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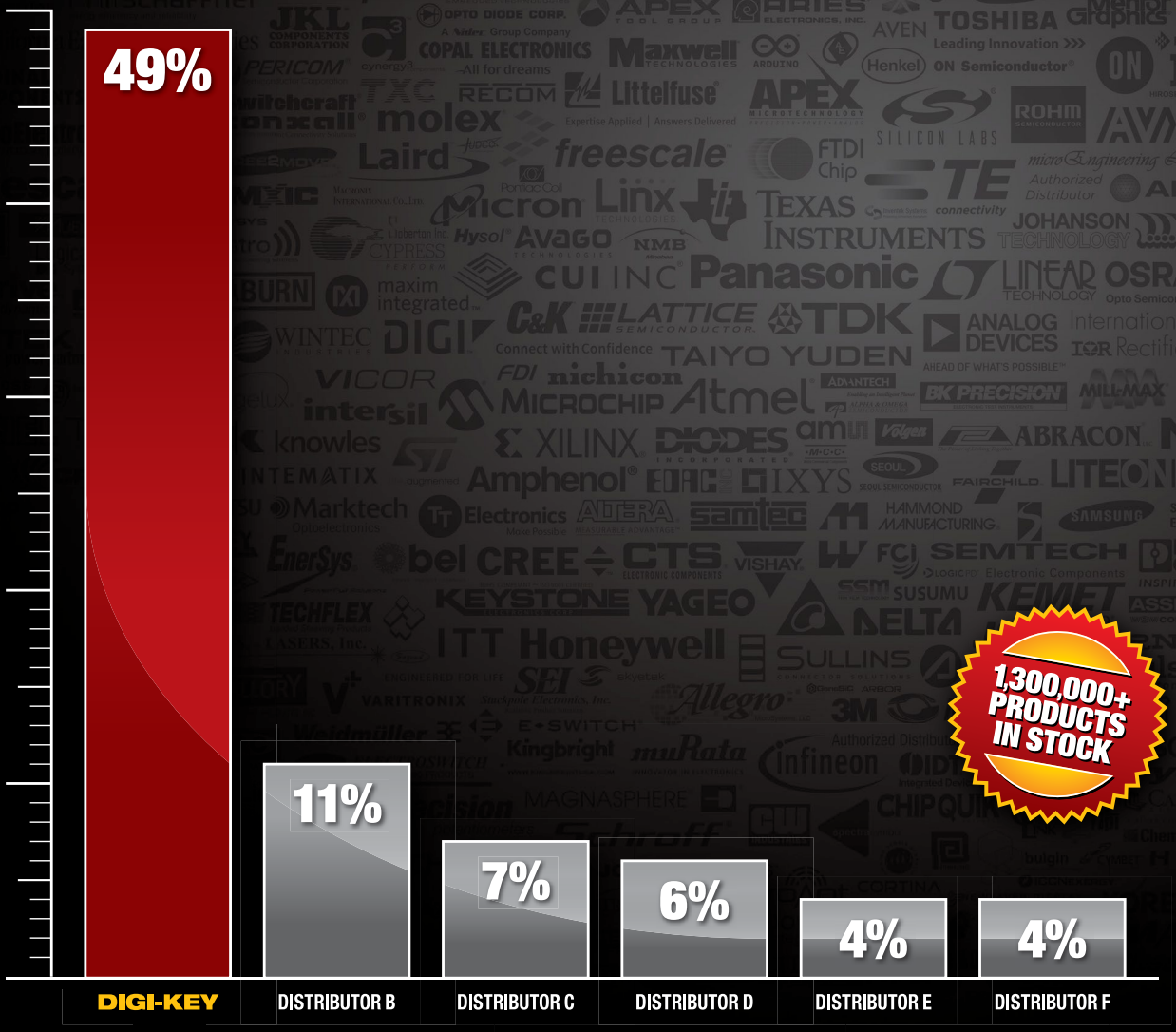

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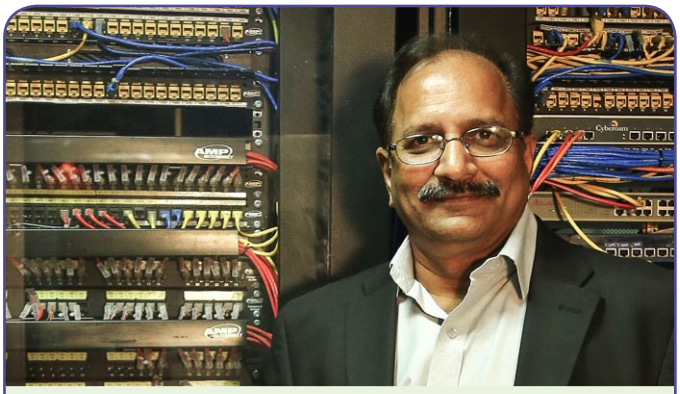
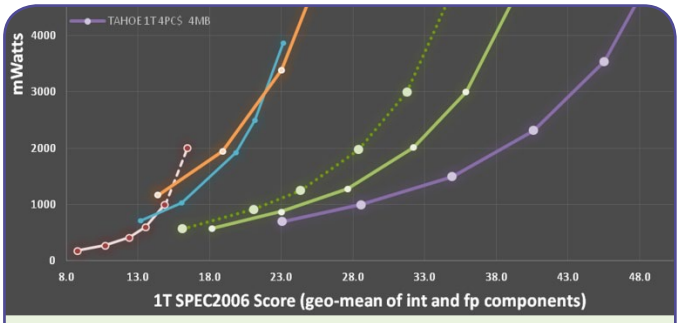
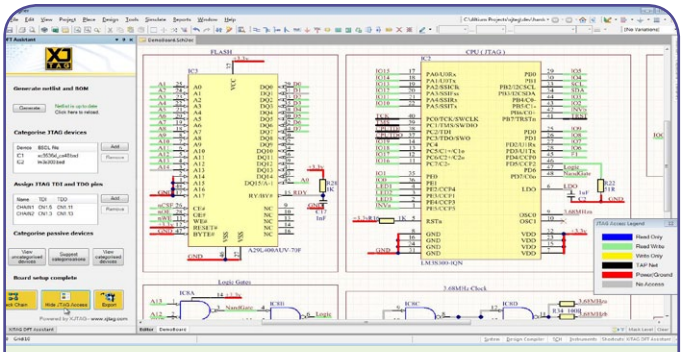
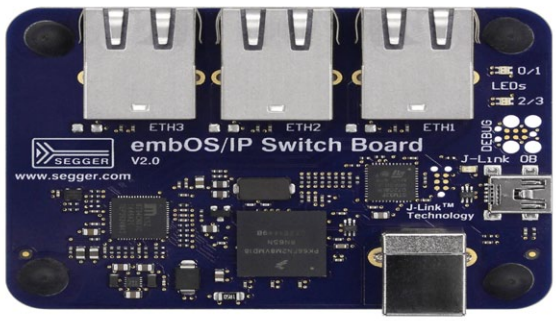








Italian startup wants to speed up transition to HEVs

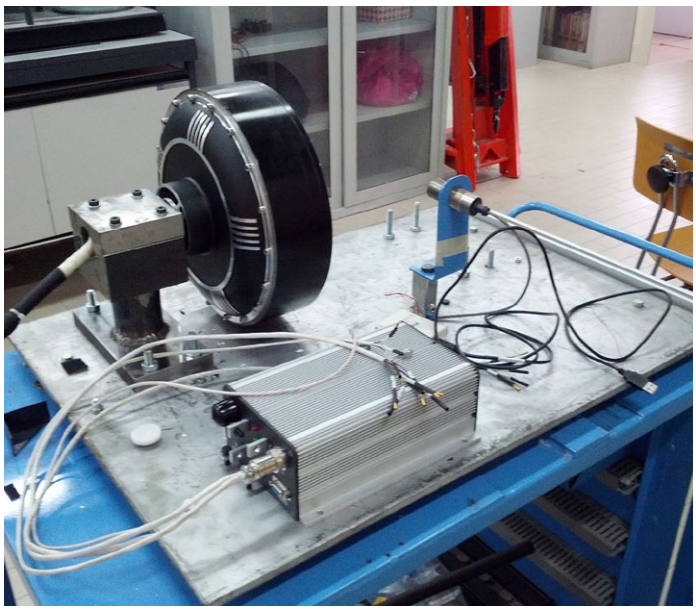
By Julien Happich

Italian researchers from the Energy and Propulsion Laboratory (eProLab) at the University of Salerno have developed a kit, dubbed the HySolarKit, which converts conventional internal combustion engine (ICE) two-wheel cars into a four-wheel drive hybrid.

Currently prototyped and tested on a FIAT Punto, the hybridization kit consists of two in-wheel motors replacing conventional passive rear wheels, flexible photovoltaic panels mounted on the roof and the car bonnet, a battery and some control electronics.

Lead project researcher and professor at the Industrial Engineering Department of Salerno's University, Gianfranco Rizzo says the prototype served as a proof-of-concept to study the upgrade feasibility from ICE to hybrid vehicles and to work on the control algorithms. Together with research partners, he has set up the startup EProInn (short for Energy and Propulsion Innovation - www.eproinn.com) and is now seeking funding through the Equity Crowdfunding platform Assiteca Crowd to produce and commercialize the kit.

The spin-off company is also looking at a possible partnership with Landi Renzo SpA, a company that designs and sells Liquefied petroleum gas (LPG) and Compressed natural gas (CNG) alternative automotive fuel systems and components and whose distribution network could give a boost to EProInn's visibility.



Initial tests have shown that during sunny days, the on-board photovoltaic panels can contribute up to 30% of the overall energy requested for vehicle traction, when vehicles are used for approximately one hour per day in urban areas (all this without relying on a lagging EV recharging infrastructure). This has two effects on the ICE car, reducing fuel consumption and emissions while improving performance thanks to the added traction.

Currently, the hybridization kit sports 18% efficient flexible single-crystal silicon HF65 photovoltaic panels manufactured by Enecom, adding to the car about 270W of solar power. But Rizzo is confident that by the time the kit matures to a full production run, he'll be able to choose more efficient solar panels at decreased costs.

The researcher has published several papers on the optimization of power distribution across the four wheels, correlated with the driver's behaviour. Together with his colleagues, he developed a mathematical model for the real-time identification of the active gear, using only data measured by the On Board Diagnostics (OBD) port to effectively detect the driver's intention (based on pedal position, vehicle speed, engine speed and other variables) and deliver the appropriate torque to the rear wheels.

"We don't enter the vehicle's ECU because we don't want to invalidate the manufacturer's guarantee, but we use fuzzy logic to interact with the vehicle's management unit. We also plan to apply ABS to the rear wheels and in principle, the vehicle's stability could be improved".

The kit will be priced to be on par with the typical difference between today's ICE and hybrid vehicles, around 3000 euros. The investment payback for consumers is estimated to be within 3 to 4 years for the hybrid configuration but could be shortened when using the plug-in option (recharging from the grid).

"The good thing is that you could make your vehicle greener without having to buy a new and more expensive one" emphasized Rizzo. After the retrofit, your ICE car may even qualify as a hybrid under new legislations that restrict the circulation of conventional cars in some cities during carbon emissions peaks, hopes Rizzo.

In principle, the kit could be sold B2C, directly to consumers, but preferably, Rizzo would want to license the IP for car manufacturers to integrate the hybridization kit at the end of their manufacturing line.

"This would allow for a better integration and a better optimization of the fuel saving modes" he expects.

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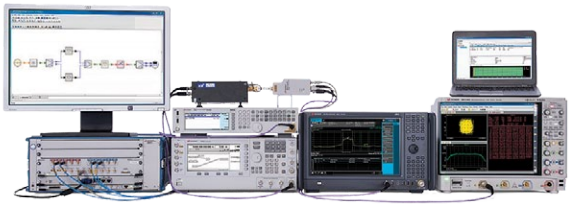

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ARM has R&D interest in neural network cores

By Peter Clarke

Intellectual property licensor ARM Holdings plc (Cambridge, England) has a research interest in machine learning and neural networks but is not yet prepared to say whether it can be turned into commercial business.

ARM is the global leader in the licensing and supply of hardware in the form of IP. The company had about a 46 percent share of the global market with $1.2 billion worth in business in 2014, according to market research company Gartner.

ARM's 25 years of existence have seen it expand from the supply of 32bit CPU cores with the addition of GPUs, video processors and crypto-acceleration processors. Expanding ARM's processor domain is something the company is always looking at, James McNiven, general manager of ARM's CPU group, told EE Times Europe during the Embedded World exhibition in Nuremberg.

"Where there are specific requirements we will take a look," McNiven said.

In recent months companies such as IBM and Intel have introducing general-purpose neural networking chips and cores to the market. There are also numerous smaller companies, startups and research groups focused on applying machine learning to applications such as computer vision.

So what about machine learning and neural network cores as a next step in ARM's diversification?

"We have a lot of research interests. That's one of the areas," McNiven said. He added that there is a difference between something working at a technical level in R&D and it being a profitable commercial business proposition. McNiven declined to say more on the topic.

It is notable that even though ARM conducts its own R&D and has partnerships with universities around the world when it comes to making new business it often chooses to build product groups around skilled people that it acquires through company acquisitions.

To enter the GPU core market ARM acquired Falanx Microsystems AS (Trondheim, Norway) in 2006 and ditched a graphics partnership with Imagination Technologies Group plc. In 2015 ARM acquired Sansa Security Inc. (Kfar Netter, Israel) and Offspark BV (Eindhoven, The Netherlands) to beef up its IoT security offering, In the same year ARM acquired Wicentric Inc. and Sunrise Micro Devices Inc. to create a Bluetooth-related set of wireless protocol IP under the name Cordio.

So an ARM acquisition of a small company expert in neural networks and machine learning could be the step that indicates that not only is deep learning technology fit for purpose but that the time is right for commercial exploitation.

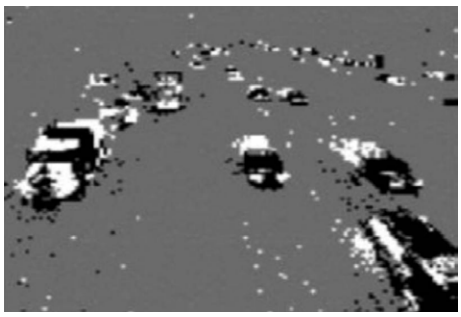
Neural network teaches itself to count cars

By Peter Clarke

BrainChip Holdings Ltd. (Perth, Australia), the listed parent company of BrainChip Inc., has reported the development of an Autonomous Visual Feature Extraction system (AVFE) based on its spiking neural processor technology. BrainChip's neural network processor is known as SNAP and uses signal spikes as a means of data transfer and a method known as Spike Time Dependent Plasticity (STDP) for learning.

The AVFE is a breakthrough and has demonstrated unsupervised learning from a visual data stream with implications for applications such as collision avoidance in autonomous driving and drones.

The AVFE on SNAP is able to process 100 million visual events per second. And within seconds learns and identifies patterns in the image stream, BrainChip said in a regulatory statement for the Australian Stock Exchange. The AVFE/SNAP was attached to a Davis artificial retina purchased from the developer Inilabs GmbH (Zurich, Switzerland) as a source of streaming digital video information.



Visual image captured using Inilabs' Davis silicon retina showing cars travelling along highway. Source: BrainChip Inc.

The Davis Dynamic Vision Sensor is an artificial retina that has an AER (Address Event Representation) interface, the same interface that is used by SNAP. Rather than outputting frames of video, each pixel outputs one or more spikes whenever the contrast changes.

Potential applications for the AVFE running on SNAP and linked to an appropriate source include collision avoidance systems in road vehicles and drones, anomaly detection, surveillance and medical imaging.

The system initially has no knowledge of the contents of an input stream. The system learns autonomously by repetition and intensity, and starts to find patterns in the image stream. This image stream can originate from a visible image sensor – such as Davis – but alternatively from an appropriately engineered radar or ultrasound source.

The AVFE was tested on a highway in Pasadena, California, in a trial run lasting 78.5 seconds. The SNAP spiking neural network learned to recognize cars and started counting them in real time.

Peter van der Made, BrainChip CEO and Inventor of the SNAP neural processor said: "We are very excited about this significant advancement. It shows that BrainChips neural processor SNAP acquires information and learns without human supervision from visual input."

The development of AVFE has prompted BrainChip to expand its commercial efforts and form a partnership with Applied Brain Research Inc. (Waterloo, Ontario).

The two companies have entered into a joint development and marketing agreement.

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Sniffing and cloning contactless cards: a simple buy on kickstarter

By Julien Happich

Having secured more than eight times its initial €22,222 goal on Kickstarter, the ChameleonMini from German startup Kasper & Oswald GmbH should stir up the debate around poor smartcard implementations.

The open source project launched by co-founders Timo Kasper and David Oswald (note that the company's logo reads like chaos) promises a freely programmable, standalone tool for NFC security analysis. The smartcard-sized device can emulate and clone contactless cards, read RFID tags and sniff transiting data.

That's all what you need to assess the security aspects of your RFID and NFC equipment or to perform functional tests. But the ChameleonMini Rev.G (which integrates a PCB antenna and can operate as a basic active 13.56MHz RFID reader) also makes an attractive proposition to many would be fraudsters willing to perpetrate different attack scenarios, such as replay or relay attacks, state restoration attacks, or simply to sniff NFC communication and clone other cards.

The platform can create perfect clones of various existing commercial smartcards, including cryptographic functions and the Unique Identifier (UID). The small board can emulate various ISO 14443, NFC, and ISO 15693 cards, as well as other types of RFID transponders operating at 13.56MHz, including NXP Mifare Classic, Plus, Ultralight, Ultralight C, ntag, ICODE, DESfire / DESfire EV1, TI Tag-it, HID iCLASS, LEGIC Prime and Advant, Infineon my-d, and many other tags. New firmware can be uploaded via a USB bootloader and a human-readable command set allows to configure the card's behaviour and update the settings and content of up to eight internally stored, virtualized contactless cards.

In a demonstration video, Managing Director Timo Kasper shows the card in action, granting himself free access to parking lots, hotel rooms, public libraries, or even crediting his lunch card with extra meals at the university canteen.

Originally, Kasper was due to become an electronic engineer, not a cryptographer, but he soon versed into cryptography back in 2006 as his Diploma thesis related to practical relay attacks on contactless NFC cards. This is when he built his first in-house test boards which would pre-figure today's ChameleonMini kits. Later, both Kasper and Oswald undertook PhDs in the field of embedded security, doing research on smart card security analysis and publishing their results on side-channel attacks, fault injections and power analysis to retrieve cryptographic keys.

More notoriously, at the 2011 Workshop on Cryptographic Hardware and Embedded Systems (CHES 2011), Oswald presented a paper titled " Breaking Mifare DESFire MF3ICD40: Power Analysis and Templates in the Real World". The two friends then left university and founded Kasper & Oswald GmbH in 2012 to offer their consulting services and carry out product development in the field of embedded security and IT applications.

When asked if that Kickstarter campaign could lure some makers into designing smartphone-based fraudulent applications, Kasper points to the other side of the coin.

"If you sell a hammer, it can be used to hammer some nails, or it can be used to commit crime. Of course, it would be criminal to use our kit to gain unlawful access or to steal from other people. But from the feedback we have received, most people are into penetration testing. They want to figure out if their system is working correctly and securely. The only way to convince your manager that they have a security problem is to open a door in front of their eyes or to show them that their coffee machine is distributing free coffees" he argues.

"By making our kit so cheap and easily accessible, what is going to happen is that more companies are going to realize that their systems are not so secure or not well implemented. There are hundreds of NFC door lock companies, but often they don't have the knowledge to correctly implement cryptography. It requires key management, individual firmware to be programmed for each lock. They may use very secure and capable chips from semiconductor vendors, but for a lack of know-how, they don't change the default security settings, or simply put, they don't read the instructions" Kasper continues.

So, is Kasper a sort of agitator in this market?

"Well, there should be no market for useless door knobs!" he answers. "Then secure chip vendors are happy to create better chips too as a way to renew their business among better educated customers".

The company sees the ChameleonMini as a non-profit project. "If it pays for itself and we can make it available cheaply, then we'll be happy with the extra visibility our business will gain from it" says Kasper, "this could drive more companies to

come to us for help, to implement a better solution for them".

Kasper hopes the open source community will strive to find new exciting applications and contribute back to the project. "It would be interesting to see if some makers find new uses for their current smartcards, say to connect and control an IoT network at home".

In the end, selling the ChameleonMini could well bring some income, but Kasper & Oswald GmbH could use that money to support PhDs candidates performing valuable research for them, while staying connected with the academic world, in some way, feeding the money stream back into more knowledge for the open source community.

Licensible IP core accelerates neural networks

By Peter Clarke

French researchers have developed a IP for deep neural networks that is available for licensing to run in software, for implementation in FPGA fabric, for synthesis within an SoC.

The Pneuro Engine is a multipurpose energy-optimized accelerator designed for neural networks and image processing chains. It utilizes a clustered SIMD architecture optimized for MAC operations (as found in SIMD extensions of popular processor architectures) but with a distributed memory optimized for near neighbourhood accesses and design reuse management.

Target	Frequency	Performance	Energy efficiency (SoC only)
Raspberry PI 2 B	900 MHz	480 images/s	380 images/W
Odroid Xu3	2000 MHz	870 images/s	350 images/W
PNeuro (FPGA)	100 MHz	5000 images/s	2000 images/W

➢ Performance & Area projections (FDSOI 28nm)
➔ Up to 1.8 TOPs/W, <0.5 mm²

The research team is from CEA List based at Saclay-Paris and at Embedded World demonstrated the use of an FPGA-based Pneuro on a GlobalSensing Technologies board to perform face recognition. The same technology has also been ported to a Raspberry Pi 2B containing a quad-core Cortex-A7, and to an Odroid XU3 board based on a quad Cortex-A15 processor.

The embedded convolutional neural network requires 450 kilo operations per second and has 60 neurons in a hidden layer and was tasked with identifying faces from a database of 18,000 images, which it was able to do with a 96 percent accuracy rate. Pneuro has more than five times higher performance when implemented in FPGA than when running in software on an ARM processor and because of the parallelism offered this can be achieved at much lower clock frequencies, as shown in the table below.

It would be more efficient again if implemented as synthesized hardware in an SOC. The engineers estimate that in 28nm FDSOI manufacturing process technology the Pneuro block would occupy less than 0.5 square millimeters and could run at up to 1.8 tera operations per second.

Frederic Surleau, the research executive responsible for industrial partnerships, is contactable through CEA Tech List at Saclay, Paris to discuss licensing and collaboration.

European pilot line aims to commercialize flexible OLED lighting

By Paul Buckley

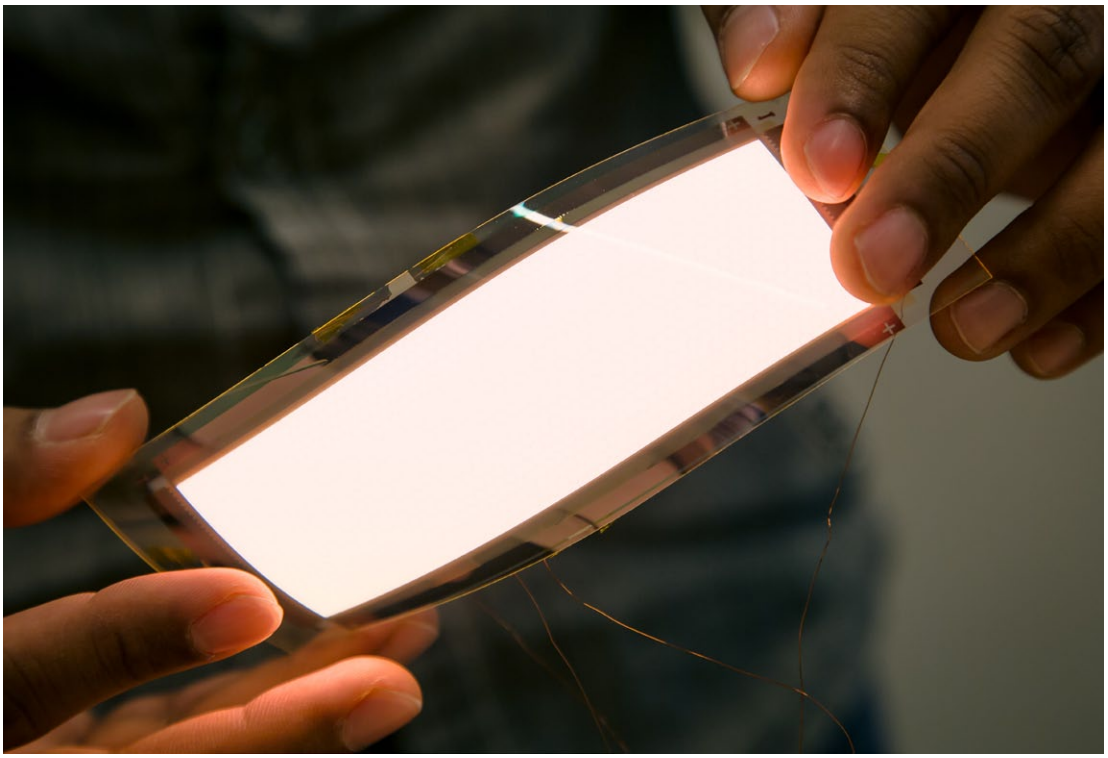
Europe's technology leaders in the development of flexible organic light-emitting diodes (OLEDs) for lighting and signage applications have joined together in a consortium to develop an open access pilot line to accelerate the commercial adoption of the technology.

The project titled 'PI-SCALE' aims to create a European-wide pilot line which will enable companies of all sizes to quickly and cost effectively test and scale up their flexible OLED lighting concepts and turn them into market ready products.

The project is supported by the European Commission through the Photonics Public Private Partnership with a contribution of €14 million.

Flexible OLEDs have the potential to be integrated into formed parts or seamlessly bonded onto curved surfaces, and the commercialisation of this technology will open up a host of exciting design opportunities to create new value adding lighting products in many different application areas, such as architecture, automotive, aerospace and consumer electronics.

The technology allows for ultra-thin (under 0.2 mm), highly bendable, lightweight, and even transparent, energy efficient lighting solutions that can be made or cut to any shape or size.



PI-SCALE will offer world class capability and services in the pilot production of customised flexible OLEDs and initially focuses on product streams in the areas of automotive, designer luminaires and aeronautics applications. Coordinated by the Holst Centre, PI-SCALE brings together fourteen expert partners from five European countries and includes the Audi AG, CPI, VTT, Fraunhofer, M-Solv, FlexEnable, DuPont Teijin Films, Brabant Development Agency (BOM), REHAU, Emdedesign, Pilkington, Coatema Coating Machinery and AMIRES.

PI-SCALE will allow companies unique access to test and develop their specific applications at an industrial scale and thus achieve the product performance, cost, yield, efficiency and safety requirements that facilitate mass market adoption. The consortium will combine and utilise existing capability from each of the partners to create a self-standing, open access European flexible OLED pilot line. The pilot line will be available during and after the lifetime of the project to companies on an open access basis, and the specialist infrastructure will include all the steps required to turn OLED lighting concepts into manufactured products.

"PI-SCALE gives REHAU the opportunity to gain in-depth knowledge of flexible OLED production with the top European players in this field. This will help us to integrate flexible OLEDs into our premium polymer products in the best possible way," explained Dr Ansgar Niehoff, Researcher at REHAU AG+Co, Department of Advanced Materials, who are one of the end users in the project.

"The creation of this pilot line is a fantastic opportunity for a wide range of companies to get flexible OLED technology out of the research and development phase and into products," said Dr Joanne Wilson from the Holst Centre, who are coordinating the project.

PI-SCALE is one of three major pilot lines which have been launched by the European Photonics Public Private Partnership (PPP) to help companies to take photonics technologies from the lab into commercial markets.

The pilot lines will mean that thousands of high tech companies, who often lack access to advanced, cost-intensive infrastructures and expertise, will be able to take their good ideas, scale-them up and validate them into innovative products for commercial manufacture.

The two other pilot lines 'MIRPHAB' and 'PIX4Life' will focus on photonics technologies for health applications and sensors for the detection of chemicals in gas and liquids. The European Commission has invested €35 million in these projects to boost Europe's industrial competitiveness. This is part of the Commission's €700 million investment in the Photonics Public Private Partnership over the seven years of Horizon 2020, the Framework Programme for Research and Innovation.

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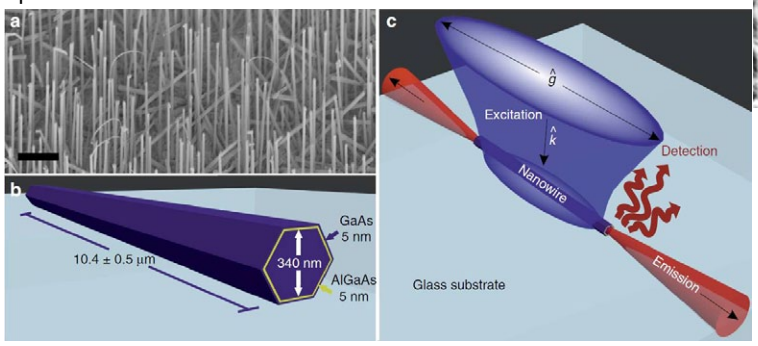
Vertical nanolasers open optical ports out of silicon

By Julien Happich

Whilst today's silicon-based photonics chips require complex manufacturing processes to connect the light sources to the silicon, involving wafer-level stacking, physicists at the Technical University of Munich (TUM) have managed to grow vertical nanolasers, only 360nm in diameter, directly onto silicon.

This opens up new optical ports for the integration of photonic components on top of CMOS circuits.

Because the materials have different lattice parameters and different coefficients of thermal expansion, growing a III-V semiconductor onto silicon leads to strain and typically yields a large number of defects, which makes the layers unsuitable to create operational devices.

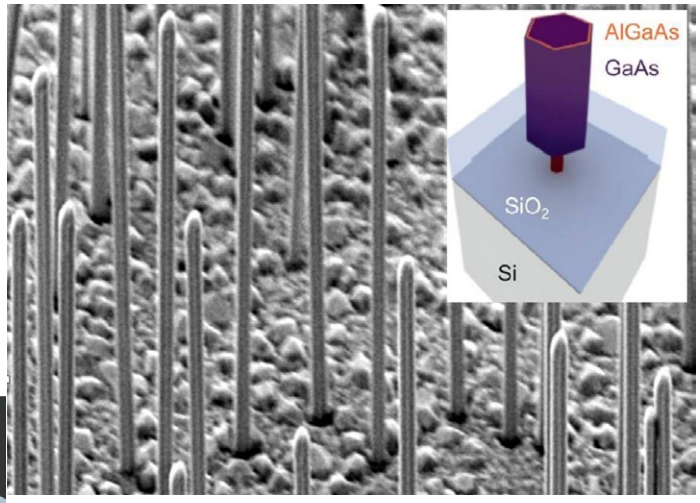


Scanning electron microscopic image of the GaAs/AlGaAs NWs (a), size measurement (b) and lasing experimentation (c) through external optical pumping.

The TUM team solved this problem by first depositing GaAs nanowires freestanding on silicon, with a footprints only about 40 to 50nm in diameter, corresponding to the diameter of seeding pinholes in a 250nm thick SiO_2 interlayer. They then used molecular beam epitaxy (MBE) to grow the inner core nanowire up to around 10um in length, before widening selectively the diameter of the GaAs nanowire through a controlled lateral growth, into coaxial laser structures.

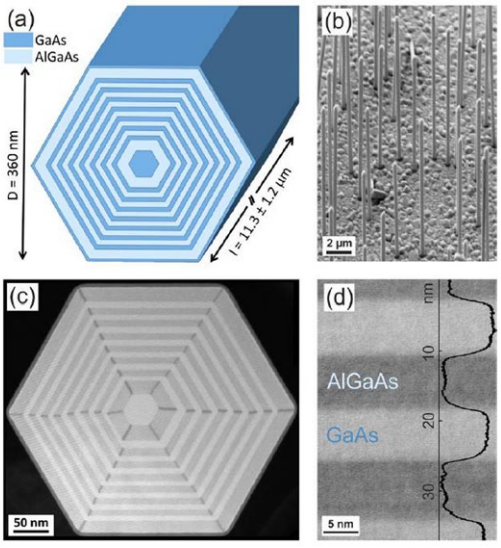
By altering their chemistries, the researchers managed to build multiple layers of Quantum Wells (QW) through depositing multiple hexagonal GaAs-AlGaAs core-shell structures. They demonstrated a 8nm thick GaAs QW sandwiched between 75nm thick AlGaAs barrier layers, but also a multiple quantum well laser structure consisting of seven 8nm thick GaAs QWs separated by 10nm thick AlGaAs barriers. In both designs, the core–shell GaAs–AlGaAs nanowires remain connected to the silicon substrate via the inner core that extends throughout the SiO_2 interlayer, the later acting as one mirror in the lasing operation.

In previous work, the researchers had investigated detached GaAs-AlGaAs core-shell NW lasers to characterize and probe their intrinsic properties and performance. In their latest paper, "Coaxial GaAs-AlGaAs core-multishell nanowire lasers with epitaxial gain control" just published in the Applied Physics Letters, they proved near-infrared lasing operation (through external optical excitation using a Ti:sapphire laser tuned to 780nm) with the nanowires standing on top of their silicon base, at room temperature.



Next, the researchers want to improve the NW-laser performance by improving the end-facet reflectivity via chemical polishing or by depositing dielectric Bragg mirrors. Also, for a practical use, the lasers should emit unidirectionally into the underlying silicon where patterned photonic hardware could be nested, including on-chip waveguides. For a true integration, they will also require electrical injection.

"Our current research goals focus on developing methods to realise electrically pumped NW lasers on silicon and also integrated lasers emitting into underlying photonic circuitry. Until now the devices are optically pumped but they are grown site selectively on the silicon substrate" commented Dr. Jonathan J. Finley, Professor at the Technical University of Munich Walter Schottky Institute.



(a) Schematic illustrations of the coaxial GaAs-AlGaAs MQW NW heterostructure; (b) SEM image of the laser structure as grown on Si; (c) Cross-sectional HAADF-STEM image of the same structure showing the GaAs layers in bright and the AlGaAs regions in dark; (d) Magnified image as well as Z-contrast function across a section of adjacent GaAs QWs and AlGaAs barriers.

"We have already filed patents for the basic technologies for the NW laser on silicon and we are certainly interested to discuss licensing of IP to interested parties" he concluded.

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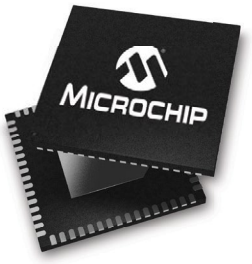

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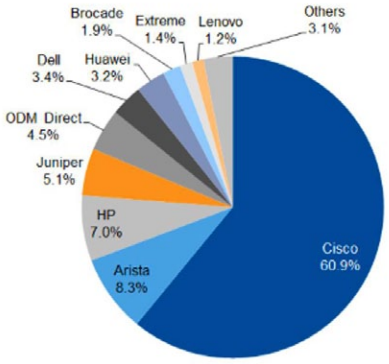
Cisco rolls 16nm ASICs

By Rick Merritt

Cisco Systems is shipping its first 16nm ASICs in switches that are part of new data center products announced the first of March. The ASICs leapfrog features offered by Broadcom whose 28nm chips are used in a wide swath of switches made by Cisco and its competitors.

The new ASICs enable a more flexible set of interfaces for ports carrying 100Mbit to 100 Gbit/second Ethernet and 32 Gbit/s Fibre Channel traffic. The company claims the chips are the first to pack 36 100G ports in a system that fits in a single rack unit. The ASICs also implement flow control tables to monitor all traffic running across leaf and spine switches.

Cisco designed a family of three closely related ASICs for its systems with aggregate bandwidth ranging from 3.6 to 1.6 Terabits/second. Two of the chips, made in TSMC's 16FF+ process, started shipping in systems in February, a third will ship within two months.



Cisco dominates in data center switches, according to International Data Corp. (Image: IDC)

"We wanted the performance and cost advantages" of going to 16nm, Thomas Scheibe, senior director of product management for Cisco's data center switch group told EE Times.

The process helps Cisco pack 20 to 40 MBytes of memory into the ASICs, eliminating the need for external memory. The cost of external memory "is significantly higher with lower reliability and higher power consumption" than embedded memory, said Scheibe.

Cisco, long one of the world's largest ASIC designers, has its own approach for dynamically parsing the memory into shared or private buffers as needed. The memory serves the flow tables which are the largest new blocks in the ASICs. The tables help calculate average flow completion times, a key metric to avoid data collisions and get full use from its computer networks.

"Today no top-of-rack switch has a flow table for cost reasons and most chips can't export the flow data fast enough," said Scheibe.

The ASICs also let users select the data rates at which they want to run Ethernet and Fibre Channel traffic. They support SFP interfaces for 10G or 25G traffic and QSFP links for 40G or 100G links.

The switch team was the first to use 16nm process technology inside Cisco. Scheibe claims the ASICs were the first switch chips of any kind produced in a 16nm process.

The ASICs are relatively large, about the same size as Cisco's prior 28nm switch chips. Die size is one of the gating items for switch chips, Scheibe said. He credits Cisco's ASIC simulation tools for helping the company go from "first prototypes to shipping products in 6-8 months."

Cisco is making two versions of its new switch systems. One uses Broadcom's Tomahawk chips as a system fabric and line card switch; the other uses the new ASICs. Some customers demand merchant chips because they modify the software running on the systems to program their own networks, he said.

"Cisco believes a significant proportion of its datacenter-networking installed base will be receptive to the price-performance attributes and capabilities of the Nexus switches based on its new proprietary ASIC technology," said Brad Casemore, an analyst following the sector for International Data Corp.

"They emphasized use cases that spotlight the flow tables, analytics, and flexible port configurations to position the technology for where the market is going…private and hybrid cloud, containers and microservices [and] distributed IP-based storage," he said in an email exchange.

Cisco commands a whopping 60% of the data center switch market. Its closest rival, Arista Networks, is a heavy user of Broadcom chips, but got just 8% of the market by revenue in 2015, according to IDC. Cisco, Arista and a group of ODMs took a percentage point each in share last year, while Hewlett Packard fell from second place, it said.

Storage software from startup Springpath is one of the key ingredients in Cisco's latest servers, announced along with the switches. The code manages solid-state and hard-disk storage distributed across server nodes and uses solid-state drives as a new tier of cache memory.

Cisco is an investor in Springpath, founded in 2012 by members of VMware. The startup provides a software interface for storage as well as a proprietary file system to optimize flash reads and writes for performance and chip endurance.

Cisco implements a NAND flash caching layer in its new HyperFlex servers. (Image: Cisco Systems).

The new servers support continuous, real-time data de-duplication and compression. "Other vendors grabbed open source code; [Springpath] did it right, adding a ton of technology differentiation," said Todd Brannon who manages Cisco's data center server group.

In December rival Hewlett Packard Enterprise rolled out its latest data center servers, claiming they let users more easily configure in software compute, storage and networking resources. Like HPE, Cisco claims its latest systems simplfy the job of flexibly managing complex collections of data center gear.

Cisco entered the server business in 2009 and now claims it has more than 52,000 customers. It used ASICs in its first servers to more than double the DRAM memory linked to a Xeon processor.

Cisco's new server nodes pack multiple solid-state drives (SSDs) and hard disks. They use a 120 GByte SSD to store data logs, a 480GB to 1.6 TB SSD for caching, two SD cards as boot drives and up to 23 1.2 TB 10,000-rpm SAS hard drives.

The SSDs use PCI Express interfaces and are based on commodity flash. Cisco did not adopt 3-D NAND drives for the new systems. The 2U servers use one or two Xeon E5-2600 v3 CPUs.

Femtocells get mobile in the car and become CrowdCells

By Chistoph Hammerschmidt

At the Mobile World Congress which took place in Barcelona, carmaker BMW unveiled the research project "Vehicular CrowdCell". This project extends the concept of the "Vehicular Small Cell" presented last year in Barcelona. While the "Vehicular Small Cell" is a mobile femtocell that optimises the mobile radio reception inside vehicles, it is now also capable to enhance the capacity and coverage of mobile radio networks.

BMW has teamed with Nash Technologies and Peiker (which in turn has recently been acquired by automotive electronics supplier Valeo) to showcase a prototype of the "Vehicular CrowdCell" integrated into a BMW research vehicle.

The rapid growth of mobile data traffic, e.g. due to the increasing use of multi-media services such as music or video streaming with mobile devices, requires more powerful mobile radio networks in the future. One strategy to increase the capacity and coverage of future networks is the integration of a large number of small cells and relays in addition to the existing base stations.

In 2015 the BMW Group, together with its partners presented the world's first mobile femtocell in a vehicle. The "Vehicular Small Cell" optimises the reception available to mobile devices inside vehicles via the vehicle's aerial. Now the concept has been extended to create the "Vehicular CrowdCell". Based on data traffic and coverage demands, the mobile femtocells are dynamically activated to locally enhance mobile radio networks.

One possible application of Vehicular CrowdCells are car-sharing fleets – in particular with electric vehicles. Here, a large number of vehicles spread over cities and regions could serve as local radio relays when parked.

If one or more users are located close to a mobile femtocell, it is activated on demand in order to increase the bandwidth or provide additional network coverage.

In such a way, the performance of the existing network can be dynamically optimized. Benefits for mobile phone users in hotspots include a higher data rate and the absence of reception white spots – especially in areas where the signal coverage is low. "The Vehicular Small Cell will optimise in-vehicle connectivity of mobile devices for our customers," explains Peter Fertl, project manager at the BMW Group. "At the same time, the integration into a network of Vehicular CrowdCells will enable the ubiquitous and seamless availability of high-quality mobile radio connections outside the vehicle as well."

Volkswagen wants to be a digital company

By Christoph Hammerschmidt

At the Geneva Motor Show, carmaker Volkswagen has highlighted the significance for the future of the company. Johann Jungwirth who as recently as past November moved from Apple to Volkswagen where he now acts as Chief Digital Officer had his first grad appearance.

In a presentation held at the Geneva Motor Show, Jungwirth said Volkswagen will change its profile towards being a software and services group – much like VW subsidiary Audi did a few of days ago. Jungwirth said that Volkswagen has the competitive edge of mastering the automotive hardware. "I am firmly convinced we will become a leading mobility provider by 2025", he said.

At the show Volkswagen also announced the creation of three new "Future Centres" – one each in Europe, Asia and the U.S., with the latter one being headquartered in California.

In these centres, car designers, software developers and digitisation experts will jointly build the car of the future. In this context, the company announced to mesh vehicle design and digitisation more tightly, with focus on customer experience, HMI design, operating logic, interior design and infotainment. The European Future Centre, located in Potsdam near Berlin, is already operative while the exact location for the centres in California and Asia has yet to be determined.

At the same opportunity, the company drew a positive balance of its position in electromobility. Currently Volkswagen has nine battery electric vehicles and plug-in hybrids in its catalogue. Within the next four years to come, 20 new models will enter series production, announced CEO Matthias Müller. Within the same time frame, driving ranges of more than 500 km (370 miles) are "feasible", the top executive said. By the same token, charging times will be reduced to "the same time span as needed for a coffee break." Plus, in the long run, electric vehicles will be cheaper than those with an internal combustion engine inside. Müller on this occasion called for a joint effort of economy and politics to establish an extensive charging infrastructure.

Müller also responded to the ongoing discussion about the company's exhaust gas software scandal (Müller used the term "exhaust gas topic"), without however going much into details. The callback action has been launched in Europe, Müller said. Within the foreseeable future, the company will submit a "substantial report" with respect to the clarification of the exhaust gas affair. "2016 will be the year in which we want to solve the problem with our diesel engines and align the Volkswagen group for the future", he said.

Big in Japan! Geomagnetic indoor positioning

By Julien Happich

Leveraging smartphones' built-in magnetometers, Finnish startup IndoorAtlas promises meter-accurate indoor positioning through its cloud-based geomagnetic mapping services.

The company was founded in 2012 but is already gaining traction in Asia, most notably with a $10 million A investment from China's top search company Baidu (back in 2014) for exclusive access to their technology in China, but also in 2015 by signing a $3 million partnership with Korean commerce service platforms provider SK Planet, and now signing a brand new contract with Japan's leading internet portal, Yahoo! Japan.

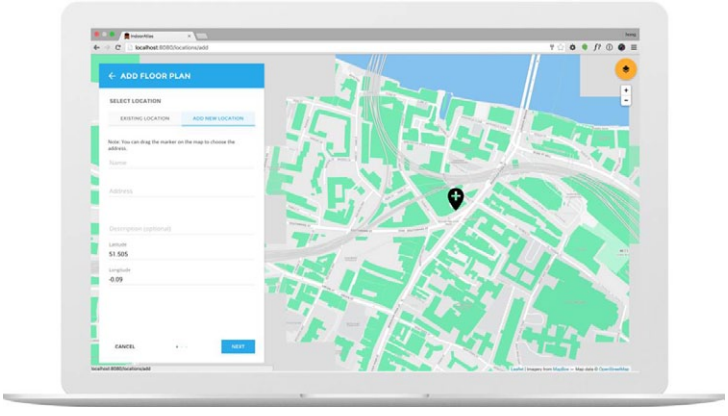
EETimes Europe caught up with Daniel Patton, IndoorAtlas' Chief Commercial Officer to learn more about the company's technology and strategy for Europe.

"The technology is simple", explains Patton, "modern buildings all have a unique magnetic signature". The building's structure and materials interact with the Earth's magnetic field and that yields a unique magnetic map for each floor, which once recorded and stored in the cloud, can be used to accurately pinpoint and track a person's location indoors. Today's magnetometers are sensitive enough to make this work.

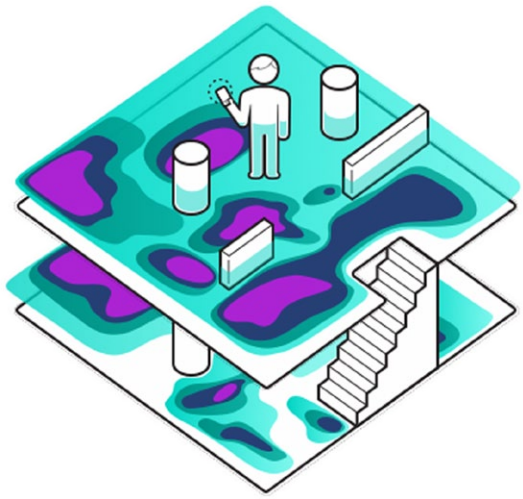
Patton is keen to emphasize that the data is very stable over time (unlike RF signals from WiFi hotspots or Bluetooth beacons), and that no other indoor positioning technology can scale so easily, simply because it is a software-only solution, with no hardware infrastructure to deploy and maintain. It is also easy to scale across millions of users.

For a subscription fee, IndoorAtlas' Platform-as-a-Service (PaaS) delivers all what developers need to design in-building geolocation mapping services and to map new locations, if need be.

Say you want to map a large train station with multiple levels and hundreds of corridors, it may take two days for a person to walk through its mazes, starting from a known anchor point and validating the collected geomagnetic data at key anchor points.



IndoorAtlas' web tool can be used to create locations and add floor plans.



A building's magnetic fingerprint as exploited by IndoorAtlas' tools.

Although users can upload 2D floorplans before collecting data points, the company owns and manages the final data.

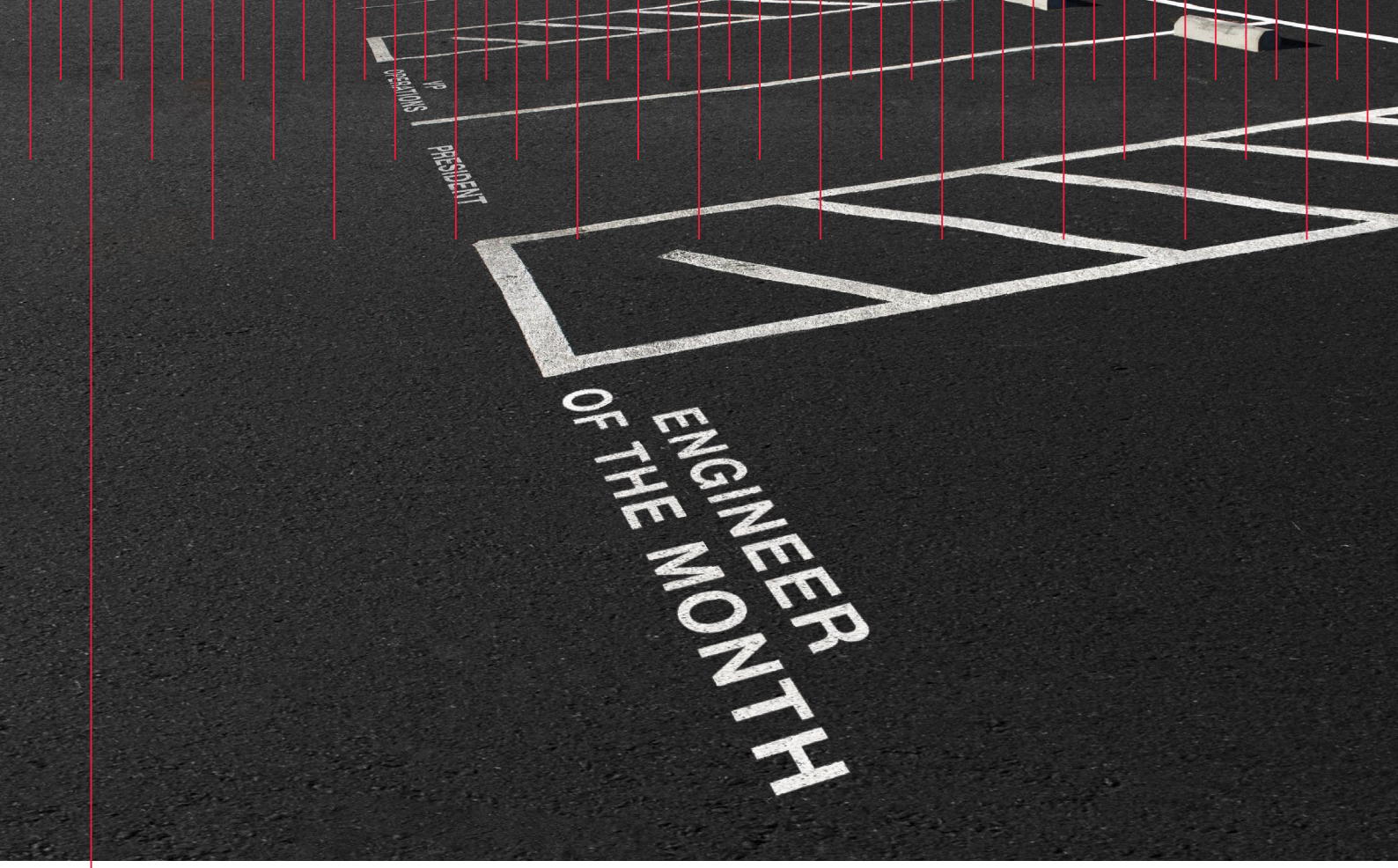
It already boasts 25,000 developers using its PaaS in over 100 countries, claims over 200,000 monthly active users and says it has crowdsourced over 15,000 buildings.

The Chinese deal with Baidu gave the company a boost, which Patton hopes will help IndoorAtlas reach critical mass, meaning that as users walk around cities, more building indoor maps can be crowdsourced, hence creating new data points for free and increasing IndoorAtlas' overall coverage.

"Last year, Baidu rolled out our technology in its Baidu Map service, it has already mapped thousands of buildings in China, and it expects to increase its indoor mapping coverage ten-fold in 2016", said Patton.

The new contract with Yahoo! Japan is also promising. The portal generates 63 billion page views per month and Japan

The MapCreator mobile app lets designers access floor plans and collect sensor data throughout a venue. The collected data is uploaded to the cloud where a landscape of the sensor reading in the venue is created for the positioning algorithm.



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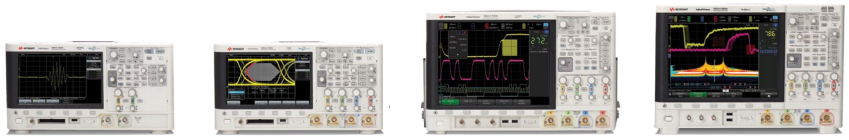

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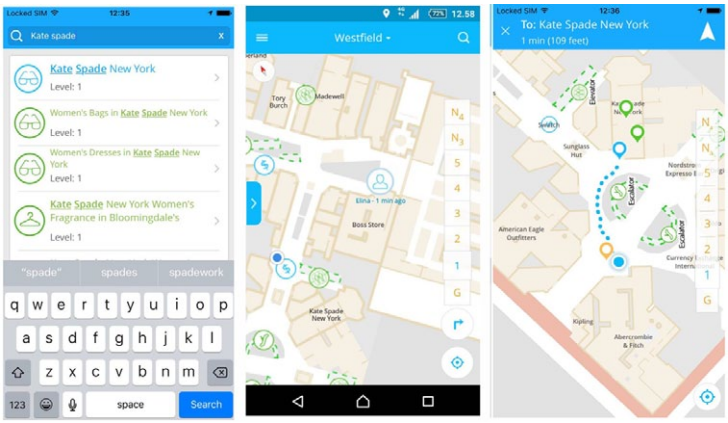
ranks number four in smartphone penetration worldwide, even a small percent of active users could rapidly grow the number of maps.

"What's happening in Europe is that we've been reached out by a number of organizations wanting to develop mapping services for hospitals, train stations, but also by private industries where apps are created to keep track of the flow of workers, for safety or security reasons", explains Patton.



Original screen shots from the Westfield Mall app (NewYork), showing way-finding/navigation, search and multi–dot.

"Often, the apps are designed to enhance the user's experience, say in a shopping mall for proximity marketing. We are aware of several airports using our app, to ease transfers. The app may serve the coming flights time and schedules, the direction to a connecting flight and the time it will take passengers to walk there, and on their way, it highlights where the shops and restaurants are". "We are also in conversation with transportation companies", he added.

The company offers a freemium pricing model so customers pay as they grow, based on the number of monthly active users. An SDK can be downloaded and used for free up to 100 monthly users to get a flavor of the indoor mapping and positioning capabilities.

"On the economics side, our subscription model offers the lowest cost approach compared to beacons", the CCO concluded.

Alternative to Li-ion batteries ready for series deployment?

By Christoph Hammerschmidt

With allegedly sensational driving range and performance, the Quantino and Quant FE electromobiles from startup company Nanoflowcell already made headlines. The company now showcases the vehicles in a near-series version at the Geneva Motor Show – but with a completely new business model.

With features like large driving range and short tank stops, Nanoflowcell attacks the existing electromobility paradigm at its weakest points: the company claims driving ranges of 1000 kilometres for vehicles equipped with its electrolyte-based liquid battery – twice as much as the currently most advanced battery-operated e-cars. And with a simple refill process at a kind of gas station that would not require significantly more time than filling the tank of a gasoline or diesel vehicle, the usability barrier of existing electromobility through lengthy charging stops would be cleared away. The company recently announced that its Quantino vehicle has been driven for 14 hours without a refill, and all of this under realistic driving conditions. But while Nanoflowcell hitherto aims at series production of its cars, albeit in low quantities, the company now apparently has changed its strategy and is offering its energy storage technology to carmakers.

"Our goal is not manufacturing these vehicles in series production", a spokesperson explained EE Times Europe. "They (the vehicles) are ready to enter production, but we intend to market the flow cell technology", adding that the company has something like a franchise model in mind. "The system could be integrated in any electric car", the spokesperson said. With its properties, the Nanoflowcell system would beat conventional lithium-ion batteries, the spokesperson claimed.

"Since it is based on liquids, it can easily be customised to any type of vehicle, be it a city car or a large sedan," he said. "We are the alternative to lithium-ion."

Under technological aspects, the Nanoflowcell system however is somewhat mysterious. The company only discloses that the energy is stored in a non-toxic, incombustible and environmentally harmless liquid. The vehicles are equipped with two tanks – one for the unused liquid, the other one for the used liquid where it is pumped to after it has delivered its energy to the electric drive. In gas stations, the used liquid has to be drained while at the same time the empty tank can be refilled with the unused electrolyte. The problem is that the company does not disclose the exact composition of its "power liquid" – for fear of industry espionage, as the spokesperson said. However, media reports raised doubts if such a liquid can potentially exist, given the miraculous performance Nanoflowcell is promising: The vehicles can accelerate to 100 kmph (60 mph) in less than three seconds, reach top speeds of 200+ kmph and have a driving range of 1000 km – "and this is a rather cautious estimate", the Nanoflowcell spokesperson said.

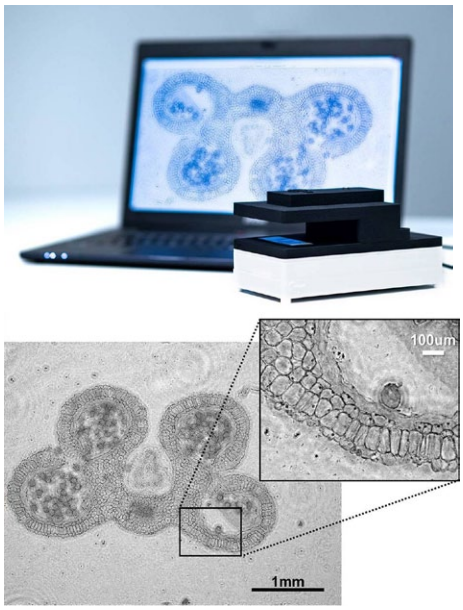
Since the energy is stored in liquid form the existing gasoline station infrastructure could be used to utilised for distribution, making complex and costly charging infrastructures unnecessary.

Remains the issue that so far, no independent testers have been able to verify the promised performance. "We simply have not enough vehicles", the spokesperson said. "The few units are needed for the homologation process and for internal tests and optimisations. Being a small company, our resources are limited." Adding, "in a few months we will enable independent tests."

Lens-free digital microscope opens up new fields of view

By Julien Happich

At SPIE Photonics West 2016, imec demonstrated a lens-free microscope for large field-of-view live imaging at micrometer resolution. The compact microscope is based on holographic imaging where the light diffracted by an illuminated object and captured by an image sensor is software post-processed to compute the focused image. Hence a single 2D image capture is sufficient to volumetrically image a 3D sample.



"The current demonstration features a 4.7x3.5mm CMOS sensor, however, we have built systems with much larger sensor sizes for some of our customers too. The inspected area scales with the sensor size", explained Andy Lambrechts, Program Manager and Team Leader for the Integrated Imaging CMORE program at imec.

"We have coupled the lens free microscope to a GPU accelerated image processing unit. This allows fast and user-friendly operation of the system. For very large area inspection, computational requirements will scale up with the inspected area".

"No lens means that we can focus on a certain depth, without any mechanical movement, by re-computation in software. The inspected area or field of view is a parameter in the system design and linked to the magnification of the system.

The magnification is not depending on the height of the sample. It is pre-calibrated and can be reported to the user. The software can use auto-focus to automatically detect the distance to the sample and this can be reported to the user as well", Lambrechts added.

Of course, compared to conventional optical microscopes, lens-free digital microscopy removes the need for expensive and bulky optical lens components to acquire and visualize microscopy images. The unit features a micrometer-scale accuracy comparable to that of traditional optical microscopes, while being much smaller and less expensive, but also much faster to use (thanks to the larger field-of-view).

For now, imec is focusing on the customisation of the technology towards the requirements of its partners. The ready-to-use demo kit is a starting point for those partners, and can also be delivered as is, including a light source, image sensor, control and read-out electronics and a software interface.

According to Lambrechts, the new microscope format will enable an abundance of applications where traditional microscopes are just not applicable.

Creating the future with start-ups

One of the leading lights in India's technology industry, Gude 'GD' Dasaradha emerged from humble beginnings to become CEO of Ineda Systems. GD has an impressive career as a serial entrepreneur leading multiple start-up companies

Hanns Windele: Despite the fact that you work within the structure of a company, you've always been something of an entrepreneur… what qualities do you think this requires?
Gude Dasaradha: The way I look at this is always very clear. Whether you are in a big company or a start-up, I always feel that unless you 'want it' you won't be able to make things happen and won't be able to take things to the next level very quickly. I always feel that I am good at start-ups and the number of companies I have started is in two digits now. I always try to do things in the same way. Even when in a big company, I try to create the start-up atmosphere. Am I afraid of failure? Of course. I'm always afraid to fail, but I never want to be in the position where I will think tomorrow that I was the root cause or the reason for the failure. So typically due to this part of my nature, I am always driven to success. There are many reasons to fail, such as the market, but I don't want it to be because of my individual effort and so I ask if I am doing everything the right way. If a disaster comes along then you can't do anything about it.

Gude 'GD' Dasaradha, CEO of Ineda Systems: "Even when in a big company, I try to create the start-up atmosphere".

HW: The high-tech industry can be a volatile place and there is the constant risk of failure. How do you mitigate against that?
GD: First of all you have to believe in what you are doing and your team has to believe you can take them to the next level. If your team doesn't believe, that means you have failed from the very first step. Failure comes from lack of stability. If your team is not behind you that means you have already failed. I strongly believe that if you find yourself losing your way it will come back again. It also takes time. It may take two years instead of four if your team backs you and believes in your idea. So I would always like to work with my team and get their belief throughout to progress to next level.

HW: When you are considering your next start-up, how do you select which markets to approach? Is there a specific thought process?
GD: There is an IP and ASICs company that I started a year ago called Invecas. I strongly believe we can bring in the revenues and my wish is to become the number one in the next four years. The main reason to choose this area is due to the semiconductor consolidation. Major companies are getting into the IP market and there are no third parties today who can support these companies. Even if you look at foundry enablement, like GUC or any other company, they have not come to a point where they are doing 'me too' kind of ASICs. If you really want to do high-end support for companies, whether it's Qualcomm, AMD or any other company, they expect to have some kind of support outside. I believe this is the time for me to invest in this area.

HW: Do you think that the industry will consolidate?
GD: It will, because big companies cannot afford to do IP development in house. But they need to have independence and we are going to provide that. My focus is only on IP and support, unlike other companies. As an IP and ASIC company, I believe in five years we will be number one.

HW: But you don't just set up new companies and ventures. You are selling them too. Doesn't that feel like abandoning your work, when you have put in so much blood, sweat and tears?
GD: To be honest, when we start a company, we have already decided when to sell it. For each and every company, we already have the time frame of when we want to sell and at what stage we want to sell it. So we don't decide about selling suddenly – it's planned the day we start our company.

HW: So is it just about making money?
GD: It's not the money. It's about potential for money. For example: Invecas, I didn't try to sell it right away. I am trying to take it to the next level. My revenue targets are strategically planned and I intend to make it much bigger.

HW: Can you think of anything that would make your life as an entrepreneur significantly easier?
GD: I don't think that I would manage anything differently. Even in a big company, my style is not going to change. My style has been simple, unique and this has helped me to be successful. The Government regulations always make a lot of difference and it isn't always easy to start a start-up company in India from a regulations point of view. The main reason for setting up here was largely due to the talent pool available. There are a lot of complicated rules in India and all these rules need to be made straight forward to make things easier for every entrepreneur to understand and move forward.

HANNS WINDELE is Vice President, Europe and India at Mentor Graphics. www.mentor.com

HW: What changes do you see happening in the semiconductor industry in the next decade other than consolidation of foundries?
GD: Technology is going to change in a big way in the future and as per my gut feeling, it is the interconnect technology that is going to change drastically. I'm hoping that photonics will take it to the next stage, but that is not a reality today. Right now the problem that we are facing is that 'on-chip is okay', but 'off-chip is a major problem'.
Photonics technology will help the semiconductor industry and I am really thinking that will happen.

HW: Why aren't more companies involved in this area?
GD: Mainly because of the cost and power considerations. You need to manage that and you need new technology. I'm reading a lot of stuff about it, but it's not a reality today. But very soon in the next five years, it will be a reality. I'm very confident about that, particularly in data centres. Actually, that is what is going to drive the technology going forward. I think that the market is ready and I am recommending two fabs to the Indian government. Firstly don't do the traditional fabs, as it's not worth it: do RF or photonics fabs. These can be done with a reasonable amount of money and also make a difference in the ecosystem.

HW: What are the recent changes in the market that have left the biggest impression on you?
GD: The internet is one big thing and part of it is IoT. Virtual reality and augmented reality in education are also a big thing. These will change the world. The way we are studying, along with the teaching mechanism, is going to change based on virtual reality and that's my reading. You don't get that experience online and with virtual reality you get the experience, you can feel it and you are part of it. Take for example, when you mix two chemicals in a lab. In reality you get an explosion and there is damage. But in virtual reality you can see what happens without the damage and you get to learn through the technology. You can feel it, simulate and this is going to be a reality in the next five years. These technologies have really impressed me and will make a big impact globally.

HW: What do you see happening in the wearables market?
GD: The reason wearables haven't taken off is because of the accuracy and size of the sensors. Once the technology grows the market will come back. Until that time IoT will become big. Another main reason that people are not wearing gadgets, especially for medical applications, is because of the battery life. You need a minimum battery life of a week to ten days, and if you can get to that stage, the wearable market will start to come back. But it's not just battery life that is the consideration. It's the size of the battery also. And then there is the 'appeal/elegance' factor, as well. As of now they really don't look great, so no one wants to wear a square watch or Google glasses if it's not going to increase their appeal/elegance factor. Of course, this should be coupled with good battery life and the size of the battery.

HW: What do you think you can learn from other CEOs?
GD: Every year I go on holiday with a group of CEOs and this is a good time for us to talk and learn from each other. We get together and enjoy talking to each other. We don't necessarily talk about business, but it is the only time CEOs can talk to each other. It means that you can get to talk about things that happen in business in a more informal way. In addition, you get to learn things from people from other domains and industries.

HW: Any final thoughts about what makes a technology-based entrepreneur successful?
GD: As a technologist you have to like what you are doing and be passionate about it. At the same time you have to work hard as it is all about results at the end of the day. The one thing I have always believed from the beginning is that we should be satisfied with a future where we have not lost out on anything. A lot of people think it is about making money, but in reality it is about enjoying the experience of developing the company and making it successful.

QUICKFIRE QUESTIONS

Who would you most like to go sailing with?
Sanjay Jha, CEO of GlobalFoundries and Dave E. Orton.

How many digital devices do you have on you?
Around five or six. Phone, video conferencer. Battery charger-cum-extension speaker.

Is there a gadget you would never give up?
Yes. My cellphone.

If you could be CEO in any area other than high-tech, what would it be?
I'd really like to be the CEO of an educational foundation.

If you had two hours more per day, what would you do with them?
Another start-up? I only sleep three or four hours a day. So more sleep would be fantastic.

Startup with mixed-signal ASICs to boost 4G capacity

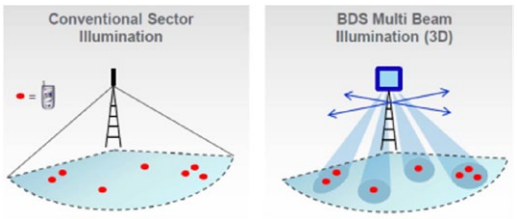
By Junko Yoshida

No doubt 5G is coming to save a mobile world that's struggling to keep up with the explosion in data traffic. But mobile network operators must find a solution - not in 2020, but today. Blue Danube Systems, a Mountain View, Calif.-based startup armed with a unique 3D beam-forming technology, came to the Mobile World Congress to pitch high-definition antenna systems that increase by tenfold the average LTE spectrum efficiency of a typical base station.

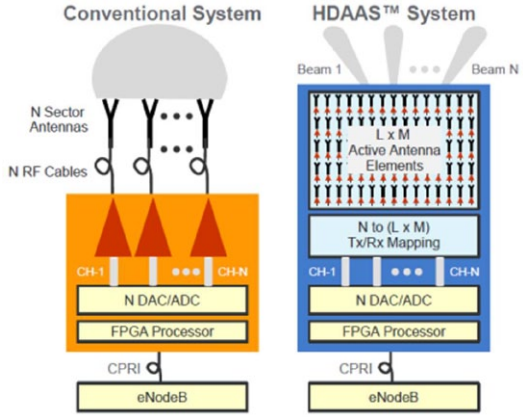
In an interview with *EE Times*, Mark Pinto, CEO of Blue Danube, noted that "capacity is the key issue" for every mobile network operator. To deal with "spectrum starvation," as Pinto calls it, the mobile industry has been trying a number of 5G experiments while implementing LTE carrier aggregation plans. There has been some incremental progress.

But the industry needs to increase base station capacity much more efficiently and dramatically, he explained, by allocating spectrum when and where it's most needed.

Historically, building new towers, adding more spectrum and bringing small cells were the options available for network service providers.



Blue Danube Systems' beam forming solutions aimed at 5G.



Blue Danube's matrix of active antenna elements.

However, Pinto said that small cells aren't spreading as fast as initially thought, largely due to cost issues associated with siting and wiring. "There are also issues in managing interferences among small cells," he added. Naturally, putting up new towers isn't cheap, either.

5G is viewed as the answer to capacity issues, "But that [standardization] is going to be a while," Pinto said. "We think we have a true breakthrough based on our proprietary VLSI design."

Blue Danube Systems believes it can offer beam-forming solutions that integrate easily with LTE at "commercially viable cost." Pinto explained that there is nothing new about beam-forming itself. The technique is used in sensor arrays for directional signal transmission or reception. It's common in military radar.

The 5G technical committee is also discussing the use of massive antennas for beam-forming. But existing implementations and emerging proposals tend to rely on a "brute- force digital approach" that requires complex algorithms, Pinto explained. In contrast, Blue Danube has designed a true mixed-signal ASIC, whose analog technology is used to form beams.

The company's high-definition antenna system requires "no need to use 'real-time channel estimation' or DSPs to form beams," said the company.

Radio placed behind each array of antennas shapes radiation to form beams. As each transmitter and receiver is coordinated at Giga Hertz speed, Blue Danube's HD antenna systems quickly raster and scan the area, forming beams exactly where all the traffic is coming from, Pinto explained.

The system, designed to form highly precise 3D beams by using a large number of array elements, deploys low-cost RF components.

Assume, for example, 100 elements inside a single box. The Blue Danube's mixed-signal ASICs can keep them all synchronized and calibrated. Meanwhile, the system's "optimization algorithms adapt to component drift and provide array resiliency," according to the startup.

Blue Danube's solution is designed to boost signal quality by concentrating signals where users are, while focusing on frequency re-use where beams do not overlap. The company claims that beams in both transmitter and receiver provide up to 10 times improvement in capacity.

The real key to Blue Danube's system, though, is that it can be used by mobile operators for capacity increase without making big changes in today's 4G/LTE infrastructure. "Our technology is revolutionary but it is designed so that it's easy for operators to integrate and upgrade their systems," Pinto told *EE Times*.

More specifically, Blue Danube's high definition antenna systems can be quickly installed at existing antenna locations using conventional mounting techniques. They are also fully compatible with LTE 3GPP Release 8 and above, said Pinto.

Blue Danube has raised $25 million in total thus far including $16 million in Series B funding. AT&T made a strategic investment in that round.

At this point, many CTOs at service providers and equipment vendors already know Blue Danube, said Pinto. Some equipment vendors are even asking Blue Danube to collaborate on 5G's massive MIMO designs, or to supply Blue Danube's own mixed-signal ASICs to them.

Pinto, former executive vice president of Applied Materials and a Bell Labs fellow, said that becoming a chip vendor isn't exactly his company's plan. The startup wants to sell systems – initially to the current 4G/LTE market.

Asked how quickly Blue Danube's system will be adopted by network equipment vendors, Pinto observed that some companies are struggling with a new model, under which the radio portion (supplied by Blue Danube) will be decoupled from the rest of the network gear they are selling. "They are so used to package them together."

His company's next step is network trials. Pinto said, "We've done a lot of simulations but haven't done the live network trials. We're shooting for it in the first half of 2016."

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NATIONAL INSTRUMENTS

Consumer fuel cells to gain traction from drones?

By Julien Happich

Cartridge-based hydrogen and methanol fuel cells have been around for a long time, with many demonstrators showcased by consumer electronics companies including Nokia, NEC, Toshiba, Fujitsu, and Hitachi. Yet, while promising quick recharges and very long device autonomies, the technology never really took off in the consumer world, but this is about to change, according to Intelligent Energy.

The company licenses fuel cell platforms and technology IP for partners to produce the goods. Currently, it derives about 95% of its revenues from licencing its IP for large fuel cells (in the multiple kW range), such as those used to power remote telecom power sites (often replacing diesel power generators), or to be designed into cars. But in 2014, the company also opened Consumer Electronics division with the launch of Upp, a portable hydrogen fuel cell power solution with re-usable fuel cartridges now available in Apple stores throughout the UK. The 210x40x48mm unit, which can typically deliver one week's worth of power to a smartphone, received "CE" and "CSA" certification, it was declared safe for carriage on aircraft and got the company some publicity at CES 2015.

In January this year, Intelligent Energy has signed a Letter of Intent (LOI) with a drone manufacturer to develop hydrogen fuel cell powered drones (hoping to rollout technological solutions to increase drone flight time).

Then in February, the company also signed a joint development agreement with an emerging smartphone OEM, aiming to develop embedded fuel cell technology for the manufacturer's devices. The customer funded £5.25m project is expected to deliver embedded week-long mobile phone power.

So what makes fuel cells ripe for consumer electronics this time?

"Longer battery operation is a generic requirement across the mobile industry", recognizes Dr. Henri Winand, Intelligent Energy's Chief Executive Officer. "Nowadays, you'll find mostly software differentiation across different smartphone hardware platforms, but consumers have all come to the realization that they are being held back by the battery lifetime. And while about 1.3 Billion of us have access to electricity, a larger portion of the world's population lives off the grid", he reminded *EETimes Europe*.

A drone prototype equipped with a fuel cell stack from Intelligent Energy.

"It is not us, as a technology company, saying that we are going to push fuel cells to the consumer market, it is a handset OEM who came to us to find a solution" he notes.

"Secondly, the Upp USB-compatible fuel cell power backup unit that we sell across Apple Stores validates the need for longer energy autonomy. Every single time that a consumer buys a unit or a refill cartridge (RRP of £149 and £5.95 respectively) is a market validation of the product design and pricing strategy."

"I could compare this to bottled water. What we've seen is that in the developed world, people are ready to pay £5.90 worth of energy per week if we offer them a sufficient degree of convenience (independence from the grid), whilst in developing countries, people pay from necessity, to conduct their business despite having difficult access to the grid. When most of a country's GDP is traded through cell phone communications, no smartphone means no trade and no business".

A condition for such a business model to work is that refill cartridges be easy to access, either at local corner shops, or through a monthly or yearly subscription model. But Winand says the distribution model for refill cartridges is akin to selling chocolate bars, easy to implement.

"With Upp, we've proven the ramping up of fuel cell and cartridge manufacture as well as the business case for it. Now, the joint development of an embedded fuel cell solution for a smartphone OEM will probably take a couple of years, but if the OEM or its manufacturing partners were to ramp up the production of refill cartridges in parallel, then you could see a product ready to hit the market within two

The Upp fuel cell unit recharging a smartphone. The refill cartridge is in lighter grey.

years". To enhance user experience, the fuel cell solution will be hybridized with a battery, giving the choice for consumers to recharge either from the grid or from a fuel cartridge.

At CES, Intelligent Energy made an impression on the drone market, demonstrating drones equipped with its technology, with flying autonomies extended to the hour range.

"We've been watching the drone market for a long time" admits Winand, "back in 2000, we equipped the first aircraft powered by fuel cells, and drones are definitely a killer app for fuel cells." he concluded.

A compact fuel cell stack connected to a cylindrical fuel reservoir.

The company is targeting the prosumer drone market (in the £1000 price range) where flight times could be more than doubled, from a typical 20mn to over an hour. Based on customer requirements, the company could design cartridge-based solutions for quick plug-and-play refills, or more complex but longer range compressed gas solutions. For drone applications, it could scale up its solutions to cover the power range from 50W to 5000W.

Winand likes to see his company as the ARM-equivalent of fuel cell technology, holder of a vast catalogue of IP and patents and ready to license custom made solutions based on different bricks of IP.

According to Winand, it will take some years before drones and consumer electronics (including IoT devices) can beat telecom towers in terms of business growth for the company, but as more customers come to Intelligent Energy for sub 100W fuel cell solutions, then the numbers could add up and embedded fuel cells could become a significant business driver, thinks the CEO.

Eventually, the company can only wish that higher volumes will drive manufacturing costs down, attracting more device makers and pulling fuel cells further into the mainstream.

Omnifocal glasses pioneer raises Series A

By Peter Clarke

Deep Optics Ltd. (Petach Tikva, Israel) has raised $4 million in Series A funding to fuel the development of its "omnifocal" eyeglasses and potential extension into augmented and virtual reality applications.

The company is developing eyeglasses that include sensors and liquid crystal materials to adjust continuously to the wearer's near- and long-distance viewing (see Video: Sensors, liquid crystals make omnifocal glasses).

Two optical sensors in the frames continually analyze the eyes' pupilliary distance, which changes when the wearer is focusing on objects at different distances. This information used to calculate the distance the wearer is trying to focus on and determines the optical compensation needed to produce sharp vision at that distance. This is used to control the lenses, which are a sandwich construction including liquid crystal material in the middle layer, to produce the appropriate degree of refraction by altering the voltage applied across the liquid crystal and thereby changing its refractive index.

Funding has come from strategic investor ophthalmic optics company Essilor, Taiwan-based Atomics 14 Ventures and several private investors including Saar Wilf, Deep Optics' chairman and first investor.

Deep Optics is exploring applications for its adaptive electronic lens technology and said it has started discussions with companies in the field of augmented and virtual reality (AR/VR).

Phil Chen, founder of Atomic 14 Ventures, said he believes that Deep Optics has come up with a breakthrough technology for improving the depth perception of AR/VR.

Chip market off to slow start in 2016

By Peter Clarke

The three-month average for the global market for semiconductors fell in January 2016 on both a sequential and a year-on-year basis. The sequential fall of 2.7 percent to $26.88 billion is in-line with seasonal variation but the year-on-year fall was of 5.8 percent.

Both metrics were affected by sluggishness in the Americas region with avergad sales decreasing 16.9 percent year-on-year. Other geographic markets also dropped, but by less while China was the only market to show growth, just as it did through the winter months (see China is chip market's only growth region).

Sales also decreased across most major semiconductor product categories, with the notable exception of microprocessors, which increased year-to-year by 2.1 percent. All monthly sales numbers are compiled by the World Semiconductor Trade Statistics (WSTS) organization and represent a three-month moving average.

"Global semiconductor sales decreased in January across most regional markets and product categories, largely due to softening demand and lingering macroeconomic headwinds," said John Neuffer, CEO of the Semiconductor Industry Association, in a statement.

In January European three-month averaged chip sales were $2.721 billion, down by 1.7 percent compared to December 2015. Nevertheless, in Europe, demand remained strong for several key product categories, according to the European Semiconductor Industry Association.

Discretes, optoelectronics, sensing and emitting chips, analog devices, logic ICs and ASICs all showed growth compared to December, ESIA said in a statement. Euro-dollar exchange rates did not affect the European sales picture as much as in previous months. Measured in euros sales were €2.512 billion in January 2016, down 0.6 percent versus the previous month and an increase of 4.0 percent versus the same month a year ago.

Monthly data is given by the SIA and ESIA as a three-month average, although the WSTS organization tracks actual monthly data. The SIA and other regional semiconductor industry bodies opt to use averaged data because it evens out the actual data that typically show troughs at the beginnings of quarters and peaks at the ends of quarters.

January 2016			
Billions			
Month-to-Month Sales			
Market	Last Month	Current Month	% Change
Americas	5.75	5.41	-5.9%
Europe	2.77	2.72	-1.7%
Japan	2.57	2.48	-3.3%
China	8.45	8.41	-0.4%
Asia Pacific/All Other	8.08	7.85	-2.8%
Total	**27.62**	**26.88**	**-2.7%**
Year-to-Year Sales			
Market	Last Year	Current Month	% Change
Americas	6.51	5.41	-16.9%
Europe	2.95	2.72	-7.7%
Japan	2.62	2.48	-5.1%
China	8.07	8.41	4.3%
Asia Pacific/All Other	8.40	7.85	-6.5%
Total	**28.55**	**26.88**	**-5.8%**
Three-Month-Moving Average Sales			
Market	Aug/Sep/Oct	Nov/Dec/Jan	% Change
Americas	6.05	5.41	-10.6%
Europe	2.91	2.72	-6.4%
Japan	2.70	2.48	-7.8%
China	8.58	8.41	-1.9%
Asia Pacific/All Other	8.75	7.85	-10.2%
Total	**28.97**	**26.88**	**-7.2%**

Three-month average of sales for January 2016 and December 2015. Source: SIA/WSTS.

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Silicon based material could upstage graphene for solar energy conversion

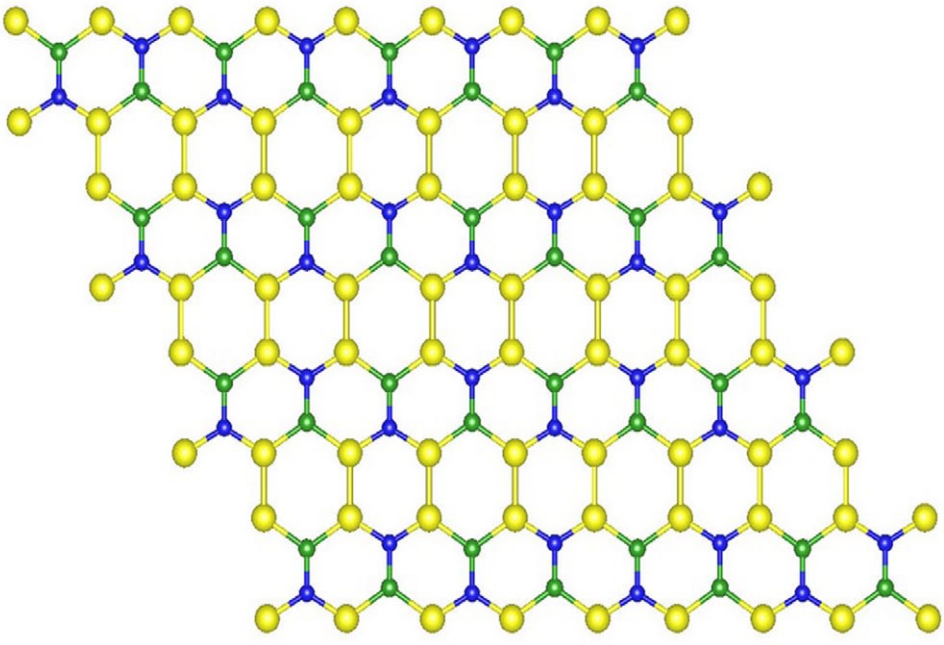
By Paul Buckley

Researchers at the University of Kentucky working with scientists from Daimler in Germany and the Institute for Electronic Structure and Laser in Greece have discovered a single atom-thick flat material that could upstage graphene and advance solar energy conversion.

The material, which is reported in Physical Review B, Rapid Communication, is made up of silicon, boron and nitrogen - all light, inexpensive and earth abundant elements - and is stable, a property many other graphene alternatives lack.

"We used simulations to see if the bonds would break or disintegrate - it didn't happen," said Madhu Menon, a physicist in the UK Center for Computational Sciences. "We heated the material up to 1,000 degree Celsius and it still didn't break."

Using state-of-the-art theoretical computations, Menon and his collaborators Ernst Richter from Daimler and a former UK Department of Physics and Astronomy post-doctoral research associate, and Antonis Andriotis from IESL, have demonstrated that by combining the three elements, it is possible to obtain a one atom-thick, truly 2D material with properties that can be fine-tuned to suit various applications beyond what is possible with graphene.



While graphene is touted as being the world's strongest material with many novel properties, it has one downside which is that graphene is not a semiconductor and therefore disappoints in the digital technology industry. Subsequent search for new 2D semiconducting materials led researchers to a new class of three-layer materials called transition-metal dichalcogenides (TMDCs). TMDCs are mostly semiconductors and can be made into digital processors with greater efficiency than anything possible with silicon. However, these are much bulkier than graphene and made of materials that are not necessarily earth abundant and inexpensive.

Searching for a better option that is light, earth abundant, inexpensive and a semiconductor, the team led by Menon studied different combinations of elements from the first and second row of the Periodic Table.

Although there are many ways to combine silicon, boron and nitrogen to form planar structures, only one specific arrangement of these elements resulted in a stable structure. The atoms in the new structure are arranged in a hexagonal pattern as in graphene, but that is where the similarity ends.

The three elements forming the new material all have different sizes; the bonds connecting the atoms are also different. As a result, the sides of the hexagons formed by these atoms are unequal, unlike in graphene. The new material is metallic, but can be made semiconducting easily by attaching other elements on top of the silicon atoms.

The presence of silicon also offers the exciting possibility of seamless integration with the current silicon-based technology, allowing the industry to slowly move away from silicon instead of eliminating it completely, all at once.

"We know that silicon-based technology is reaching its limit because we are putting more and more components together and making electronic processors more and more compact," explained Menon. "But we know that this cannot go on indefinitely; we need smarter materials."

In addition to creating an electronic band gap, attachment of other elements can also be used to selectively change the band gap values - a key advantage over graphene for solar energy conversion and electronics applications.

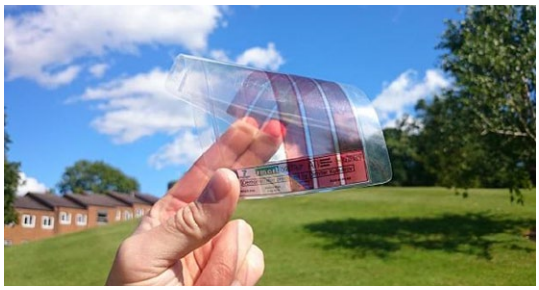
Other graphene-like materials have been proposed but lack the strengths of the material discovered by Menon and his team. Silicene, for example, does not have a flat surface and eventually forms a 3D surface. Other materials are highly unstable, some only for a few hours at most.

The bulk of the theoretical calculations required were performed on the computers at the UK Center for Computational Sciences with collaborators Richter and Andriotis directly accessing them through fast networks. Now the team is working in close collaboration with a team led by Mahendra Sunkara of the Conn Center for Renewable Energy Research at University of Louisville to create the material in the lab. The Conn Center team has had close collaborations with Menon on a number of new materials systems where they were able to test his theory with experiments for a number of several new solar materials.

"This discovery opens a new chapter in material science by offering new opportunities for researchers to explore functional flexibility and new properties for new applications," said Menon. "We can expect some surprises."

Graphene goes ultra-thin, absorbent

By Jessica Lipsky



Flexible solar cell. Source: University of Surrey

Researchers at the University of Surrey in the U.K. have developed nanometer-thin graphene sheets that can better absorb light and heat. Traditionally a poor absorber of light, the sheets could power smart wallpaper or other applications in the Internet of Things.

A team at Surrey's Advanced Technology Institute (ATI) employed nanotexturing, a technique involves growing graphene around a textured metallic surface, to make the sheets. The sheets are 90% more light absorbent than traditional graphene, largely due to nano-patterning to localizes light into the narrow spaces between the textured surface.

"Nanotexturing graphene has the effect of channeling the light into the narrow spaces between nanostructures, thereby enhancing the amount of light absorbed by the material," wrote Dr. José Anguita, the study's lead author. "Typically a graphene sheet would have 2-3% light absorption. Using this method, our ultrathin coating of nanotextured few-layer graphene absorbs 95% of incident light across a broad spectrum, from the UV to the infrared."

The nano patterns on the graphene sheets resemble moths' eyes, which have microscopic patterning that allows them to see in dim conditions.

"These work by channelling light towards the middle of the eye, with the added benefit of eliminating reflections, which would otherwise alert predators of their location," wrote ATI Head, Professor Ravi Silva.

ATI researchers reported their findings in the journal Science Advances, adding:

We demonstrate the utility of our approach to produce the blackbody absorber on delicate opto-microelectromechanical infrared emitters, using a low-temperature, noncontact fabrication method, which is also large-area compatible. This development may pave a way to new fabrication methodologies for optical devices requiring light management at the nanoscale.

Solar cells could be coated with these thin graphene sheets to harvest very dim light or be installed indoors to generate electricity from light or heat to power smart home applications.

MIT demonstrates the thinnest, lightest solar cells ever produced

By Paul Buckley

Researchers at MIT claim to have demonstrated the thinnest, lightest solar cells ever produced. The solar cell is so thin, flexible and lightweight that it could be placed on almost any material or surface.

The laboratory proof-of-concept shows an approach to making solar cells that could help power the next generation of portable electronic devices. The new generation of solar cell could be included in clothes, smartphones, a sheet of paper or a helium balloon.

The process is described in a paper by MIT professor Vladimir Bulovic, research scientist Annie Wang, and doctoral student Joel Jean, in the journal Organic Electronics. Bulovic, MIT's associate dean for innovation and the Fariborz Maseeh (1990) Professor of Emerging Technology, said the key to the new approach is to make the solar cell, the substrate that supports it, and a protective over-coating to shield it from the environment, all in one process. The substrate is made in place and never needs to be handled, cleaned, or removed from the vacuum during fabrication, thus minimizing exposure to dust or other contaminants that could degrade the cell's performance.

"The innovative step is the realization that you can grow the substrate at the same time as you grow the device," explained Bulovic.

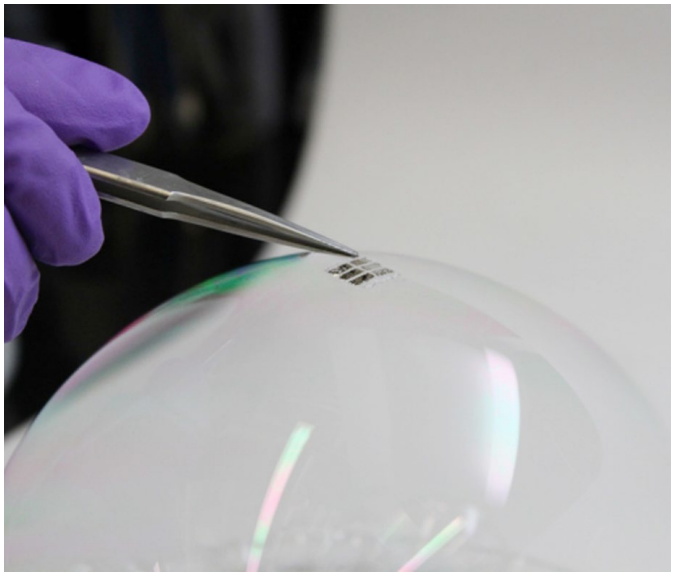
In the initial proof-of-concept experiment, the team used a common flexible polymer called parylene as both the substrate and the overcoating, and an organic material called DBP as the primary light-absorbing layer. Parylene is a commercially available plastic coating used widely to protect implanted biomedical devices and printed circuit boards from environmental damage. The entire process takes place in a vacuum chamber at room temperature and without the use of any solvents, unlike conventional solar-cell manufacturing, which requires high temperatures and harsh chemicals. In this case, both the substrate and the solar cell are 'grown' using established vapour deposition techniques.

The team emphasizes that the particular choices of materials were just examples, and that it is the in-line substrate manufacturing process that is the key innovation. Different materials could be used for the substrate and encapsulation layers, and different types of thin-film solar cell materials, including quantum dots or perovskites, could be substituted for the organic layers used in initial tests.

To demonstrate just how thin and lightweight the cells are, the researchers draped a working cell on top of a soap bubble, without popping the bubble. The researchers acknowledge that this cell may be too thin to be practical. "If you breathe too hard, you might blow it away," said Jean. Parylene films of thicknesses of up to 80 microns can be deposited easily using commercial equipment, without losing the other benefits of in-line substrate formation.

A flexible parylene film, similar to kitchen cling-wrap but only one-tenth as thick, is first deposited on a sturdier carrier material – in this case, glass. Figuring out how to cleanly separate the thin material from the glass was a key challenge, explains Wang, who has spent many years working with parylene.

The researchers lift the entire parylene/solar cell/parylene stack off the carrier after the fabrication process is complete, using a frame made of flexible film. The final ultra-thin, flexible solar cells, including substrate and overcoating are about two micrometers thick, yet they convert sunlight into electricity just as efficiently as their glass-based counterparts.



MIT's thin and lightweight solar cells draped on top of a soap bubble. (Photo: Joel Jean and Anna Osherov)

"We put our carrier in a vacuum system, then we deposit everything else on top of it, and then peel the whole thing off," explained Wang. Bulovic said that like most new inventions, it all sounds very simple — once it has been done. But actually developing the techniques to make the process work required years of effort.

While they used a glass carrier for their solar cells, Jean said "it could be something else. You could use almost any material," since the processing takes place under such benign conditions. The substrate and solar cell could be deposited directly on fabric or paper, for example.

While the solar cell in this demonstration device is not especially efficient, because of its low weight, its power-to-weight ratio is among the highest ever achieved. That's important for applications where weight is important, such as on spacecraft or on high-altitude helium balloons used for research. Whereas a typical silicon-based solar module, whose weight is dominated by a glass cover, may produce about 15 watts of power per kilogram of weight, the new cells have already demonstrated an output of 6 watts per gram — about 400 times higher.

"It could be so light that you don't even know it's there, on your shirt or on your notebook," said Bulovic. "These cells could simply be an add-on to existing structures."

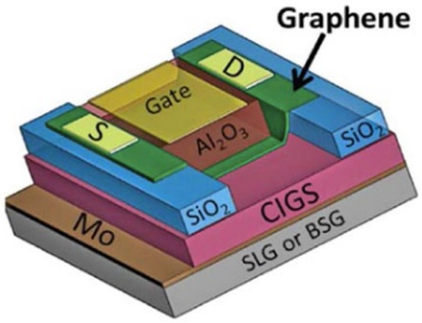
The work could open up new applications for solar power in the long term. "We have a proof-of-concept that works," said Bulovic. The next question is, "How many miracles does it take to make it scalable? We think it's a lot of hard work ahead, but likely no miracles needed."

Graphene-on-glass makes doped transistor

By Peter Clarke

Scientists from across New York State have developed a method for creating graphene layers on common glass with advantageous doping. Graphene is a sheet form of carbon one atom thick with high electron mobility and the scientists have developed a scalable and inexpensive process for the creation of microelectronic and optoelectronic devices. Graphene's high conductivity and transparency make it a candidate as a transparent, conductive electrode to replace the relatively brittle and expensive indium tin oxide (ITO) in applications such as solar cells, organic light emitting diodes (OLEDs), flat panel displays, and touch screens.

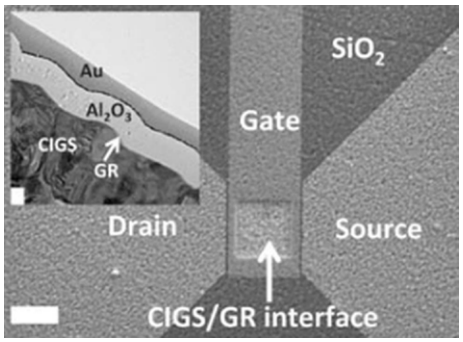
The scientists built the graphene devices on substrates of soda-lime glass – the most common glass used in bottles and windows – and found that the sodium present in the glass could act as dopant for the graphene. The effect remained strong in the devices even after they had been exposed to air for several weeks.



Schematic of a graphene field-effect-transistor used in this study. The device consists of a solar cell containing graphene stacked on top of a high-performance copper indium gallium diselenide (CIGS) semiconductor, which in turn is stacked on an industrial substrate (either soda-lime glass, SLG, or sodium-free borosilicate glass, BSG). Source: Brookhaven National Laboratory.

"The sodium inside the soda-lime glass creates high electron density in the graphene, which is essential to many processes and has been challenging to achieve," said Nanditha Dissanayake of Voxtel, Inc., but formerly of Brookhaven Lab and one of the journal Scientific Reports.

The team initially set out to optimize a solar cell containing graphene stacked on a copper indium gallium diselenide (CIGS) semiconductor, which in turn was stacked on an industrial soda-lime glass substrate. The scientists then conducted preliminary tests of the novel system to provide a baseline for testing the effects of subsequent doping. But these tests exposed something strange: the graphene was already optimally doped without the introduction of any additional chemicals.



A scanning electron micrograph of the device as seen from above, with the white scale bar measuring 10 microns, and a transmission electron micrograph inset of the CIGS/graphene interface where the white scale bar measures 100 nanometers. Source Brookhaven National Laboratory.

It was consequently found that sodium atoms were doping the graphene and could form a vital part of the creation of transistor devices where the differences in electron-hole densities contribute to the transistor action. Pinpointing the mechanism by which sodium acts as a dopant involved a painstaking exploration of the system and its performance under different conditions, including making devices and measuring the doping strength on a wide range of substrates, both with and without sodium. The collaboration was led by scientists at the US Department of Energy's (DOE) Brookhaven National Laboratory, Stony Brook University (SBU), and the Colleges of Nanoscale Science and Engineering at SUNY Polytechnic Institute.

The scientists now need to probe more deeply into the fundamentals of the doping mechanism and more carefully study material's resilience during exposure to real-world operating conditions. The initial results, however, suggest that the glass-graphene method is much more resistant to degradation than many other doping techniques.

Power supply & EMC coexistence in the medical space

By Patrick Le Fèvre

From gadget to vital, connected devices and the Internet of Things (IoT) are everywhere and we see them gradually changing our lives throughout; the exponential development of small to large products embedding radio-transmitters is developing whilst creating some concerns, in terms of interferences and equipment disturbance, especially in the case of medical applications where it could have severe consequences!

With the multiplication of products transmitting radio signals, it becomes very complex for medical equipment manufacturers to ensure their equipment is secure, using either published IEEE standards or proprietary protocols, which many are operating at unlicensed frequencies in the ISM (Industrial, Scientific and Medical) or in the MICS (Medical Implant Communication Service) bands to properly operate, without interfering in been interfered by other equipment. Consequently ensuring wireless coexistence in medicals applications, all over the world, regulatory bodies have focused efforts to standardize protocols and processes, which will require from power supplies manufacturers to include "Wireless Coexistence" testing and verification when designing power sources for medical equipment.

When the unpredictable could happen!

As the world would stop without reliable power, the power industry has a long history in building robust power systems. Industry permanently innovates new technology, improving energy efficiency, reliability and safety though out. With the rapid development of multiple Connected Devices in medical applications, some may be powered by harvesting energy, making them very sensitive to radio interference whilst others might even get their power from radio-waves. Power supplies coexistence with radio signals and need to be considered differently from our previous experiences; especially with medical equipment installed outside professional healthcare controlled environment, such as at home.

As the number of connected devices and radio transmission within medical environments increased, starting in 2010, the number of cases of medical equipment reporting false alarms, having random failures, or malfunctioning, has grown significantly, warning the medical community about the coexistence of multiple radio transmitting equipment that patients' lives might depend upon. In many cases of reported faults, it was very difficult to pinpoint the exact cause, until in-depth investigations revealed radio interferences were the root cause of the problem. In the US, the Food and Drug Administration (FDA) records malfunctions in a central database "MAUDE", which includes a growing number of EMC problems.

When welding turns the alarm on

A patient affected by respiration and heart problems was connected to a very advanced ventilator at home, coupled to a wireless cardio-monitoring. The patient's health was monitored from a remote healthcare center, which received a series of

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Fig. 1: A typical hospital operating theatre combine strategic and vital equipment with more and more connected devices.

	IEC 60601-1-2 3rd Edition	IEC 60601-1-2 4th Edition	
		Prof. Healthcare	Home Healthcare
ESD IEC 61000-4-2	8 KV Air Discharge (Max.) 6 KV Contact Discharge	15 KV Air Discharge (Max.) 8 KV Contact Discharge	
Radiated Immunity IEC 61000-4-3	3 V/m – Non Life Support 10 V/m – Life Support 80 MHz – 2.5 GHz 80% @ 2Hz (or 1 KHz) AM Modulation	3 V/m 80 MHz – 2.7 GHz 80% @ 1 KHz AM Modulation	10 V/m 80 MHz – 2.7 GHz 80% @ 1 KHz AM Modulation
EFT/Burst IEC 61000-4-4	±2 KV, 5KHz – AC Mains ±1 KV, 5KHz – I/O Ports 5 KHz or 100 KHz PRR	±2 KV – AC Mains ±1 KV – I/O Ports 100 KHz PRR	
Surges IEC 61000-4-5			
AC Mains, Line to Ground	±0.5, 1, 2 kV	±0.5, 1, 2 kV	
AC Main, Line to Line	±0.5, 1 kV	±0.5, 1 kV	
DC Input (>3m) Line to GND	No test	±0.5, 1, 2 kV	
DC Input (>3m) Line to Line	No test	±0.5, 1 kV	
I/O Line to GND	No test	±2 kV (outdoor lines only)	
Conducted Immunity IEC 61000-4-6	3 V (0.15 – 80 MHz) 10 V ISM Bands (Life Support)	3 V (0.15 – 80 MHz) 6 V ISM Bands	3 V (0.15 – 80 MHz) 6 V ISM Bands + Amateurs
Magnetic Immunity IEC 61000-4-8	3 A/m – 50 and 60 Hz	30 A/m – 50 and 60 Hz	
Voltages Dips And Interrupts IEC 61000-4-11	>95% dip, 0.5 periods, 0° and 180° 60% dip, 5 periods 30% dip, 25 periods Interrupt >95% drop, 5 seconds	100% drop, 0.5 periods, 0°, 45°, 90°, 135°, 180°, 225°, 270°, 315° 100% dip, 1 period 30% dip, 25/30 periods Interrupt 100% drop, 5 seconds	
Proximity Field from Wireless Transmitters (NEW TEST)	No test	9 V/m to 28 V/m 15 specific frequencies	

Orange text highlights the changes from the Third Edition.

Table 1: IEC 60601-1-2 4th editions changes.

alarms. After calling the patient, who fortunately was doing very well, all alarms were classified as false, motivating the replacement of the monitoring units. Despite replacing the system, randomly, it was still signaling warnings! Equipment manufacturers conducted thorough analysis, without finding either hardware or software issues. By coincidence a Nurse visiting the patient noticed a strange noise coming from the radio and, at the same time the monitoring alarm came on. Further investigations identified that a nearby industrial company was using a high energy welding equipment, which had a default shielding; radiating radio waves were interacting with the control loop of sensors, trigging alarms. This example is probably anecdotal but is one of many motivating the medical industry to rethink Electromagnetics Interferences within the medical space ensuring everything works smoothly and safely.

Hospital operating theatre

Considering the amazing evolution of tele-medicine, including remote surgery operated by robots, radio interferences in medicals applications have become a high priority for that industry.

Figure 1 is an example of hospital operating theatre in which a number of strategic and vital equipment are operated, including more and more connected devices.

Electricity signal cables, infusion pumps, echo cardiogram, anesthetic machine, physiological monitoring, pressure infuser, pacemaker, transit-time flowmeter and even mobile phones and pagers are all generating radio signals, without mentioning high energy equipment such as plasma-knife that could generate electromagnetics interferences. In such environments, adding the IoT dimension and the multiplication of connected devices, it is obvious that thorough procedures guaranteeing the electromagnetic compatibility and immunity to radio interference is a must, which is what the IEC 60601-1-2 4th edition (2014) is addressing to make the unpredictable, more predictable.

Coexistence & EMC, the IEC 60601-1-2 (2014)

With the need for intensive work and cooperation between the different players, including Power Supplies manufacturers, the International Electro technical Commission (IEC) published a revision of the electromagnetic compatibility (EMC) requirements for medical devices under a 4th edition of IEC 60601-1-2 in 2014. These revisions contained a number of changes, including new immunity and more robust risk analysis requirements.

Taking in consideration the growing number of connected devices, new operated radio frequency bands and the risk of interferences between the different pieces of medical equipment, the revised standards included increased immunity test levels, with the range for radiated immunity, magnetic-immunity, conducted-immunity, significant increases in electrostatic discharge (ESD) levels and voltage dips and interruption phase angles. In addition, immunity testing has been added which follows the rationale of 60601-1-11 (collateral standard for home healthcare) in the form of immunity to proximity fields from RF wireless communications equipment at significantly higher levels than have been used for radiated RF immunity testing in the past.

The main goal of the 4th edition is to ensure that the medical practices aimed at saving lives are not disturbed by common EMC phenomena. By testing, verifying and certifying units according to the new standards, including collateral, products will become safer and secured to operate in harmony with others equipment. Table 1 summarizes the differences between IEC 60601-1-2 (2007) 3rd edition and the (2014) 4th edition, though major changes can be summarized in few points:

Used environments - Taking in consideration that medical equipment is operated in environments controlled and exposed to different risks, three categories have been identified. In the previous 3rd edition of the standard, the requirements were based on the purpose of the equipment. In the current 4th edition, the requirements are based on the intended use/environment of the equipment:

- Professional healthcare facility environment (hospital, physician offices…)
- Home healthcare environment (homes, nursing home, public places…)
- Special environment (military areas, heavy industrial areas, high power medical equipment)

In addition, the 4th edition introduces new definitions:

- Intended use (medical purpose only)
- Normal use (including medical use and transport, maintenance, standby)

EMC compliance – The EMC compliance tests and limits will be defined according to risk and intended use instead of a device type. Tests are based upon where the equipment will be operated in the three defined categories; healthcare facility, at home or in a special environment such as military, heavy industrial, or medical treatment area with high-powered medical equipment. All tests will be performed with "Intended Use." (Note: manufacturers will need to prepare a test plan/risk analysis prior to testing. Clause 6.2 requires that an EMC test plan be provided to the EMC test lab).

Special Environments – Considering the very specific to this environment, immunity test levels, higher or lower, than those specified for the professional healthcare and home environments might be appropriate, which has to be defined, during the design phase, in close cooperation with final user.

EMC Risk Management - Risk management analysis will be required from the medical equipment, including external power supplies manufacturers to state the risk from EMC disturbances. This test includes new frequencies and different levels depending on the category.

ESD level goes up – Products will be subjected to increased immunity test levels to minimize the risk of electromagnetic interference: for example, the ESD test levels are increased to 15KV air and 8KV contact and the levels of conducted immunity testing are now increased to 6v in the ISM frequency bands.

Wireless proximity – As a result of increased wireless equipment and strength of radiated signals, the radiated immunity test level is now up to 28V/m at certain frequencies. These levels have been raised to evaluate the products susceptibility to interference from common wireless devices. (Note: all products must comply with the new test).

Fig. 2: Low EMI external medical power supply Powerbox EXM30 powers IoT.

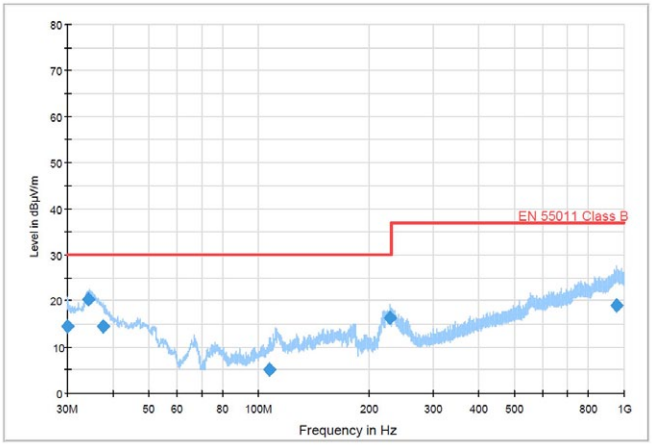


Fig. 3: EXM30 Radiated EMI curves pushing down the limits.

Immunity levels – Very low flexibility to use lower immunity levels for compliance; the Annex "E" describes the process for determining the immunity test levels for products used in special environments where different immunity levels could be justified. To assist manufacturers to prepare their test plans, a guideline has been added in Annex "G" of the standard.

Implementation

IoT and smart connected devices continue to take the world by storm, even in the medical device industry, so it is essential that the industry adopts as quickly as possible the new standard. The fourth edition of the IEC 60601-1-2:2014 standard is out and the revision mandates compliance of new products by April 2017 in the USA though, in late 2014, the FDA issued a letter recommending that devices undergo EMC testing to the 4th standard as soon as possible. Taking in consideration the number of new connected devices addressing the medical space, as well the growing risk of interferences, it has been reported that the FDA is asking for compliance with the 4th Edition now; on new 510(k) applications.

In Europe, the withdrawal date of the 3rd Edition is expected in a 2017-2018 timeframe. The estimated compliance date of EN 60601-1-2:2014 was December 31st 2018. However, this date will be finalized upon the information being published in the European Official Journal though, considering FDA in US pushing for quick implementation, it could happen much earlier. After the published date, all medical devices sold to the EU must comply with the new standard.

Powering IoT in medical space

Taking in consideration that EMC is very important when powering equipment, but even more important when supplying power to medical applications and medical IoT, power supplies manufacturers developed new technologies to reduce EMI, without having to package final product in heavy metal cases. Power switching units designed for self-contained EMI – see figure 2 - are now reaching the market; performing across all bands (30 MHz to 1 GHz) an average of 15 dB below the EN 55011 Class B – see the EXM30 radiated emissions shown in figure 3.

Low EMI is very important when the power supply coexists with low power sensors, such the ones deployed in medical applications and reducing the level of EMI to almost no radiation at all, will require new technologies. IoT devices in the medical world are being rapidly deployed, requiring the power industry to rethink the basic fundamentals of radio interferences and radio coexistence, which is exciting for power designers and opening up amazing fields of technological innovations.

"Detecting and dealing with stress using sensors is quite a challenge!"

By Chris Van Hoof

Chip technology enables us to improve existing measurement and diagnostic methods for conditions such as cardiac and neuro disorders. It makes the equipment more compact, more economical and more comfortable for the patient, too. In 2015, we carried out a number of projects in this area. Of course you need to have the right expertise, but in itself, this is not the greatest challenge in terms of medical sensor systems.

So, what is the greatest challenge? Developing new methods, that's what!

For example, our research group is looking at how sensor systems can make a contribution in the diagnosis and/or monitoring of heart failure, stress, sleep apnea and head trauma. Working with medical specialists, we're examining which parameters are relevant and how we can measure them accurately. The difficult thing in all this is that the method has to be demonstrated and approved in trials with a sufficient number of patients. Which of course means that you need a robust and mature demonstrator – and that is by no means straightforward in the research phase. But it's not impossible: this year we succeeded in setting up trials for heart failure (30 patients) and stress detection (1,500 people).

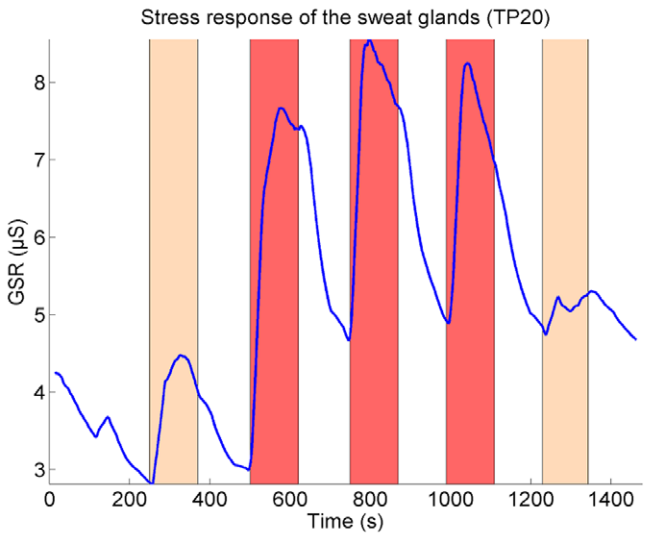
In the area of sensor systems for lifestyle applications, there are all sorts of other challenges. These include genuine ease of use, the personalization of algorithms and the creation of convincing applications that help persuade us to change our behavior. Most of the gadgets you find on the market today tend to be disappointing when it comes to accuracy. They are very good for checking whether fit people manage to do their 10,000 steps or cycle enough kilometers, but they are of no use at all for the other 90% of the population. They are simply not accurate enough for measuring whether your elderly aunt is getting up and moving about the house enough, or whether your overweight uncle is increasing his level of fitness by doing the extra exercises given to him by the doctor. Overall, current devices are not at all inspiring and don't actually anticipate your individual needs and habits.

How can you use sensors to encourage older and obese people to exercise more? How can you get someone to stop smoking? How can you help a person to keep their stress levels under control?

imec's stress monitoring wristband.

We at imec and Holst Centre are confident that sensors can help to recognize habits and make adjustments to behavior. But it is certainly no easy task: not technologically, but also not because psychologists and behavioral scientists tend not to be very familiar with modern technology. As a result, there is still some skepticism about whether or not sensors are of any value in changing people's patterns of behavior. We are currently working with some enthusiastic behaviorists from UZLeuven and KULeuven to investigate the usefulness of sensors for stress management.

One of the main problems with using sensors to change behavior is the personalization required for the sensors themselves. Take stress, for example, which expresses itself differently in each individual. One person may start sweating, while other gets heart palpitations – and so on. This is in stark contrast with heart rhythm measurements, for instance, where all of the signals are more or less the same. They are also well known and any discrepancies are clearly identifiable. Personalized sensors and algorithms are needed to identify behavior correctly with any accuracy and then make adjustments. In practical terms, imec and Holst Centre took the first steps in 2015 to validate the measuring technique used for stress and to recognize people's habits and trigger moments using sensors and artificial intelligence technologies. In 2016, the emphasis will be on providing feedback, for example to reduce stress. A project will also be started to help smokers to quit their bad habit with a 'virtual coach', as we also call our sensor approach. Because one thing is certain: if we were all to have a personal coach who kept an eye on us 24/7, we wouldn't have to make a list of New Year's resolutions any more. Or maybe we would – even if it was simply to pass them on to our virtual coach.



Galvanic Skin Response (GSR) measured while people were subjected to a stress factor (red bars) or while they were talking (grey bars).

Chris Van Hoof is program director for wearable healthcare & fellow at imec – www.imec.be

Artificial skin sensor provides low-cost environmental monitoring solution

By Paul Buckley

Electrical engineers from King Abdullah University of Science and Technology (KAUST) have used aluminum foil, sticky note paper, sponges and tape to develop a low-cost sensor that can detect external stimuli, including touch, pressure, temperature, acidity and humidity.

The sensor, which is called Paper Skin, is claimed to perform as well as other artificial skin applications currently being developed while integrating multiple functions using cost-effective materials.

Wearable and flexible electronics show promise for a variety of applications, such as wireless monitoring of patient health and touch-free computer interfaces, but current research in this direction employs expensive and sophisticated materials and processes.

"Our work has the potential to revolutionize the electronics industry and opens the door to commercializing affordable high-performance sensing devices," claimed Muhammad Mustafa Hussain, KAUST associate professor of electrical engineering from the University's Integrated Nanotechnology Lab, where the research was conducted.

"Previous efforts in this direction used sophisticated materials or processes," said Hussain. "Chemically functionalized inkjet printed or vacuum technology-processed papers - albeit cheap - have shown limited functionalities. Here we show a scalable 'garage' fabrication approach using off-the-shelf and inexpensive household elements."

The team used sticky note paper to detect humidity, sponges and wipes to detect pressure and aluminum foil to detect motion. Coloring a sticky note with an HB pencil allowed the paper to detect acidity levels, and aluminum foil and conductive silver ink were used to detect temperature differences.

The materials were put together into a simple paper-based platform that was then connected to a device that detected changes in electrical conductivity according to external stimuli.

Increasing levels of humidity, for example, increased the platform's ability to store an electrical charge, or its capacitance. Exposing the sensor to an acidic solution increased its resistance, while exposing it to an alkaline solution decreased it. Voltage changes were detected with temperature changes. Bringing a finger closer to the platform disturbed its electromagnetic field, decreasing its capacitance.

The team applied the various properties of the materials they used, including their porosity, adsorption, elasticity and dimensions to develop the low-cost sensory platform. They also demonstrated that a single integrated platform could simultaneously detect multiple stimuli in real time.

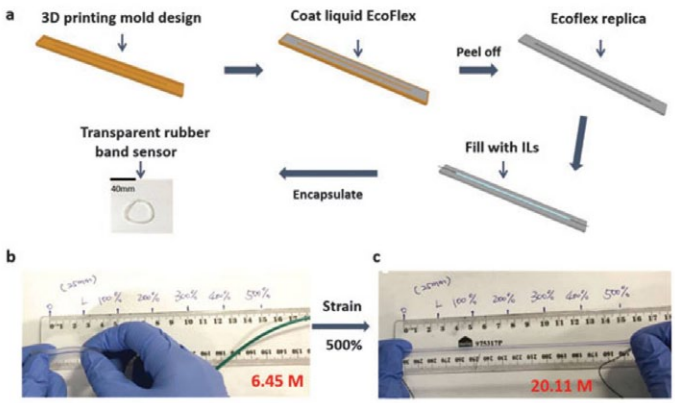
Several challenges must be overcome before a fully autonomous, flexible and multifunctional sensory platform becomes commercially achievable, explained Hussain. Wireless interaction with the paper skin needs to be developed. Reliability tests also need to be conducted to assess how long the sensor can last and how good its performance is under severe bending conditions.

"The next stage will be to optimize the sensor's integration on this platform for applications in medical monitoring systems. The flexible and conformal sensory platform will enable simultaneous real-time monitoring of body vital signs, such as heart rate, blood pressure, breathing patterns and movement," said.

"We may also transfer the achieved functionalities of the technology to biologically grown skin and develop mechanisms to connect it to neuronal networks in the human body to assist burn victims, for example. Other applications include robotics, vehicular technology and environmental surveys".

Stretchable band does it all for biomedical wearables

By Julien Happich



Researchers from Monash University, Australia have been tackling the issues around the bending and stretching capabilities of wearable sensors for biomedical applications. Led by Prof. Wenlong Cheng, Director of Research at the Department of Chemical Engineering, the researchers took a novel approach to sensing motion and vital signs by devising a highly stretchable and very sensitive elastic strain sensor that could closely conform to the wearer's skin.

Rather than rely on wavy patterns of conductive inks or other metallic/semiconductor particles compounded into an elastomeric material, the researchers embedded a channel filled with

ionic liquid (IL) as a variable conductor. Interestingly, the fabrication process is very simple, and very cheap too. The researchers used 3D printing to build a simple mould before pouring and curing Ecoflex silicone material to obtain a band featuring the imprinted microchannel.

Once filled with ionic liquid, the millimetre-thin channel was sealed with another layer of silicone.

Because the ionic liquid flows freely within its stretchable channel, it doesn't suffer from the fatigue, cracking or local delamination issues that make alternative stretchable electronics eventually fail under repeated flexures.

As the band is bent or stretched, the micro-channel is elongated and its width reduced (the liquid's volume remains constant), affecting the distribution of the conductive ions and decreasing the channel's overall electrical conductivity.

Once applied to the skin, monitoring the resistance change in the elastic band is akin to measuring skin motion and strain. The researchers demonstrated that they could tune the sensitivity of the band by adjusting the dimensions of the microchannel, from sub-millimetre to just under 2mm.

Applying a voltage of 3V across the band, they were able to detect a wide range of strains from 0.1 to 500% with repeatability, long-term stability and negligible variations. In fact, the band was so sensitive that even woven into a bracelet, it could detect minute deformations, such as identifying wrist pulses in real time, or monitoring different hand gestures such as clenching, palm bending or the bending of individual fingers.

But that's not all, the researchers also noted that increased temperature contributed to enhanced conductivity sensitivity. They incorporated the device in a LED circuit and observed how the LED's brightness could be regulated by the bracelet's temperature, hence monitoring current resistance changes based on temperature. The current for human body temperature (37°C) was around 10.2uA, making the elastic strain sensor potentially suitable as a wearable thermometer.

Another interesting observation is that this cheap strain sensor is not only waterproof, but remains operational under water and in fact, is pressure sensitive too.

An interpretation is that upon submersion, water pressure shrinks the embedded channel and thus concentrates the ions, decreasing overall channel resistance.

To complete their extensive battery of tests, the Australian team performed washing tests at different temperatures, they also tested the bands to 50 000 life cycles under both low (5%) and high (100%) strains at frequencies of 1, 2 and 7Hz, always observing a high signal–noise-ratio, reliable dynamic responses and negligible peak losses (0.26%). Six month of shelf storage didn't alter these results.

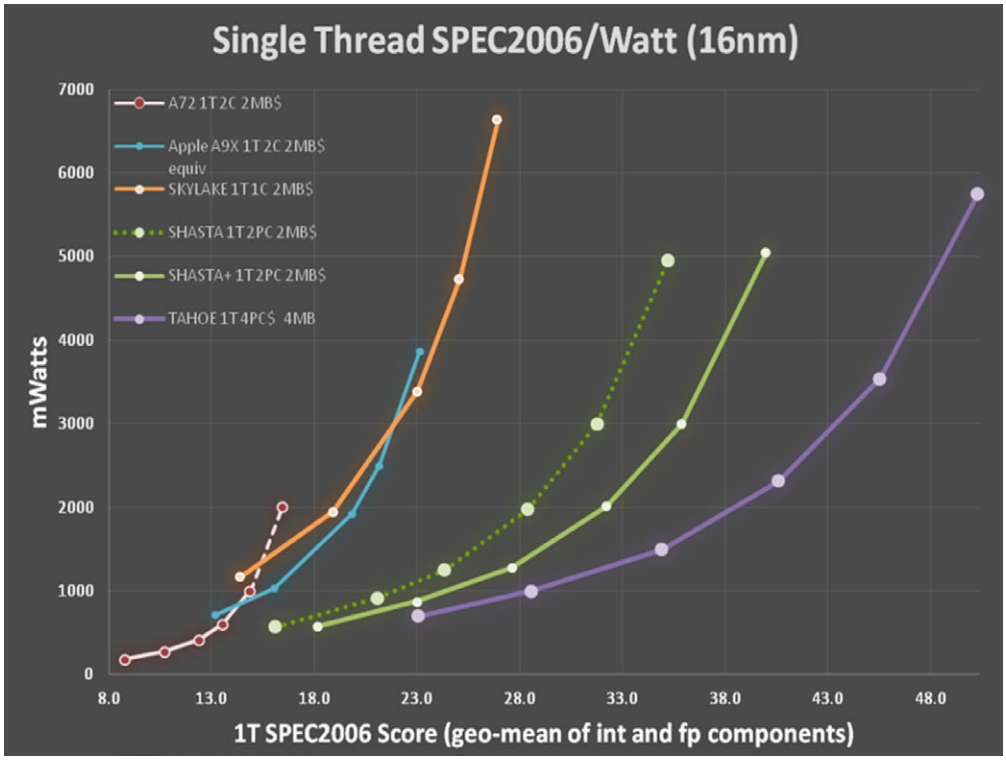
The complete results are detailed in the paper "Volume-invariant ionic liquid microbands as highly durable wearable biomedical sensors" published in the journal Materials Horizons from the Royal Society of Chemistry.

Soft Machines: promising, not proven

By Kevin Krewell

Soft Machines is working on a new architecture that, if successful, will represent a major breakthrough in single- and multicore CPU performance. The company claims it can build a multicore processor where hardware orchestration logic allows multiple CPU cores to act as one, significantly improving instruction per cycle (IPC) performance over a single CPU core and allowing multicore processors to perform significantly better on single-threaded code.

The company has built a multi-national team, raised $175 million and is now close to demonstrating the first real products using its VISC technology.



Soft Machines' simulations show its Shasta (green) and Tahoe (purple) chips outperforming Intel Skylake and Apple A9x chips. Chart courtesy of Soft Machines.

Soft Machine's business model is flexible – offering a mix of both chips and licensable CPU IP. The company's first test silicon was built in late 2014 in a 28nm process. The details of the original test chip were reported back in 2014. The original demo didn't silence the skeptics, but was enough to convince a number of investors to put more money in Soft Machines.

This year the company plans to tape out a SoC code named Mojave in a 16nm FinFET process based on a core named Shasta. The company also revealed an ambitious roadmap at The Linley Group Processor Conference in 2015 to deliver a new CPU and SoC every year for the next three years.

While the original 28nm proof-of-concept design was 32-bit, the new Shasta CPU emulates the 64-bit ARMv8 instruction set. Shasta includes two physical cores and can support one to two virtual CPUs. Future versions will support up to four physical cores. The company's stated goals are to deliver up to 2.5x performance improvement at the same power, or up to 4x energy advantage at the same performance compared with a standard ARM core. The comparison is of a present day ARM CPU with a future four core VISC CPU called Tahoe, schedule to ship in 2018.

Soft Machines recently updated its simulated performance numbers with comparisons to Apple's A9X and Intel's Skylake shown in the figure below. The company doesn't have physical Shasta-based chips for testing, so its data was from simulations. Actual Shasta core RTL is scheduled to be released mid-2016 and the Mojave SoC tape out is expected in Q3 of 2016.

For the sake of an apples-to-apples comparison in its performance charts, Soft Machines normalized the processor configurations (cache sizes) between the ARM Cortex-A72, Apple A9X, Intel Skylake, and its VISC cores.

This does not mean that the VISC cores will be configured exactly this way with regard to cache size.

The numbers look impressive as the single-threaded SPEC benchmark code sees a significant performance jump of roughly 40% even over high IPC processors like the A9X and Skylake. With that said, the SPEC code is statically compiled and easy to optimize for. The tougher task for VISC will be dynamic code like Java. In addition, multicore benchmarks may not benefit as much from the dynamic workload balancing.

The VISC concept is similar to Transmeta's Crusoe processors in that it uses a layer of software that emulates an existing instruction set architecture (ISA). The Transmeta processors emulated x86. The Soft Machine architecture can also emulate multiple ISAs, but the company is most interested in ARMv8.

Transmeta used a complex software layer that was responsible for providing higher performance by optimizing code that runs on simple CPU hardware cores. Soft Machines uses a thinner software layer that does quick ISA conversion for compatibility. The chips get nearly all of their performance gains from the hardware architecture.

The Soft Machines simulations were limited to 2.5 GHz peak rates, which indicates a short pipeline was chosen for VISC. But clock speed is no longer the sole measure of performance, so the 2-2.5 GHz range is considered acceptable for most mobile and power-constrained processors.

The architecture gets its performance lift when a single thread can use the resources of two or more VISC cores, making the cores act like one very wide core. A global front-end inside the VISC cores allocates and packs VISC instructions to each core based on dynamic load balancing.

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This step inside the hardware is a key ingredient of Soft Machine's secret sauce.

This is a big differentiation from any other processor that only schedules one CPU core. Dynamically allocating resources from two cores allows single-threaded code to execute faster - not quite 2x faster, but significantly faster.

The VISC architecture is also flexible enough to allow one fat thread to schedule part of the resources from a second VISC core, using roughly 1.5 cores. A second thin thread can still execute using the remaining resources of the second VISC core.

There is about 5% overhead involved with using a software layer to translate ARMv8 instructions to the native VISC instruction set, Soft Machine previously said.

Still, by dynamically using the second core, the VISC architecture gets more performance with less power than an inflexibly ultra-long-instruction-word architecture.

Each VISC core has a relatively high IPC, giving each core more performance at lower clock speeds, which saves power. In addition, there is some power savings is due to the simpler micro-architecture and shorter pipelines.

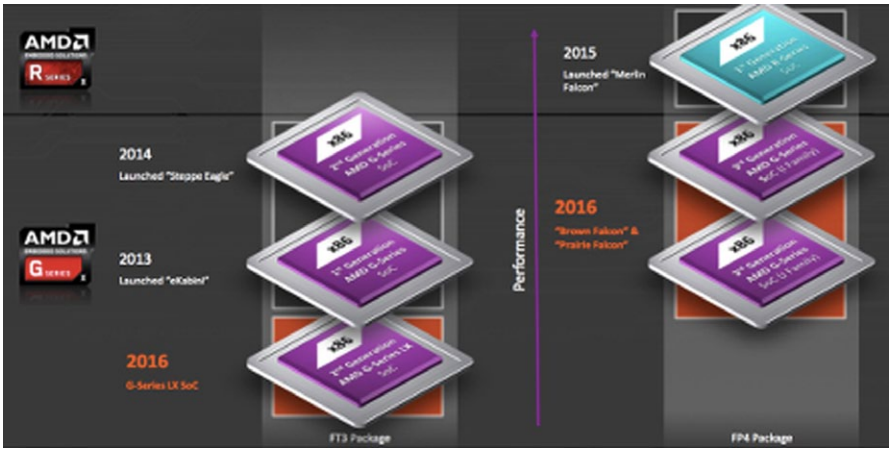
Past Soft Machines demos have shown promise, and the new simulation data shows significant IPC performance in the sweet spot for mobile computing. With the quality of the backers and the team, it's tempting to give them the benefit of the doubt.

However, until the Shasta SoC can be tested running multiple workloads by a third party, it's hard for the company to convince the doubters. For some, the technology appears to be too good to be true.

I hope Soft Machines turns out to be the real deal. We need some radical new innovation as present CPU designs offer mostly incremental improvements and Moore's Law is drawing to an end. And it comes just as microprocessor design was getting boring.

AMD back-fills G-series embedded SoC line

Processor vendor Advanced Micro Devices Inc. has announced three additions to its G-series of x86 architecture SoCs for embedded graphics-rich applications. The three devices are all at lower performance levels than previous G-series parts announced over the last three years, but provide lower power consumption and scalability (shown in orange in chart). The new additions to the lineup are suitable for thin clients, IP set-top boxes, and TVs, casino gaming, industrial control and automation, digital signage, and communications networks AMD said. The



LX SoC comes with two "Jaguar" x86 cores, AMD Radeon GPU, an AMD security processor and a single channel of DDR3 memory. The G-Series LX SoC uses the same FT3b socket as its predecessor codenamed Steppe Eagle. AMD has also announced two G-Series SoCs, codenamed "Prairie Falcon" and "Brown Falcon," that provide pin compatibility for G- Series processors with the higher performance AMD Embedded R-Series SoC. These provide up to two "Excavator" x86 cores, Radeon GPU with up to four cores, 4K H.265 decode and multiple format display technology, an integrated AMD security processor and up to channels of DDR4/ DDR3 memory interface. These SoCs are compatible with the FP4 socket.

AMD
www.amd.com

Russia's T-Platforms shows MIPS-based SMARC board

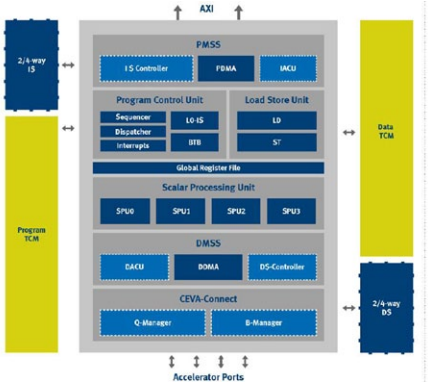
Russian personal and server computer vendor T-Platforms JSC (Moscow, Russia) has developed a SMARC-compliant computer module, the SF-BT1, based on the Baikal-T1 MIPS32-based SoC. T-Platforms is the parent company to Baikal Electronics JSC, a fabless developer of SoCs based on ARM and Imagination Technologies cores. The Baikal-T1 SoC is the world's first silicon implementation of the MIPS Warrior P5600 core from Imagination and has a power consumption of less than 5W.

The computer module is intended to be used a daughter board building block so that customers can focus on creating application-specific carrier boards in areas such as transport control systems, industrial automation, healthcare and networking equipment. The SF-BT1 module is based on the SMARC (Smart Mobility ARChitecture) v1.1 specification, a small form factor computer-on-module definition targeting applications that require low power, low costs, and high performance. The modules are already used in T-Platforms' products for industrial automation and desktop computing. The module offers multiple interfaces for communication with active devices (10GbE and GbE, USB, PCIe), as well as interaction with sensors, relays and other terminal equipment (GPIO, UART, I2C, SPI). JTAG and EJTAG interfaces are included for diagnostic and debugging purposes. When in mass production, SF-BT1 modules will feature up to 8Gbytes of RAM and optional nonvolatile memory. The first production lot will be manufactured in Russia and is scheduled for delivery in 3Q16. The virtualization technology present within the Warrior P-class CPU allows multiple Linux OS instances to run in parallel on the SF-BT1, each in its own domain protected from lateral data movement attacks. T-Platforms has demonstrated the running of the prplSecurity framework from the Prpl Foundation, a collection of open source APIs providing hardware-level security controls such as root of trust, secure boot, secure hypervisor and secure inter-vm communications. T-Platforms is also using the SF-BT1 modules as developer kits. They come with 2Gbytes of RAM, software development tools, technical design guides, and sample carrier boards for testing purposes. "We view this product as a cornerstone of an ecosystem we want to help building around Baikal CPUs, promoting and speeding up its adoption by the Russian and global development community," said Vsevolod Opanasenko, CEO of T-Platforms in a press release issued by Baikal Electronics.

T-Platforms
www.t-platforms.com

Multi-RAT multi-carrier PHY control processor takes on 5G

A leading DSP IP licensor, CEVA Inc. has just released the first of a new family of baseband processors whose derivatives will specifically target 2G/3G/4G/5G modems. Part of the CEVA-X family of multi-RAT multi-carrier PHY control processors, the CEVA-X4 leverages what the company claims to be the world's most efficient processor architecture for baseband applications, a unique implementation based on the company's brand new CEVA-X architecture framework. The CEVA-X4 incorporates a unique set of baseband-optimized features and functions in a highly efficient manner. The 128-bit wide VLIW/SIMD processor features 8 MAC units in 4 identical Scalar Processing Units (SPUs) and a 10-stage pipeline, capable of running at 1.5GHz in 16nm and achieves 16 Giga operations per second. The processor's efficient control features include an integer pipeline, a complete 32-bit RISC ISA including hardware division and multiplication, and a Branch Target Buffer (BTB), achieving CoreMark / MHz score of 4.0, 60% better (per thread) compared to the most established in-house DSP used in smartphones today, according to CEVA. For system control, the CEVA-X4 brings a holistic approach to modem design, utilizing the innovative CEVA-Connect technology to orchestrate the entire PHY system, comprising of DSPs, coprocessors, accelerators, memories and system interfaces. It is equipped with dedicated hardware coprocessor interfaces and an automated data and control traffic management mechanism that eliminates any software intervention. Its memory subsystem supports an advanced non-blocking 2-way or 4-way caches with hardware and software pre-fetch capabilities. Conceived as the company's internal design exploration tool to quickly churn out new devices on its roadmap, the CEVA-X architecture framework unifies control and DSP processing, bringing an innovative holistic approach to modem architecture to orchestrate DSPs, coprocessors, hardware accelerators, memories and system interfaces. It features a scalable VLIW/SIMD architecture, up to 128-bit SIMD, a variable length pipeline and support for both fixed- and floating-point operations. The new CEVA-X is said to delivers 2X more DSP horsepower while consuming 50% less power than the previous generation CEVA-X. The architecture also includes a dedicated 32-bit zero-latency Instruction Set Architecture (ISA), 32-bit hardware division and multiplication, dynamic branch prediction and ultra-fast context switching for the efficient Control processing required in modern baseband designs. Business Development Director in CEVA's Wireless BU, Emmanuel Gresset hinted that while the CEVA-X4 was maximizing the DSP capabilities, all other products from that family would be more on the control side. "It is like the big brother of the family, it addresses the super high-end smartphone market" he told EETimes Europe. "We had to gather a wealth of information to know which variables we needed to build into our framework. With the CEVA-X architecture framework, we are signaling the world that you can expect more cores from us to cover a wide range of baseband applications". "Of course, as any successful company, we are customer-driven, and we'll listen to their requirements to implement other derivatives" he added, saying that the new architecture framework would allow the company to be more reactive, implementing new IP within months rather than years.



CEVA
www.ceva-dsp.com

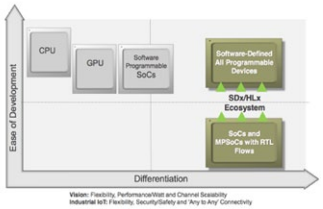
TRACE32 tools debug designs combining MIPS and ARM CPUs

Lauterbach's TRACE32 is a set of modular microprocessor development tools that provides integrated debug environments for embedded designs. TRACE32 now supports MIPS Release 6 CPUs including the new M-class M6250, the first embedded-class MIPS CPU to incorporate the MIPS On-Chip Instrumentation (MIPS OCI) flexible on-chip CPU debug architecture. Companies can use MIPS OCI to ensure the lowest possible risk and impact on their debug process for highly-integrated heterogeneous SoCs. TRACE32 enables simultaneous debug of the multiple CPUs in a design with 'mixed mode' trace streams. Users can view the interleaved results in a single trace window, with a system-level timestamp to help align the streams. Extended trigger logic enables cross-triggering between the CPU trace logic to make it even easier to debug processor interdependencies.

Lauterbach
www.lauterbach.com

Xilinx expands ecosystem around Zync MPSOC

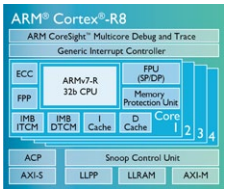
Xilinx Inc., has announced that it has expanded the ecosystem of partner companies working around its Zynq 64-bit MPSOC chip family in support of embedded vision and industrial IoT. Xilinx, best known as a supplier of field-programmable gate arrays (FPGAs), is increasingly a supplier of SoCs that are predominantly software programmable but with some FPGA fabric and programmable I/O under its Zync brand. The Zynq MPSOC is implemented in 16nm 16FF+ manufacturing process from TSMC and began shipping Sept. 30, 2015 (see 16nm Fin-fet shipping in Ultrascale FPGAs – Xilinx). The chip includes four Cortex-A53 cores and two Cortex-R5 cores together with Mali GPU, security cores and accelerators and an HEVC codec that supports graphics transmission and reception up to 4K image resolution. Applications that require security support or data fusion are suited to the chip family. An expanded range of software library offerings are available in support of neuromorphic computing from Auviz, MulticoreWare and TeraDeep.



Xilinx Inc.
www.xilinx.com

ARM Cortex-R8 processor aims for 5G

The ARM Cortex-R8 processor unveiled by the Cambridge-based IP company is expected to help chip designers double the performance of ARM-based modem and mass storage device SoCs. A quad-core configuration dramatically boosts the total Cortex-R8 performance, which when combined with its real time features and extended low-latency memory makes Cortex-R8 the highest performing processor in its class, says the company. The Cortex-R8 can be configured as single, dual, triple or quad coherent cores, which when combined with Cortex-R8's other advanced features more than double its performance compared to the Cortex-R7. It enables significantly larger tightly coupled memories (TCMs), up to 1MB of instruction TCM and 1MB of data TCM per core. The IP can be configured with 12, 16, 20 or 24 memory protection unit regions. Cortex-R8 includes out-of-order instruction execution and dynamic register re-naming, combined with advanced branch prediction, superscalar execution capability and fast hardware support for divide, DSP and floating-point functions.

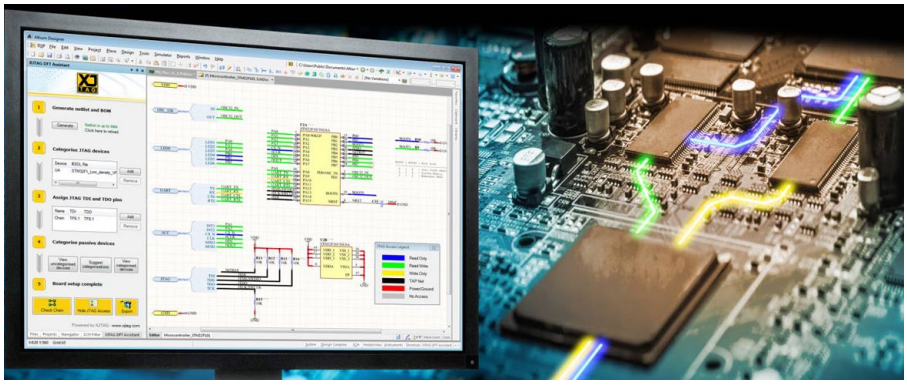


ARM
www.arm.com

Making design-for-test a push-button process

By Philip Ling

Implementing a Design for Test approach when designing PCBs at the schematic capture stage can now be significantly assisted using an innovative and free software extension that adds design verification to Altium Designer.



The concept of 'right by design' could imply that the design in question will always work as expected, so there is no need to test it once it has been designed 'right'. While this is true, in principle, it is also true that testing isn't primarily a process of finding design faults; that's a development issue.

Although there is always the potential for new 'bugs' to appear at any time, faults that appear after the design phase is complete, particularly in mature products, are likely to be the introduced by the manufacturing process. The list of potential manufacturing defects that can occur in a wave soldering process, for example, is long and includes: incomplete joints; dry, cracked or bulbous joints; lifted pads or resist; pad contamination; solder balling and, of course, open circuits and solder shorts.

Any of these defects can stop a board from working and some may not become apparent until long after it has been shipped. Adopting a Design for Manufacture (DFM) approach can help minimise the occurrence of these types of defects and these are measures that are normally best applied at the PCB layout stage. Modern design tools can help automate this by imposing design rules during this stage, for example.

Despite how well a board is laid out, manufacturing defects are inevitable and so need to be found before the product is shipped, during the test process. Adopting a Design for Test (DFT) approach can ensure that detecting and locating manufacturing defects is possible, even faults that are located beneath surface mounted devices. Rather than strict design 'rules', such as minimum spacing between tracks, or routing on specific layers, DFT involves approaches that need to be more widely adopted earlier, and implemented at the schematic capture stage.

DFT, right by design

Designing for test is, perhaps, more subjective than designing for manufacture. What may be right for one design may not be right for another, due to cost, space or complexity constraints. What is almost uniformly agreed amongst IC manufacturers, however, is that including a DFT technology such as Boundary Scan in complex integrated devices is now the norm.

While JTAG is often used to debug software running on a microprocessor, boundary scan has far wider application. It was developed to address the challenge of finding manufacturing defects 'hidden' beneath advanced surface mount components (typically Ball Grid Arrays, or BGAs).

Philip Ling is Technical Marketing Manager at XJTAG - www.xjtag.com/altium

It offers a level of test access that is significantly greater and more cost-effective than many other forms of test and, perhaps even more significantly, because it is 'built-in' to devices it doesn't impose a premium on the cost of those devices. Most FPGAs/CPLDs and processors (including microcontrollers), as well as some fixed-function parts such as Ethernet transceivers, interface controllers and PCI Express PHYs now implement boundary scan.

Accessing boundary scan functionality in a manufactured product requires the right specialist hardware and software, but ensuring your design is ready to offer that access is free; it simply requires a Design for Test approach at the schematic capture stage of development. Attempting to implement or correct a boundary scan chain during or after PCB layout is effectively futile; making sure it's right by design during schematic capture is simpler and, therefore, much more cost effective.

Getting the scan chain correct

Boundary scan is implemented using a dedicated bus, which comprises between four and five signals. These signals, collectively referred to as a Test Access Port, or TAP, need to be correctly connected to all JTAG-enabled ICs in a daisy-chain configuration, known as a scan chain. The TAP is routed from a connector to the first IC in the scan chain and then on to the next and so on, all the way to the last IC in the chain and back to the connector.

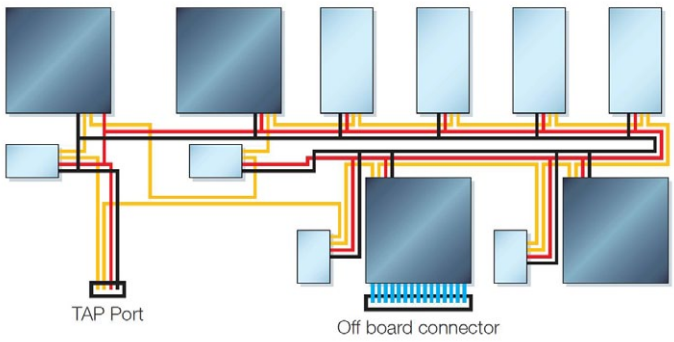


Fig. 1: The boundary scan chain sequentially connects JTAG-enabled devices on a PCB, enabling test access for running connectivity and functional tests.

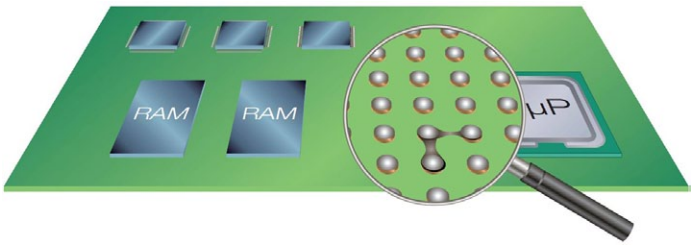


Fig. 2: Boundary scan allows manufacturing defects 'hidden' beneath BGAs to be located

The sequential nature of the scan chain means that the boundary scan test pattern must pass through each device and return to the connector. It is therefore imperative that there are no broken or weak links in the scan chain. This introduces a number of DFT considerations, such as ensuring the scan chain is connected to every JTAG-enabled IC in the design, that the chain's TAP signals are correctly connected to the right pins on those ICs and that the recommended termination is used on the TAP signals.

As well as defining the electrical characteristics of the TAP, the IEEE 1149.1 (boundary scan) standard defines the scan chain's protocol. This enables the identification of devices, the pins used for the TAP and the test capabilities that device supports. This information is stored in a dedicated file known as the Boundary Scan Description Language file (BSDL); every IC that is JTAG-compliant must have a BSDL file associated with it. The information held in this file enables specialist software and hardware providers to create the products used to access and control JTAG-enabled devices during test.

Automating DFT

Checking that all JTAG-enabled devices in a scan chain are connected correctly is normally a manual process and therefore just as susceptible to human error as any other manual design process. But it has recently become possible to automate the design verification of a boundary scan chain. Using its expertise in boundary scan testing, XJTAG has developed a free software extension for Altium Designer that assists with the design verification of a boundary scan chain, enabling a new level of DFT capability to the environment.

The extension, called XJTAG DFT Assistant, uses the netlist generated by Altium Designer during schematic capture to form a profile of how the scan chain is connected in the design. This picture is complemented by importing BSDL files to the project, allowing it to understand how the scan chain should be routed. From here the extension is able to not only check the connections of the scan chain in the schematic but also show the level of test access the design offers to boundary scan software/hardware.

The extension achieves this through two main features; the XJTAG Chain Checker and the XJTAG Access Viewer. The data collated can also be exported for use in XJTAG's boundary scan test development environment, XJDeveloper. This supports the development of boundary scan tests for both JTAG-enabled and non JTAG-enabled devices. It is possible to extend test access to a larger percentage of the circuit if it is designed with boundary scan testability in mind. Using the XJTAG Access Viewer feature, designers can monitor, evaluate and maximise their test access at the schematic capture stage, something that couldn't be automatically verified before the introduction of this free software extension.

Crucially, the extension is also able to detect errors in the scan chain long before the PCB moves to the layout stage.

By making it part of the design process, the XJTAG DFT Assistant can help designers avoid the common faults that would normally inhibit a scan chain from working, such as incorrectly routed TAP signals or poorly terminated signals. Perhaps more importantly, it shows the board designer which ICs are accessible to boundary scan testing, thereby highlighting any ICs that should be connected and aren't, or areas of a design that are currently inaccessible to boundary scan testing but could be, by making some design changes.

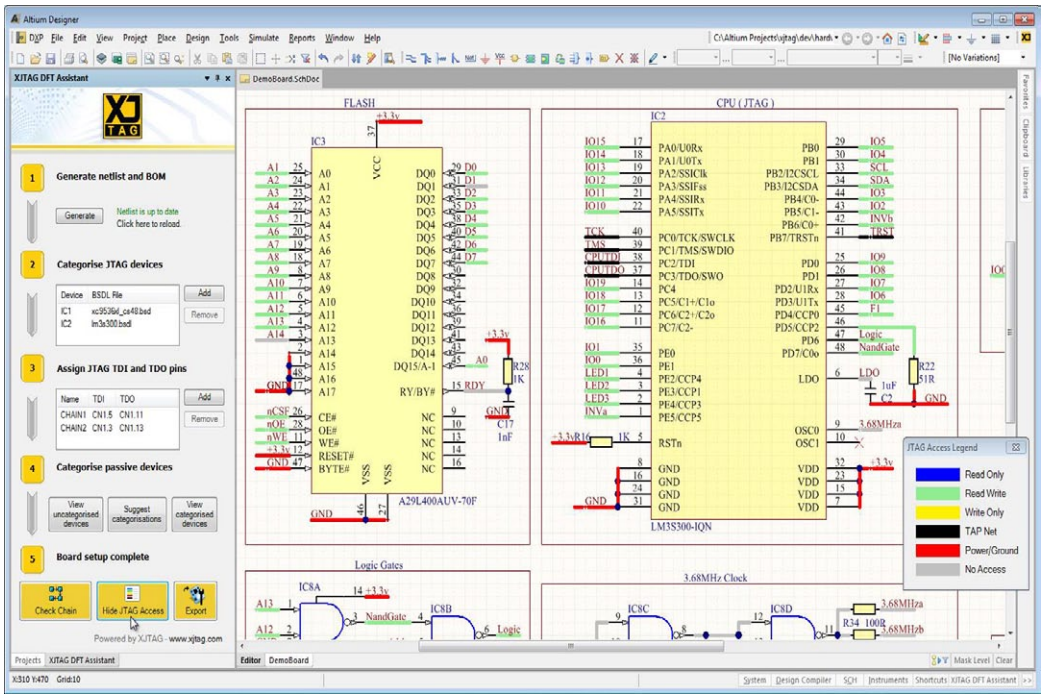


Fig. 3: The XJTAG DFT Assistant's Access Viewer mode clearly displays the level of test access available, allowing board designers to maximise test access at the schematic capture stage of design, long before moving to PCB layout.

These features can be used iteratively as the design evolves, ensuring that test access is maximised and that the boundary scan chains are right by design. Having this information at their fingertips will not only make developers more aware of how to implement boundary scan, but help automate the entire DFT approach to schematic design.

Understanding boundary scan and BSDL files enables specialists like XJTAG to develop the software and hardware products needed to use boundary scan throughout a product's life-cycle, from prototype bring-up to volume production.

By applying this expertise to develop a free software extension for Altium Designer, developers now have access to a powerful design verification technology that greatly increases their ability to get it right first time.

Rohde & Schwarz 2 GHz scope offers linked multi-domain views

Rohde & Schwarz' RTO2000, is a compact lab oscilloscope for multi-domain applications, displaying correlations between time, frequency, protocol and logic analysis measurement results.

Via the analogue input channels, the user simultaneously sees the signal in the time and frequency domain, and if desired, the spectrogram. Newly added functions such as peak list, max. hold detectors and the logarithmic display make frequency analysis even more efficient. A new zone trigger enables the graphical separation of events in the time and frequency domain. Users can define up to eight zones of any shape. A trigger signal is activated when a signal either intersects or does not intersect the zone. This makes it easy to detect disturbances in the spectrum during EMI debugging or to separate read/write cycles of storage media in the time domain. It is the first oscilloscope in this class to offer a memory of up to 2 Gsample. This is useful for the history function, which provides access to previously acquired waveforms at any time. A trigger timestamp allows time correlation. Users can view all saved signals and analyse them with tools such as zoom, measurement, math and spectrum analysis functions.

Signal processing in the ASIC and intelligent memory management ensure smooth handling of long pulse and protocol sequences. A high definition (HD) mode increases the vertical resolution to up to 16 bits, making signal details visible. Achieved by signal processing, the high-resolution mode trades bandwidth for increased detail.

The HD mode activates configurable lowpass filtering of the signal after the A/D converter. With one million waveforms per second, the R&S RTO2000 sets a new standard in this class of oscilloscopes. Users are able to quickly detect sporadic signal faults. The scope provides high-speed analysis even when histogram and mask functions are active. With a 12.1-in. capacitive touchscreen with gesture support and colour-coded controls, users can configure the instrument for any measurement task. Users can customise the waveform display with SmartGrid. They can quickly access important tools on a toolbar and document measurement results and instrument settings at the press of a button. The app cockpit provides direct access to all available applications such as trigger and decoding functions, conformance and signal integrity tests, I/Q analysis and even customer-specific development tools. The R&S RTO2000 is available as a two or four channel model with a bandwidth of 600 MHz, 1 GHz, 2 GHz, 3 GHz or 4 GHz.

Rohde & Schwarz
www.scope-of-the-art.com

Data acquisition system scans 50,000 samples/s for dynamic testing

Micro-Measurements has introduced the company's first high-speed data acquisition system for dynamic test and measurement applications. Featuring a scanner with 12 RJ-45 strain

gage inputs and four configurable auxiliary slots to accommodate signals from thermocouples, piezoelectric sensors (both charge mode and voltage mode), and high-level voltage sensors, the System 9000 StrainSmart Data Acquisition System provides scanning rates up to 50,000 samples/second; supports full-, half-, or quarter-bridge configurations; and offers built-in precision bridge completion for 120 Ω, 350 Ω, and 1000 Ω bridges. Optimized for automotive, aerospace, rail, consumer, and military testing applications, all System 9000 channels are sampled simultaneously. Users can deploy scanners independently or use up to three together for 48 channels (36 strain gage and 12 configurable) of fully synchronized data acquisition. Each channel's data is processed in a 24-bit digital signal processor with filtering via finite impulse response (FIR) multistate filters for excellent noise rejection, stability, and unsurpassed measurement accuracy. The processors over-sample data at a rate of 128 times the selected rate, providing high-quality, low-noise data at rates of 50,000, 25,000, 10,000, and 5,000 samples/second - without the need for signal averaging. The System 9000's scanner communicates with a host PC via an auto-configured 100 Mbit DHCP Ethernet connection. Micro-Measurements' StrainSmart software, available separately, is ideal for configuring, controlling, and acquiring data from the system. To eliminate downtime associated with sending the unit back to the factory for periodic calibration, the System 9000 is available with an optional system voltage calibration card. The card allows the gain and offset of each channel to be calibrated under actual operating conditions, minimizing errors due to environmental factors.

Offering compact dimensions of 89 mm by 437 mm by 292 mm), the System 9000's scanner features an aluminum-alloy enclosure to provide superior strength and durability while minimizing RF emissions and susceptibility. A rack-mount kit is also available. Production quantities of the System 9000 are currently available from stock.

Micro-Measurements
www.micro-measurements.com

Arbitrary waveform generator and signal acquisition all-in-one

Zurich Instruments' UHF-AWG 1.8 GSa/s arbitrary waveform generator presents a unique solution for the generation and acquisition of complex signals.On each of the 2 channels signals

can be generated and measured from DC up 600 MHz with 14 bit resolution. AWG pulse sequences can be varied based on feedback from the demodulated signals or photon counter. The UHF-AWG is completely integrated into the LabOne software and can easily be controlled through a web-browser based user-interface whilst the included LabOne APIs allow a straightforward integration into an existing experimental control environment using LabVIEW, MATLAB, Python or C.
Arbitrary waveforms can be generated and played up to a length of 128 MSa. These signals can be used for the modulation of the 8 internal oscillators, guaranteeing perfect phase-coherence and, using the internal trigger functions, precise synchronization of the measured signal.All relevant signal parameters such as frequency, delays and amplitudes can be adjusted using the advanced sweeper and trigger tools.

Zurich Instruments AG
www.zhinst.com

Digital data acquisition card takes up to 720MBit/s rates

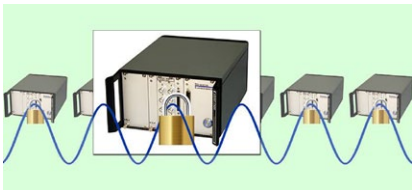
The Spectrum M4i.77xx series of Digital Data Acquisition cards represent a major performance breakthrough for test engineers

who require high-speed digital data logging with multi-channel logic analysis over extended time periods. Based on Spectrum's proven M4i series PCI Express (PCIe) platform the cards are small and compact.Each card comes equipped with 32 fully synchronous channels, large 4 GB on-board memory and a PCI Express x8 Gen 2 interface that offers outstanding data streaming performance. If more channels are needed, up to eight cards can be linked together with Spectrum's Star-Hub clock and trigger distribution system that fully synchronizes up to 256 channels. Five different models are available with two offering differential inputs, for LVDS, (LV)PECL, (N)ECL and other differential signals, and three models with single-ended inputs for logic levels of 1.2, 1.5, 1.8, 2.5, 3.3, and 5.0 V. The cards are equipped with two VHDCI connectors for the digital channels as well as for the external trigger, clock input and clock output. These connectors also provide two separate multi-function inputs/outputs that can be individually programmed to perform different operations such as trigger out, status output (armed, triggered, ready, etc.) as well as providing additional asynchronous I/O lines.Top of the range for the single-ended cards is the model M4i.7730-x8 that offers an internal data rate of 720 MBit/s. Other models are available with 125 and 250 MBit/s performance.

Spectrum Systementwicklung Microelectronic GmbH
www.spectrum-instrumentation.com

Data acquisition wave tracking module

Microstar Laboratories has released the Wave Synchronization Module (WSM) software for aligning measurements in real time to a reference time-base signal provided in the form of a precision sine wave. This complements the Time Base Synchronization module previously released, which required time base signals to be digital signals such as IRIG-B or GPS. Synchronization is about providing a common source for timing and aligning to it. Widely-distributed, network-intensive solutions can do this by embedding signal conditioning, converters, processor, and networked communication interface into every sensor.



The Wave Synchronization Module (WSM) can be used when a centralized station derives an accurate sinusoidal time reference signal. This can be synchronized to an external master time base. The sine wave is then distributed to each of the local data acquisition nodes. Any data acquisition activity that aligns to this timing wave aligns to the master time base. The xDAP sampling clock can operate at any arbitrary rate high enough for good signal representation and for satisfactory time resolution.

Microstar Laboratories
www.mstarlabs.com

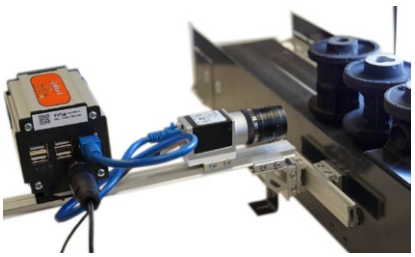
90W LED driver controllers support flicker-free operation

Dialog Semiconductor plc has introduced two driver controllers for high power commercial LED lighting applications up to 90 W. In these applications flicker-free operation is essential to avoid eye stress where there is long-term exposure to the light source. Dialog's patented Flickerless technology claims to virtually eliminate flicker through digital control that achieves near-zero line frequency ripple. The iW3629 (non-dimmable) and iW3631 (dimmable) digital power controllers simplify the design of LED power supplies by replacing up to 45 discrete components. Both devices can be used with small input and output bulk capacitors, and small transformers which cuts power supply size, bill of materials and costs while optimizing performance. The controllers feature better than 0.95 power factor (PF), less than 15% total harmonic distortion (THD) and 85%+ efficiency over a wide load range, easily meeting the requirements of the Design Lights Consortium (DLC). The controllers comprise a two-stage design with a rectified AC-input (90 to 277 VAC), active start-up, and a boost circuit feeding a flyback converter. The latter provides a constant current drive to the LEDs. Quasi-resonant control in both stages maximizes power efficiency. Fast, smooth start-up takes less than half a second and PF settling time is minimal. Interfacing to industry-standard, 0-10 V analog dimmers The iW3631 has a flicker- and shimmer-free dimming range of 1% to 100%.

Dialog Semiconductor
www.dialog-semiconductor.com

Machine vision model kit eases technology adoption

With the EyeMount system, cameras, lenses and industrial lights can be easily and securely integrated into the machine, while the EyeVision software allows the creation of inspection programs for visual measurement and inspection, with an easy drag-and-drop function.

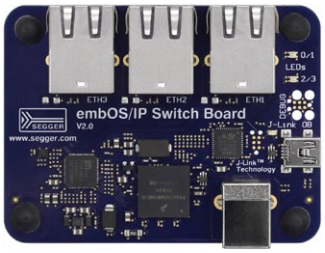


The EyeMount system consists of a multitude of components, which are mounted to each other with a standardized dovetail connection. Cameras, lenses and lighting can be positioned to a conveyor belt with simple clamps. Both smart cameras and standard cameras can be mounted swiftly to the right position with any housing protected up to IP67 for rough environments. Building blocks of the EyeVision software allow for simple measurement applications as well as complex object detection or robot-vision applications. EyeVision supports all standard cameras such as USB, GigE, FireWire, CameraLink and CoaXPress.

EVT Eye Vision Technology GmbH
www.evt-web.com

Adding physical Ethernet ports the easy way

This month, Segger is giving away ten embOS/IP switch boards, worth 98 Euros each, for EETimes Europe's readers to evaluate the company's embedded IP stack embOS/IP Tail Tagging feature. Micrel/Microchip has developed switches which can expand one Ethernet port into 1+n fully independent ports, supported by the so-called Tail Tagging mode. This enhancement establishes a virtual Multiport when only one physical Ethernet port is available on the CPU - by choosing another PHY. The embOS/IP switch board features an NXP Kinetis K66 CPU clocked at 180 MHz, with 256 KB SRAM as well as 2 MB Flash memory, the Micrel/Microchip switch PHY KSZ8794CNX with three usable Ethernet ports and an on-board version of Segger's popular J-Link debug probe for quick and easy debug access to the Kinetis core MCU. The embOS/IP Switch board is powered by the USB device connector (B-type connector). Current consumption drawn depends on the configuration and connected Ethernet links, but the board will only draw 140mA in idle mode.



Check the reader offer online at

www.electronics-eetimes.com

Wearable enclosures accept standard 18mm strap

Body-Case is OKW's first ever series of fully wearable standard electronic enclosures, designed specifically for fitting a standard 18 mm wrist strap so it can be worn just like a watch. Each enclosure is supplied with two 18mm spring bars for fitting the wrist strap. An optional fastening kit allows Body-Case to be hung around the neck on a lanyard, clipped to a belt/pocket or carried loose. Applications include mobile data recording and transmission; tracking and monitoring; emergency call and notification; bio-feedback sensors for healthcare, wellness and sports fitness. The ergonomic enclosures enable wearers to use wireless electronics inconspicuously and without restriction of movement. The cases can accommodate touchscreens, push buttons or voice-activated electronics. Power is supplied by round or button cells on the PCB or by a rechargeable battery with a copper loop for charging the device inductively. The enclosure is available in a 55x46x17mm form factor and can be specified either with or without a recessed top for a membrane keypad or product label. Protection levels are up to IP 67. Customising options include custom colours, special materials (V-0), EMC shielding, CNC machining, screen, tampo and digital printing of legends and logos and assembly of accessories.

OKW
www.okw.co.uk

Optical sensor measures heart rate to smarten wearables

GoerTek and Infineon have produced optical sensors for precise, ultra-low power heart rate monitoring for smart devices. The high-resolution, highly integrated optical sensors are designed to deliver the precise measurement, small size and ultra-low power consumption demanded by ambient light sensing, proximity detection, heart rate and pulse oximetry monitoring applications such as headphones, fitness bands, smart watches and phones. They integrate three LED outputs, a photodetector, a low-noise analogue front-end, a digital interface and a state machine into a single die. For best application results the bare die is either packaged with an infrared or a green LED or can drive up to three external LEDs. The sensors offer a fully integrated solution for optical heart rate measurement featuring an I²C interface for a programmable sample rate of up to 256 per second. This allows a significantly better signal-to-noise ratio (SNR) than discrete alternatives. Additionally, monitoring algorithms can filter out motion artifacts and deliver precise heart rate and pulse oximetry measurements during exercise. High optical sensor resolution enables accurate measurement across the widest possible variety of skin types, while high optical sensitivity reduces photo diode area and drives down LED power consumption with a typical 300 µA LED current on fair skin. A standby current of 0.3 µA further reduces power consumption. Infineon and GoerTek sensor solutions are available either as bare die or as 3.94x2.36x1.35mm packaged products.

Infineon
www.infineon.com

Fully programmable audio DSP digital effects

Cliff Electronics is making available a new range of digital signal processing audio effect modules including four models, all of which are fully user programmable. For user convenience

they also feature a range of built-in presets which can be modified if required. The entry point is the FM68030 dual sound controller, and its professional version the FM68031, with the FM68032 Professional 2 input, 4 output sound controller and the FM68033 professional quad channel sound controller completing the range. Key features include a wide range of digital reverb, echo and delay special effects, including: chorus, flanging, pitch shifting, spring reverb and emulation. The modules are designed for use in musical instrument amplification and mixing consoles. They consist of PCB assemblies incorporating surface mounted components including custom designed CMOS LSI digital processors. A number of programming methods are available as standard to simplify operation. These include programming from a PC utilising the supplied RC1 software which allows all characteristics to be fully programmable in real time and shown on screen and also via an Alpha-Numerical display using rotary encoders, momentary push button switches or potentiometers. Programming and control software is included with each purchase.

Cliff Electronics
www.Cliffuk.co.uk

Minimal space for 5W medical-spec off-line power provision

XP Power's EME05 series of single output, PCB-mount, 5W AC-DC power supplies is presented as one of the smallest 5W

supplies available; in either an encapsulated or open frame mechanical format, the EME05 measures 35.6 x 23.7 x 17.6 mm. The EME05 is approved to the 3rd edition of the international medical safety standards EN60601-1:2006 and ANSI/AAMI ES60601-1:2005. The device provides a reinforced (double) insulation with 4000 VAC input / output isolation and two means of patient protection (2 x MOPP). The convection-cooled series provides eight single output models covering all the popular nominal outputs from 3.3 to 48 VDC. A peak load capability allows up to 130% of the rated output power to be available for up to 30 seconds for accommodating application start-up. The EME05 has universal input and offers full power across the complete input range of 90-264 VAC without any derating. All models employ Class II construction so no earth/ground connection is required. The units meet the EN55011 Class B EMI standard for conducted and radiated emissions. No additional filtering components are required, saving PCB space and BOM costs. Capable of delivering full power up to +50C and operate across a wide temperature range from -25 to + 70C, the EME05 can be used in most environments without heat sinking or forced airflow.

XP Power
www.xppower.com

Plug-and-play IoT development kit supports battery-free wireless sensing

ON Semiconductor has teamed up with RFMicron to develop a game-changing 'plug-and-play' development tool to speed the

deployment of wireless passive sensor solutions onto any Internet of Things (IoT) cloud platform. The IoT Platform Development Kit brings together a series of performance-optimized computing and connectivity modules to facilitate quick and effective deployment of battery-free wireless sensing technology and IoT hardware in locations where power and space constraints are of particular concern. This streamlined and flexible solution takes the approach of moving much of the system's intelligence away from where the sensors are situated, and placing it on the cloud. Each IoT Platform Development Kit incorporates ON Semiconductor's battery-free wireless sensor tags, which use RFMicron's Magnus S2 Sensor IC, and can perform temperature, moisture, pressure, or proximity sensing functions. The platform also features a UHF RFID reader module with 32 dBm power rating and an 860 megahertz (MHz) to 960 MHz frequency range. Localized data processing is performed by the ARM Cortex-A8 based AM335x system-on-chip (SoC). The platform has the capacity to transfer captured data either wirelessly (via WLAN, Zigbee, Z-Wave, UHF Gen 2, etc.) or using wireline infrastructure (via KNX, CAN, SPI, Ethernet. etc.).

ON Semiconductor
www.onsemi.com

Do you have a back-up power supply?

By Olivier Bomboir

Power is the lifeblood of a modern business. In the 21st century, almost everything we do requires a power source. But what do you do if that power source fails? For many sectors, this is a key consideration when putting a business continuity plan in place, especially as large scale failures become more common.

Research suggests that we can expect blackouts and brownouts to become more common as our infrastructure struggles to cope with increased demand and inadequate investment. For example, after two fallen trees caused all of Italy to blackout in 2003, it proved that the power generation systems in place were fragile and unreliable.

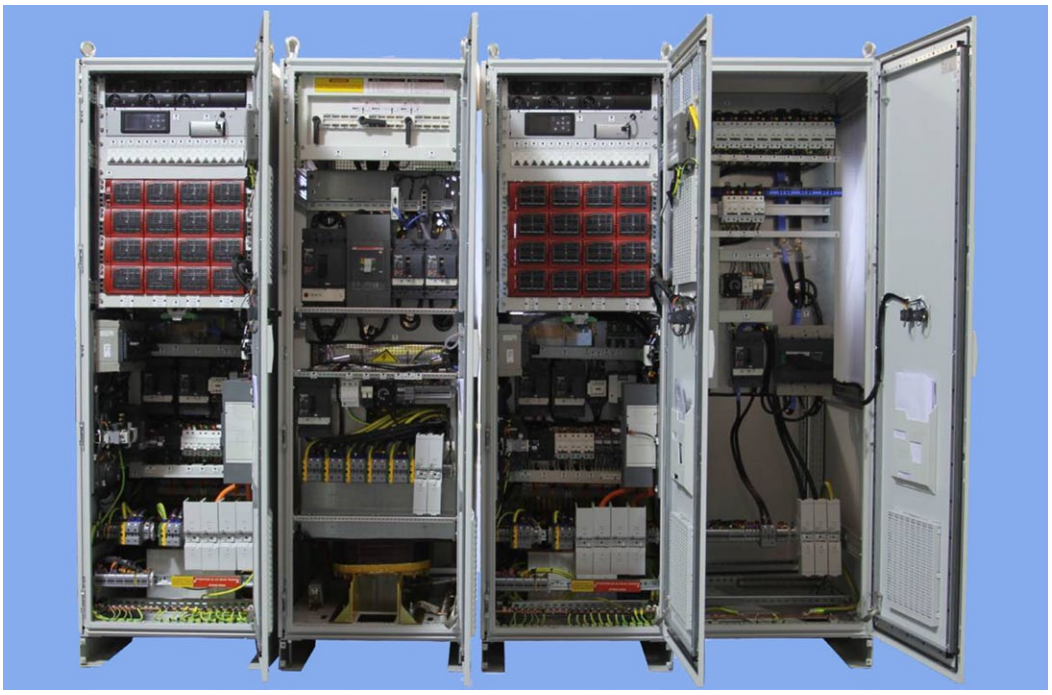


Fig. 1: The two inverter cabinets each contain 16 TSI BRAVO EPC 110Vdc/230Vac Inverters, in EPC mode. Each inverter module has an output of 2.5kVa, making 40kVa in total.

With network failure due to inadequacy a growing concern, the importance of having sufficient and resilient backup in place is clear. The primary aim for choosing a back-up power system is preventing a complete power outage; therefore, preventing a loss of business and earnings. In some sectors, such as telecommunications, mass transportation, oil & gas, power & utilities, data centers and healthcare, the implications to public safety and data security mean that having a power back-up solution in place is no longer a choice, but a necessity.

While keeping businesses and public services running at all costs is of course essential, there is another key consideration which is sometimes overlooked when choosing a sustainable back-up power supply – efficiency. As well as providing peace of mind, it is important that your business continuity plan does not place an undue level of financial strain on your business. Some power inverters lose large amounts of energy during the conversion process, amounting to money spent on basically nothing.

You should therefore take care to select a system which provides both the safety and security that you require, as well as keeping your operational costs to a minimum.

Businesses rely on and sometimes take for granted the ability to keep going, and if you work in one of the critical public sectors, you will be keenly aware of the importance of power and the potential implications of an outage. In today's modern era where the vast majority of processes have been computerized (records are stored on databases and even local convenience store points of sale are electronic), a sudden power cut can mean considerable loss of earnings, which spells disaster to a business owner.

One of the most challenging areas for implementing power supply systems is in Oil & Gas exploration due to tough environmental conditions and high operating costs. For example, a team in charge of replacing the UPS system on Sonangol's offshore oil platform in Angola had to mount power supplies on an offshore oil platform in the midst harsh, tropical weather conditions.

The platform – powered by an uninterruptible power supply designed to ensure complete reliability of power for all essential systems – had a few problems. The main issue was that if one of the units needed repair or replacement, heavy lifting gear was required, the system had to be taken offline, and expert technicians had to be brought in by helicopter or boat. Sonangol opted to install two modular 40kVA UPS systems with Twin Sine technology, to replace the outdated system.

The new UPS would run with a NiCad battery bank, occupy considerably less space and offer substantial maintenance advantages. Able to be completely housed in four cabinets, the new architecture offered several key benefits for Sonangol, including hot-swappable capacity, compact size, capability to run from NiCad battery packs, compliance with Oil & Gas industry standards, and guaranteed maintenance and support from the manufacturer for a minimum of 10 years.

The key component in every effective backup power system is either the power converters (battery charger AC/DC, inverter DC/AC and DC/DC converter) or the batteries. They work in the background, monitoring power levels, detecting commercial power grid abnormalities and, in many cases, correcting them immediately. It is this system which will kick in when a power failure is detected, running off high powered batteries to maintain your power, and allow you enough time to deploy

Olivier Bomboir is VP of Business Development & Product Management at CE+T Power - www.cet-power.com

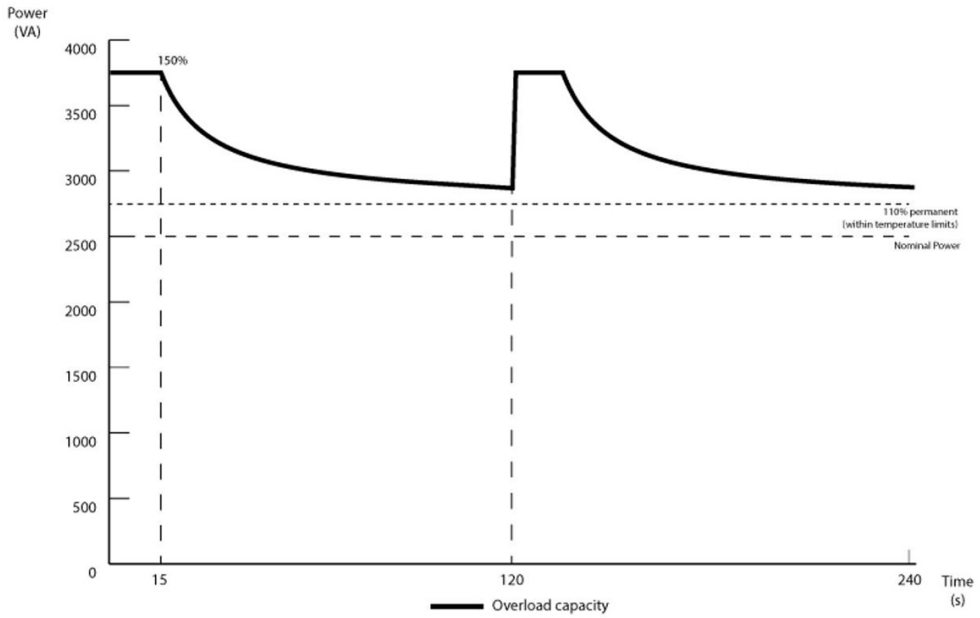


Fig. 2: Overload power capacity as a function of time.

your emergency power source. Although it may only be active for anywhere between a few minutes to several hours, it is vital in ensuring that your critical applications do not lose power and your business activities do not cease. No loss of power means no loss of revenue.

Inverters have been around for a long time, but modern inverters are generally a vast improvement on their predecessors. One example of how a modern inverter should perform is illustrated below.

This system uses Twin Sine technology to ensure that there is no loss of power. In the event of a system overload, the system can deliver up to 150% of the nominal power for 15 seconds, then for the next 105 seconds the output power will slowly decrease (to approximately 115%) before 150% of the nominal power is available again. In addition to this, as long as the system is within the correct temperature range (up to approximately 50°C), it will deliver 110% of the nominal power permanently. This is the case whether the system is drawing power from an AC or DC source.

Implementing an inverter or a UPS system which will provide you with that all important back-up (should the worst happen) is not always cheap. Many providers will want to sell you a complete solution, with capacity which will never be a necessity for you or your business as well as a costly maintenance contract tying you in for many years.

This is another example of the importance of researching your requirements. There is no 'one size fits all' when it comes to back up for critical applications and it is essential to be fully aware of what you need at this point in time, because – provided you have selected the right system – there will be the opportunity to add to it as your business grows.

Although this may sound obvious, it's surprising how many businesses don't consider this when setting out their business continuity plan. Modern inverter units should be modular and able to accommodate as many units in parallel as possible. This is important not just for ease of expansion, but also when it comes to installation and maintenance. The ability to isolate individual modules and 'hot-swap' them without turning off the main power supply enables your business to function as normal without a drop in power.

But what about the possibility of your back-up power failing? Traditional AC back-up systems are fitted with a static bypass switch which can become a bottleneck, causing a single point of failure in the installation. In the event of a failure, critical AC load could cease, in most cases resulting in service outage. However, some more modern inverters – like the ones discussed in this article – are now using a technology referred to as Twin Sine Innovation (TSI).

TSI is based on a single module containing three converters, which allows for a precise containment of any failures, resulting in a completely redundant system. In short, this means that – even in the unlucky event that one converter fails – you will not experience a loss of power. The system will simply isolate the faulty component and allow the others to continue supplying the output power.

Of course, every business is different, and it is simply not possible to give a definitive answer on the best method of back-up power for every business. But with a little know how and armed with as much knowledge as possible about your business and the challenges you face, it is possible to select a back-up power supply for your critical applications which will help to protect not only your revenue, but also your balance sheet, for many years to come.

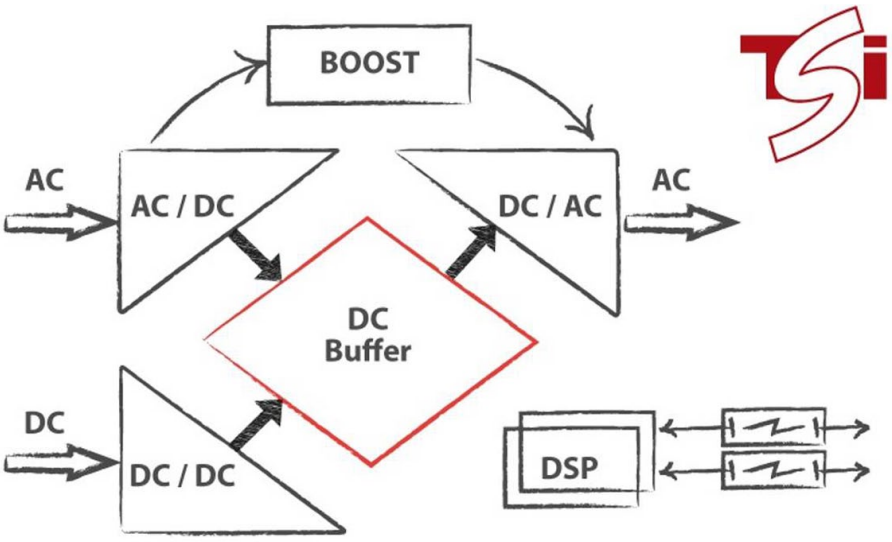


Fig. 3: TSI technology packs three energy converters into one module.

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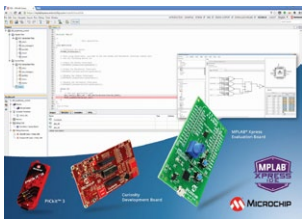
Farnell element14 to back Atmel Xplained concept

Farnell element14 and Atmel have launched the SAMA5D2 Xplained Ultra evaluation kit for the fast prototyping and evaluation of Atmel's SMART SAMA5D2 Series of microprocessors. The board offers multiple memories including eMMC, DDR3 and QSPI as well as a comprehensive set of connectivity options. With its secure design architecture, cryptographic acceleration engines, and secure boot loader, the SAMA5D2 is suitable for point-of-sale (POS), Internet of Things (IoT) and industrial applications requiring anti-cloning, data protection and secure communication transfer. The embedded MPU is based on the ARM Cortex-A5 processor and features an advanced user interface and connectivity peripherals.



element14
www.element14.com/designcenter

Cyntech to distribute Elenco's Snap Circuits in Europe

Components, a specialist supplier of electro-mechanical components and power supplies, has been announced as the European distributer for Elenco's Snap Circuits, an educational product aimed at teaching children aged 8 and up about electronics. Manufactured in the US, the Snap Circuit kits come in a range of sizes and applications. The popular Snap Circuit Jr. 100, with the potential to build 100 different projects, has 30 parts including a photo resister, music integrated circuit, motor, and space sound integrated circuit.

Cyntech Components
www.cyntech.co.uk

MSC Technologies stocks -40 to +85° DDR4 modules

MSC Technologies now stocks the industry's first DDR4 wide temperature module, designed for industrial platforms and applications for harsh environments. Supporting the Intel Skylake H/S/U and Broadwell platform, the DDR4 wide temperature module series is Jedec compliant and offers up to 30% higher performance with 20% lower power consumption compared to the mainstream DDR3 modules. Its built-in thermal sensors alert the respective system to temperature changes, while its industrial-grade wide temperature components allow the operation to withstands temperature changes.

MSC Technologies
www.msc-technologies.eu

Mouser offers TI designer tool to speed designs

Mouser Electronics, Inc. is offering the WEBENCH Designer online software design tool from Texas Instruments to enable designers to create customized designs in seconds. WEBENCH Designer lets designers generate, optimize, and simulate designs that conform to their specifications. Mouser Electronics will support the complete design with its large breadth of in-stock products from TI and other leading suppliers. The Texas Instruments WEBENCH Designer gives electronic design engineers a proven way to quickly and accurately simulate power converter circuits. Designers can build a circuit and simulate it over time and temperature.

Mouser Electronics
www.mouser.com

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Right solution for mid-range to high-end LED Drivers

Infineon's latest Multimode Flyback Controller IC for LED lighting is targeting mid-range to high-end LED Drivers for outdoor, interior, office and industrial lightings. Its integrated startup cell together with CrCM, DCM and burst mode optimize overall efficiency from standby to 100 percent while keeping time to light less than 0.5 second and minimum use of external components.

The benefits of the high voltage startup cell are:

- Fast time to light < 0.5 s while maintaining > 90 percent efficiency
- Eliminate external components for voltage dividing
- CrCM/DCM/Burst modes enables wide range operation from standby to 100 percent
- Key application is isolated flyback with CV mode and also capable of non-isolated flyback with CC/CV mode

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www.infineon.com/led-lighting-acdc

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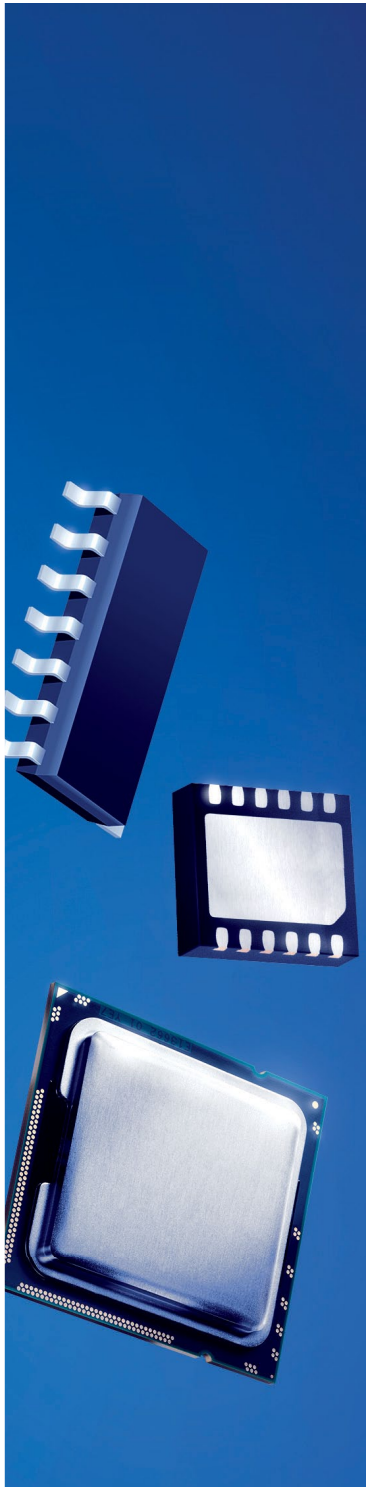

Engineering Development Tools

Engineering Development Tools

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Audio Development Tools																•										•			
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Data Conversion Development Tools			•		•			•								•													
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Processor Development Tools							•		•	•	•		•	•		•			•	•			•		•		•		•
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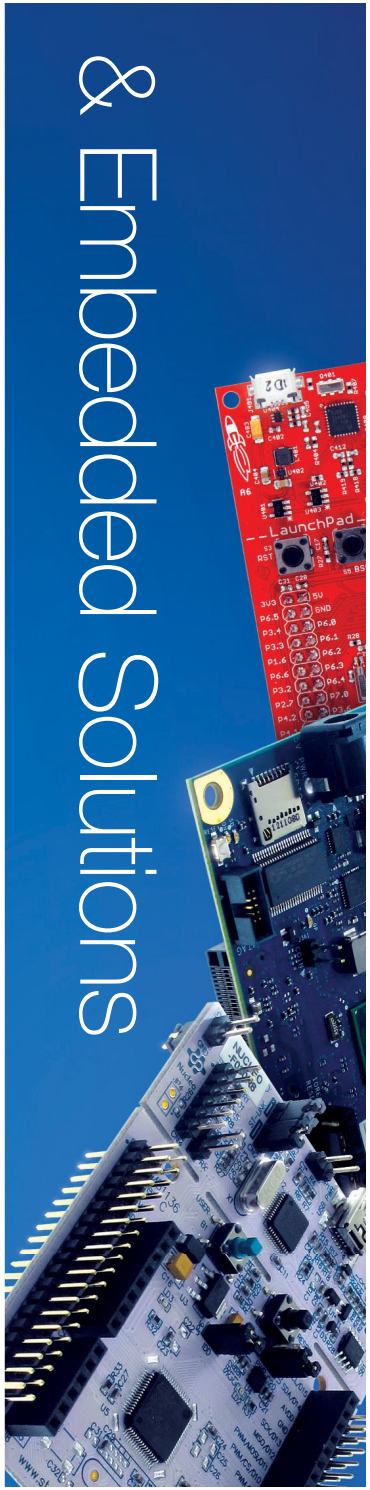
Ethernet & Communication Modules					•				•						•				•					•
Interface Modules		•			•				•								•			•		•	•	
Processor Modules			•		•				•	•				•		•	•		•	•	•	•		•
RF / Wireless Based Modules	•	•			•	•		•	•		•		•		•		•		•	•		•		•
Single Board Computers			•		•		•			•		•						•			•			

& Embedded Solutions

•		•				iBASE Technology
•	•	•	•	•		Intel
		•				Ka-Ro
	•				•	Laird Technologies
	•					LS Research
	•					Maestro Wireless
	•					Microchip
					•	Mide Technology
	•					Murata
		•		•		NetBurner
	•					NXP Semiconductor
	•					Panasonic
		•				PandaBoard.org
	•	•	•		•	Parallax
					•	Powercast
•	•	•		•		Rabbit Semiconductor
	•					Redpine Signals
	•					RF Digital
	•		•		•	Seeed Studio
	•			•		Silex Technology
	•					SkyeTek
	•					STMicroelectronics
	•					Taiyo Yuden
	•					TDK
•						TechNexion
	•		•		•	Texas Instruments
	•					TriQuint Semiconductor
•						Udoo
	•					Wi2Wi
	•					WIZnet
•						ZiLOG

				•		•				•						Keil
			•													Laird Technologies
				•	•					•						Lattice Semiconductor
•						•										Leopard Imaging
			•													Linx Technologies
	•					•	•	•			•	•	•	•		Maxim Integrated
		•	•	•		•	•	•	•	•	•		•			Microchip
		•														Micronas
						•		•	•							mikroElektronika
										•						National Instruments
						•			•							NetBurner
				•												Nordic Semicondutor
		•	•	•		•	•	•	•							NXP Semiconductor
						•										Olimex
			•	•			•									ON Semiconductor
•		•	•	•		•	•	•		•						Parallax
			•	•		•	•		•							Rabbit Semiconductor
			•													Redpine Signals
			•													RF Digital
		•	•				•									Seeed Studio
				•		•										SEGGER Microcontroller
			•			•			•							Silex Technology
		•	•	•		•	•	•	•	•		•	•			Silicon Laboratories
			•													SkyeTek
						•		•	•							SMSC (Microchip)
		•	•	•		•	•	•	•				•	•		STMicroelectronics
•					•											Terasic
						•										TechNexion
•		•	•	•		•	•	•	•	•	•	•	•	•		Texas Instruments
			•													TriQuint Semiconductor
							•									Vicor
						•										Wandboard
			•			•										WIZnet
				•		•		•		•						ZiLOG



Optoelectronics, Lighting and

Optoelectronics

Optoelectronics	3M Touch	4D Systems	Adafruit	ams	Amulet Technologies	Avago Technologies	BIVAR	CEL	Chicago Miniature	CREE	Dialight	Diodes Incorporated	Displaytech	ELECTRONIC ASSEMBLY	Emerson Connectivity	Everlight
Displays	•	•	•	•	•	•							•	•		•
Fiber Optic Communi-cations						•									•	
Infrared Data Communi-cations																•
Lamps & Holders							•		•		•					
Lasers Diodes																
LED Drivers					•		•				•	•				
LED Indication			•			•	•		•	•	•					•
Optical Detectors & Sensors				•		•										•
Opto-couplers / Photo-couplers						•		•								•
Photo-interruptors																•
Photomicro-sensors																

Optoelectronics	Fairchild Semiconductor	Finisar Corporation	Fujitsu	Harvatek Technologies	Intersil Corporation	Infineon	JKL Components	Kingbright	Kyocera / AVX	Lite-On	Lumex	Lumileds	Microsemi	Microtips Technology	Mitsubishi Electric	Newhaven Display
Displays			•		•			•	•	•	•			•	•	•
Fiber Optic Communi-cations		•														
Infrared Data Communi-cations	•							•		•	•					
Lamps & Holders							•									
Lasers Diodes																
LED Drivers	•				•	•							•			
LED Indication				•				•		•	•	•				
Optical Detectors & Sensors	•							•		•						
Opto-couplers / Photo-couplers	•									•						
Photo-interruptors	•									•						
Photomicro-sensors																

Optoelectronics	NKK Switches	Noritake	NXP Semiconductor	Omron	ON Semiconductor	Optek	OSRAM Opto Semiconductors	Panasonic	Phoenix Contact	ROHM Semiconductor	Seeed Studio	Seoul Semiconductor	Sharp Microelectronics	STMicroelectronics	Texas Instruments	Toshiba
Displays	•	•		•			•						•			
Fiber Optic Communi-cations				•		•			•				•		•	•
Infrared Data Communi-cations						•	•			•		•	•			
Lamps & Holders																
Lasers Diodes						•		•								
LED Drivers			•		•					•			•	•	•	•
LED Indication						•	•	•		•	•	•	•			•
Optical Detectors & Sensors				•		•	•	•		•	•		•		•	
Opto-couplers / Photo-couplers						•			•				•			•
Photo-interruptors				•		•	•			•			•			
Photomicro-sensors				•												

Lighting

Lighting		Avago Technologies	Califia Lighting	CREE	DBM Optix	Dialight	Heatron	Infineon	JKL Components	Kingbright	LED Engin	Ledil	LEDLink	Lite-On	Lumex	Luminus Devices	Lumileds	Maxim Integrated
Backlighting Components				•					•						•		•	
LED Lighting	High Power LED	•		•						•	•			•	•	•	•	
LED Lighting	LED Arrays, Modules & Light Bars	•	•	•		•	•		•	•				•	•	•	•	
LED Lighting	LED Technology Light Bulbs			•							•							
LED Lighting	Optics	•			•	•					•	•	•					
Drivers				•		•		•				•						•

Sensors

VCC	Vishay	ZiLOG	Sensors	All Sensors	ALPS	ams	Analog Devices	Atmel	Avago Technologies	Azoteq	BEI Sensors	Bosch Sensortech	CHERRY	Cypress Semiconductor	Diodes Incorporated	EPCOS	First Sensor	GE Sensing	Hamlin	Heraeus	Honeywell	Infineon Technologies	Intersil Corporation	Kionix	Measurement Specialities Sensors	MEDER Electronic	Micronas	Microchip	Microsemi	Murata	NXP Semiconductor	Omron	ON Semiconductor	Optek	OSRAM Opto Semiconductors	Panasonic	Plessey	ROHM Semiconductor	Sharp Microelectronics	Silicon Laboratories	Silicon Microstructures, Inc.	SMSC (Microchip)	Spectrum Sensors	Stancor	STMicroelectronics	Tamura	TDK-Lambda	Texas Instruments	Toshiba	Vishay
	•		Accelera-tion				•					•													•	•					•	•					•							•					
			Capacitive Touch					•		•																					•	•					•							•					
	•	•	Current												•						•						•												•					•				
			Flow																•		•												•																	
•			Gyro-scopes				•					•																			•														•					
			Hall Effect / Magnetic		•		•				•	•	•		•				•			•	•				•				•	•		•					•					•			•		
			Humidity															•				•				•																								•
•	•		Motion & Position		•			•			•		•		•				•			•									•						•				•								•
			Optical			•		•	•					•			•					•		•					•					•	•	•	•	•	•	•	•							•
	•		Photoelec-tric																													•					•													
	•		Pressure / Force	•				•				•				•		•				•	•			•						•	•				•					•							
			Proximity						•				•						•	•	•					•		•				•	•			•													
	•		Tempera-ture				•	•						•		•		•				•				•		•		•	•	•		•				•			•	•	•	•	•		•	•		•
	•		Vibration & Tilt																							•					•	•																	

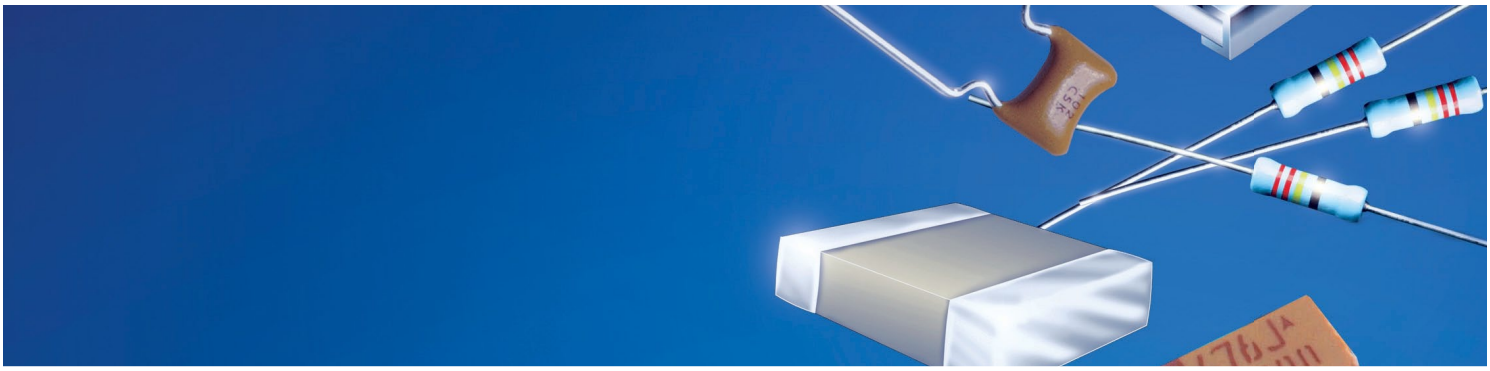
NXP Semiconductor	ON Semiconductor	Optek	OSRAM Opto Semiconductors	Seoul Semiconductor	Sharp Microelectronics	STMicroelectronics	TDK	Texas Instruments	Toshiba	Vishay
			•		•		•			
		•	•	•	•				•	•
		•		•						•
•	•				•	•		•		

MOUSER ELECTRONICS

Passives & Circuit Protection

Passives

		ABRACON	ALPS	American Technical Ceramics (ATC)	Anaren	Antenna Factor	Antenova	API Delevan	Arcol	AVX	Bourns	Caddock	Citizen Finetech Miyota	Coilcraft	Cooper Bussmann (Eaton)	Cornell Dubilier	Crystell	CTS	ECS	Ecliptek	EPCOS	EPSON	ETI Systems	Fair-Rite	FOX	Honeywell	ICE Components	IOXUS	IPDiA	Johanson	KEMET	KEMET NEC TOKIN	Knowles	KOA Speer	Laird Technologies	Leadertech	MACOM	Maxwell Technologies	Murata	Nichicon	Ohmite	ON Semiconductor	Panasonic	Piher	Pletronics	Pulse	Quatech	Schaffner	Seed Studio
Antennas		•			•	•	•																			•				•					•				•							•	•		•
Attenuators				•						•																																						
Audio & Signal Transformers											•										•					•										•	•		•					•				
Capacitors	Aluminum Electrolytic Capacitors															•					•									•										•								
Capacitors	Ceramic Capacitors			•						•						•					•								•	•		•						•									
Capacitors	Feed Thru Capacitors									•																				•								•				•					
Capacitors	Film Capacitors									•						•					•									•									•				•					
Capacitors	Mica Capacitors															•																																
Capacitors	Niobium Oxide Capacitors									•																																						
Capacitors	Polymer Capacitors									•						•															•	•						•	•			•					
Capacitors	Silicon Capacitors																												•																		
Capacitors	Supercapacitors / Ultracapacitors									•					•	•											•				•	•					•	•	•			•					
Capacitors	Tantalum Capacitors									•						•															•																	
Capacitors	Trimmer / Variable Capacitors									•																							•						•									
EMI/RFI Components		•						•		•	•										•			•						•	•	•	•	•	•			•			•	•			•		•	
Frequency Control & Timing Devices		•								•			•				•	•	•	•	•	•			•					•					•			•			•	•		•	•			
Inductors		•	•	•				•		•	•			•	•						•			•		•				•	•	•		•	•			•				•			•		•	
Potentiometers & Rheostats			•								•							•					•		•															•		•	•					
Resistors	Carbon Composition Resistors																																	•							•								
Resistors	Ceramic Composition Resistors																																	•							•								
Resistors	Current Sense Resistors								•		•	•						•																•							•			•					
Resistors	Film Resistors	Carbon Film Resistors																																•										•					
Resistors	Film Resistors	Metal Film Resistors											•																					•							•			•					
Resistors	Film Resistors	Thick Film Resistors								•		•	•																					•							•			•					
Resistors	Film Resistors	Thin Film Resistors										•	•																					•										•					
Resistors	High Frequency / RF Resistors			•	•					•	•	•																					•															
Resistors	Metal Oxide Resistors																																	•							•								
Resistors	Power Resistors			•						•	•	•																					•							•			•					
Resistors	Resistor Networks & Arrays									•	•	•						•															•										•					
Resistors	Wirewound Resistors								•		•														•															•								
Resistors	Trimmer Resistors										•							•							•															•		•						



Circuit Protection	Altech	Ametherm	AVX	Bourns	Carling Technologies	CMD / ON Semiconductor	Diodes Incorporated	Eaton	EPCOS	Fairchild Semiconductor	Honeywell	Infineon	KOA Speer	Littelfuse	Murata	NXP Semiconductor	ON Semiconductor	Panasonic	Phoenix Contact	Schurter	Semitec USA	STMicroelectronics	TDK	TE Connectivity	Texas Instruments	Vishay	Wurth Elektronik
Circuit Breakers	•			•	•			•						•					•	•				•			
ESD Suppressors			•	•		•		•	•			•		•	•	•	•	•				•	•	•	•	•	•
Fuses	•		•	•				•					•	•				•		•				•		•	
Fuseholders, Clips, and Hardware	•							•						•						•							
Gas Discharge Tubes / Gas Plasma Arrestors				•				•	•					•										•			
PTC Resettable Fuses				•				•						•						•				•			
Surge Suppressors				•				•						•					•					•			
Thermistors - NTC		•	•						•		•		•		•			•			•		•			•	
Thermistors - PTC				•					•				•		•											•	
TVS Diodes - Transient Voltage Suppressors			•	•		•	•	•	•	•		•		•		•	•	•			•	•		•	•	•	•
Varistors - MLV			•	•				•	•					•				•					•			•	•
Varistors - MOV				•					•					•				•		•	•			•		•	•

MOUSER ELECTRONICS

Connectors

Connectors	3M	Alpha Wire	ALPS	Altech	Amphenol	Anderson Power Products	Avery Dennison	AVX	Bel Power Solutions	Belden Wire & Cable	Bulgin	Cinch Connectivity Solutions	CONEC	CUI	Delphi Connection Systems	DEM Manufacturing	EDAC	ERNI Electronics	FCI	FCT Electronics	Fujitsu	Glenair	HARTING
Audio / Video Connectors					•							•		•		•			•				
Automotive Connectors					•			•				•			•				•				
Backplane Connectors	•				•			•											•				•
Board-to-Board / Mezzanine Connectors	•				•			•										•	•		•		•
Card Edge Connectors	•							•				•	•				•		•				
Circular Connectors	•				•						•	•		•	•			•				•	•
DC Power Connectors					•	•																	
D-Subminiature Connectors	•				•				•			•	•			•	•	•	•	•		•	•
FFC / FPC Connectors								•											•				
Fiber Optic Connectors	•				•																		•
Headers & Wire Housings	•				•			•				•					•	•	•		•	•	•
IC & Component Sockets	•																		•				
I/O Connectors	•				•			•				•					•		•		•		•
Lighting Connectors					•			•															
Memory Card Connectors	•		•		•			•											•				
Memory Socket Connectors	•																		•				
Photovoltaic (Solar) Connectors					•																		
Pin & Socket Connectors	•																						
Power Connectors					•	•			•			•		•					•	•			•
Power Entry Modules					•						•												
RF Connectors					•							•											
Telecom & Ethernet Connectors					•			•			•	•	•				•		•				•
Terminal Blocks				•	•				•			•											
Terminals	•			•	•																		
Tubing & Sleeving	•	•								•												•	
USB & Firewire Connectors	•				•						•	•	•				•		•				•
Wire and Cable	•	•			•					•		•						•					
Wire & Cable Management	•	•			•		•																

Harwin	Hirose Electric	JAE Electronics	JST Automotive	Kycon	LEMO	Mill-Max	Molex	Neutrik	NorComp	Omron	Panasonic	Panduit	Phoenix Contact	Pomona	Pulse	Qualtek	Radiall	Schaffner	Schurter	Seeed Studio	Souriau	Spectrum Control	Switchcraft	TE Connectivity	Temp-Flex Cable, Inc.	Tri-Star	Vicor	Volex	Winchester Electronics
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Electromechanical

Electromechanical		Aavid Thermalloy	Advanced Thermal Solutions	ALPS	Altech	AMSECO	Apem	APM Hexseal	Applied Motion	Avago Technologies	BEI Sensors	Bergquist Co.	BI Technologies	Bourns	Bulgin	C&K Components	Carling Technologies	CHERRY	Clare	Continental Industries	Coto Technology	Crouzet	Crydom	CTS	CUI	CW Industries	DB Unlimited	Delta Fans	EAO	ebm-papst	Electroswitch	EPCOS	E-Switch
Encoders				•						•	•			•										•							•		
Hardware					•		•	•						•	•		•																
Industrial Controls																		•				•		•					•					
Knobs & Dials				•			•							•																		•		
Audio	Audio Indicators & Alerts					•																			•		•							
	Microphones																								•		•						•	
	Speakers & Transducers																								•		•							
Relays & I/O Modules	General Purpose / Industrial Relays																						•											
	I/O Modules																			•		•	•											
	Low Signal Relays - PCB																																	
	Reed Relay					•															•													
	RF (Radio Frequency) Relays																																	
	Solid State Relays									•									•	•		•	•											
	Time Delay & Timing Relays																					•												
Motors & Drivers									•																									
Switches	Basic / Snap Action / Limit Switches															•		•																•
	DIP Switches / SIP Switches						•									•								•										•
	Magnetic / Reed Switches					•										•					•													
	Pushbutton Switches			•	•		•								•	•	•	•								•			•		•			•
	Rocker Switches & Paddle Switches			•			•									•	•	•								•					•			•
	Rotary Switches			•	•		•							•		•								•							•			•
	Slide Switches			•			•									•	•									•			•					•
	Tactile & Jog Switches			•			•						•	•		•																		•
	Toggle Switches						•									•	•														•			•
Thermal Management	Fan Cords & Accessories																																	
	Fans & Blowers																											•		•				
	Heatsinks	•	•																				•	•										
	Thermal Interface	•										•																						
	Thermoelectric Modules																																	

																								•				ETI Systems
																			•		•							Fujitsu
					•	•	•	•	•	•		•																•	Grayhill
												•														•			Heyco
					•				•	•			•								•			•	•		•	•	Honeywell
																•													International Rectifier
										•			•																ITW Switches
																											•		Keystone
																					•	•							Knowles
•	•																												Laird Technologies
	•																												LeaderTech
									•		•													•					Lorlin
															•	•		•	•		•								Magnecraft
																						•		•			•		Mallory Sonalert
					•		•		•	•			•																Marquardt
											•							•											MEDER electronic
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																			•		•								NEC
					•	•	•	•	•	•		•												•					NKK Switches
		•						•																•		•			Ohmite
						•			•	•		•	•		•	•	•		•	•	•				•	•			Omron
																													Optek
			•	•																									Orion Fans
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	•					•						•	•			•	•		•	•	•							•	Panasonic
													•		•	•				•	•						•		Phoenix Contact
																						•	•	•					PUI Audio
				•																									Qualtek
																											•		RAF
			•	•																									Sanyo Denki
															•				•										Schneider Electric
										•																			Schurter
																											•		Seeed Studio
	•															•													Sharp Micro
																			•		•								Song Chuan
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		•			•	•	•	•	•	•		•	•		•	•	•	•	•	•	•						•		TE Connectivity
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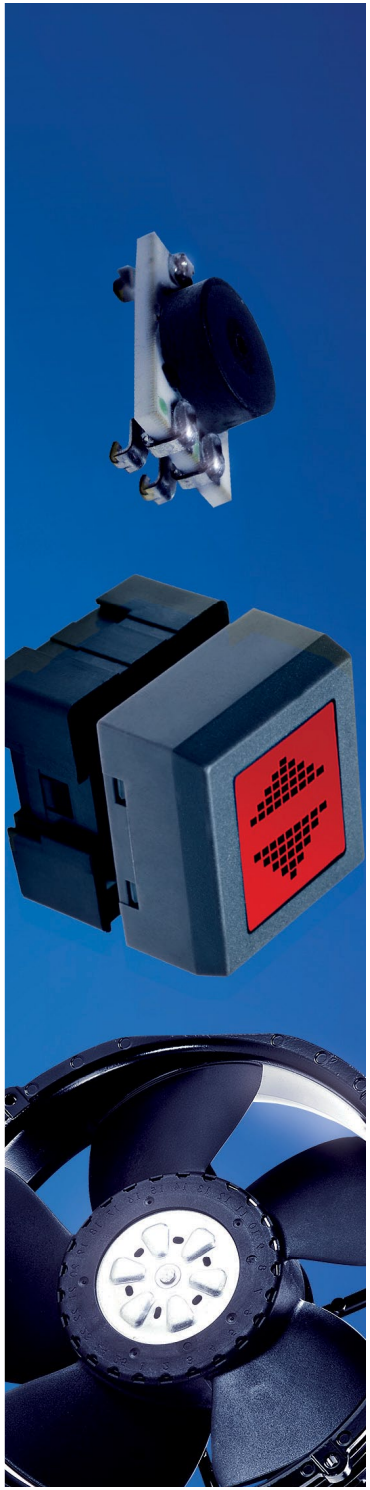

MOUSER ELECTRONICS

Power, Test & Measurement

Power

	APC by Schneider Electric	Artesyn Embedded Technologies	B&K Precision	Bel Power Solutions	Bourns	Bulgin	Cincon	Cosel	CSB	CUI	Cymbet	Delta Electronics	Elpac (Inventus Power)	EPCOS	Ericsson Power Modules	ETA-USA	GE Critical Power	Hammond	International Power	Mean Well	Murata Power Solutions	Omron	Panasonic	Phihong	Phoenix Contact	Pulse	Qualtek	RECOM	Renata	Schaffner	Seeed Studio	SL Power	Sola/Hevi-Duty	Tadiran
Batteries									•		•												•		•				•					•
Battery Chargers									•											•														
Battery Holders, Snaps & Contacts					•	•												•											•					
Bench Top Power Supplies			•																															
DC/DC Converters & Regulators		•		•	•		•	•		•		•			•	•	•			•	•			•				•			•		•	
LED Driver Power Supplies		•					•			•										•				•				•				•		
Linear & Switching Power Supplies		•	•	•			•	•		•		•	•			•	•		•	•	•	•		•	•		•	•				•	•	
Plug-In AC Adapters		•					•			•			•			•				•				•									•	
Power Conditioning																															•		•	
Power Line Filters														•			•										•			•	•		•	
Power Outlet Strips	•																	•																
Transformers														•				•			•				•	•				•			•	
UPS (Uninterruptible Power Supplies)	•																								•								•	

Enclosures

	BIVAR	BUD Industries	Hammond	New Age Enclosures	PacTec	Pomona	SERPAC
Accessories for Racks & Cabinets	•		•				
Enclosures, Boxes & Cases		•	•	•	•	•	•
Racks & Rack Cabinets		•	•				

and Enclosures

Test & Measurement

	3M	Adaptive Interconnect Electronics	B&K Precision	Extech	FLIR Systems	IET Labs	Mueller Electric	Murata	Omron	Pomona	Seeed Studio	TDK-Lambda	Teledyne LeCroy
Bench Top Power Supplies			•	•								•	
Decade Boxes				•		•							
Environmental Test Equipment			•	•	•								
Frequency Counters			•										
Function Generators & Synthesizers			•								•		•
Insulation Testers / Megohmeters			•	•		•							
Multimeters & Voltmeters			•	•	•					•			
Oscilloscopes			•								•		•
Panel Meters								•					
Stopwatches & Timers									•				
Spectrum Analyzers			•										•
Test Equipment Accessories	•	•	•	•			•	•		•	•		•
Thermal Imaging					•								

Tamura	TDK - Lambda	Triad Magnetics	TE Connectivity	Ultralife	Vicor	Wurth Electronics
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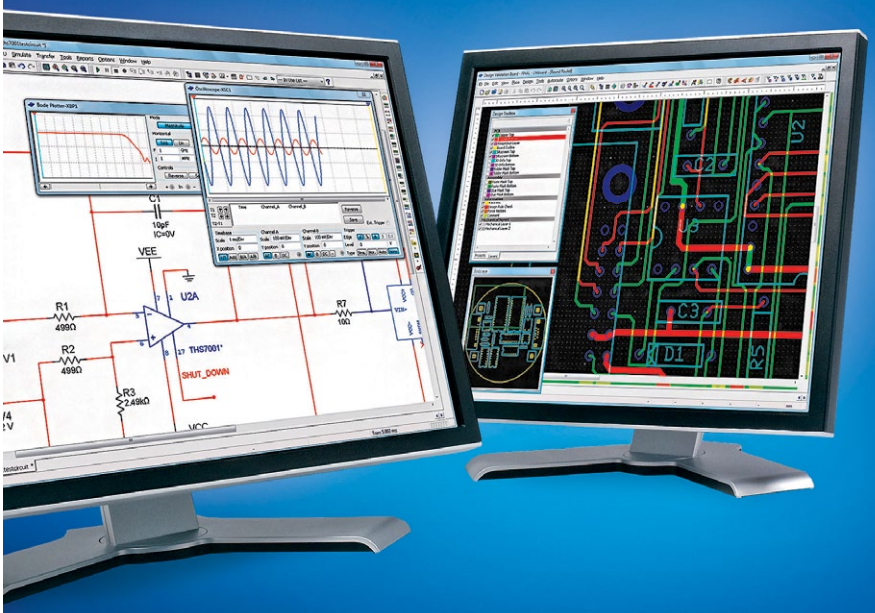

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