise is critical. Aeroflex www.aeroflex.com

New 100A, 3-phase burst pulse tester targets networks using renewable energy

Swiss EMC test equipment maker Teseq has launched 100A, 3-phase burst pulse coupling/decoupling network (CDN) designed for electrical fast transient (EFT) or burst testing in the power and telecom industries. The manual CDN 3083-B100 can easily carry out applications that require higher AC and DC voltages as well as high inrush or pulse-shaped peak currents like those found in renewable energy. Some applications include smart grid, inverters, solar, energy monitoring as well as applications for electric vehicles and charging stations. The CDN 3083-B100 can couple up to 8.8 kV (5/50 ns – 50 Ohms) EFT pulses simultaneously into the supply lines of the equipment under test (EUT). It is designed to be used with an EUT supply up to 690 VAC, either line-to-line or line to protective earth, or up to 1,000 VDC line-to-line or line to protective earth. The compact, lightweight CDN is compliant to IEC 61000-4-4-Ed. 3.0, compatible with all brands of burst generators and is extremely portable for field testing. It allows for more set-up options in standard compliance applications because it is external to the generator and is compact. Although it is designed for continuous performance up to 100 A per phase, the CDN 3083-B100 can withstand higher currents for shorter durations of time. The CDN also features built-in temperature monitoring to prevent damage to its internal components and avoid overload. Teseq’s CDN 3083-B100 includes screw terminals rated for 200 A, a SHV burst input connector with maximum burst voltage of 8.8 kV and earth terminal grounding. Weighing approximately 5 kg, the CDN measures 410x170x190mm. Teseq www.teseq.com

Signal analysers gain improved phase-noise performance, sweep speed

Agilent Technologies has announced greater core performance in two of its X-Series signal analysers, the midrange MXA and general-purpose EXA. The respective improvements in phase noise allow you to more precisely characterise the frequency stability of oscillators and synthesisers. The faster sweep speeds of these analysers accelerate searches for spurious signals in the testing of transmitters, active antenna arrays and power amplifiers. Phase-noise performance is a key factor in obtaining low and accurate error vector magnitude values for communication systems and devices. In the MXA, phase noise has been improved by 10 dB or more for close-in and pedestal offset frequencies, providing a best-in-class advantage of 7 dB over the closest comparable competitor. EXA phase-noise performance is up to 5 dB better across wide offset frequencies. The new “fast sweep” capability of these analysers is up to five times faster than that of competitive models, depending on resolution bandwidth. Faster sweeps improve measurement throughput and make it easier to check the spurious-free dynamic range of devices under test. The N9069A noise figure measurement application now includes advanced features that support measurements of multistage converters, multipliers and dividers. The N9080A (FDD) and N9082A (TDD) LTE measurement applications now support multimedia broadcast single-frequency network (MBSFN) signals with mixed cyclic-prefix subframe structures. Agilent Technologies www.agilent.com

Scopes offer mixed-signal probing to 33 GHz

Tektronix has added to its flagship mixed-signal Oscilloscope family; the MSO/DPO70000DX series enhances mixed signal performance and probing capability to 33GHz, and offers upgrade paths as users’ needs change MSO/DPO70000DX oscilloscopes feature models with 23 GHz, 25 GHz, and 33 GHz bandwidth and enhanced tools for debugging digital and analogue circuits. Tek has also announced the fastest and lowest noise Oscilloscope probe with 33 GHz bandwidth and highest sensitivity for low-voltage, High-Speed serial and RF signals. MSO70000DX mixed signal oscilloscopes span 70MHz up to 33GHz in analogue bandwidth. With 16 digital channels provided on all Tektronix MSO’s, the instruments provide an 80 psec digital timing resolution. This enables engineers to get accurate feedback on logic or protocol performance for serial buses such as USB, PCIe, and SPI in real-time while performing analogue validation of high speed DDR memory on the four high-bandwidth channels. With the addition of the 33GHz P7600 series TriMode probe Tektronix claims the highest bandwidth probing system on the market. The TriMode probing system gives engineers a single probe setup for differential, single ended and common mode measurements for more value from each scope channel. Tektronix www.tek.com
Vector network analyzer features advanced pulse measurement capabilities

Anritsu has expanded its VectorStar family of Vector Network Analyzers (VNAs) with the MS4640B series. The instrument features new measurement capabilities, including PulseView, which provides pulse profile, point-in-pulse and pulse-to-pulse measurements of S-parameters, and DifferentialView for true mode stimulus S-parameter measurements. It is particularly suited to testing and characterizing components and sub-systems designed for Radar and today’s High-Speed serial applications. The 2.5ns resolution with 100 dB dynamic range, coupled with independent measurement gates offer clear results. It also enables users to see performance perturbations on the rising/trailing edges and within a pulse that have been previously missed by other systems. A capture time of 500ms permits users to measure under long pulse repetition interval conditions or to conduct pulse-to-pulse measurements over an extended number of pulses. An additional IF digitizer option provides fast digitization for the PulseView application, as well as four internal pulse generators. The pulse generators can be used to modulate devices under test or one of a series of associated modulation test sets also available. VectorStar VNAs are available in frequency ranges from 70 kHz to 20, 40, 50 and 70 GHz, and as broadband systems from 70 kHz to 125 GHz. VectorStar can also provide frequency coverage up to 750 GHz, with mm-wave modules from either Virginia Diodes or OM. Anritsu

www.anritsu.com

Probing of 25-µm-diameter micro-bumps is a step towards 3D ICs

Breakthrough probing results, achieved with CM300 probe system, are seen as an enabling technology for progress in the 3D IC market. Cascade Microtech, wafer-probing specialist, and Belgian research centre imec, have announced breakthroughs in probing stacked integrated circuits (3D-SICs). Cascade partnered with imec to successfully probe 25-µm-diameter micro-bumps on a wide I/O test wafer with its fully-automated CM300 probe solution using an advanced version of Pyramid Probe technology. Through-Silicon Vias (TSV) used in 3D-SICs, shorten interconnects between logic elements, thus reducing power while increasing performance. Cascade Microtech’s CM300 flexible on-wafer measurement system was designed to deliver superior positioning accuracy and repeatable contact, offering a level of precision that supports both shrinking pad sizes and pitch roadmaps. The CM300 captures the true electrical performance of devices with high-performance capabilities that include low leakage and low noise. The CM300 has proven to meet the fine-pitch (40-µm area array), low-force (< 1gf/ tip) advanced probing requirements of 3D-SICs. The probe solution is designed to provide greater alignment accuracy to probe directly on small, fragile micro-bumps.

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By Michael Lippert

PELLWORM ISLAND, off the North Sea coast of Germany, represents a vision of the renewable energy mix of the future. Its current share of renewables already corresponds to the country’s target for 2050. The annual energy production of around 21 GWh from wind energy turbines, photovoltaic (PV) power plants and biogas plants is around three times the annual consumer load of 7 GWh. There is also a remarkably high level of night storage heaters and heat pumps. Yet, even with this large excess of local production over local consumption, the community of 1,200 people on the island still rely on their connection with the mainland grid, via two 20 kV subsea cables, both for balancing local surpluses or for importing energy at peak periods when demand exceeds supply.

An E.ON-led pilot project, running from 2012 to 2015, is now implementing a smart grid for Pellworm, based on a combination of intelligent control technology, flexible load management and central energy storage. One of the main aims of the project is to increase the island’s self-consumption of its own renewable energy generation and to transmit less energy to the mainland.

The SmartRegion Pellworm project is one of the first projects being backed by the German Federal Ministry of the Environment, Nature Conservation and Reactor Safety. The project partners include: E.ON (Schleswig-Holstein Netz AG and E.ON Hanse AG), Fachhochschule Westkust, Fraunhofer-Anwendungszentrum Systemtechnik, Gustav Klein GmbH, RWTH Aachen, Saft.

Feasibility study is the basis for the smart grid project

An initial feasibility study showed that Pellworm Island would be the ideal location for a smart grid project to show how the energy world of the future can be realized on a small, manageable scale. This was based both on the technical suitability of the Island, including its power requirements and generation resources, as well as the willingness of the population to cooperate and the availability of suitable technology.

The key findings of the survey were the availability of well-established renewable energy resources. E.ON’s Hybrid Power Plant, now comprising 300 kW wind and 780 kW photovoltaics (PV), was first established in 1983. With an installed capacity of around 9 MW, Pellworm produces almost three times as much electricity a year as the local consumers need. The high proportion of electric heating, which corresponds to approximately 10 percent of Pellworm’s annual energy consumption, is appropriate for use as a flexible load in DSM (Demand Side Management). Over 75 percent of the population showed an open-minded attitude towards the idea of renewable energy and the expansion of the electricity grid. The development of the infrastructure (information and communication technologies used in home, as well as the automation of over 50 local 20 kW/400 V distribution substations) is mandatory for the implementation of a smart grid. A smart grid could relieve the pressure on Pellworm’s network infrastructure and the upstream electricity grid.

Developing an energy storage blueprint

The major goal of the Pellworm smart grid project is to achieve the maximum usage of regionally based renewable resources, with an optimal utilization of the existing grid infrastructure to ensure more efficient integration into a congested distribution grid. This requires an intelligent balance of production, consumption and storage as well as recognition of the important role of consumer interaction, technology acceptance and community collaboration. The project relies on the installation and operation of different complementary decentralized storage technologies with a focus on innovative batteries. These should support the integration of flexible loads at the household level with central optimization of the storage system by an energy management system. Automatic local substations are also required in this project, together with smart meters with advanced meter management and integrated load control functionality, particularly for the usage of decentralized controllable loads in the low voltage grid. Overall, the aim is to develop a storage blueprint for a future decentralized energy system.

The decentralized hybrid storage system

Different storage technologies are being implemented to cover the range of needs to store and deliver energy over time-scales ranging from “minutes-to-hours” and “hours to days”. A combination of commercially available storage systems within an overarching hybrid storage system concept has enabled a reduction in investment costs. Retrofitting thermal loads with the potential for flexibility also reduces the system cost for the integration of renewable energy sources. The “hours to days” storage is provided by a 200 kW, 1.6 MWh Vanadium Redox-Flow battery. Load flexibility in terms of “hours” storage is provided by a combination of night storage heaters and heat pumps, with an average energy capacity per household of 135 kWh and an average power of 17 kW.

The “minutes to hours storage is provided by a Saft Intensium Max 20 Lithium-ion (Li-ion) battery system providing 560 kWh of energy storage and 1 MW power. Delivered in a standardized 20-foot container for ease of transportation and installation, the Intensium Max integrates the communications interface, battery management and cooling. The Heatpac® system is also a storage system for hours-to-days storage that is currently under development and is expected to be ready for field testing in 2014.

Michael Lippert is Marketing and Business Development Manager for Saft Energy Storage Systems – www.saftbatteries.com – He can be reached at michael.lippert@saftbatteries.com
tion systems. Saft’s well proven Li-ion technology will ensure long calendar and cycle life for the system, with an expected operating life of at least 15 years. The project’s main technical aim is to collect real-world experience with innovative battery and other energy storage solutions and observe the effect of energy storage on the grid’s operation.

Pellworm Island smart grid - operational strategies

The operational strategies for the Pellworm smart grid will comprise market, grid and local supply-oriented storage and RES (Renewable Energy Sources) operation including the direct marketing of renewables, a joint operation of fluctuating renewables and storage systems to address different markets for RES and VPP (Virtual Power Plant) operators, a day-ahead and intraday market, and finally reserve power markets. For the DSO (Distribution Service Operator), the primary goal of the project is the grid integration of renewables to support the distribution grid operation. This will enable the service operator to prevent power curtailment, support voltage and reduce losses. For power companies, Renewable Energy Sources (RES) and Virtual Power Plant (VPP) operators, the project should support the direct supply of local customers with energy from regional renewable generation units while storage systems could be operated to balance generation and local demand. This yields a combination of direct regional supply and market transactions which are also grid compatible with the aim of reducing curtailment.

Energy storage - making smart grids smarter

Dr. Klaus Peter Röttgen, Head of Energy Storage at E.ON’s Innovation Center, explains why E.ON believes that energy storage will play a vital role in smart grids:

“E.ON regards energy storage as a key innovation that will help improve the grid performance and especially the integration of renewable energy, and Li-ion batteries are one of the most interesting and important technologies in this sector. Pellworm Island is therefore a crucial lighthouse project that will enable us to evaluate how Li-ion technology can operate in a real-world situation to help make smart grids even smarter.”

“Further detailed analysis will be required to determine how much energy storage capacity is required, but the initial suggestions are that for Europe it will be in the order of Gigawatts. The horizon for implementation at this scale is very closely tied to the penetration of renewables, since the more renewables that are connected onto the grid then the greater the need for storage to address the volatility and grid compatibility issues. "For E.ON, the most important barriers to the introduction of energy storage are not technical, so much as legal and administrative. Key questions need to be answered such as: how will energy storage systems be financed? How will the services they provide be paid for? How can we provide potential investors with the security they need in planning their investments?"

Overall, the prospects for energy storage being accepted are good, especially with compact solutions such as Li-ion technology that are easy to install within a restricted footprint. The main measures for the success of this particular project will be that the system works as promised, that there are no HSE (Health, Safety and Environmental) concerns and that the costs are acceptable for future commercial installations. But it is equally important that politicians and the general public they serve are happy with this solution.

Grid integration of Pellworm island’s energy storage portfolio.
Battery lab testing and the limits of the datasheet

By Achim Loesch

Unlike many other kinds of electronic component, a battery pack is highly sensitive to changes in operating conditions. In most cases, the battery specifications that design engineers pay close attention to include cycle life, capacity and peak power output. The values of all these parameters vary with variations in operating conditions such as ambient temperature, discharge profile and charging rate.

As this article shows, the engineer can infer a certain amount of information about the expected performance of a battery system in a real application from specifications contained in the cell’s datasheet.

But in many cases the actual usage conditions will deviate substantially from the ideal conditions specified in a cell datasheet. This means that, if a design engineer needs to be certain about the way a battery pack will perform in the field, additional methods of measuring or calculating expected performance will be required.

The value of the datasheet

When designing or specifying a battery pack, components such as the charging circuit, protection circuit and housing all have a measurable effect on the performance of the system. But the primary limiting factor on the electrical performance of the battery pack is the performance of the cell or cells. This is why the datasheet of a cell is – or at least should be – an important resource for the battery pack designer.

In practice, however, a typical cell datasheet tells the engineer about the performance of the cell only under a specific set of conditions. Let us take as an example a widely used product, the NCR18650, a cylindrical lithium-ion cell supplied by Panasonic. The product’s datasheet (dated February 2010) specifies a minimum nominal capacity of 2,750mAh.

This specification, however, only applies at a constant discharge current of 550mA and at a temperature of 25°C. The same datasheet provides discharge curves, showing the voltage and total power output at three discharge rates – but again at constant current and 25°C. The effect of variations in temperature on output voltage and discharge capacity is shown in a separate graph, but now only at a single – again constant – output current. Cycle life – the number of charge/discharge cycles that the cell can sustain – is also shown, but again at a single constant-current output and at a constant 25°C.

These data are useful for comparing one cell with another, and making a relative judgement about different cells’ performance. For instance, if the designer judges that discharge capacity is an important parameter in an application that will normally operate at an average ambient temperature of 5°C, a comparison showing that cell A has a greater discharge capacity than cell B at both 0°C and 25°C is useful, and suggests that cell A will probably also have a greater capacity at 5°C.

This kind of relative judgement is important in component selection. But to know how the selected cell will actually perform in an end product, absolute performance data are required – and here, the designer runs up against the limits of the datasheet. True, by applying common sense the engineer can extrapolate a certain amount from the datasheet specifications. Such extrapolation is not, however, normally supported by de-rating models supplied by the cell manufacturer.

It is impossible in any case to extrapolate from datasheet specifications for usage conditions that vary markedly from the datasheet conditions. And in practice, this will apply to many different kinds of end product.

For example, a pedelec (electrically assisted bicycle) typically has a discharge profile that is completely different from the datasheet’s neat, constant-current output. On a trip through hilly terrain, the rider might draw the peak power output when climbing a hill, then switch off the electric motor as the pedelec freewheels downhill, in a repeating pattern of high-discharge/zero-discharge episodes.

In many cases, the temperature inside the battery pack’s housing will be much higher than 25°C, as high currents flow through the power circuit and generate waste heat.

Equally, however, the pedelec might also need to be rated for operation in cold northern climates in which operation and storage at temperatures far below 25°C can be expected. Clearly, for the designer of a pedelec a cell’s datasheet specifications showing performance at a constant current and a constant mild temperature are not adequate as an indication of the performance of the battery pack in the field.

The effect of abuse on a battery

Other conditions are, in any case, explicitly not specified in the datasheet of the cell or any other component of the battery pack. Abuse takes many forms, but its effects can be hard to predict. Manufacturers of portable data loggers, for instance, know that their devices will occasionally be accidentally dropped by users, normally from around waist-high to the ground. Other abuse conditions suffered by battery-powered devices include over- and under-temperature, use of non-approved chargers, and vibration. A battery pack can potentially fail for mechanical or electrical reasons when subject to abuse. But how much abuse leads to failure? How is the data logger manufacturer to know whether the battery can withstand multiple drops?
Measuring performance in the field

The cell datasheet will not provide the answer to this question. It will also not tell the pedelec manufacturer how the capacity of a battery pack is affected by a continually varying discharge current, nor how cycle life is affected if the battery is normally charged in the user’s garage at 5°C rather than the 25°C specified in the datasheet.

One way of measuring the performance of a battery pack in the field is to conduct field trials, which may be done with a pilot product or a pre-production prototype. This can provide useful data: for instance, total failure or reduced run-time between charges can be readily observed.

Such field trials, however, suffer from two important drawbacks: control, and timing. In a field trial, the usage conditions cannot be precisely controlled. In a field trial involving multiple samples, it is unlikely that any two samples will undergo the same stresses. This makes it hard to derive general conclusions. Also, while performance of the battery as a whole might be impaired, a field trial might not isolate components of the system to show which is responsible for the impairment.

In addition, field trials can necessarily only take place once the end product in which the battery pack is embedded has been designed. If the field trials then reveal that modifications to the battery pack are required, a wholesale re-design of the end product might be necessary: this will be costly, and will also delay the full release of the product to market.

Lab testing: a better way?

Laboratory testing avoids the drawbacks inherent in field trials. While the main advantage of a field trial is that it exposes the battery to real-world conditions, with careful modelling of the conditions that the battery will encounter in the field, laboratory testing can be equally realistic.

In other respects, laboratory testing provides many advantages. Test conditions can be precisely controlled. In a pedelec field trial, riders might be asked to collect range and power output data on mountain rides, thus subjecting the batteries to widely varying test conditions. In a lab test, a sample of batteries can be stressed precisely at peak power output for a precise period of time, producing repeatable results that are valid for all production units.

Lab testing of a battery pack can be carried out in parallel with development of the end product in which it is to be embedded. Testing and subsequent modification of the battery can thus be completed before the end product design is finalised, entailing no delay in its release to market.

Laboratory testing can isolate specific parts of a battery system. For instance, drop testing of multiple samples in laboratory conditions enables the battery assembler to provide a universal failure rate - see figure 2. But the batteries under test can also be closely examined during the course of the drop testing to find at an early stage the weaknesses that will eventually cause failure. This can inform a design modification, such as a change to the technique for welding the housing, which can make the pack more robust and improve its failure rate.

Laboratory testing of many kinds of use and abuse conditions is possible. For instance, electrical testing can measure performance for various power output profiles, charge conditions and operating temperatures. Abusive testing can measure the effect of shock, vibration, over- and under-temperature operation, humidity and fire.

Testing the right things in the right way

Independent industrial testing facilities are equipped to provide laboratory tests of these kinds. Varta Microbattery, a cell manufacturer and battery pack assembler, also offers lab testing services. Unlike general test service providers, Varta is able to bring its knowledge and understanding of the operation of batteries. This means that it can not only perform battery tests in the right way – it can help ensure that the OEM is specifying the right tests.

For many end product types, the battery is a source of anxiety and concern in the mind of the end user. Success in the market for pedelecs, for instance, depends on the users’ confidence in the range and lifetime of the battery power source.

As shown above, the cell datasheet provides performance information for only a limited range of usage conditions. For an OEM to feel confidence in the performance of their power pack under non-standard conditions, laboratory testing is an excellent and helpful complement to the design process.
Single-IC supercapacitor-based power supply backup solution

By Ashish Kirtania

Supercapacitors are used in an increasing number of applications that require a ready source of backup energy that can be called on to provide short-term power when regular input power is lost. In these applications, supercapacitors have a number of advantages over traditional energy storage devices such as batteries, including low maintenance requirements, a virtually unlimited cycle life, and low effective series resistance. The LTC3226 simplifies the design of supercapacitor-powered backup application with a single-IC solution that charges the supercapacitor when input power is available, and then delivers energy from the supercapacitor to the load when nominal input power fails.

Figure 1 shows a typical 3.3V backup supply application in which the main power path from the input source to the load goes through the external PFET. As long as input power is available, the LTC3226 maintains the supercapacitor stack at a full 5V charge. If the input voltage falls below 3.15V, the 1.2F supercapacitor stack becomes the supply, supporting a 2A load at 3.3V for 600ms - see figure 2.

Achieving a seamless transition from main supply to backup storage requires four principal circuit components: a dual mode (1×/2×) charge pump with automatic cell balance and cell voltage clamp, an LDO to supply the load current during backup, an ideal diode controller to prevent the LDO from back-driving the input supply, and a power-fail comparator to detect the input voltage threshold below which a backup needs to be initiated.

The dual-mode constant-frequency (900kHz) low noise charge pump charges the supercapacitor stack to an externally programmed target voltage. The input current to the charge pump is programmed by an external resistor between the PROG pin and GND. At the beginning of a charge cycle, when the CPO pin voltage is less than VIN, the charge pump operates in 1× mode, acting like a pass element, and the charge current is approximately equal to the programmed input current. As the CPO pin voltage rises to within 200mV of VIN, the charge pump enters 2× mode (voltage doubler) and the charge current drops to half of the programmed input current.

One of the limitations of supercapacitors is low cell voltage, typically 2.7V, requiring a series connection of two cells for 5V applications. Since supercapacitors have more self-discharge due to leakage than most batteries, they require cell balancing to prevent overcharging of one of the series capacitors. The LTC3226 charge pump is equipped with an active balancer circuit, thus eliminating the need for external balancing resistors. However, since this balancer has limited source and sink capability, the charge pump is equipped with voltage clamp circuitry which constantly monitors cell voltages during the charging process and prevents the cells from overcharging.

A fast comparator detects when the input voltage falls unacceptably low and enables the LDO which powers the load from the supercapacitors. This power-fail threshold is programmed by an external resistor divider via the PFI pin. The output of the PFI comparator drives an open-drain output on the /PFO pin to indicate the status of the input source. An external resistor divider to the LDO_FB pin sets the LDO output voltage.

The LTC3226 enables seamless supercapacitor-based power backup solutions by integrating the functions of a charge pump, an LDO and an ideal diode controller in a 3x3mm 16-pin QFN package. Its low 50µA quiescent current and small footprint make it particularly suitable for battery powered applications, as well as 3.3V systems that require protection from short power interruptions.

Ashish Kirtania is Senior Design Engineer for Power Products at Linear Technology Corporation - www.linear.com
Test system characterizes Zinc-air batteries
FuelCon has designed a test system for the special requirements of zinc-air batteries, dubbed the Evaluator series, which provides both material characterization and life cycle testing in a power range up to 5kW. The test system is equipped with multiple storage tanks for liquid media. This allows circulation of the zinc paste either through one storage tank (continuous flow) or via two different tanks (single pass) when life cycle test are performed. In order to ensure a constant concentration the tanks are continuously purged with nitrogen. All critical test system components such as tanks, pipes, valves and sensors are made of plastic (PFA, PVDF, PTFE). This avoids a corrosion of the components by aggressive media.

The Evaluator testing system also boasts extensive safety features for protecting persons, test item and laboratory environment.

FuelCon
www.fuelcon.com

1-kW power supply and charger in one unit for 400-V ultracaps
PULS has introduced the PAS395 1 kW Power Supply and Charger which can be used as a regular Power Supply with an adjustable output voltage between 360-V and 460-V or as a Charger for EDLC capacitors (Electrical Double Layer Capacitors). The charging method is a constant current – constant voltage followed by a float charging mode. The output is protected with a serial diode to avoid return currents from the capacitors. To ensure that the capacitors never become overcharged, a redundant control circuit monitors the end-of-charge voltage and switches the output off in case of high voltage. The internal fan which starts running when necessary, allows the unit to be used in any mounting orientation at altitudes as high as 6000 m. The unit operates from AC 230 V mains, includes an electronic inrush current limitation and an active power factor correction circuit. The unparalleled high efficiency of 94.4% reduces the heat in the cabinet and achieves the true MTBF figures resulting in the long service life of the unit. Additional features include, wide operational temperature range from -40 to +65°C, light weight of only 2.3 kg, small size of only 310x154x80mm, and the capability for flange mounting anywhere in any mounting orientation at altitudes as high as 6000 m.

Dishwasher-sized fuel cells designed to be ten-fold cheaper
Maryland-based start-up Redox Power Systems struck a partnership deal with researchers at the University of Maryland to commercialize a potentially game-changing distributed generation product is said to offer more than 25% increase in system mean time between failures (MTBF) and a three-fold increase in cycle life through upgrades to the fuel processor module. Durability has also been extended through the increased use of corrosion-resistant coatings on many system components as well as improvements to the fuel level sensor and fluid flow paths. Finally, servicing and maintenance have been made easier through added functionality in system firmware, along with better component access and labelling. These methanol-fuelled systems include a fuel reformer that converts HydroPlus (a methanol-water liquid fuel mixture) into hydrogen gas to power the fuel cell.

Redox Power Systems
www.redoxpowersystems.com

Methanol fuel cell system addresses telecom backup power needs
The methanol-based ElectraGen-ME backup power fuel cell is what Ballard Power Systems has announced as its next-generation system for use in the telecom market. The product is fuelled by methanol and features a number of enhancements that further improve reliability, durability as well as ease of maintenance and servicing. From a reliability perspective, the next-generation product is said to offer more than 25% increase in system mean time between failures (MTBF) and a three-fold increase in cycle life through upgrades to the fuel processor module. Durability has also been extended through the increased use of corrosion-resistant coatings on many system components as well as improvements to the fuel level sensor and fluid flow paths. Finally, servicing and maintenance have been made easier through added functionality in system firmware, along with better component access and labelling. These methanol-fuelled systems include a fuel reformer that converts HydroPlus (a methanol-water liquid fuel mixture) into hydrogen gas to power the fuel cell.

Ballard Power Systems
www.ballard.com
MRI-compatible rotary encoder comes with 13-bit resolution and 12-bit multi-turn tracking

Micronor’s MR330 system is what the company claims to be the world’s first commercially available, magnetic-resonance imaging (MRI)-compatible fibre optic absolute rotary encoder system. The all-optical, non-metallic MR338 passive sensor provides precision absolute angular measurement from 0° to 360° with 13-bit (8192 count) resolution and 12-bit multi-turn tracking. A duplex multimode fibre optic link connects the passive MR338 sensor to the active MR330 controller module installed outside the MRI area. This absolute encoder system is designed for use in functional-MRI research, MRI training phantoms, EMC test facilities and other challenging electromagnetic environments where EMF and RF transparency is required. The controller transmits a burst of light to the code disk in the sensor which accurately modulates the spectral components of the light based on angular position. The position information is imprinted in the optical spectrum of the light and guided back to the controller for the position readout. The sensor requires no electrical power and houses no electronic components whatsoever. The controller’s built-in interfaces include SSI, USB, RS485, RS232, Modbus RTU, programmable digital set points and analog outputs (4-20mA and ±10V). The DIN-rail mount module operates from 24 VDC and supports encoder links extending up to 2500 meters.

Micronor
www.micronor.com

Infrared line-scanner provides real-time thermal imaging

Ircon’s ScaniIR3 series of infrared line-scanners and thermal imaging system includes a choice of eight models that provide accurate, real-time thermal imaging in a wide variety of industrial applications. Combined with Ircon ScanView Pro software, the ScaniIR3 scanner is designed for reliability and continuous operation in harsh industrial environments. Its robust housing incorporates standard water-cooling and air purge, and also features built-in laser sighting. A rugged processor box provides universal input and output (I/O) capabilities in the field without the need for an external computer. Unlike point Sensors that measure a single point, the line-scanner measures multiple temperature points across a scan line. Its motorized mirror scans at rates up to 150 lines per second, allowing rapid detection of temperature non-uniformities and hot spots. Rotating optics collect infrared radiation at 1024 points within a 90-degree field of view, and industry-leading optical resolution (up to 200:1) enables detection of smaller temperature anomalies. A two-dimensional image is formed as the material moves across the line-scanner’s field-of-view. The multifunctional ScanView Pro software allows custom configuration of ScaniIR3 operating parameters and the display of thermal images and temperature profiles on a standard PC. An optional high-temperature enclosure can protect the scanner from exposure to ambient temperatures up to 1090°C.

Ircon
www.ircon.com

To win: iC-Haus’12-bit angular encoder evaluation kit

This month, iC-Haus is giving away five evaluation kits for its iC-MH8, a 12-bit angular encoder suitable for brushless DC motors. Worth 204 Euros each, the kits could be used to evaluate the single chip magnetic encoder for controlling a motor by means of an on-axis magnet and generate the position data to be displayed on a PC. The data can also be used to generate the UVW commutation signals. Each package comes with the iC-MH8 evaluation board (iC-MH8 EVAL MH2D) plus the iC-MB43U BiSS to USB-adapter and a PC-compatible graphical user interface. The iC-MH8 position sensor integrates Hall Sensors for scanning a permanent magnet. The chip’s Signal Conditioning unit generates constant-amplitude sine and cosine voltages that can be used for angle calculation. The resolution can be programmed up to a maximum of 4,096 angular increments per rotation. The integrated serial Interface also enables the position data to be read out to several networked sensors. It supplies quadrature signals with an edge rate of up to 8 MHz and interpolation can be carried out with maximum resolution at a speed of 120,000 rpm.

Check the reader offer online at www.electronics-eetimes.com

Autofocus 8MP USB 3.0 camera supports uncompressed full HD video streaming

e-con Systems has launched the See3CAM_80, part of the Sea3CAM family of USB3.0 SuperSpeed cameras. It supports video streaming at resolutions of up to 1080p at 30fps and includes an eight megapixel autofocus camera module, the e-CAM80_M18825_MOD, with an OV8825 CMOS image sensor. The UVC compliant camera is plug-and-play in both Windows and Linux. In Windows, the camera is exposed as a DirectShow device and in Linux, as a V4L2 capture source. The See3CAM_80 supports VGA at 30, 720p30, 1080p30 preview resolutions for high end video recording, video analytics and HD video conferencing applications. e-con is also bringing the full 8 Megapixel still video streaming at resolutions of up to 1080p at 30fps and includes an eight megapixel autofocus camera module, the e-CAM80_M18825_MOD, with an OV8825 CMOS image sensor. The UVC compliant camera is plug-and-play in both Windows and Linux. In Windows, the camera is exposed as a DirectShow device and in Linux, as a V4L2 capture source. The See3CAM_80 features an OV8825 CameraChip sensor from OmniVision.
**LED driver handles up to eight white LEDs for backlighting**

Advanced Power Electronics has released a new step-up converter capable of efficiently driving up to eight white LEDs in series for backlighting applications. The APE1612-3 uses current mode, 1.2MHz fixed frequency architecture to regulate the LED current, which is set using an external current sense resistor. The APE1612-3 features a low 300mV feedback voltage that reduces power loss and improves efficiency. The OV pin monitors the output voltage and turns off the converter if an over-voltage condition is present due to an open circuit condition. The APE1612-3 includes under-voltage lockout, current limiting and thermal shutdown protection preventing damage from an output overload. The APE1612TY-HF-3 comes in a small RoHS/REACH-compliant TSOT-26 package.

**Advanced Power Electronics**
www.a-powerusa.com

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**High-speed 940nm IR emitter supports gesture remote control**

Vishay Intertechnology has introduced a High-Speed 940nm infrared emitter for gesture remote control applications, delivering a radiant power of 40mW at 100mA. The VSLB9530S is offered in a clear moulded, leaded TELUX package with an oval lens designed to support an angle of half intensity of ±18° in the vertical direction and ±36° in the horizontal direction. The VSLB9530S is built on GaAlAs multi-quantum well technology. The device’s unique angular distribution makes it suitable for gesture remote control of televisions and gaming systems, where it provides excellent spectral matching with silicon photodetectors. The IR emitter’s wider angle in the horizontal view helps maintain position flexibility for users, while the narrower angle in the vertical plane focuses the distributed radiant intensity. The device measures 7.62x7.62x4.6mm and provides a low thermal resistance of 200 K/W. While standard IR emitters typically offer drive currents to 100 mA, the low thermal resistivity of the VSLB9530S allows continuous drive currents up to 150mA, which pushes the achievable radiant intensity to 60mW/sr at 150 mA. The device offers high modulation bandwidth of 24 MHz and is suitable for high pulse current operation.

**Vishay Intertechnology**
www.vishay.com
**Ultra-miniature crystal oscillator is only 0.5mm high**

IQD Frequency Products has launched one of the world’s smallest quartz crystals measuring just 2.0x1.6mm with a height of only 0.5mm. The IQXC-42 ultra-miniature model is especially suitable for many portable applications such as hand held inventory control devices, battery powered telemetry equipment, notebook computers and surveillance devices. The IQXC-42 crystal is available in frequencies between 20MHz and 50MHz and operates over the full industrial temperature range of -40 to +85°C. Frequency stabilities can be specified as low as ±10ppm over the commercial temperature ranges. In line with the requirements of the latest generation of microprocessors the load capacitance can be as low as 8pF. Housed in a 4-pad ceramic package with a hermetically sealed metal lid which helps to minimise the EMI radiation, the product is designed to able to withstand shock levels of up to 1000G in accordance with IEC 60068-2-27. The IQXC-42 is available on tape and reel for automatic assembly as well as loose in bulk pack for low volume prototypes.

**IQD Frequency Products**
www.iqd.com

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**Programmable system timers draw only 30nA**

The programmable system timers TPL5000 with watchdog timer and TPL5100 with MOS driver draw only 30nA of current, a reduction of 90% compared to competitive solutions says manufacturer Texas Instruments. They also replace a microcontroller’s internal timer, allowing the MCU to remain in low-power sleep mode. These so-called nano timers address a wide range of battery-powered and energy harvesting systems where the main system is in sleep mode or power-down mode most of the time. By drawing much lower current than an MCU timer, the TPL5000 and TPL5100 greatly reduce power consumption and extend the operating life of these systems. The devices feature programmable timer intervals with a selectable timing delay that can be set from one to 64 seconds for the TPL5000. It can be programmed for 16- to 1,024-second intervals in energy harvesters, wireless sensor nodes and dataloggers, where measurement data changes slowly. The TPL5000 and TPL5100 are available today in 10-pin, 3x5mm VSSOP packages.

**Texas Instruments**
www.ti.com

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**Consumer GPS/GNSS receiver supports 50Hz update rates**

SkyTraq Technology has introduced what the company claims to be the fastest consumer grade S1216F8 GPS receiver module, supporting GPS, QZSS, WAAS, EGNOS, MSAS, and GAGAN satellite signal reception with a 50Hz update rate. The S1216F8 receiver is based on SkyTraq’s newest 55nm Venus 8 GPS/GNSS chipset. The Venus 8 incorporates an IEEE-754 compliant FPU. With RISC/FPU running at 100MHz, the S1216F8 GPS receiver module ensures very fast and accurate positioning/speed response suitable for UAV, RC plane flight logging, and high-performance race car or speed boat data logging applications. When running at lower 1Hz, 5Hz, or 10Hz update rates, the S1216F8 receiver can be used as a typical GPS receiver module currently available on the market. The device measures 12x16mm, consumes 26mA at 3.3V during continuous navigation at 50Hz update rate.

**SkyTraq**
www.skytraq.com.tw

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**4 to 10GHz driver amplifier delivers 20dB of gain**

Custom MMIC has added the CMD191C4 to its growing MMIC library of standard products. The GaAs MMIC driver amplifier housed in a leadless, RoHs compliant 4x4 mm surface mount package offers high output power and low current consumption. Well suited for complex communication systems where small size and high linearity are needed, the device operates from 4 to 10GHz and delivers 20dB of gain with a corresponding output 1dB compression point of greater than -21dBm. It is a 50 ohm matched design, which eliminates the need for external DC blocks and RF port matching. The CMD191C4 is biased with a single 5.0V positive drain supply. RF power can be applied at any time. Suitable applications include WiLAN, C and X Band communication systems, and military end-use.

**Custom MMIC**
www.CustomMMIC.com
Digi-Key to distribute Sanken Electric’s portfolio globally

Electronic components distributor Digi-Key has signed a global distribution agreement with Sanken Electric Co., a leading global supplier of analog power Semiconductor products. Sanken’s long history began in 1937, when the Toho Industrial Research Laboratory was established and commenced research and trial manufacture of selenium rectifiers. Boasting one of the widest ranges of electronic components in the industry, Sanken manufactures products including ICs, transistors, thyristors, diodes, LEDs and CCFLs, as well as A/C Adapters and power supplies, among others.

Digi-Key
www.digikey.com

RF, IF and microwave signal processing components

Components distributor Richardson RFPD and Wavelex have launched the Wavelex website. Offering the full portfolio of the company’s RF, IF and microwave signal processing components for the RF and microwave industry, the website showcases Wavelex’ devices, well-suited for test and measurement, wireless infrastructure, medical, and military applications. Each product listing on the new site includes key specifications and a link to the corresponding data sheet. Product category tables can be sorted by any of the key technical specifications. Each product listing also includes a “buy” button for online purchasing via Richardson RFPD, the exclusive worldwide distributor for Wavelex products.

Richardson RFPD
www.richardsonrfpd.com

Mouser adds smallest-outline transistor from Rohm

Mouser Electronics now supplies the smallest transistor package on the market, manufactured by Rohm Semiconductor, suited to designs for thin, compact portable devices. Rohm Semiconductor ultra compact MOSFETs and bipolar transistors in the VML0806 case type measure 0.8x0.6mm with a height of only 0.36mm. Until recently, problems related to internal element miniaturisation, bonding stability, package process accuracy, and surface mount technology limited the smallest conventional transistors to the 1006 size (1.0x0.6mm, t=0.37mm). Rohm was able to overcome these challenges by using a smaller element and high-precision package process technology, resulting in a compact form factor.

Mouser Electronics
www.mouser.com
Physically unclonable functions - ready to serve smart card security?

By Heiner Fuhrmann

IT IS THE NATURE OF THINGS. Put a product into the limelight with exceptional security promises and you draw the attention of both potential customers and attackers.

This is what has happened when Physically “Unclonable” Functions (PUF) - used to extract indivisuality from semiconductors - were recently promoted for the high end chip card market as “100 % secure”, “unhackable” “silicon fingerprints.” University students and engineers set out to prove the vulnerability and ease of attack of PUF. The resulting plethora of attacks should be taken very seriously, as they show that PUF in its current state is not ready to serve applications with high security demand such as payment cards and government identification documents.

For this class of well-established applications, PUFs today do not increase security at all. Worse, adding a weak link to a formerly secure system can render the whole system insecure.

The concept of PUF is not new. It originated in the 1980s but gained attention in the smart card market only in the 2010s. It refers to specific characteristics of semiconductor chips that can be used to generate chip-individual keys or functions like fingerprint biometry in the human world. This is due to the fact that chips - based on the manufacturing process - differ slightly from each other. These small deviations have no relevant influence on proper function of the chip but allow the derivation of unique keys.

PUF is arguably a creative way to provide uniqueness in electronic systems that do not have the means to securely store keys, such as pure logic products that come without non-volatile memory (NVM). But one must look closely at the boundary conditions before delegating security critical functionality to PUF technology. Particularly the term “unclonable” is overreaching and raises high expectations that will be disappointed.

Pursuant to the exaggerated security claims for PUF in smart card applications, numerous attacks on the technology have been published, and the stream of papers still swells (see some examples at http://www.infineon.com/Literature_PUF_attacks). Early this year researchers from the Technical University of Berlin demonstrated how to actually clone a Physically “Unclonable” Function in practice in only a few hours. This was achieved with standard university equipment and applied to the most wide spread PUF implementation, which uses SRAM memory cells as the source for the chip individual key material.

Additionally, an array of well-known attack classes has been successfully deployed against PUF implementations. These include side channel attacks (using the unintended leakage of secret information), fault attacks and physical manipulation of the chip. Manipulated PUF implementations have also been identified as a potential gateway for the introduction of Trojan Backdoors into security chips that are manufactured in typical mass production processes. In this case an assumed security function would in fact turn out to be a non-identifiable entrance for invaders.

To sum it up, secure identification of semiconductor products is an important functionality and several technical implementations are already available or under research for multiple application fields. Physically “Unclonable” Functions are one specific way to address this challenge under certain boundary conditions such as the absence of secure key storage and low security requirements of the application in question. However, the steadily growing evidence of severe security weaknesses of current PUFs clearly forbids using this technology for applications with high security demand such as payment and government identification.
Solutions from AC to Point of Load

Our Latest Products
Picor Cool-Power Isolated ZVS DC-DC Converters

Simple to Use
- Complete Isolated DC-DC converter with zero-voltage switching module
- Three input voltage ranges for communication, industrial, rugged/M-Grade applications
- Communication converters have max peak input voltage of 100 V / 100 ms (non-operating)
- 2,250 V input to output isolation

High Density
- 50 W / 60 w output power (dependent upon converter model)
- Surface mount 22mm x 16.5mm x 6.7mm high-density package
- 900 kHz switching frequency, minimizes input filtering and reduces output capacitance

Rich Feature Set
- On/Off Control, positive logic ENABLE
- Wide trim range +10/-20% Trim
- Temperature monitor™ & Over-temperature Protection (OTP)
- Input UVLO & OVLO and output OVP
- Over current protection with auto restart
- Adjustable soft-start
- Output voltage sensing without opto coupler use for higher reliability

Resources
- Blog Post: The technology behind the Cool-Power ZVS DC-DC Converters
- Video: An Introduction to Vicor’s Cool-Power ZVS DC-DC Converters

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<th>Cool-Power</th>
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<td>3.3 V</td>
<td>18 A</td>
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<td>9.6 to 13.2 V</td>
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<tr>
<td>FB110-01-HVZ</td>
<td>41 – 57 Vn</td>
<td>18 V</td>
<td>16.2 to 19.8 V</td>
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</table>

| Industrial (-40°C to 125°C) |
| FB109-01-HVZ | 18 – 36 Vn | 5 V | 10 A |
| FB106-01-HVZ | 12 V | 9.6 to 13.2 V | 4.2 A |

| M-Grade (-55°C to 125°C) |
| FB109-00-HVMZ | 16 – 50 Vn | 5 V | 10 A |
| FB106-00-HVMZ | 12 V | 9.6 to 13.2 V | 4.2 A |
| FB111-00-HVMZ | 15 V | 12 to 16.5 V | 3.3 A |

Two-Part Web Seminar Series About EMI

Watch Part 1
- The Causes and Impact of EMI in Power Systems; Part 1

Register Now for Part 2
- to be broadcast on 18 September

Practical Design Considerations and Solutions for the Reduction of Conducted EMI and Filter Size in Power Systems
VI Brick AC Front End

Overview
- Universal Input: 85 – 264 Vac
- Output: 48 Vdc - isolated, regulated (SELV)
- Power: 330 W - over entire input voltage range
- Isolated AC-DC converter with active Power Factor Correction (PFC)
- Integrated rectification, filtering and transient protection
- Peak efficiency: >92%
- EN55022, Class B EMI conducted emissions with a few components
- EN61000-3-2 harmonic limits
- -55 to 100°C baseplate operation

Features
- Low profile, 9.55 mm height above board
- Small footprint, size of a business card
- Flanged aluminum package for secure mounting and thermal management
- Consistent high efficiency across the worldwide mains (flat efficiency curve)
- Reduced power loss and cooling requirements
- Module includes PFC, regulation, isolated 48 V output (SELV), filtering, rectification, transient protection, agency approvals, simplified thermal management
- Simple design, requires few external components
- Module power density, 121 W/in³
- Complete solution including hold-up capacitors, 54 W/in³

Basic Application

Resources
- An Introduction to the Vicor AC Front End Module
- Webinar: Designing High Performance AC-DC Power Systems Using a Power Component Approach
- AC Front End Product Information

Consistent High Efficiency
Over Line, Load, Temperature

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Input Voltage</th>
<th>Output Voltage</th>
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<td>330 W</td>
<td>-55 to 100°C</td>
</tr>
</tbody>
</table>

Replace the "–00" suffix in the part number with "–CB" to order an evaluation board.
Picor Cool-Power ZVS Buck Regulators

Wide Operating Range
- Wide $V_{in}$ (8 – 36 V) and wide $V_{out}$ (1 – 16 V)
- 12 V-optimized performance with PI34xx Series
- -40°C to 125°C operating range

Simple to Use: Fast Development Time
- Internal compensation - few external components
- No additional design or additional settings required

High Efficiency
- Up to 98% peak efficiency (19 $V_{in}$ to 15 $V_{out}$)
- PI34xx Series optimized for 12 $V_{in}$ with even higher efficiency
- Light and full load high-efficiency performance

Flexible and Rich Feature Set
- Paralleling and single wire current sharing
- Frequency synchronization
- User adjustable soft-start & tracking
- Power-up into pre-biased load
- Optional I2C functionality & programmability

Benefits of Zero-Voltage-Switching Topology
- Reduces Q1 turn-on losses
- Reduces gate drive losses
- Reduces body diode conduction

Resources
- Video: Interview with ECE Europe about ZVS Regulators
- Webinar: Design Considerations For High Performance On-Board Power Design
- Cool-Power ZVS Buck Regulators Product Information
**VI Chip PRM Module**

**Simple to Use**
- Point-of-load, Buck-Boost regulation
- Factorized Power Architecture
- Minimal external components

**High Density**
- Up to 1,700 W/in³, with 500 W in 1.1in² package

**Wide Vin Optimized for 48 Vout**
- 24 Vin, 18 – 36 Vin range
- 36 Vin, 18 – 60 Vin range
- 45 Vin, 38 – 55 Vin range
- 48 Vin, 36 – 75 Vin range

**High Efficiency**
- Full chip 500 W: 97.8%
- Half chip 250 W: 96.7%

**Flexible**
- Regulation: Remote sense, local loop, adaptive loop
- Parallel capabilities

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**Resources**
- Video: Overview of Vicor’s VI Chip PRM Module
- PRM Product Information
- Configure a PRM for your application’s requirements

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**PRM Modules**

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<thead>
<tr>
<th>Model Number</th>
<th>Input Voltage Nom. (V)</th>
<th>Range (V)</th>
<th>Output Voltage Range (V)</th>
<th>Output Power Max.</th>
<th>Output Current Max.</th>
<th>Package Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>P024F048T12AL</td>
<td>24 V</td>
<td>18 – 36 V</td>
<td>26 – 55 V</td>
<td>120 W</td>
<td>2.5 A</td>
<td>Full</td>
</tr>
<tr>
<td>P036F048T12AL</td>
<td>36 V</td>
<td>18 – 60 V</td>
<td>26 – 55 V</td>
<td>120 W</td>
<td>2.5 A</td>
<td>Full</td>
</tr>
<tr>
<td>P045F048T17AL</td>
<td>45 V</td>
<td>38 – 55 V</td>
<td>26 – 55 V</td>
<td>120 W</td>
<td>4.0 A</td>
<td>Full</td>
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<tr>
<td>P045F048T24AL</td>
<td>45 V</td>
<td>38 – 55 V</td>
<td>26 – 55 V</td>
<td>170 W</td>
<td>3.5 A</td>
<td>Full</td>
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<tr>
<td>P048F048T12AL</td>
<td>48 V</td>
<td>36 – 75 V</td>
<td>26 – 55 V</td>
<td>120 W</td>
<td>2.5 A</td>
<td>Full</td>
</tr>
<tr>
<td>P048F048T24AL</td>
<td>48 V</td>
<td>36 – 75 V</td>
<td>26 – 55 V</td>
<td>240 W</td>
<td>5.0 A</td>
<td>Full</td>
</tr>
<tr>
<td>PRM48BF480T200A00</td>
<td>48 V</td>
<td>36 – 55 V</td>
<td>5 – 55 V</td>
<td>200 W</td>
<td>4.17 A</td>
<td>Full</td>
</tr>
<tr>
<td>PRM48BF480T500A00</td>
<td>48 V</td>
<td>36 – 55 V</td>
<td>5 – 55 V</td>
<td>500 W</td>
<td>10.42 A</td>
<td>Full</td>
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<td>PRM48AF480T200A00</td>
<td>48 V</td>
<td>36 – 55 V</td>
<td>20 – 55 V</td>
<td>250 W</td>
<td>5.21 A</td>
<td>Full</td>
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</tbody>
</table>

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**Cool-Swap**
- 85 – 264 Vac

**Filtering**
- AC Front End
- 48 Vdc
- Input Active EMI Filter
- Output Filtering

**Power Management**
- Cool-Switch
- Cool-Swap
- Cool-Offing
- µRDS(on)FET
- Buck-Boost
- Cool-Power
- Bus Converter
- Buck

**Solutions from AC to Point of Load**
Introducing... The Growing ChiP Lineup

“Converters housed in Package” Technology

Recent Press Articles
- EDN: Vicor reveals new ChiP power package at APEC 2013
- Power Electronics: New Thermal-Design Options Drive Power Density

Resources
- 2013 APEC Plenary Session
  Patrizio Vinciarelli, CEO, Vicor Corporation
- Stephen Oliver
  Vice President, Vi Chip Product Line

Vicor’s CEO discusses ChiP technology at APEC
An introduction to ChiP technology
Online Design Tools

Online Simulator
- Simulate electrical and thermal behavior
- User defines line and load conditions, input and output impedance and filters
- Simulations include start-up, steady state, shutdown, Vin step and load step, as well as thermal.
- Electrical and thermal performance showed in charts and tables

Design Calculators
- Determine trim resistors for fixed and variable output voltage trimming
- Calculate required bus capacitance for VI-ARM, FARM, and ENMod modules
- Thermal calculator for heat sink selection

Filter Design
- Select attenuation and frequency
- Choose from five different topologies
- Supports regulated and unregulated converters

Resources
- Video: Using Vicor’s online simulator
- Online simulator: VI Brick IBCs
- Online simulator: BCMs
- Online simulator: PRMs
- Filter design tool
- Design calculators

Calculate of Components for Parallel Damped Filter

Configure Your Product

PowerBench™ online design center
- Design your own DC-DC converters to meet your application’s requirements
- Or use hundreds of predefined designs
- Online registration allows designs to be saved

VI Chip® PRM® Module
- Point-of-Load Buck-Boost regulation with remote sense
- Full Chip (up to 500 W in 1.1 in²)
- Half Chip (up to 250 W in 0.57 in²)

Other DC-DC Converters
- Maxi, Mini, Micro Series: Full (160–600 W), Half (100–300 W), Quarter (50–150 W)
- VI-200 / VI-J00 Series: Full brick (50–200 W), Half brick (25–100 W)
- ComPAC, VIPAC Arrays and chassis-mount MegaMods

AC-DC Converters
- VIPAC - Autoranging input with filtering, multiple output, cold plate chassis,
- FlatPAC - Multiple output and autorange input with heat sink or conduction-cooled models

Complete power systems
- Westcor custom AC-DC
- High power density, small size, high efficiency
- Fan-cooled, slide-in assemblies

Resources
- PowerBench online design center
- Design calculators
- Webinar: Modeling, Simulation, and Selection Techniques in Power Design
Enabling Our Customers’ Competitive Advantage

At Vicor, we enable customers to efficiently convert and manage power from the wall plug to point of load.

We master the entire power chain with the most comprehensive portfolio of high efficiency, high-density, power distribution architectures addressing a broad range performance-critical applications.

Vicor’s holistic approach gives power system architects the flexibility to choose from modular, plug-and-play components ranging from bricks to semiconductor-centric solutions.

By integrating our world-class manufacturing and applications development, we can quickly customize our power components to meet your unique power system needs.

Focus Performance-Centric Markets/Applications

<table>
<thead>
<tr>
<th>Communications</th>
<th>Computing</th>
<th>Industrial</th>
<th>Automotive</th>
<th>Defense/Aerospace</th>
</tr>
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<tbody>
<tr>
<td>&gt; 400 VDC Power Distribution</td>
<td>&gt; Data Centers</td>
<td>&gt; ATE</td>
<td>&gt; Electric Vehicles</td>
<td>&gt; Aircraft Test Equipment</td>
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<tr>
<td>&gt; Datacom</td>
<td>&gt; High Performance Computing</td>
<td>&gt; Lighting</td>
<td>&gt; Hybrid Vehicles</td>
<td>&gt; Ground Vehicles</td>
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<tr>
<td>&gt; Netcom</td>
<td>&gt; Process Control</td>
<td>&gt; Transportation</td>
<td>&gt; Radar</td>
<td>&gt; Telemetry</td>
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<tr>
<td>&gt; Telecom Infrastructure</td>
<td>&gt; Network Servers</td>
<td>&gt; Transportation</td>
<td>&gt; Telemetry</td>
<td>&gt; Unmanned Vehicles</td>
</tr>
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Infinite Designs, One Platform
with the only complete system design environment

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