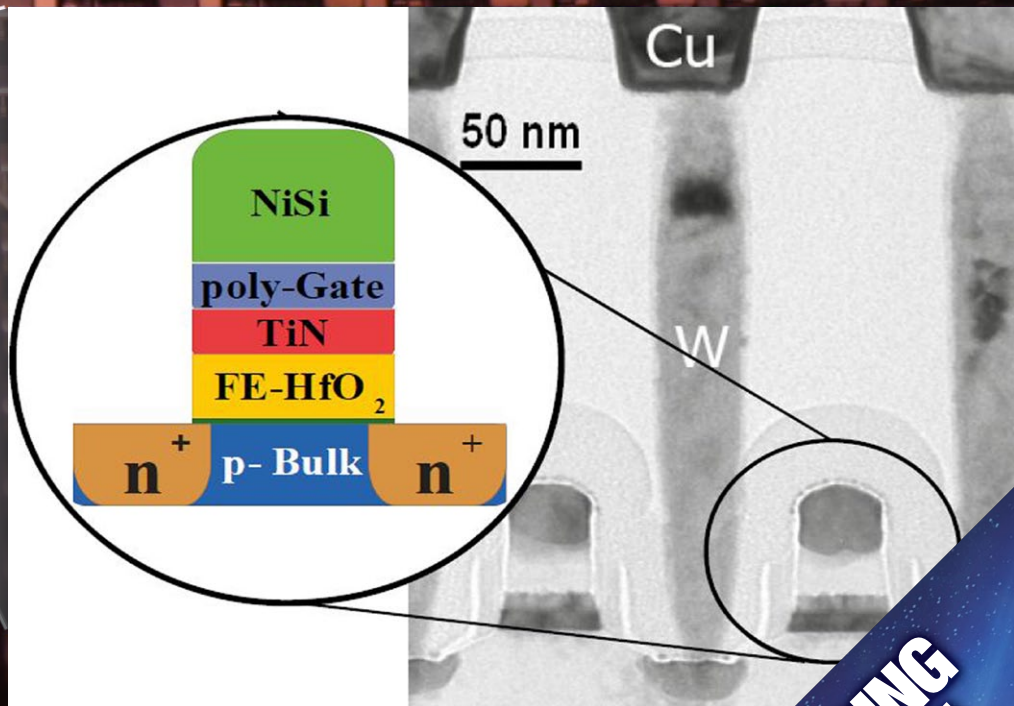
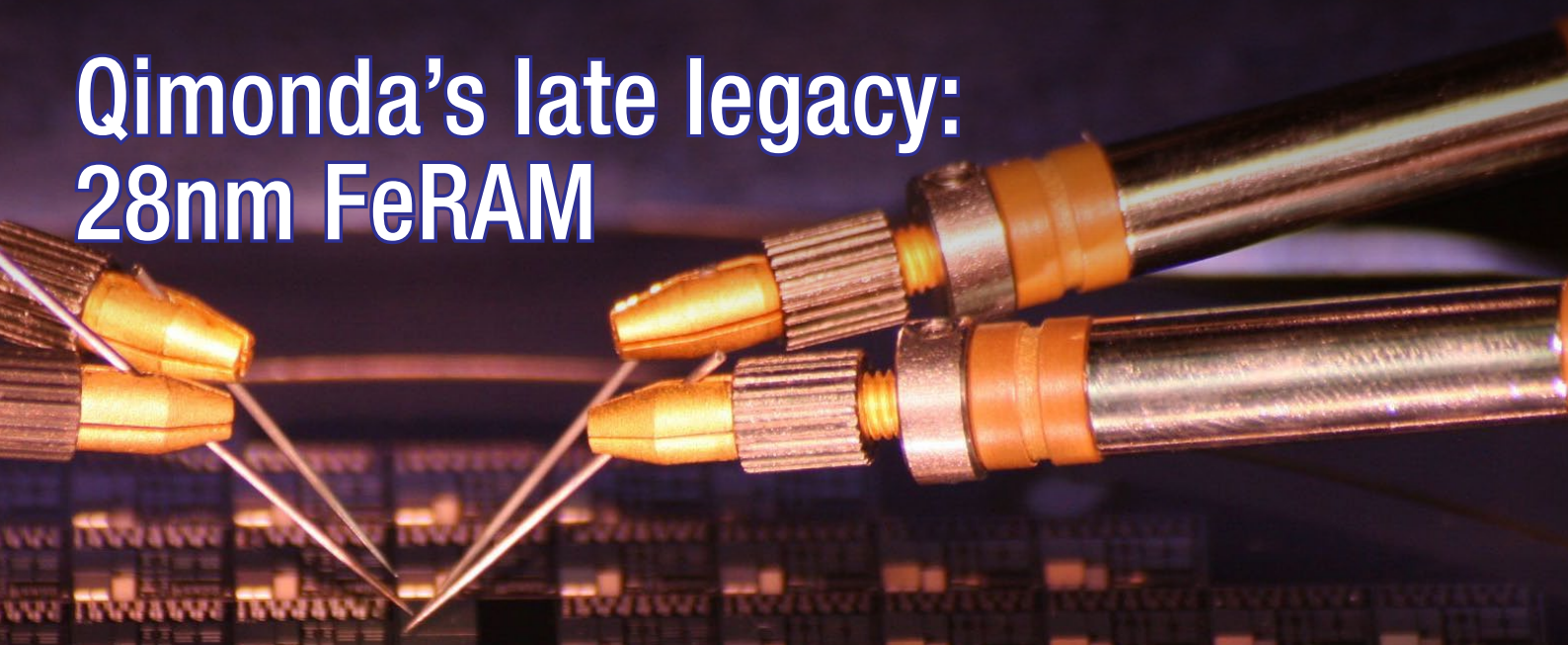


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## Qimonda's late legacy: 28nm FeRAM



Closing the loop with 3D printing

Executive interview:  
Bosch's IoT startup CEO: Thorsten Mueller

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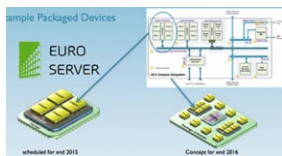


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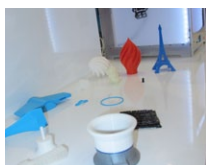
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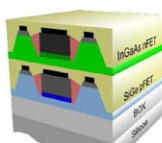


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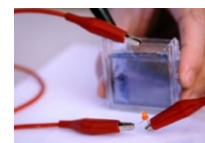


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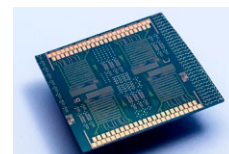
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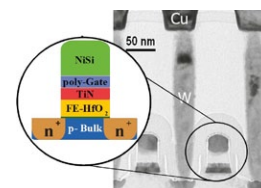


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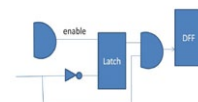
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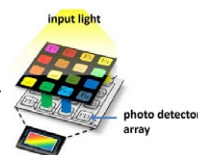
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## Tracking offenders and consumers alike

By Julien Happich

**LAST MONTH WAS TAKING** place the 9th annual CEP (Confederation of European Probation) conference in Frankfurt, aiming to address the state of electronic monitoring (EM) in Europe and set this penal measure in the context of human rights (including data protection).

It is interesting to note that such a conference would address the very same issues around privacy (while monitoring a convict outside jail) as they would typically need to be addressed at consumer level with smartphone geo-localization and relentless in-shop behaviour analysis.

Leading EM solution provider Track Group was among the conference attendees, closely watching the market evolutions with plans to expand in Europe. EETimes Europe caught up with the company's CTO, Tom Gilgan, to learn more about the specificity of the European market.

Like many of its competitors in this niche market, Track Group commercializes EM bracelets, looking very much like beefed-up wearables with a tamper-proof strap (including tamper detection and alert). One model, the Shadow, reports real-time GPS data about the wearer and can automatically notify the offender of a no-go area (through a flashing LED, sound or vibration), based on pre-established geo-fencing scenarios.

A more elaborate device, the ReliAlert XC, not only tracks offender movements but features two/three-way voice communication as well as a loud 95-db siren that can be activated through the monitoring centre in case the offender would not comply with his/her geo-fencing restrictions.

All right, that's all a bit coercive, but still better than jail, so much so that in some countries, EM is nearly considered as a favour being made to convicts who have a good conduct track-record or for mild criminals (the economics and better re-insertion are other drivers). While in the US, Canada and in a lot of countries outside Europe, law enforcement agencies typically grant themselves the right to do whatever they want with the GPS data to ensure public safety (on the basis that a convict's privacy doesn't matter to them), Europe apparently has a different stance.

"The most interesting part of the conference was the discussion about electronic monitoring human rights on data protection. There is a huge diversity across countries, and in Europe, each country has a very different mandate", said Gilgan.

In Germany for example, officers are not even allowed to look at GPS data from the previous day. So together with its wearables, Track Group has developed strong data analytics solutions that crunch the GPS data into summary reports rather



The ReliAlert XC, a tough wearable.

than detailed views of the convict's whereabouts.

Gilgan sees these analytics as a key differentiator for the company, a capability on data interpretation that can be tuned to whatever country's legal framework.

"This analytics side of our reporting software helps officers understand loads of things about the offender, but in a summarized way that respects data privacy. Our analytic tools can bring up patterns of life that can be interpreted so as to prioritize the officer's actions", Gilgan said.

"There is a lot of academic work involved in this, but the behavioural analysis gives a lot of clues on the lifestyle. For example, it has been shown that an unstructured lifestyle is more likely to lead to recidivism".

When big data is thrown into the equation, for example blending GPS data with crime data, gun registry data, or other known offenders' addresses, the picture gets wider and wider. Without even having to dig into all of the data, at regular intervals, a probation officer could notice suspect repeat visits or acquaintances and issue warnings (either these stop or you go back behind bars).

Although Track Group is selling its products globally, Europe is a growing market for the company. Each country is its own market, with specific mandates on how offenders should be dealt with, and the analytics can be tuned accordingly to safeguard their privacy.

Recently, Track Group acquired Canadian G2 Research, a global provider of analytical software with solutions ranging from data analysis and reporting to advanced predictive analytics. This acquisition is very much in line with the company's goals to expand in Europe with customizable tracking solutions.

But with this acquisition, the company is also hoping to break the mould from its niche surveillance market to adjacent markets, including the advertising industry prone to track consumers' dollars.

Gilgan admits that although advertising has nothing to do with Track Group's today core offerings, the behavioural analysis and lifestyle pattern extractions share something in common with today's big data marketing tactics, and the advertising market is just too tantalizing to be ignored.

"We have to think about how we want to approach the consumer market, but some of our predictive technology could be used to launch mobile ads. For example, we could serve a Starbucks promotion just before they make a move to take their coffee break", said Gilgan. According to market research, such predictive advertising could be 5 to 10% more effective than merely geo-localized advertising.



The TrackerPAL Mobile App, a web-based application that records and stores all data transmitted from ReliAlert, for real time and historical offender location viewing

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Keysight E6640B EXM wireless test set with V9080/82B LTE FDD/TDD measurement applications and N7624/25B Signal Studio software for LTE-Advanced/LTE FDD/TDD

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Unlocking Measurement Insights

# European server project promotes ARM on FDSOI

By Peter Clarke

A COLLABORATIVE EUROPEAN microserver project has teamed processor IP licensor ARM and chipmaker STMicroelectronics up with a number of academic and commercial computer and software specialists to try and make technical progress in microservers.

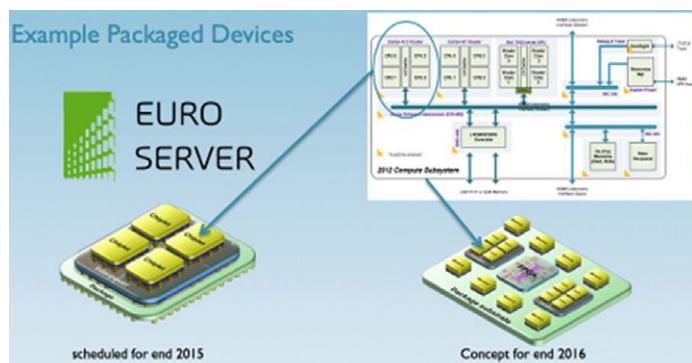
The three-year project, which started September 2013, is expected to deliver an innovative scalable computer system architecture this year and a hardware-software prototype implementation by the end of 2015.

The rise of cloud-enabled smart devices, cloud-based client services and the Internet of Things (IoT) is expected to create an opportunity as they will drive a shift in the needs of the IT infrastructure which is already under pressure to reduce power consumption even as it tries to scale up to serve increasing numbers of applications.

The Euroserver project is advocating the use of low-power ARM processors in a server architecture that uses 3D integration to scale processors, memory and I/O, all managed by system-wide virtualization and efficient use of resources by cloud applications. The group is aiming for a factor of ten improvement in energy efficiency over traditional server and microserver architectures.

Microservers are typically servers designed to serve applications that don't individually require high levels of computing performance but that may have to be done in large numbers and or may have critical latency aspects to performance. In the past servers tended to aim at ever higher performance and in recent years were the almost exclusive domain of the x86 processor architecture of Intel. Lower power microservers are now expected to take up an increasingly diverse number of data handling opportunities. And microservers have long been the chosen ground on which ARM has chosen to fight Intel in data centre.

John Goodacre, director of technology and systems at ARM and a visiting professor of computer architectures at the University of Manchester, said that the groups collaborating in Euroserver reflect the microserver profile.



Server in a package, potentially including hybrid memory cubes.

"TU Dresden is interested in the handling of databases in embedded telecom. Eurotech is a systems company looking at more deeply embedded applications," said Professor Goodacre. He also noted that that Spain's Barcelona Supercomputing Center is present which reflects an interest in scaling up to take on high performance computing.

## The unit of compute

The Euroserver project is leveraging the availability of an octa-core processor chip that ST makes on its FDSOI manufacturing process and also sees importance in using the latest 3D manufacturing techniques, courtesy

of project participant CEA-Leti to build the best power-performance trade off it can. "We've tried to take a holistic view of the challenge. It's a mixture of both hardware and software," said Professor Goodacre.

One of the foundation stones of the Euroserver project is an idea that Professor Goodacre laid out in a keynote speech at the DATE conference in 2013 – the 'Unit of Compute.'

This is the idea of what is the minimum requirement within a

computer node to allow its memory to be used by the outside world coherently with a minimum of overhead. A 'unit of compute' is managed by a single symmetric multiprocessing (SMP) operating system within a coherent region of memory. It has a processor system – from one to many cores – local memory, provides a coherent view of its memory to the outside world and has a path to access remote memory attached to other 'units of compute.'

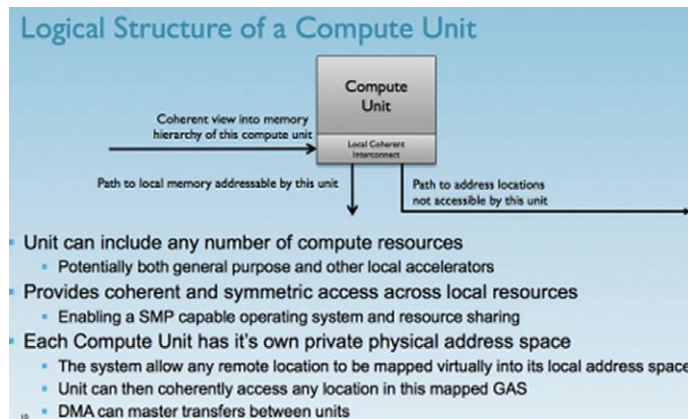
The net result allows the simplification of memory handling compared with traditional server computer architectures and is scalable. And such simplification can result in energy saving argues Professor Goodacre.

## The Unimem model

The project has developed a universal memory model or Unimem to build on this by making the memory a key focus of the architecture and dispensing with some traditional cache coherency requirements that have traditionally been implemented in servers.

In a presentation Professor Goodacre observed that there is no need for sequential consistency to be imposed in most data centre workloads. Applications tend to partition datasets and it is best to place the processor and its cache near the dataset of a particular application task.

In other words, rather than moving data sets around at great energy expense in terms of moving data and imposing cache coherency requirements it is more energy efficient to keep the data set still and move the task to a processor that is near the required data set. "We have tried to come up with a software-centric architecture," said Professor Goodacre. The Unimem approach not only maintains a consistent and coherent access



Compute unit. Source: ARM.

from each compute node to its local DRAM but manages access to the system-wide memory resource. "Most importantly it can be implemented using available ARM technology with little additional hardware overhead," Professor Goodacre said.

### Would you like chiplets with that?

The project will make use of 64-bit ARM cores but makes the argument that at present levels of integration for servers chip costs are at the level \$400 to \$800 per unit and likely to double as production moves on to FinFET processes below the 20nm node. For reasons of yield the project sees a benefit in only implementing in leading-edge processes what needs to be and minimizing die size. These processor die become "chiplets" in the Euroserver nomenclature and sit on top of an interposer that carries peripheral circuitry. In the physical implementation each chiplet will be an octa-core Cortex-A53 part implemented in 28nm FDSOI. And four of these chiplets will go on top of an interposer in a packaged part.

The Euroserver project started in September 2013 and for its first year has been working to flesh out and validate the computer architecture. One of the aspects of the architecture is to try and minimize use of long-distance interconnect and such bus standards as PCIe which were largely designed and optimized for performance rather than per-bit transferred energy consumption.

"We've spent time looking at software access patterns and the communication between the islands of coherence. We can

see how to achieve 100 nanoseconds compared with typical traditional figures of 500 microseconds," said Professor Goodacre.

Professor Goodacre said that the use of the ARM processor or the FDSOI process were not the most critical things in achieving a highly efficient and scalable architecture compared with the main thrust; how data is handled. However, having a low power processor on an intrinsically low power process all helps.

### How much does it cost?

"Using ARM allows us to design a low-power system," said Professor Goodacre. "And 28nm FDSOI gives us a very interesting power management lever with back biasing and retention modes. So it's the FDSOI, the chiplets, the 3D stacking, the software that all together make the difference," said Professor Goodacre.

While European Commission funded projects are not supposed to be used as a means of subsidizing commercial operations, if it should spark European-based commercial success in datacenters at the expense of Intel's x86 ecosystem few tears will be shed across Europe which has seen the strength and depth of its electronics base decline for many years.

The total cost of the project is €12,925,771 (about US\$15.6 million) of which European tax payers are expected to provide €8,599,929 (about US\$10.4 million).

## MIT discovers superconductor law

By R. Colin Johnson

**SUPERCONDUCTORS ARE IN** the news again. This time, the Massachusetts Institute of Technology (MIT) has discovered a law governing thin-film superconductors, eliminating much of the trial and error for companies that manufacture superconducting photodetectors that can sense single photons and squids for super-accurate measurements of minute magnetic fields.

Other applications that may benefit include the voltage standard chip used by the National Institute of Technology (NIST), the world's first quantum computer from D-Wave Systems Inc., and numerous meteorology applications from Hypres Inc.

"The applications for thin-film superconductors today are squids, photodetectors, voltage standards, metrology, and D-Wave's quantum computer," EE professor Karl Berggren told EE Times. He was assisted by Yachin Ivry, a postdoc in MIT's Research Laboratory of Electronics.

Today making thin-film superconductors involves a lot of trial and error, because there are no formulas that relate the different parameters. But with MIT's new mathematical law, new superconducting chips can be designed with the correct parameters determined ahead of time with his and Ivry's formula.

"Understanding superconducting thin films makes designing them easier, when you know the relationship between critical temperature, resistivity, and film thickness," Berggren said.

Perhaps the most important parameter is "critical temperature" -- the temperature at which the material turns into a superconductor. Though that temperature can be optimized with MIT's new formula, unfortunately, it cannot be reduced to room temperature with it.

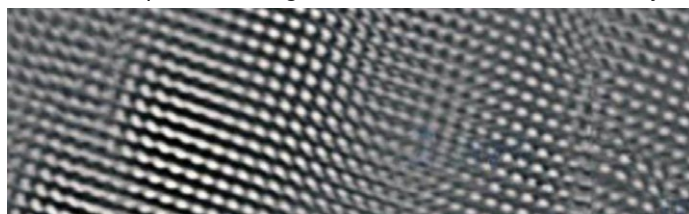
"We can optimize the critical temperature, but unfortunately, the thinner the films, the lower the critical temperature."

However, super-cooled superconductor chips can be better engineered for applications ranging from quantum computing to integrated ultra-low power devices.

Berggren's lab -- the Quantum Nanostructures and Nanofabrication Group, where Ivry works -- has built circuits that use only one-hundredth the energy of non-superconducting chips performing the same function.

The scientists' latest test material is niobium nitride, a so-called high-temperature superconductor. By holding constant two of the three parameters -- critical temperature, thickness, and resistivity -- they could see a clear relationship between the three parameters and a constant, which you can read about in their free paper "Universal scaling of the critical temperature for thin films near the superconducting-to-insulating transition."

Next the researchers tried out their new law on other superconductors and found it held for three dozen different superconductors (each of which had a different constant in the same formula depending on the regularity of their lattice).



Ultra-thin superconducting film of niobium and nitrogen shows individual atoms, a view that helped MIT discover a universal law of superconductivity. (Image: MIT, Yachin Ivry)

# A copyright mess in 3D

By Julien Happich

JUDGING BY IDTECHEX'S latest market figures about 3D printing materials, with a total consumable market expected to reach \$8bn by 2025 (a ten-fold increase from 2013's \$800m), 3D printing is no longer a rapid prototyping solution for niche markets but is increasingly being adopted for mass customisation in regular production flows, with a strong potential to relocate a large part of the manufacturing industry.

There isn't a week that passes-by without new 3D printing claims (faster, cheaper, more precise, more materials capabilities, more volume capacity, more colours etc...) and at any given time, crowd-funding sites such as KickStarter and IndieGogo typically host dozens of new 3D printer concepts to come.

But before you can print, you need a 3D model, easy for the CAD professional in an engineering company, maybe less obvious for the mere consumer. But hardware and software are catching up fast in the consumer space.

Reverse-engineering and metrology companies such as Kreon or Creaform Inc. have been offering professional-grade handheld 3D scanners for a while.



Creaform's Go!SCAN 3D handheld white-light 3D scanner.

Last May, Creaform was announcing its Go!SCAN 3D handheld white-light 3D scanner together with VXmodel, a 3D scan-to-print software module that cleans up the 3D meshes and prepares them for print. Of course, this type of professional-grade instruments (with an accuracy of up to 0.1mm and full-colour capture) is too expensive for consumer applications.

In the race of additive manufacturing and 3D scanning, 3D



Fuel3D's handheld scanner.



Systems who is active in the professional market is also addressing consumer needs with the recently released iSense 3D Scanner, an add-on scanner reselling for just under USD 500 that clips to the iPad Air, iPad mini or iPad 4 and promises users easy access to 3D selfies (with direct upload options to Cubify, the company's consumer hub for 3D printing).

A number of other low-cost 3D scanners are being marketed or under development, such as Fuel3D's handheld scanner which was successfully funded through a Kickstarter campaign.

Planned for release in 2015 for less than a thousand dollars, the point-and-shoot 3D imaging system will capture the shape and colour information of objects at a resolution of around 0.350mm, processing the files within seconds for on-screen manipulation before 3D printing.

But standalone solutions are not your only option as a consumer. Hewlett-Packard who recently made big news with its entry in the 3D printers market (claiming much faster printing speeds on its professional-grade multi-agent HP MultiJet Fusion thermal inkjet 3D printer), is now integrating a 3D scanner to its latest PC offering, the Sprout.

The Sprout features a depth sensor, a high-resolution camera and a projector for 3-D scanning and imaging, together with a special sensing mat. It allows users to seamlessly integrate real-world objects into their digital workspace.

At last consumer electronics show (CES), Intel's CEO Brian Krzanich demonstrated the company's RealSense 3D gesture camera integrated into a tablet, so it could be used to effectively perform real-time 3D scanning. The company plans to have the technology in tablets from 2015 onwards and may be pushing it into smartphones.

Even before you get to buy dedicated hardware, or before 3D scanners become mainstream, you can already turn your smartphone into a 3D scanner using apps like AutoDesk's free 123D Catch or Replica Labs' Rendor.

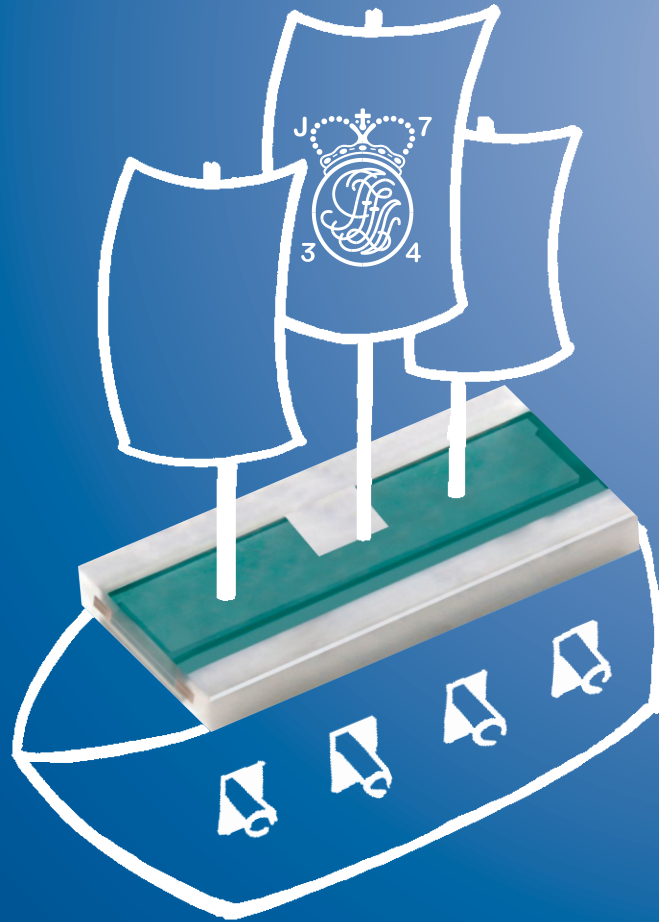
While the former is free (enticing users to buy CAD file manipulation software), the latter allows you to create a 3D scan of almost anything by taking surround video (the object being positioned on a specially printed paper grid for reference) and



3D Systems' iSense 3D Scanner.



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then sending the files to the Rendor servers for processing (for a small fee).

### When cheap 3D scanners and printers meet

So as prices come down, what will happen when consumers will be able to 3D scan any gadget they like and replicate it through a low-cost 3D printing service (think of all the portals out there such as [i.materialise.com](http://i.materialise.com), [www.shapeways.com](http://www.shapeways.com) or Cubify's Design Feed) at a better rate than buying the original product?

Copying is bad, and typically, you would get sued for infringing copyrights if you were caught replicating and reselling items originally designed by someone else.

But what happens if as a consumer you do it for your own good, simply because you want to change the colour, the material, or add a minor personalized touch to what you've seen in a shop?

Sooner than later, you'll find 3D copy shops in most cities, ready to print on demand whatever CAD files you throw at them. For bigger and larger objects, you could probably find your way around the limitations of today's small printers by parsing the CAD files into easy-to-assemble modular pieces, very much like the puzzle-chair demonstrated by Dutch designer Joris Laarman with his Bits&Parts project.

The project's aim is to design customizable and fully recyclable furniture (at the end of life, the used furniture could be molten and made into pellets and wire for new 3D printing), to be produced locally through fully automated mass digital fabrication units. The ultimate goal would be for consumers to stream catalogue parts from the cloud to 3D printer farms (for reasonable throughput).

The likes of Shapeways and [i.materialise](http://i.materialise.com) offer well-equipped and well-staffed 3D printing centres with a real expertise, their business models revolve around printing your personal designs (with engineering help as a service) and allowing anyone to sell their designs (as 3D products printed on demand).

As for intellectual property rights, no company will check for the origins of the CAD files, whether they come from a scanned object or whether they are modified files from someone else's original design. In fact, an easy and simple disclaimer consists in assuming that the persons who upload a 3D model for print are the rightful owners of the IP (they only remove the conflictual IP if the rightful owner comes by and happens to notice the copyright infringement).

Now, even if you are not reselling a gadget that you took time to scan and model for your own needs, potentially thousands or even hundreds of thousands of consumers creating their unique personalized copies could potentially represent quite a loss for a traditional business (producing toys or whatever).

Would there be a way to register CAD contours and patterns (with volumetric and density signatures) against which printing shops could match submitted designs? And could there be a matching percentage (between two shapes or collections of data points) above which one CAD file owner could sue another?

Discussing this matter with Creaform's Product Director,



HP's Sprout combines PC and 3D scanner in one portable work station.

François Leclerc, I was amazed at the lack of solutions in this nascent industry.

"There are currently no way to tag 3D scans or CAD files, and even if they were, the tags could easily be lost upon modifying and resaving the file", explained Leclerc.

"In fact, no one would want to have any limitations on the manipulation of the data sets they acquire with a 3D scanner", he added, "most of our

customers use the technology to design custom fit solutions on existing products, or to replicate a missing or broken part during a restoration project, or simply to acquire CAD data on legacy products for which they only have a clay model or the original mold".

Although Creaform doesn't address the consumer market, Leclerc's understanding is that global manufacturing will have to evolve and adapt to this new technology. Today's copyright law already applies, just like for MP3 files and software in general, but it will just become more difficult to enforce as the data manipulation tools become mainstream.

When becoming cheap enough, 3D scanning and printing technologies may encourage some original equipment manufacturers to lease CAD files rather than produce the actual goods in far flung countries.

At least, some complex equipment vendors may retain their market by offering full customization and original replacement part CAD files for their products, rather than passively witness consumers grab their designs or fix broken bits in an amateurish way.

You may even expect new forms of distributed manufacturing with catalogues of compatible parts for ready-to-assemble 3D furniture and objects. Who knows if specific assembly standards will pop up, with CAD add-ons enabling consumers to plug different files together and assemble whatever shapes printed separately).

With 3D printing services in the neighbourhood (understand local pick up or cheap delivery fees), will consumers' quest for customization re-shore manufacturing and initiate the collapse of large manufacturing centres in Asia? Will it become cheaper to operate in Europe?

For sure, original makers will always argue that materials and processes are not the same, and only they will ensure the original design quality, but in some cases, copycats could reverse the argument by upgrading the original materials and colours, or even making multi-material 3D prints when the original good may be cast from only one material.

So it seems there is only one roadmap to success, embracing and integrating 3D printing in volume manufacture to enable mass customization as a selling argument.

Or even better, make customization your competitive advantage, just like new York City-based start-up Normal - [www.nrml.com](http://www.nrml.com), which offers to 3D-print your headphones to a custom fit based on a series of photos of your ear cavities taken through its smartphone app.

# Printer-ready 3D CAD files: a marketing plus

By Julien Happich

**BOTH IN EUROPE AND** in the US, there has been a clamp-down on the illegal download of MP3 music files and movies, which seems to have been less effective than the deployment of legitimate digital stores or subscription services such as iTunes, Deezer or Spotify.

On these platforms, users can get the original files they want, discreetly, without taking any bet on quality nor taking any legal risk. Developing such legal platforms for the delivery of printer-ready 3D CAD files, with the participation of original manufacturers is the way forward for the 3D printing industry and probably the best counter-measure against unlawful design imitations or erroneous unprintable files, according to Stefaan Motte, Director of the 3D Printing Software Segment at Materialise N.V.

In an interview with *EETimes Europe*, Motte confirmed the trend for mass-personalization across a number of industries. He sees more and more customers take 3D printing as an opportunity to offer easy customization, mostly on casings even if the overall product design isn't affected.

Secure 3D CAD exchange isn't anything new across professionals, but giving access to a whole new catalogue of original CAD files for consumers to buy and print is something entirely new that most OEMs should consider.

"Not long ago, one of my colleagues had to fix a bumper link on his car. Because the replacement part didn't even exist on the aftermarket, he had to 3D scan it and print it himself before he could go to the garage for a repair. If the part had been available on the original manufacturer's site as a 3D CAD file, even for a small charge, it would have saved him time and effort".

Arguably, working at Materialise, Motte's colleague was well acquainted with 3D printing CAD software and the technologies at hand. The company has over 100 3D printers spread across different sites (one at its headquarters in Leuven, Belgium), capable of processing 17 different types of materials, ranging from polymers to metals and ceramics. But not everyone would be so confident with such a DIY 3D printed repair job.

"If you look at services such as iTunes or Spotify, users are ready to pay a reasonable amount if the service is easy to use and offers some quality assurance compared to illegal downloads. This would be even truer for 3D CAD files", told us Motte.

"Especially if you 3D print functional objects, there is a material cost associated to it and you don't want to launch a printing session (even at home) only to find out that the part isn't adequate, or isn't well prepared for 3D printing".

"Here consumers will have a much higher motivation to pay

for services that will guarantee them a good 3D print output, or that they get the right files compatible with their home printer", he added.

Motte sees quality assurance as a strong argument for original manufacturers to offer CAD files for lease or for print through accredited additive manufacturing services. Such services can ensure OEMs that their customers get the replacement parts or the custom parts built with exactly the same characteristics and the same qualified materials as the original parts, something they could endorse as an after-sales service.

Among other things, Materialise offers 3D design and engineering services, scanning or preparing CAD files for printing, in some cases fixing submitted designs. In the future, Motte expects more and more portals to offer such services.

So far the only CAD files you can find are mostly self-serving,

in the sense that most 3D printer manufacturers or 3D printing houses put forward on their portals a number of verified 3D objects, ready-to-print, knowing that every materialization is a win, either through paid-for printing services, or through consumables.

MakerBot does that through its digital-store and extends that with printing services for a gallery of designs from third party contributors under its thingiverse community. The company even launched several apps to help consumers design and print stuff in 3D.

Materialise does that through its MGX design division, named after the .MGX file extension of the company's 3D-printable data preparation software package, Magics.

But traditional manufacturers and brands should be next, offering product customization through consumer-friendly apps and replacement parts as 3D print-ready CAD files tied to a number of recommended materials or specific printing houses (read accredited for their quality assurance).

Just for the sake of branding, it would hardly cost anything for

a company to give away their 3D CAD logos as downloadable, customisable key-rings and miniature items for their fans to print, very much like today's desktop wallpapers.

Bringing up a full-fledged catalogue of replacement parts is another matter, but for some industries, the whole logistic for replacement parts or for assembly is a nightmare, and integrating 3D printing to the volume manufacturing chain could drastically change inventory and stock management. For those who currently don't offer such parts for the aftermarket, it simply opens up new business opportunities.



For some, 3D printing can help them re-localize their manufacture, nearer the original design centres, especially during the prototyping phase when shipping delays can have a big impact on the design process.

"In some cases, more particularly in the medical industry, even a day's worth of shipping delay will make the difference between a viable business and a non-viable business. This is where the concept of re-localization through 3D printing makes

the most sense", told us Motte, commenting on Materialise's presence in the US specifically to service more closely the medical market.

Depending on each industry, there will be an economical judgement to be made, for re-localization or for off-shoring 3D printing farms but providing consumers with a more direct access to original CAD files seems to be the way forward.

## Feeding scrap plastic into your designs

By Julien Happich

**LOCALIZED DESIGN AND MANUFACTURE**, shorter supply chains and minimal waste are all hot topics that the 3D printing industry promises to address. For sintering-based or stereolithography-based additive manufacturing, it is common practise to re-use all the non-sintered powder or the non-hardened liquid resin for the next process, after an object has been removed and cleaned up.

For extruded plastic wire spool-based 3D printers, which is the most common design offered to consumers at an affordable price, waste material consists mainly in temporary and removable support structures, as well as unsatisfactory prototypes or failed prints. And while more affordable 3D printers are reaching the market every month, the real cost in 3D printing lays in the consumables, spools after spools of extruded plastic sold at prices ranging from around 30 euros per kilo for the most basic colours to in excess of a hundred euros a kilo for filaments with particular mechanical or optical properties (flexible, elastic, translucent, or phosphorescent etc.).

No wonder that makers are trying to create their own spools, and in many cases, the plastic wires could not only be drawn from repurposed 3D printing waste, but also from cheap plastic pellets or even from selected plastic waste, from the bin (or before it reaches the bin).

With an IndieGogo crowdfunding campaign only started a few days ago, and nearly half-way through its \$70,000 goal, startup ReDeTec is promoting a desktop filament extruder. Dubbed the ProtoCycler (because part of the initial prototypes were re-used to build the final prototype), the unit comes complete with a built-in grinder, computer control, safety certification, and real time diameter feedback.

With an expected list price of \$799, ReDeTec says the ProtoCycler will pay for itself in just 10 to 20 spools, or maybe



less if you can selectively re-use some of your plastic trash (at your own risks, since they can only guarantee good extrusion specs from qualified material).

Of course, filament extruders are not new, you can easily find more than a dozen models available online, from established vendors, to kickstarter projects or even open-source designs such as the RecycleBot which promises to turn your household polymer waste into valuable 3D printer feedstock (cutting on waste transportation and CO<sup>2</sup> emissions).

ReDeTec claims it beats all competitors on specifications, with a filament diameter tolerance of +/- 0.02mm, an extrusion speed up to 10 ft/minute and automated spooling. For now, the ProtoCycler will operate from the push of a button for ABS or PLA plastic, but you can experiment with your own settings and custom materials. "If your 3D printer can print with it, ProtoCycler can make it!" states the campaign.

In the context of 3D printing, feeding scrap plastic into new designs truly encourages distributed and localized recycling. Pushing this concept to a full blown business model, startup company Plastic Bank is on a mission to reduce poverty and waste plastic worldwide.

The company is to set up plastic repurposing centres around the world, where there's an abundance of both waste plastic and poverty. It will reward locals for removing plastic waste from the land, oceans and waterways, harvesting plastics as a currency they can exchange for various things including tools, household items, parts and 3D printed goods.

Pioneering what it calls the Social Plastic movement, Plastic Bank claims it can do better than today's recycling centres as it has the processes and knowhow to recycle just any plastic, including mixed plastics. The company describes its goal in a youtube video on which it shows how it could monetize waste plastic, among other things by repurposing into high-value consumables for 3D-printers.



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Benoit Neel  
Vice President and General Manager  
Keysight Technologies, Inc.

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# Piloted driving takes centre stage at Audi's CES presentation

By Christoph Hammerschmidt

**CARMAKER AUDI OPENED** the Consumer Electronics Show with a particular bang: A sedan prototype drove all the way from the Silicon Valley to Las Vegas under computer control. Journalists were admitted to take the driver's seat but could relax and watch the sensors and algorithms to steer the vehicle across the 550 miles drive. At CES, the manufacturer showcased innovative approaches to infotainment, HMI, and connectivity.

"Jack", as the electronic chauffeur of the A7 piloted driving prototype was nicknamed, can autonomously change lanes and pass other cars. Its radar, lidar and optical sensors enable the vehicle to identify its position in relation to other traffic participants. The two-day ride from the Volkswagen Electronics Research Lab in Stanford (Volkswagen is Audi's parent company) to the fairgrounds in Las Vegas has been conducted for the first time under "customer conditions", as Audi Board Member Ulrich Hackenberg put it.

Though still a prototype, the sensors used were near-series versions: Two long-range radar sensors (associated to the ACC) observe the area in front of and behind the vehicle, assisted by two mid-range radar sensors each to both sides which complement the 360° all-round vision. The two laser scanners in the radiator grille and the rear apron provide redundant information - necessary to gain a complete, detailed multi-source 3D image of static and dynamic objects. A high-definition 3D camera at the windshield and four additional cameras at the front and rear corners of the vehicle provide additional information about the near surroundings, and all these information is blended in a complex multi-step data fusion algorithm that eliminates false echoes and identifies speed and direction of moving objects.

All data related to the vehicle's environment detection and automated driving functions run on a computer called zFAS, the German acronym for *zentrales Fahrerassistenzsystem* or central driver assistant system. In future versions, these environment data will be transferred through an ultra-fast data link to a cloud-based IT backend. There they will be processed by Machine Learning and artificial intelligence algorithms and fed back to the vehicle. Thus, the vehicle will constantly be learning to improve handling and driving style in complex situations. At the same time, the expertise gathered will be shared with other drivers.

The CES presence of the carmaker is focusing on the connected car; in addition the company shows several innovative assistant systems such as something Audi calls Predictive Efficiency Assistant - probably the company's expression for



The A7 piloted driving prototype, Jack.

Continental's "electronic horizon" which feeds topographical data into systems relevant for speed control. Such a system, for example, takes virtually the feet off the gas pedal ahead of a decline

and thus help saving energy.

As to the connectivity, Audi shows a module that connects the vehicle with the internet via the LTE mobile radio infrastructure. Inside the vehicle this module appears to its passengers as a WiFi hotspot, offering connectivity services to the passenger's smartphones and tablets as well as to the vehicle's online and infotainment services. The system also automatically updates the navigational map.



In-car WiFi hub connects to smartphone; to the outside world it communicates via LTE

In the dashboard, Audi long-term partner Nvidia plays a key role with its T30 quad-core processor that powers the virtual tachometer: It computes the image of the RPM needle 60 times per second, enough to make it appear smoothly and without jolts. At the same time, the processor powers the central navigation display with three-dimensional map and other details.

An important building block in Audi's hardware strategy is the Progressive Semiconductor Program (PSCP) set up in 2010. Under the program, Audi directly involves not just its system suppliers but also semiconductor makers. It is a key factor for future innovations. As in hardware, so Audi develops solutions of its own in software - a task falling mainly to its subsidiary e.solutions GmbH.



Nvidia powered virtual dashboard instruments

In vehicle electrics, Audi has developed a scalable architecture, the 48V onboard partial network. It will soon complement conventional 12V power network and permit deployment of a new generation of high-power electric components. These will include an electric compressor as a supplementary turbocharger or an extra-strong generator capable of recuperating a higher amount of kinetic energy and, when used as a motor, transforming the car's powertrain into a mild hybrid.

Though piloted driving (Audi speak for automated driving) has been discussed over the past months as a feature for next decade vehicles, it actually might be closer than it appears. At the fair, the carmaker announced to make these technologies available to buyers already in this decade.

# 5.600 fuel cell patents open for free usage

By Christoph Hammerschmidt

**IN A MOVE AIMING AT** boosting acceptance of the fuel-cell technology for electric vehicles, carmaker Toyota has announced to release more than 5.600 patents related to this technology and allow interested parties to use them without charge.

Hydrogen-based fuel cells can serve as energy source for electrically driven vehicles. Like battery-driven cars, these vehicles are not emitting any exhaust gases locally; instead of CO<sub>2</sub> and other gases all they emit is H<sub>2</sub>O - pure water. But unlike their battery-driven counterparts, fuel cell vehicles offer driving ranges comparable to conventional cars with gasoline engines. Many OEMs including Daimler and GM are investing heavily into fuel cell development and have plans to bring the technology to series maturity.

Market and technology leader in this field is Toyota - the Japanese carmaker is the first one to commercially sell such a vehicle. Available since mid-December in Japan, this vehicle named Mirai is scheduled for market entry in Europe and the U.S. by April 2015.

The downside of the fuel cell technology is the lack of an infrastructure: The fuel cell is fed with hydrogen carried along in a tank, much like other fuels such as gasoline or PNG. During the ride, the liquefied hydrogen is used up and needs to be refilled. In contrast to the abovementioned liquids however, hydrogen filling stations are still very rare, and a single vehicle vendor won't justify the investment to establish such an infrastructure.

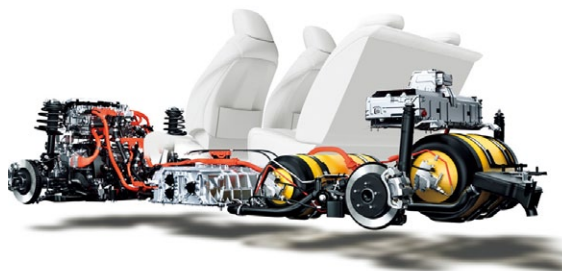
To foster the acceptance of the technology and thus to cre-

ate the critical mass, Toyota aims at starting joint initiatives with other carmakers and energy suppliers. Towards this end, Toyota now has announced to allow the free use of the intellectual property content of some 5.680 patents it is holding globally. In order to benefit from the technologies and methods developed by Toyota, interested parties have to close a contract with the Japanese OEM that defines the usage intentional usage and the usual licence topics.

According to Toyota, the patents in question refer to fuel cell stacks (1.970 patents) and high-pressure hydrogen fuel tanks (290 patents). By far the largest number of patents however (3.350) describes the software necessary to control the processes and reactions in the fuel cell. Enterprises and organisations aiming at establishing a network of filling stations can access and use 70 additional patents dedicated to the design and operation of such fuelling stations.

Toyota's move reminds much of a similar action by Tesla Motors in mid-2014. The US manufacturer of battery electric vehicles opened up its patents for free use by anyone contributing to the development of such cars. Like the fuel cell technology, the battery technology for electric vehicles urgently depends on scale effects that make batteries better and more affordable.

Increasingly it turns out that both approaches - battery electric vs. fuel cell - are sliding into a competitive position against each other. The outcome of this competition will greatly depend on which camp will be able to mobilise more - and more creative - supporters.



# Volvo airs cloud-based cyclist protection system

By Christoph Hammerschmidt

The facts are disturbing: 50 percent of all cyclists killed in Europe's traffic have collided with a car. In Germany, the Netherlands and Poland, more than 85% of cyclist fatalities occurred at crossroads. To make cyclist's life safer, Volvo has developed a technology that increases the awareness both for cyclists as for car drivers by utilising mobile radio technology.

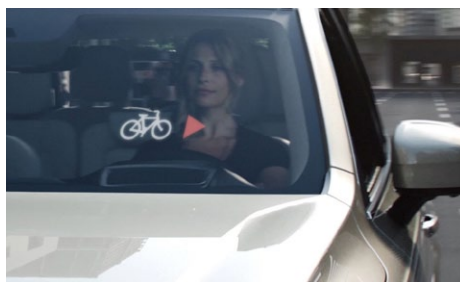
For the technology, Volvo collaborated with telecommunications equipment provider Ericsson and protective sports gear manufacturer POC. The system utilises a smartphone app to announce the cyclist's position to the Volvo cloud and from there to the cars in the surroundings. The information is also passed vice versa; if the danger of an imminent collision is identified, both the car driver as well as the cyclist will be warned - the car driver gets a message in his head-up display; the cyclist is warned through a helmet-mounted alert light.

The system has the advantage that car drivers - as long as

they drive a Volvo with the system installed - can detect cyclists even in the blind spot or under poor visibility conditions (night, unlighted bike etc).

Similar attempts have already been launched at several places. For instance, the Munich Technical University a year ago launched a trial in which it equipped pedestrians and cyclists with a mobile handset that took the function of a transponder. Back in 2010, the Kassel University conducted a similar experiment. All of these approaches share the same problem: While the safety for persons carrying such a transponder or smartphone will improve, traffic participants who are not

equipped with the system are effectively becoming less visible - the system simply directs the driver's attention to the better equipped objects. The advantage of Volvo's new approach is that it is a two-way system, passing its alerts also to the cyclist - former systems did not do this.



# CEO interview: Bosch's IoT startup is all about the system

By Peter Clarke

**THORSTEN MUELLER**, CEO of Bosch Connected Devices and Solutions GmbH (Reutlingen, Germany), has been guiding the latest startup subsidiary of Robert Bosch GmbH since 2013 when he started the initiative with just two staff.

The formation of the company, known as BCDS, was announced in December 2013 and has now grown to 100 employees split between Reutlingen and Coimbatore, India. There are plans to expand early in 2015 at locations in Chicago and Shanghai, Mueller told *EE Times Europe*, although there are no specific head-count targets.

But the staff are focused on the company's mission of rolling out ready-to-use Internet of Things (IoT) systems for customers to take to market in four areas; smart home, transport and logistics, connected industry and personal smart activity.

Mueller, a PhD in physics, joined Robert Bosch, in 2005 at which time he was put to work in corporate research on inertial MEMS. In 2008 he joined the automotive business unit of Bosch working on strategic planning and clustered MEMS sensors and was also worked on the due diligence behind the acquisition of MEMS microphone company Akustica Inc. in 2009.

Mueller said that although BCDS is intended to be a follow-on initiative to the successful Bosch Sensortec GmbH – which has taken the parent company into consumer markets and adding to original success in automotive – it will be different. Whereas Bosch Sensortec is essentially a component and hardware company, BCDS is a system-level company with a much greater emphasis on software.

This is partly because BCDS can, and should, stand on the shoulders of the initiatives that have gone before and partly because levels and styles of integration have changed and the creation of value in the Internet of Things will often be in the data that is collected.

## Corporate R&D and reuse

Although BCDS is like a startup within Robert Bosch, it can lean on 1,000 engineers engaged in corporate research and BCDS will re-use MEMS sensors created by Bosch Sensortec for use in consumer applications, Mueller said. BCDS will focus on complete solutions that include sensor platforms, software and services and extend from leaf-node to the cloud.

"Bosch Sensortec and Akustica are supplying components. BCDS is providing solutions that are market ready. We will heavily use the devices provided by Bosch Sensortec and Akustica," said Mueller.

"Our first product is a stick-on door sensor the size of a matchbox, that detects the status of the door, can tell the difference between movement, knocking and violent intrusion and send reports to the cloud which can in turn send a phone alert to appropriate persons." The HIS110 unit can also be applied to windows and detects conditions such as whether doors and windows are open, closed or tilted and offers advanced detection of intrusion attempts. This functionality can even be extended to monitor universal movement detection. The product is being made for BCDS in a Bosch automotive electronics factory in Suzhou, China.



**Thorsten Mueller, CEO of Bosch Connected Devices & Solutions GmbH.**

This is another example of how BCDS can leverage the investments that have gone before into other parts of Robert Bosch.

"Typically BCDS will produce something that includes a PCB with multiple sensors, local intelligence with an MCU and a radio, be it Bluetooth, ZigBee or GSM radio. We are not a component business. Our solid foundation is ready-to-use equipment as a tier-one supplier. There is no intention to design sensors on our own. A sensor is a component we would buy in. Obviously Bosch is the preferred supplier but we can source externally," he told *EE Times Europe*.

This explains why BCDS' is recruiting staff in India to work on embedded software.

*EE Times Europe* asked if this one-step-removed approach to hardware could be a disadvantage to BCDS when it came to miniaturization and integrating sensors, MCUs and RF monolithically.

"There will be a trend towards miniaturization. It is something



Bosch Sensortec will be following. But for our customers right now high integration is not necessary and too expensive. In the domains we are addressing the customers value short time-to-market and flexibility. So we are not only hardware but also a software company. There is the great scope to save energy for battery-operated device by crafting the best algorithms and writing optimized embedded software.”

### Every Bosch product connected to the Internet

Mueller said that BCDS will also be supported by an internal market for its solutions within Robert Bosch as it will have a dual role with both external and internal customers. “The company has stated that every Bosch product will be connected to the Internet,” said Mueller indicating that this represents a significant amount of work that BCDS will be required to contribute to other divisions. “We are starting with home appliances and power tools. And for these customers time to market is key.”

With regard to external customers BCDS is likely to start with the smart home and transport and logistics, Mueller said. “We will also be working on the connected industry but there are many locations internally where we can deploy wireless sensor networks. And it is much better where we can bring proven solutions to market,” Mueller said.

There is another way that BCDS may differ from previous Bosch subsidiaries, partly because of the position it is taking in the market, closer to systems and services. “The automotive group does much work alone. BCDS will have to be very open to partnership.”

Mueller pointed out that ABB, Bosch, Cisco plan to establish a joint venture that will develop and operate an open software platform for smart home devices and applications. In addition to developing and operating the software platform, the companies intend to invite appliance manufacturers, home automation vendors, and service providers to join a business ecosystem.

By creating a standard open software platform that will enable the exchange of data between different manufacturers’ devices the three companies hope that software developers will be able to create a wide variety of applications for use in the areas of energy management, security technology, and entertainment.

### Data security

When asked whether that open-ness to partnership included being prepared to join Thread, a similar group based around Google, through its Nest Labs subsidiary, Samsung Electronics, Freescale Semiconductor, ARM Holdings plc Yale Security and Silicon Labs. The Thread group wants to create an IP-based wireless networking protocol for use in the smart home. “You cannot be part of every alliance,” said Mueller. “The groups we join will depend on our customers.”

With further regard to intellectual property provider ARM, Mueller said: “ARM is very prominent. Many of our microcontrollers are ARM based but it is not strategic.”

“In 2015 about 6 billion devices are connected to the Internet. We think that by 2020 30 billion devices will be connected and most of them will not be classic products, PCs, smartphones.”

So Mueller is clearly a believer in the significance of IoT. “I think it will be transformational. But the term IoT is abstract. This transformation will be about specific applications that connect to the smartphone. It all depends on what you do with the data.” Which means that of all the things BCDS will be working on, data security and encryption will be among the most significant, said Mueller.



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# Monolithic 3D integration cheaper than moving to next node

By Julien Happich

**DURING A 3D-VLSI WORKSHOP**

preceding IEDM 2014, in San Francisco, CEA-Leti presented its latest results on multi-layer transistors stacking for true 3D monolithic integration, that is without relying on tall through silicon vias (TSVs) and coarse redistribution layers typically used for wafer-on-wafer die stacking.

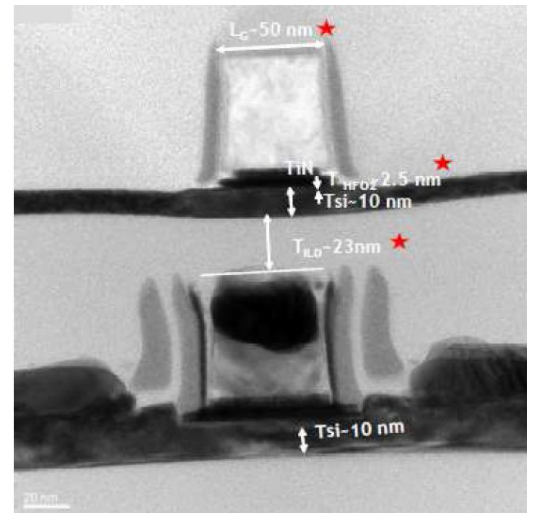
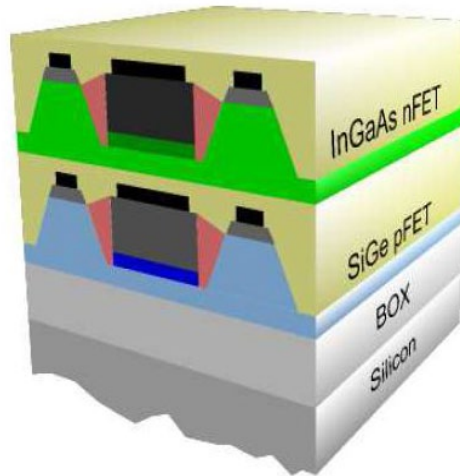
Only recently dubbed CoolCube for its future commercialization, the technology can be essentially described as sequential 3D ICs manufacture, enabling circuit partitioning in 3D at all granularity levels, including at transistor or gate scale through a standard lithographic process.

The key difference with the “traditional” use of TSVs, where two or more processed dies are assembled one on top of another, is the transfer and molecular bonding of a thin Si wafer film, peeled off from a wafer blank after planarization. Because the transferred film is so thin and optically transparent, well under a micron (compared to around 50 microns thin for thinned wafers), the new layer of transistors that are processed on top can be aligned to the bottom transistors with lithographic precision.

Hence the stacked layers can be connected at the transistor scale rather than just through the dies’ metal pads.

This approach was only possible through the use of a low-temperature-budget MOS transistor technology on top, the “COOL” layer processed under 600°C so as not to alter the first bottom MOS transistor layer.

This low-temperature fabrication allows vertical integration of a transistor without degrading the performance of the transistors beneath or the metal interconnects between the layers of the transistors.



In a paper titled “3D sequential integration opportunities and technology optimization”, Leti’s Advanced CMOS Laboratory Manager Maud Vinet describes the necessary 3D contact process between the two layers as being marginally higher than a standard tungsten contact plug in an oxide, with an additional height of the 3D contact in the range of 50nm. The cool process relies on Solid Phase Epitaxial Regrowth (SPER) for dopant activation by recrystallization at temperatures between 450°C and 600°C (effective down to 500°C without any impact on the bottom layer). This is about half the typical thermal budget for manufacturing transistors (around 1000°C).

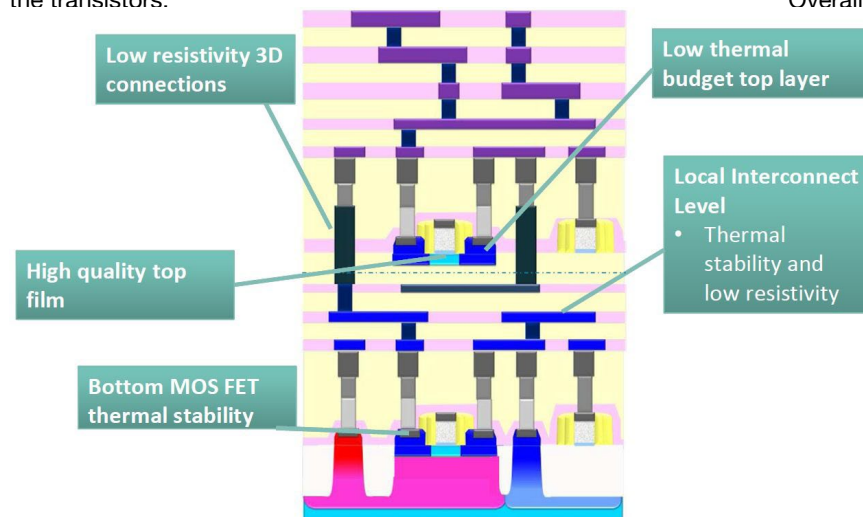
“This is really different from using TSVs, which are several orders of magnitude bigger than these contact plugs”, explained Vinet during an interview with EETimes Europe.

“We are using a classic front end process, these 3D vias are in the range of 100nm with a very small diameter and do not require a keep-out zone (as TSVs do)”, she added.

Overall, this approach could support a via density up to 100millions/mm<sup>2</sup> between layers while allowing for different materials and processes to be stacked one upon the other.

Using 14nm node design rules FDSOI transistors, the research team at CEA-Leti worked on a 3D monolithic FPGA stacked on two levels, with memory cells placed in the bottom layer and the logic cells in the top one. Compared to a 14nm planar FDSOI integration and thanks to the dense vertical interconnects, the 3D stacked design shrank 55% in area and nearly halved the Energy Delay product. Another step in the more-than-Moore race, this 3D monolithic integration enables a 30 percent increase in speed compared to the same technology generation in classic 2D.

“In effect, we had more than one node gain by stacking N-1 over N-1 as compared to node N in a planar process”, concluded Vinet.



# IoT: Collaborate or else, says Samsung CEO

By Junko Yoshida

**SAMSUNG ELECTRONICS CEO BOO-KEUN YOON**, in a keynote speech at the International Consumer Electronics Show made a passionate pitch to “unlock the infinite possibilities of the Internet of Things,” while suggesting that the industry fall in line behind Samsung’s leadership.

On the one hand, Yoon stressed the importance of an “open ecosystem” for IoT, noting that “cross-industry collaboration is the key.”

On the other hand, Yoon was less than subtle in reminding the audience of Samsung’s unequivocal dominance in the global consumer electronics market today, and the company’s commitment to the IoT market of tomorrow.

Yoon noted that Samsung put 665 million products in the hands of consumers last year. “That’s 20 devices a second,” he said, before pausing for a second. “We just made 20.”

The implication of his joke was obvious. Samsung is the 800-pound gorilla of consumer electronics.

Backed by its prowess in mass production, marketing, and technology, Samsung will call the tune in the IoT market. He promised that by 2017, 90% of Samsung devices will be IoT devices. Yoon said he hopes to make that 100% within the next five years.

The Samsung CEO described the challenges of IoT today as the lack of an “open ecosystem” and a need for “cross-industry collaboration.” On that note, Yoon declared, “Our IoT components and devices will be open.” Further, he promised to the thundering applause of the audience: “Samsung will be open!”

But hang on.

If Samsung is to make so many IoT devices in volume (and Samsung hopes to sweep the IoT market), Yoon appears to be suggesting that the best way to achieve an open ecosystem for IoT is to concede Samsung’s leadership.

Yoon in his speech made no mentioning of competing IoT ecosystems promoted by Samsung’s rivals, including Qualcomm, Intel, and Apple. Instead, he talked about a number of partnerships (or acquisitions) Samsung has already made to promote its open ecosystem.

First, Yoon trotted onto the stage SmartThings CEO Alex Hawkinson. SmartThings, a startup that has developed technologies to control connected devices using a mobile app, was acquired by Samsung in August for a reported \$200 million.

Prodded by Yoon to talk about the progress SmartThings has made since the acquisition, Hawkinson said that all SmartThings gadgets work with all of Samsung’s connected devices. He rattled off some of his company’s new partners including Netgear, Chamberlain, Philips Hue, and Honeywell.

Hawkinson added that SmartThings already has a huge de-

velopment community. The number of developers building devices that connect to SmartThings’ open platform has doubled since the acquisition, he said.

Jawbone CEO Hosain Rahman also joined Yoon on the stage at the Venetian Hotel’s Palazzo Ballroom to hammer home the IoT message: “open ecosystem.” Rahman talked about Jawbone’s UP -- a smart wristband and app that helps users understand how they sleep, move, and eat, now working on the open SmartThings Platform.

Calling SmartThings “one of my favorite developers,” Rahman said, “So, as the integrations come together, more and more technologies are working for you.” In conclusion, he said, “This feels like a path to make the connected world center around the user.”

Obviously, if you have the money and market share that Samsung now commands, partnerships and collaborations in an open ecosystem are easy to come by. Yoon said Samsung will be committing \$100 million toward bolstering its IoT programs with developers and startups

Setting aside the idiosyncrasies of defining an “open ecosystem,” according to Samsung’s own universe the infinite possibilities of IoT the industry is about to unlock, illustrated by Yoon, turned out to be rather thin and superficial.



An IoT scenario Yoon unveiled at the end of his keynote speech in a short illustrative presentation began by using the example of a “connected wine cellar” (presumably Samsung’s) at home.

An IoT wine cellar identifies user consumption patterns, the video presentation said, and recommends wine, “making the ordering process much easier.” For restaurant owners, data shared through the wine cellar

will make it possible to customize marketing and effectively manage inventory.

Using the wine sales data from restaurants, wineries will then presumably improve production, refine their grape choices, and develop new products that meet consumers’ needs.

The video presentation went on to describe a “brain hat” or a pair of “glasses” embedded with tiny brain wave sensors that monitor the user’s brain health and detect life-threatening illnesses.

It also explained a connected car scenario that makes it easier for users to drive their cars, while creating the opportunity for various businesses to sell related services to drivers.

Then, armed with the promise of interactive wine storage and brain-probing fedoras, Yoon came back onstage and concluded his keynote. “What we are holding in our hands are infinite possibilities. Now it’s up to us to enact them.” In short, Yoon cheerfully implied, the rest of the world is going to work with Samsung, or else.

# Solar-powered radio chip monitors windows to save energy

By Paul Buckley

**RESEARCHERS FROM THE** Fraunhofer Institute for Microelectronic Circuits and Systems IMS in Duisburg have developed a radio sensor chip about the size of a fingernail that is mounted directly in a window. The sensor is coated with a solar cell to provide power.

The radio chip is designed to warn when windows are left open to avoid having heat escaping through the window on cold days. The sensor also detects break-in attempts early on.

An automated system will detect open windows and send an alarm signal to the tenant. There are already home and building systems today that register the window status. As a rule, however, the sensors have to be attached by cable to the alarm centre inside the home or building itself. In other cases, battery-operated radio sensors are used. But changing batteries in structures that have several windows can lead to a considerable maintenance expense.

At ten millimeters, the chip is as narrow as a pane of insulating glass is thick. The chip is installed on the aluminium profile between the glass that maintains the distance between the panes. Thanks to the window space, the solar cell obtains adequate light, even in the darkness of winter. Integrated in the chip are magnet and acceleration sensors that register if the window is open just a crack or all the way.

The chip can send a signal via radio to the base station in the building if a window has remained open for too long. The applications of the radio chip are diverse. The chip can remind homeowners to ventilate regularly or warn if a window is still open when they leave the home. In addition, it offers reliable protection from intruders even for closed windows.

Because the sensors can differentiate very precisely between various fluctuations - for example, a ball that slams against the pane, or an intruders' crowbar that ratchets open the window frame. Within a tenth of a second, the system detects the disturbance and sounds the alarm if there is any doubt.

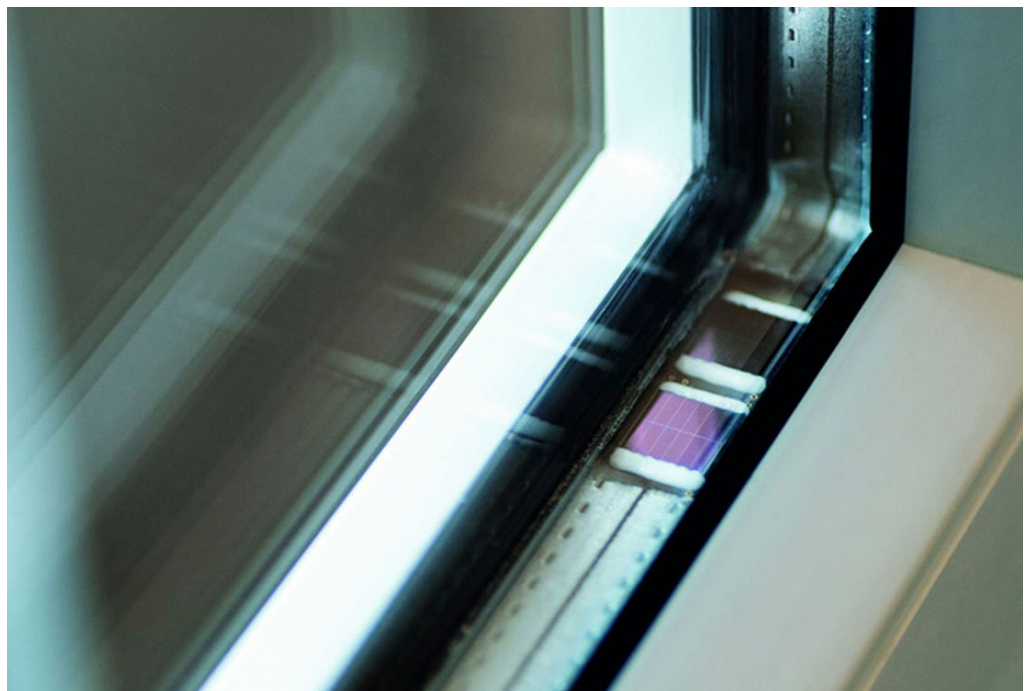
The IMS researchers around electrical engineer Dr. Gerd vom Bgel and physicist Dr. Andreas Goehlich have mastered two challenges. They succeeded in depositing the solar cell directly onto the uneven surface of the chip. Secondly, the chip consumes power so meagerly that energy from the miniscule solar cell spans the dark hours. "The microchips are coated with numerous conductor paths, its surface is thereby made very uneven.

This is why we had to find a means of filling in and evening the surface, like a street profile, prior to coating it with the solar cell", explained vom Bgel.

Currently IMS sensor prototypes can store enough power for up to 30 hours of darkness which is expected to lead to the emergence of a product over the next two years that can even bridge up to two weeks of darkness. By keeping both processor and chip small, the latter is frugal. In addition, the researchers constructed switches that consume little energy, and engineered short radio protocols.

We have extracted every possible micro-ampere, said vom Bgel. Adding to the overall conservation of power is the fact that the sensor always switches to sleep mode. Depending on the users' preferences, the sensor can be set so that it wakes up every few minutes, or even seconds, and takes a measurement.

The Israeli firm SOLCHIP, which was asking for solar cells on chips at IMS around two years ago, provided the impetus



to developing the solar radio chip. Andreas Goehlich's group of developers succeeded in integrating the solar cells on the surface of the chips. Using these solar cells, Solchip seeks to monitor the street traffic for example, or the climate conditions in vineyards.

As you can see, there are a lot of application areas, said vom Bgel. The production costs are so minimal because the application of the solar coating is directly connected to the production process of the chips. Only a handful of additional production steps are needed so that manufacturing can also be accomplished in high quantities.

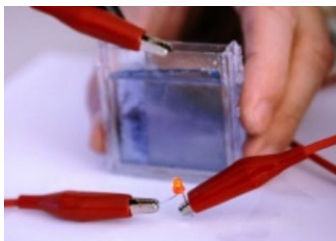
# Window tints and acts as transparent battery

By Paul Buckley

SCIENTISTS FROM NANYANG TECHNOLOGICAL University (NTU) have developed a smart window which can darken or brighten without the need for an external power source. The window's stored energy can be used to light up low-powered electronics like a LED. The self-tinting window requires zero electricity to operate and is also a rechargeable battery.

Currently, the window solutions in the market are either using permanent tinting which cannot brighten at night or are windows that can change its light transmission properties only with an external power source. The NTU smart window however can be turned into a cool blue tint in bright daylight, cutting light penetration by about half, and then reverts back to clear glass at night or as required. The research led by NTU Professor Sun Xiaowei, was published in the peer-reviewed scientific journal Nature Communications.

The self-powered smart window uses a technology developed by Prof Sun's team from NTU's School of Electrical and Electronic Engineering. "Our new smart electrochromic window is bi-functional; it is also a transparent battery", explained Prof Sun. It charges up and turns blue when there is oxygen present in the electrolyte in other words, it breathes.



The NTU smart window contains liquid electrolyte placed in between two glass sheets coated with indium tin oxide (ITO), commonly used as transparent conductive coatings for television displays. One sheet is coated with an additional layer of a pigment known as Prussian Blue and the other one is attached to a thin strip of aluminium foil. The Prussian Blue gives the glass a blue tint when it is fully charged. The two glass sheets are connected by typical electrical cables. When the electrical circuit between them is broken, a chemical reaction starts between Prussian Blue and the dissolved oxygen in the electrolyte, turning the glass blue. To turn off the blue tint, the electrical circuit is closed to discharge the battery, turning the Prussian Blue into a colourless Prussian White.

The technology can adjust the amount of sunlight coming into buildings in the day, which promises savings on cooling and lighting costs.

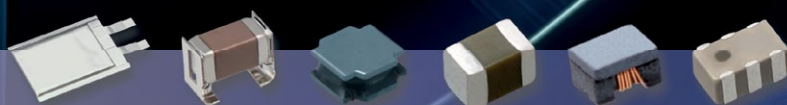
"Our technology is very attractive as a zero-sum consumption smart window. Buildings owners and even common households can reap energy savings right from the outset and over the long term. Developers who are looking at constructing environmentally-friendly green buildings will find our technology attractive for their building plans", suggested Prof Sun.

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## More for IoT: our natural roadmap says Cypress' CEO

By Julien Happich

**AFTER COMPLETING THE USD 4 Billion** all-stock 50%-split Cypress-Spansion merger, CEO T.J. Rodgers is to head the post-merger company under the global name Cypress, albeit with Spansion's world leadership in NOR Flash memory while retaining Cypress' huge SRAM memory market.

When asked about possible product line consolidations (both companies offer memory and ARM-based MCUs for the automotive market), Rodgers emphasizes the complementarity of the two companies.

"Of course, there may be some overhead and duplication of sales forces, but on the R&D front, all our programs will continue unaffected on both sides, without any cuts", Rodgers told EETimes Europe. Within three years, the merger is expected to achieve more than \$135 million in cost synergies on an annualized basis.

"We'll be able to exchange more IP and that will certainly open up new ventures, but there is virtually zero duplication between our product portfolios. One of the benefits of this merger is precisely that Cypress and Spansion's lines of MCUs are almost complementary. There is no negative revenue synergy".

Even if both companies were already present individually in the automotive market, Rodgers explained that while Cypress

tends to address embedded system solutions in the cockpit, with touch-screen interfaces, Spansion's products find their way into car engine management.

As for the memory markets that the two companies served (Spansion will retain its own name in the merger), Rodgers expects that cross-channel selling will expand the whole company's memory business.

Remaining on board as one of the four Spansion directors, John Kispert (formerly CEO at Spansion) highlighted that the resulting company has all the essential building blocks to address factory automation, next generation connected cars, and to fuel the growth of IoT.

"When we started our conversation Rodgers and I, we realized that by putting our companies together, we would see a wonderful roadmap in the growth of IoT", Kispert said, although a joint growth plan for the post-merger company has not been formalized yet.

"If we lay out our combined portfolio, we now truly have a one-stop shop for our customers, so we become a more strategic supplier. We eliminate multiple sources and this makes it easier for them too" added Rodgers, "as one company, we have doubled our number of customers".

## Computer simulation cues for blue LEDs

By Paul Buckley

**SCIENTISTS AT UNIVERISTY COLLEGE** London (UCL), in collaboration with groups at the Univeristy of Bath and the Daresbury Laboratory, have used computer simulations of gallium nitride to shed fresh light on the mystery of why blue LEDs are so difficult to make.

The key ingredient for blue LEDs is gallium nitride, a robust material with a large energy separation, or 'gap', between electrons and holes - this gap is crucial in tuning the energy of the emitted photons to produce blue light. But while doping to donate mobile negative charges in the substance proved to be easy, donating positive charges failed completely. The breakthrough, which won the Nobel Prize for the inventors of blue LEDs, required doping it with large amounts of magnesium.

"While blue LEDs have now been manufactured for over a decade," explained John Buckeridge (UCL Chemistry), lead author of the study, "there has always been a gap in our understanding of how they actually work, and this is where our study comes in. Navely, based on what is seen in other common semiconductors such as silicon, you would expect each magnesium atom added to the crystal to donate one hole. But in fact, to donate a single mobile hole in gallium nitride, at least a hundred atoms of magnesium have to be added. It's technically extremely difficult to manufacture gallium nitride crystals with so much magnesium in them, not to mention that it's been frustrating for scientists not to understand what the problem was."

The team's study, published in Physical Review Letters, unveils the root of the problem by examining the unusual behavior of doped gallium nitride at the atomic level using computer simulations.

"To make an accurate simulation of a defect in a semiconductor such as an impurity, we need the accuracy you get from a quantum mechanical model," explained David Scanlon (UCL Chemistry), a co-author of the paper. "Such models have been widely applied to the study of perfect crystals, where a small group of atoms form a repeating pattern. Introducing a defect that breaks the pattern presents a conundrum, which required the UK's largest supercomputer to solve.

Indeed, calculations on very large numbers of atoms were therefore necessary but would be prohibitively expensive to treat the system on a purely quantum-mechanical level." The team's solution was to apply an approach pioneered in another piece of Nobel Prize winning research: hybrid quantum and molecular modelling, the subject of 2013's Nobel Prize in Chemistry. In these models, different parts of a complex chemical system are simulated with different levels of theory.

"The simulation tells us that when you add a magnesium atom, it replaces a gallium atom but does not donate the positive charge to the material, instead keeping it to itself," said Richard Catlow (UCL Chemistry), one of the study's co-authors. "In fact, to provide enough energy to release the charge will require heating the material beyond its melting point. Even if it were released, it would knock an atom of nitrogen out of the crystal, and get trapped anyway in the resulting vacancy. Our simulation shows that the behavior of the semiconductor is much more complex than previously imagined, and finally explains why we need so much magnesium to make blue LEDs successfully."

The simulations fit a complete set of previously unexplained experimental results involving the behavior of gallium nitride.

# Flexible multi-touch printed sensors ready ahead of screens

By Julien Happich

**UK START-UP R&D CORE** has just announced a fully flexible touch screen sensor technology to work with Plastic Logic's flexible display. In collaboration with printed electronics pioneer Plastic Logic, the company will further develop and finalise its flexible touch screen sensor technology for flexible displays. Dubbed Digital Resistive Area Sensing (DRAS), the flexible touch screen sensor consists of printed patterns of conductive ink on two polyester substrates laminated together, with wiring patterns crossing at 90°. The touch sensor uses a four-wire sensing circuit elaborated in-house that can be read out by any MCU using the company's proprietary algorithms.

The sensor is said to overcome capacitive touch screen limitations including breakage, accidental use, moisture and an inability to operate when wearing insulating materials such as gloves.

During a phone interview with *EETimes Europe*, R&D CORE Ltd's CEO Thomas Papakostas didn't want to explicit further the technology, saying that patents are pending and that the actual touch-sensor reading circuitry and scanning procedure are part of the company's key IP.

"We have designed the sensor's printed circuits in a such a way that they work with any type of conductive inks available on the market", told us Papakostas, "not only can we scan mul-



multiple touch-points at the same time, we can also scan the contact area and measure the applied force up to approximately a kilogram". Force sensing is based on experimental data from the laminate's deformation and resistive response.

"We have prototyped our flexible sensor behind a flexible screen from Plastic Logic and it just works as a charm", said Papakostas, hinting at the limitations of too brittle ITO solutions. "The touch sensor still worked when the display was flexed back and forth or rolled up to a diameter of around 4cm". According to Papakostas, the sensor can also be made as large as the application requires without increasing the complexity of the hardware interface and without compromising the sensor performance.

Although the company wants to grab the nascent flexible display market with its DRAS technology, in the short term it expects more revenue from conformable touch-interfaces including white goods and consumer electronics or large scale interactive touch-surfaces.

"We have a demo kit that allows us to quickly deliver customized solutions to our partners, under a non-disclosure agreement. But until the big companies sort out their high-volume yield issues for flexible displays, we won't be able to disclose who is working with us or trying out our technology" Papakostas concluded.

## E-ink a winner in wearables

By Julien Happich

**SLIM, FLEXIBLE AND VERY LOW** power due to their bi-stable property, E-ink displays could be the best match for today's power-conscious wearable applications. Until full colour flexible OLED screens can be manufactured with acceptable yields, it looks like the only rugged and shatter-proof alternative to power-hungry LCDs.

So much so that despite competing in the smart watch arena with "traditional" TFT LCD-based designs such as the Smart-Watch 3 it launched last September, Sony is also developing watch bracelets based on E-ink, albeit without all the bells and whistle that more responsive screens can offer. Last September, the company officially brought to market the SmartBand Talk, designed as a life-logger, bringing call handling and voice control with an always-on curved 1.4" E-ink display.

But at the same time, Sony was further exploring that route using a Japanese crowd-funding website to probe the market with a bracelet watch fully cut out of an E-ink display sheet (dial and belt included).

Here, the whole display and bracelet can change of style, with 24 design patterns selectable manually using the crown, but also with gestures-enabled on-off dial functions or through time-dependent routines. The whole unit could operate two-months in a row on a single button battery (way better than TFT-

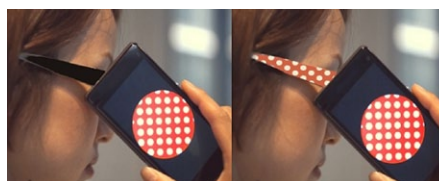
alternatives, but in my opinion still way too short for a time-keeping piece).

For discretion, the new product was crowd-sourced under the spin-off company name Fashion Entertainments (FES), and the FES watch quickly became a success, getting over its initial two million yen bid (approximately 13,000 Euros). After completing successfully its first crowd-sourcing campaign, the company initiated another run (dubbed FES watch returns) just to extend the purchase opportunity to new entrants, collecting nearly 64,000 euros at the time of writing and still going.

On the crowd-sourcing site, Fashion Entertainments also states that the FES watch is only the first step in the company's exploration of E-Ink's potential to develop other fashion products with versatile and configurable skins, such as pattern-changing bow ties, spectacle frames, or shoes. For such accessories, colour E-Ink could be envisaged and configuration could certainly be done through a special app, using a smartphone's NFC or Bluetooth LE wireless link to program the multi-pattern routines.



The FES watch as seen on crowd-funding site Makuake.



Multi-pattern configurable accessories using colour E-Ink.

# Imec aims 8-bit plastic MPU at smart labels

By Julien Happich

**HOLST CENTRE, IMEC** and their partner Evonik have demonstrated a general-purpose 8-bit microprocessor manufactured using complementary thin-film transistors (TFTs), processed at temperatures compatible with plastic foil substrates (250°C). The researchers used a “hybrid” technology integrating two types of semiconductors—metal-oxide for n-type TFTs (iXsenic, Evonik) and organic molecules for p-type TFTs—in a CMOS microprocessor circuit operating at 2.1kHz.

Although it may look like a very low clocking speed compared to GHz-capable hard silicon, these results should be seen in the perspective of organic materials’ very low charge carrier’s mobility and represent already a huge improvement over imec’s own previous research.

In an email exchange with *EETimes Europe*, Senior Principal Scientist at imec, Jan Genoe clarified:

“Today’s speed is limited by electron mobility of the n-TFT and the hole mobility of the p-TFT. In order to improve on this, exchanging the semiconductors by better state-of-art materials and processes (e.g. n-TFT with 5 to 10 times larger mobility) and moving to a unipolar n-type design would increase the operating frequency between 10k-100kbit/s.

Our previous work (i.e. microprocessor running at 6Hz) was limited in performance due to the utilization of only organic p-TFT with less performance than the one published recently. Moreover, the previous publication was limited by a unipolar p-TFT design. In the current work, we have also improved our digital standard cell library, we improved the architecture of the MPU and used a hybrid complementary technology with better performing semiconductors.

When compared with Silicon, the lower mobility yields intrinsically a speed which is about 1000 times lower than the speed of silicon. The real speed is multiple orders lower, due to the fact that we use, on the flexible foils, design rules comparable with the design rules that intel used back in 1971. But the object of this work is not the speed, it is low-cost realization on flexible circuits that can be embedded in any object”.

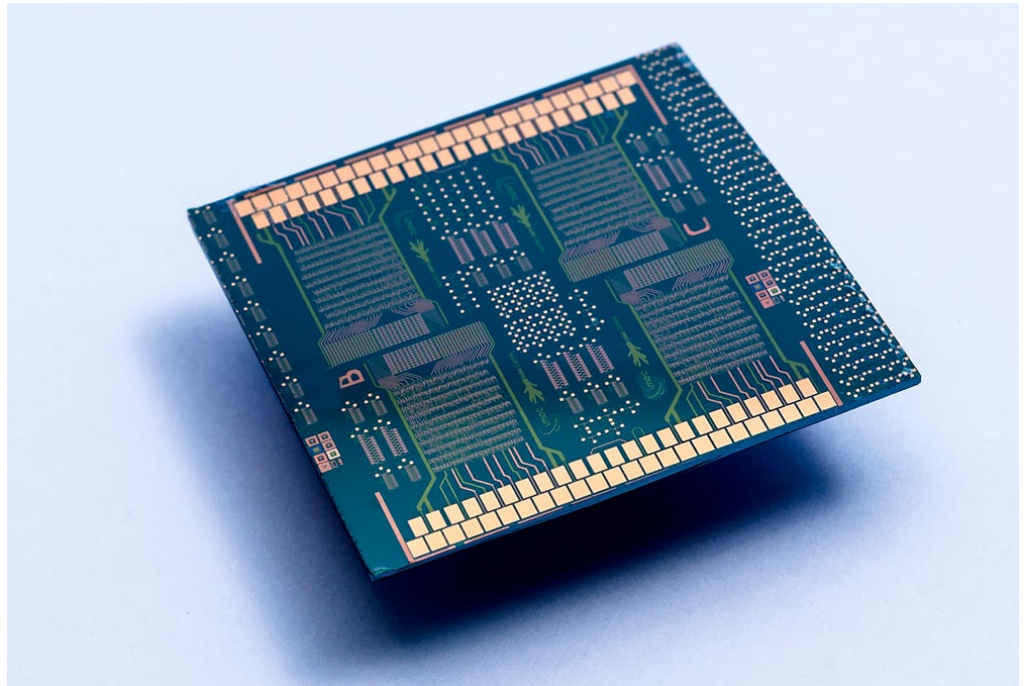
Published online in Nature’s open access journal, *Scientific Reports*, the paper describes the 8-bit microprocessor as a two chip device consisting of a processor core chip and a general-purpose instruction generator (P2ROM).

For the processor core chip (ALU), a complementary hybrid organic-oxide technology was used (p:n ratio 3:1), totalling 3504 TFTs on across a 12.0x18.8mm substrate. The n-type transistors are 250°C solution-processed metal-oxide TFTs with charge carrier mobility of 2 cm<sup>2</sup>/Vs while the p-type transistors

are small molecule organic TFTs with mobility of up to 1 cm<sup>2</sup>/Vs. The general-purpose print-programmable instruction generator (P2ROM) is a one-time programmable ROM memory with an instruction set of 16 code lines, each line providing a 9-bit instruction defined through inkjet printing, filling dedicated “ink wells” with a conductive silver ink. When programmed for a specific function (averager), the 9.0x6.9mm P2ROM chip employs 852 TFTs (it employs 403 organic p-TFTs and 412 oxide n-TFTs in its un-programmed state).

“The chip is fully operational from 6.5V onwards.

This low supply voltage (for technologies on foil) is a key



merit of the complementary organic/oxide technology. As the power consumption scales with the square of the supply voltage, the downscaling of the supply voltage from 10 V in the prior p-type only architecture to the current 6.5V in the more robust complementary architecture results in a very substantial gain in power consumption.

Furthermore, even at equal supply voltage, a complementary architecture has a much lower static power consumption than a unipolar one as a consequence of reduced static leakage current. The static power consumption in our case can still be further improved by shifting the on-set voltage of the p-type transistor towards 0V”, Genoe added.

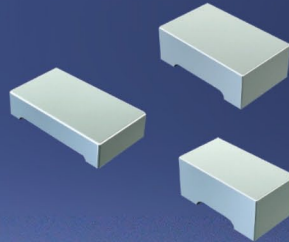
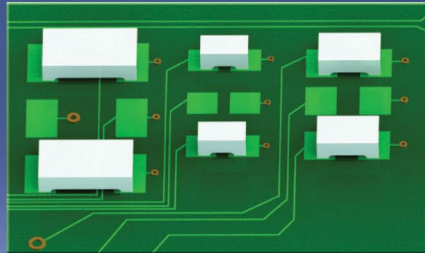
The work would need further improvements to have such MPUs operate on single flexible battery, but for now, it could run from a number of such batteries connected in series.

Interested companies can join Holst Centre’s R&D program on organic and oxide transistors, exploring and developing new technologies for producing thin-film transistors (TFTs) on plastic foils.



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# Universal memory for instant-on computing

By R. Colin Johnson

**COMBO MAGNETOELECTRIC MEMORY** technology - based on a multiferroic called bismuth ferrite - uses 10 times less energy to switch bits than its closest next-generation contender (spin-torque memory). The nonvolatile magnetic memory can be switched by a voltage potential alone - with no current flowing - making it a strong contender for replacing the entire memory hierarchy for instant-on operation in computers, according to its inventors at Cornell University in New York City.

Its biggest caveat right now is fatigue - it can only be switched a few times before failing - but the team is gung-ho that they can lick that problem.

Darrell Schlom, a professor in the Department of Materials Science and Engineering, told *EE Times*:

"This multiferroic memory could substitute for all sorts of volatile and nonvolatile memory, because of its lower energy consumption. It isn't simply replacing the active material in another memory technology with bismuth ferrite, but rather replacing the entire memory technology with a bismuth ferrite-based memory technology. This is because the readout scheme makes use of the coupling between the bismuth ferrite multiferroic with the overlying spin valve structure (Pt/Co<sub>0.9</sub>Fe<sub>0.1</sub>/Cu/Co<sub>0.9</sub>Fe<sub>0.1</sub>)."

Schlom's collaborators at Cornell include physics professor Dan Ralph, postdoctoral associate John Heron and his doctoral advisor Ramamoorthy Ramesh, at the University of California,

Berkeley who first demonstrated in 2003 that bismuth ferrite can store bits in extremely thin films with enhanced properties compared with its bulk counterparts.

The fact that no current flows when switching a bit's state and its low-voltage operation, also makes multiferroic the coolest running of the next-generation memory technologies. If only the fatigue problem can be solved.

"The biggest challenge to commercialization is fatigue - that is, extending the number of times you can switch it and it still works - right now it keeps working just a few times like in the early days of FRAMs. In fact, scientists had given up on FRAMS in the 1960s,

and only came back to them when Ramesh came up with a solution to the fatigue problem", Schlom told us.

The team is counting on Ramesh's experience with solving the fatigue problem with FRAMs, to solve their fatigue problem with bismuth ferrite.

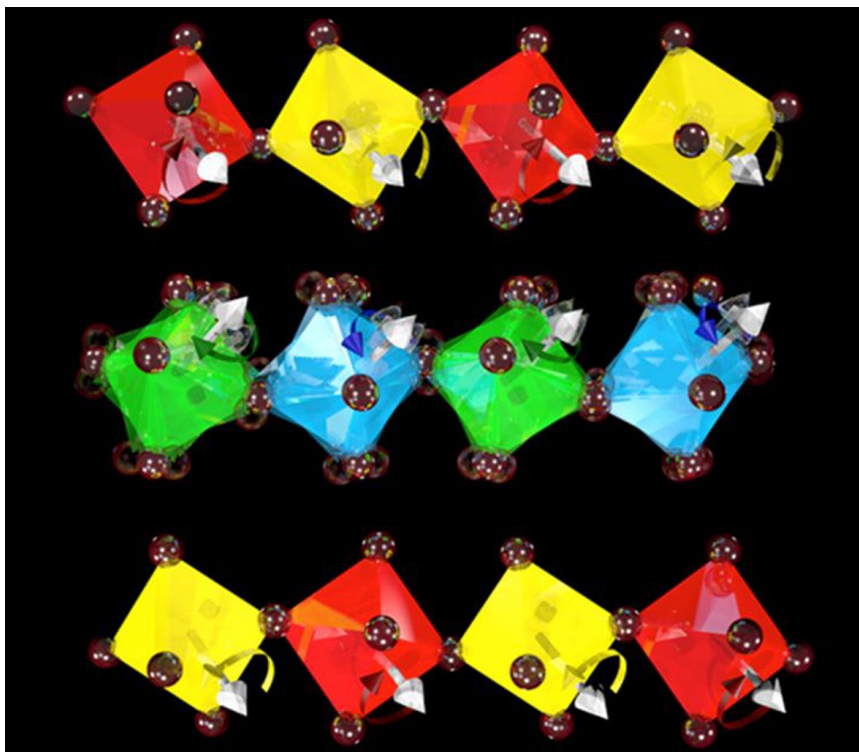
Multiferroics are different from FRAMs or MRAMs, which depend on a single mechanism to switch bits. But when you reverse the voltage potential across a multiferroic film, the magnetic pole gets dragged along with the reversing electrical dipole - giving you the best of both worlds.

Easy readouts - since the magnetic pole changes the resistance of the circuit - plus easy writing, because no current has to flow to make the switch.

## History

Multiferroics have been the subject of experimentation before, but the fatigue problems turned most engineers to other materials that were harder to switch, but at least didn't fatigue for many thousands of switches, such as flash (which endures about 10,000 switches without fatigue).

The Cornell team, however, has built a single-bit thin-film switch that works at room temperature with lower power than any other next-generation memory contender, making it worth the trouble of solving the fatigue problem.



Artist's rendering of magnetization reversal with an electric field (blue) applied across the gold capacitors. The compass needles under the electric field are rotated 180 degrees from those not under the field. (Image: Cornell)

Once solved, the team aims to measure how scalable the memory cells will be. If they can reach the multi-Gbit range, then the technology will probably be licensed out to foundries, or purchased by one of the big memory houses.

Other collaborators worked on this project at the University of Connecticut, University of California at Berkeley, Tsinghua University (Beijing) and the Swiss Federal Institute of Technology in Zurich.

Funding was provided by the National Science Foundation and the Kavli Institute at Cornell.

# Qimonda's late legacy: 28nm FeRAM

By Julien happich

**CMOS-COMPATIBLE 28NM FERAM** could become commercially available within three to five years, according to research from a collaborative project between NaMLab at TU Dresden, the Fraunhofer Institute for Photonic Micro Systems (IPMS) and GlobalFoundries.

Indeed, smashing all prior research claims on FeRAM and scalable to geometries an order of magnitude smaller than today's 130nm FeRAM commercial offerings, the results are so promising that they are being included in the current version of the International Technology Roadmap for Semiconductors (ITRS).

A result of a sub-project called 'Cool Memory' at Saxonys' cluster Cool Silicon, the technology relies on newly found ferroelectric effects in doped Hafnium oxide ( $\text{HfO}_2$ ). Considering that Hafnium oxide is already commonly used as a high-k gate dielectric in CMOS transistors, the processes are pretty much already in place for its ferroelectric variant, readily scalable with CMOS transistors.

So why look at doped Hafnium oxide in the first place?

We asked Dr. Thomas Mikolajick, Professor for Nanoelectronic Materials and Director of the NaMLab, coordinator for Cool Silicon.

"This research goes back to 2007 at DRAM maker Qimonda, when a PhD candidate Tim Böske was doing research to improve  $\text{HfO}_2$  as a high-k dielectric for capacitors in dynamic random access memories, using dopants to stabilize the material", explained Mikolajick. "At certain dopant concentrations and under specific treatments, Böske noticed that strange peaks occurred in the CV characteristic of the material, and that it behaved as a ferroelectric. This was totally unexpected!"

At that time, Qimonda's resources were already shrinking (the company went out of business in 2009), but further investigation was performed at NaMLab, historically created as a joint venture between Qimonda and the University of Technology of Dresden (TU Dresden), to do development work on FeRAM.

Back in 2009, there was still a lot of work to do, notably to make sure that the effects being observed were not just parasitics.

"We've spent the last four to five years characterizing the

material's properties and tuning its parameters to make it applicable to FeRAM devices" told us Mikolajick. "The ferroelectric effects in doped orthorhombic  $\text{HfO}_2$  were further corroborated through computational simulation at imec, among other labs".

"The next step was to convince GlobalFoundries to integrate FE- $\text{HfO}_2$  in its CMOS process, and the first samples we have already outperformed all other FeRAM technologies and other non-volatile memories at a comparable node".

So far, FeRAM manufacturers such as TI, Ramtron (recently

acquired by Cypress) and Fujitsu are all using lead zirconate titanate (PZT) as the ferroelectric material in one-transistor one-capacitor memory cells. But none of them have been successful in scaling PZT beyond 130nm, because the perovskite-type material is notoriously difficult to deposit and its FE-properties degrade at reduced thickness.

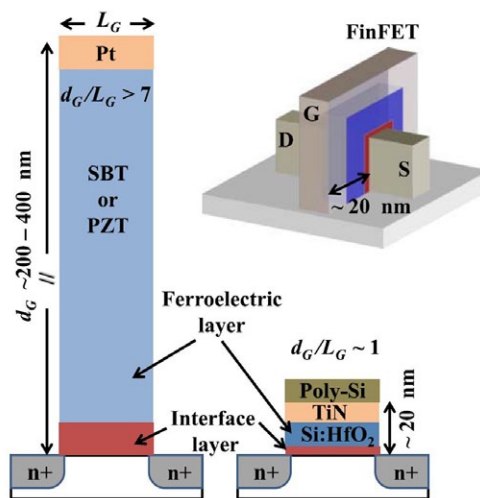
In contrast, the researchers have shown that FE- $\text{HfO}_2$  exhibits stable ferroelectric properties at film thicknesses in the nanometer range (5 to 30nm), which could make ferroelectric field-effect transistors (FeFET) a suitable alternative for non-volatile memory (1T1R) in highly integrated 2D or even 3D CMOS designs.

Mikolajick expects the technology to displace NOR-Flash in embedded memory applications, highlighting that the integration of such FeFETs RAMs is much simpler, requiring only 3 extra steps versus 7 to 10 extra layers for floating-gate based NOR-flash devices.

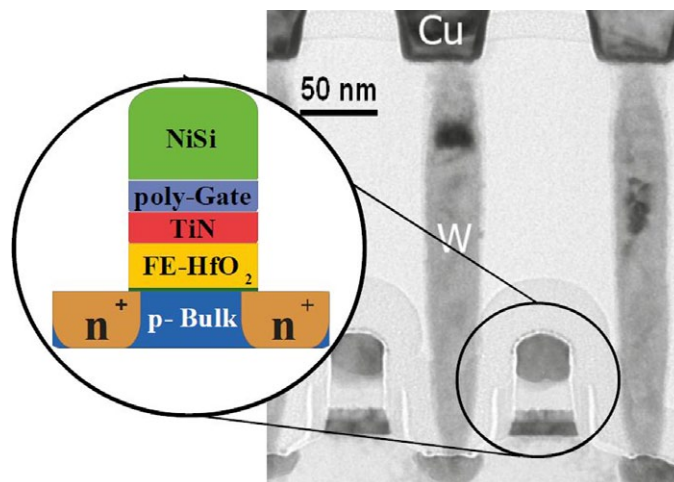
And again, hafnium oxide is readily available as high-k material in today's CMOS processes, so it is only a matter of adding another gate oxide layer, albeit a ferroelectric one.

In prior research, the NaMLab was also able to demonstrate significantly faster operation speed with program and erase times in the nanosecond range and lower voltage operation.

"Typical technologies currently used for non-volatile memory are based on the principle of charge-storage," Mikolajick says. "This has several disadvantages. Writing, for instance, requires high voltage and is very energy intensive. Due to the high voltage, certain circuit parts for controlling memory cannot be reduced to desired sizes which renders such memory inefficient for small



Comparing gate-stack structures at the 28nm node – a perovskite-type FeFET, a  $\text{HfO}_2$ -based FeFET and a FinFET cell design.



A micrograph of the Fe- $\text{HfO}_2$  structure.

and medium storage densities.”

In comparison, the ferroelectric material in the FeFET can be brought into two different polarization states by means of electric charges, and switching requires very little energy. Data retention measurements performed at 125°C during a thousand hours proved the longevity of the saturated memory state, the device remaining operational at temperatures as high as 185°C.

Talking about being cost-competitive, the new memory should enable significant cost-savings according to Mikolajick, since it cuts both on process and material costs and it also scales down nicely beyond any other type of memory so far, without any exotic 3D design intervention. The researcher reckons that such a memory may turn to be half cheaper than competing technologies.

In a first batch produced at the Fraunhofer IPMS Center for Nanoelectronic Technologies in collaboration with GlobalFoundries, the researchers have tried various cell arrangements to test different array architectures, mostly variation of NOR-type architectures.

Next on the lab's roadmap is to further reduce the operating voltage, bringing it down as low as possible to reduce the sizing and footprint of peripheral driving circuitry and also to make the devices run faster.

NaMLab acquired the IP before Qimonda went bankrupt and has now applied for patents on FeRAM memory using FE-HfO<sub>2</sub>, but Mikolajick declined to comment on future licensing strategies.

## Memory trends: a look ahead

By Janine Love

AS 2014 WAS WINDING down, there was still a lot of talk about 3D memory, mobile memory, high-performance memory, and “next-gen” memory. So what trends and challenges will make the most noise in 2015? EE Times recently spoke with Jennie Grosslight, the memory test product manager at Keysight Technologies, about what she thinks will be the prevailing memory trends in 2015.

As the memory test product manager, Grosslight is responsible for Keysight's logic analysis and compliance test tools for memory applications. With 25 years of experience and an electrical engineering degree from the University of Colorado, she has worked as an R&D engineer, technical marketing engineer, and product marketing engineer. She has been focused on helping engineers analyze and validate memory systems for the past 11 years.

### What can we expect for memory in 2015? What are the trends you see?

Price, power, and performance will continue to be the driving features of memory deployment. Both DDR4 and LPDDR4 offer impressive performance improvements and power savings. DDR4 will see broader deployment to replace DDR3 in servers and begin “trickle-down” deployment in high-end desktop workstations. This will improve cloud performance and save power. LPDDR4-based products will hit the market, and mobile memory will take over as the technology driver for the memory industry overall. As DDR4 and LPDDR4 DRAM sales increase, prices will decrease, driving even more design starts with these technologies. Finally, universal flash storage-based products will be formally introduced, laying the foundation for a quantum jump in mobile systems performance and price/performance.

### If you could tell engineers one thing about memory test, what would it be?

DDR memory is at the heart of today's cloud computing servers - most of them having at least 24 DIMMs across four channels. With some data centres reporting that DDR memory is the second-highest failure they experience, the need for robust testing of designs continues to grow. To increase margin and overall performance and create a reliable and robust system, close attention to physical layer and functional testing, characterization, and debug to validate that the system is operating

within JEDEC specifications is a critical step.

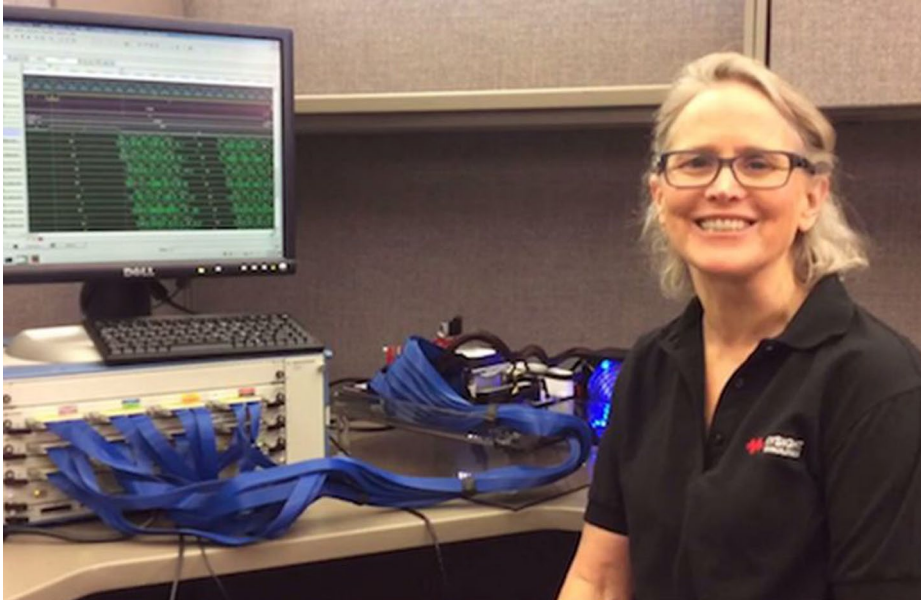
### What has surprised you most about memory development over the past 3-5 years?

In the industry, the biggest surprise has been the emergence of the “Memory Wall” as a fundamental issue, its impact on computing architectures, and the incredible burst of innovation it has stimulated. For the past 10 years, memory has progressed along an evolutionary path, with DDR succeeding SDR, then DDR2, DDR3, and DDR4. Now, everything from 3D silicon cubes to distributed memory architectures and completely new signalling methods are in development with some already deployed. Every few months a new possibility seems to emerge for consideration. It's the most interesting time to be involved in memory in the last 20 years. Along this evolutionary path, lower power and increased data rates in LPDDR technologies for mobile applications continues to push the limits. The LPDDR specification in mobile applications now has the performance of DDR technologies in computing.

From a memory test perspective, it is surprising to see that there are servers being shipped without testing to specifications. Simply designing to recommended guidelines and running software tests to validate system operation doesn't validate that the system is operating within specifications. When systems violate functional or parametric specifications for DDR/LPDDR memory, the system may not fail with each violation. However, as the number of violations increase, so does the rate of memory failures. The degree of difficulty in testing different DDR or LPDDR memory is highly dependent on the layout of the system under test and associated subsystem verification. To ensure this verification has occurred, data centres should consider requiring qualification reports.

### What are the major stoppers/technical hurdles for mobile memory? Storage?

Reducing power consumption, total memory channel throughput, and signal density are the key requirements and hurdles. Interfaces need to get faster, wider, denser, or some combination of these to improve channel throughput. Packages need to pack more signals, and this increased signal density causes cross-talk effects. Traditional single-ended signalling beyond 3Gbit/s is very hard and power hungry. Very wide I/O using 3D silicon



Jennie Grosslight, memory test product manager at Keysight Technologies.

stacking is still exotic and expensive. Combining these multiplies the difficulties. A lot of experimentation, analysis, and advancements will be required to figure out the best way to overcome these challenges. Both DDR4 and LPDDR4 specifications include multiple enhancements in these areas.

### Are standards keeping up? Do we need more/fewer?

The standards are keeping up for the most part. The main decision is what to standardize. Until now, the memory standards have been defined by the main application: desktop/server, graphics, mobile, and mass storage. The latest generations have borrowed heavily from each other to get the best performance. DDR4 has many features first done in GDDR5. LPDDR4 looks more like its desktop cousin, DDR4, than any previous generation. Going forward, standards may be classified more by the core technology, signalling system, and interconnect method than the traditional scheme. At some point, the parallel interface with DDR memory may not be able to keep up with the faster data rate. Serial lane interfaces could be considered to address that. Continued leadership and participation with JEDEC in writing and reviewing the memory standards by companies such as Keysight and their partners, such as FuturePlus Systems, will be a key part in ensuring the necessary test specifications are being created.

### How does testing differ for the various memory types? Are some memory types easier to test than others? Why?

First, read and write data separation is a very challenging task in a memory designer's work. At lower speeds, the phase difference between DQS and DQ is very obvious. Read is edge aligned with data, and write is centred aligned with data. At higher speeds, especially with LPDDR4, the phase difference between the read and write cycle is not obvious, and the preamble patterns are similar. Separating read and write cycles at higher speeds is more difficult. The use of different tools helps resolve this. For example, you can use a mixed-signal oscilloscope to trigger on the command using the command truth table.

Second, probing continues to become more and more difficult in memory test. For functional testing, using a DIMM or SODIMM interposer provides the fastest and easiest access. Access for chip down or PoP [package-on-package] designs requires BGA rework or designing probing into the system. For physical layer testing, since JEDEC standards are defined at the balls of the DRAM, the size and location of the DRAM dictate the difficulty of probing access.

### How will memory test have to evolve to satisfy emerging trends?

Memory test is constantly evolving. Physical layer and functional layer testing must continue to keep up with the JEDEC standards and data rates. Creation of standards and test specifications, along with the early design of hardware and software test



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solutions to support them prior to new memory technologies being introduced into end products, will continue to be a priority, so customers always have the latest equipment for memory testing.

One example is the U4154A/B. When it is combined with the FS2510 DDR4 DIMM interposer with FS1070 conversion from our channel partner FuturePlus Systems, we can capture the entire DDR4 bus; run functional compliance testing; follow the signal flow of address, command, and data; and view bus-level signal integrity with 5ps x 5mv resolution.

Another test evolution is protocol analyzers. Protocol analyzers, such as the FuturePlus Systems DDR Detective, are targeted to look at only the address and command signals for functional memory specification parameters, power management and performance metrics, and give engineers real insight into these complicated protocols.

For physical layer and parametric testing, the mixed-signal oscilloscope is used to decode command protocols for reliable read and write data testing. The test can be done automatically with DDR compliance test software and debug tools.

### What challenges will designers have to overcome in order to achieve success?

As chipsets scale to smaller processes, designers will have to move from DDR or DDR2 to DDR3, 50MHz flash to 200MHz

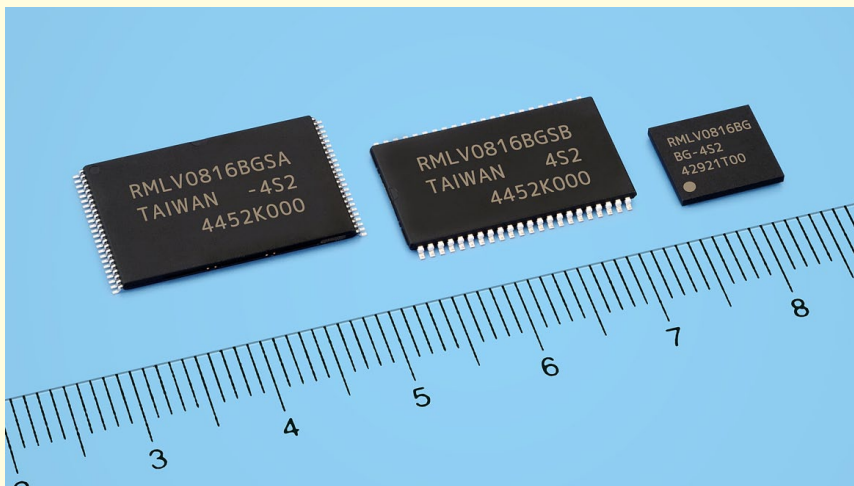
flash, and LPDDR2 to LPDDR3. The low-speed design capacitance and fanout concepts that have worked for years in flash memory will need to be updated to high-speed digital flows based on transmission lines and precise timing. Host testing may begin to be incorporated. Memory tests have always been device and not host (memory controller) focused. Host and channel specifications would be equally important and the need to characterize both would become necessary.

Probing has always been a challenge and will continue to be. We are meeting that challenge with our new DDR4 BGA interposers like the W4633A DDR4 x4/x8 probing solution. DDR4 BGA interposer products are reliable and give a connection to the address/command/control and the DQ data signals to the U4154B. Similar new BGA and PoP probing technology that is proven to achieve data rates of 3.2Gbs is available for LPDDR4.

Finally, if the interface eventually moves to serial to enable continued increases in speed, there are existing serial standards that can be adopted. High-speed designers will have to learn serial speed concepts like bit error rates, eye masks, and dual Dirac jitter/noise modelling. Test equipment that has been relied on for years will have to be upgraded and new measurement techniques applied. The concepts and products to support this are proven but will need to be mastered by a whole new group of designers.

### High reliability 8-Mb SRAMs achieve zero soft-error-rate

Renesas has grown its Advanced Low-Power SRAM series, with the RMLV0816B and RMLV0808B devices, which have a density of 8 Mbits and are built with a fabrication process technology with a circuit linewidth of 110 nm. In the Advanced LP SRAM Series, which can achieve soft-error-free and latch-up-free operation, Renesas started mass production of 4 Mbit products fabricated in a fine feature size process with a 110 nm circuit line width in December 2013 and now has launched the 8 Mbit products in this series. The new devices are high-reliability products that achieve the same soft error rate as Renesas' earlier products that were fabricated in a 150 nm process. They also achieve low-power operation with a standby current of maximum of 2  $\mu$ A at 25°C, making them suitable for data



storage in battery-backup devices. Measures to deal with soft errors due to alpha rays and neutrons in cosmic radiation are seen as critical; since Renesas has added a capacitor to the memory node in the cell of the Advanced LP SRAM devices, these devices have an extremely high resistance to soft errors. A common method for dealing with soft errors is to correct the errors that occur using an ECC (error correcting code) circuit embedded in the SRAM or user system. There are, however, limits to such techniques, such as not being able to correct

multiple bit errors depending on the performance of the ECC itself. To deal with this issue, the Renesas Advanced LP SRAM adopts structural measures that suppress soft error occurrence itself. The results of system soft error testing in Renesas currently mass produced 150 nm process Advanced LP SRAM has shown that these devices are essentially soft error free. Additionally, the load transistors (p channel) in the SRAM cell are formed as polysilicon TFT devices, and since they are stacked in the upper layer of the n-channel MOS transistors

that are formed on the silicon substrate, only n-channel transistors are formed on the underlying silicon substrate. As a result, there are no parasitic thyristor structures in the memory area and thus these devices have a structure in which latch-up cannot, in principle, occur. As a result of these design aspects, these products are SRAM devices with extremely high reliability compared to full CMOS

type devices that have the ordinary memory cell structure. Renesas Advanced LP SRAM achieves an even more compact cell size by combining polysilicon TFT stacking technology with stacked transistor technology. For example, the cell size in Renesas 110 nm Advanced LP SRAM is comparable to that in a full CMOS type SRAM fabricated in a 65 nm process. 16 Mbit products fabricated in the 110 nm process will follow.

**Renesas**

[www.renesas.eu](http://www.renesas.eu)

## Samsung bolsters mobile memory

Samsung described its work on advanced memories for mobile systems including LPDDR4 DRAMs and a novel memory stack for wearable devices in an interview with EE Times at the International CES. Factors driving advanced mobile memory include the need to process high-quality video, increasing expectations for compute power in low-to-mid tier phones, and the expanding Internet of Things with its plethora of sensors. Samsung launched a 20nm LPDDR4 4GB chip late last year. The 336b chip can handle data rates up to 3,200 Mbits/s while consuming 1.1V. A 20nm LPDDR3 chip is also in production. Samsung officials did not comment on the future of mobile memory made in finer design rules. Low power memory density is growing at a rapid rate, Samsung's Stephen Lum told EE Times. Tablets that previously had 7.5 GBytes on average have moved to 13.6 GBytes per system while smartphones are expected to average 10.9 GBytes per system in 2015. The overall DRAM demand has skyrocketed as a result, with a 50% growth in bits. "We expect 11 different sensors in smartphones in 2015 -- that affects both working memory, DRAM, and storage memory, eMMC," said Lum, a mobile memory group product marketing manager. "Higher res displays are getting more data, more pixels...and you also need more bandwidth to process that," he added. While the LPDDR4 chip received an honorary innovation award at CES, it won't make its way to flagship phones until later this year when Samsung's Chinese partners ship devices currently in development. LPDDR3 will remain the dominant memory in mid-and-low tier devices through 2016, Lum said.

**Samsung**

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## Low-power FRAM with integrated counter function, for energy harvesting apps

Fujitsu Semiconductor's MB85RDP16LX is an ultra-low-power FRAM device with an integrated binary counter function. It incorporates multiple optimisations to reduce energy consumption to less than 10% of that required by standard FRAM solutions. With the MB85RDP16LX, Fujitsu is targeting industrial automation applications involving energy harvesting for rotary encoders, motor control and sensors. The ultra-low-power device can enable self-powering solutions such as the Wiegand wire-based platform being offered by iC-Haus. Significant energy savings have been achieved by integrating the counter function into the FRAM device. Conventional system environments using standard memory require the MCU to read data from the memory device before performing computation and then writing new data back to the memory to complete the counting operation. In contrast, MB85RDP16LX replaces these separate read/write operations with a single command from the MCU, resulting in energy savings of up to 94%. The power-up time of MB85RDP16LX has been optimised to 5 µsec, which is 38 times faster than standard FRAM devices. MB85RDP16LX can be connected via single- and dual-SPI interfaces. MB85RDP16LX has been specified for an operating temperature range of -40-105 °C.

**Fujitsu Semiconductor**

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## 960GB SSDs in 2.5" standard form-factor

Toshiba Electronics Europe has released two new enterprise solid state drives (eSSDs) series – the HK3E2 for value-endurance workloads and the HK3R2 drive for read intensive workloads. These 6Gbit/s SATA Enterprise SSDs join the company's broad portfolio of enterprise storage solutions featuring a variety of endurance ratings to meet the needs of specific application requirements and customer environments. Available in capacities up to 800GB in a 2.5-inch standard form-factor (7mm thick), the HK3E2 is designed for mainstream enterprise applications such as exchange mail servers, web servers, database servers, indexing servers, and data centre storage workloads. The HK3E2 Series has a three drive writes per day (DWPD) endurance specification for five years, with random 4KiB enterprise workload. The read intensive HK3R2 series is available in capacities up to 960GB in a 2.5" standard form-factor and is designed for read intensive applications and workloads such as read caching, video streaming and data centre storage. The HK3R2 has an endurance rating of one DWPD for five years with a random 4KiB enterprise workload.

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## Structural faults leading to glitches

By Ankush Sethi

WITH THE INCREASING complexity of SoCs, multiple and independent clocks are essential in their design. The design specifications require system level muxing of some of these clocks before they are sent to actual IP.

Also to save power, clock gating cells are inserted in the path of these clocks. While implementing these muxing and gating cells, designer tends to make some mistakes that can lead to glitches. A glitch on a clock signal essentially renders a chip (or a section of a chip) to asynchronous behaviour. A glitch-prone clock signal driving a flip-flop, memory or a latch may store incorrect and unstable D (or data) input of a flip-flop, memory or a latch. This paper discusses structural faults that can lead to glitches in clocks. Also some bad design practices that lead to glitches in data are discussed briefly.

### Converging outputs of flops as clock

In the design of figure 1, the outputs of two flops converge through combinational logic to make the clock of the third flop. Here again we may have a glitch at the output of combinational logic leading to a glitch prone clock operating the third flop.

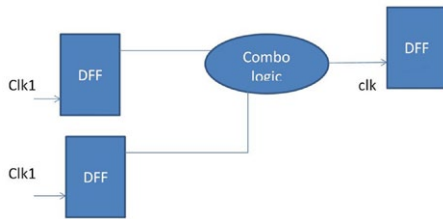


Fig. 1: Converging outputs of flops as clock

Now the designer needs to carefully review such structures. We can give waiver to such a structure if we are sure that the toggling of both paths is mutually exclusive. A typical case could be where one of the paths is through static IOMUX registers. In that case we may waive the path.

### Incorrect latching of enable signal

Clock gating is an age old and important technique to reduce the overall dynamic power of design. There could be multiple approaches to implement clock gating. In the clock gating cell of figure 2, the enable signal is generated as output of “and” gate. This may lead to glitch in the enable signal which may lead to erroneous (glitch prone) clock as input to the flop.

One must always ensure that the enable signal of any clock gating cell is outout of a flop else we may see a glitch in the en-

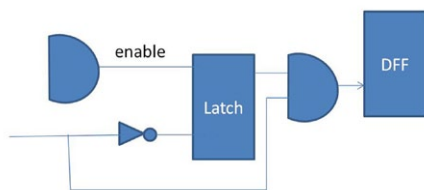


Fig. 2: Incorrect latching of enable signal.

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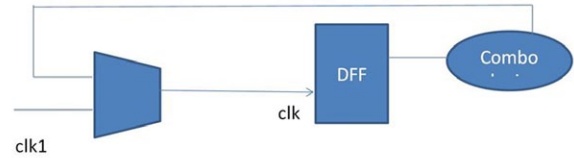


Fig 3: Clock signals re-converging on a mux.

able. If such structures cannot be avoided it must be ensured that at least one input to the “and” gate is static when used (say driven out of some configuration register). This ensures that there is no glitch in the enable signal when it is used. Such structures can be caught with any structural verification tool or in gls.

### Clock signals re-converging on a mux

In figure 3, the output of the mux after passing through the clock-pin of the flip-flop/latches re-converges back on the same mux. This results in creation of a glitch. We must ensure that we don't have such structures in our design.

### Glitch due to reset crossing

Referring to the design of figure 4, the enable of a clock gating cell is coming from a flop which clears the enable signal asynchronously due to assertion of asynchronous reset ( Func\_rst) while the input clock is still active, this can produce glitch at the output of the cell. A design solution for this is to synchronize the enable using 2-DFF structures which are either non – resettable flops or having POR as reset. This ensures that there is no asynchronous path from flop generating enable and clock gating cell.

### Other scenarios

There are other scenarios that can lead to glitches in clock. One of them being the use of combinational gates (and, nor, xor etc ) and instead of cg cells for gating of clocks – see figure 5.

While using a cg cell, there might be a case where the enable is launched from a clock domain that is different from that of the clock to be gated. This may also lead to glitches in the clock. Such cases need to be carefully reviewed and fixed in design after being caught by a tool or gls.

### Sources of data glitches

Any combinational logic used in a data path is glitch prone. But since the timing parameters are met for each and every synchronous path, the glitch will not be sampled in the destination domain. But there are cases (described below) where such timing parameters are not met and glitches may get sampled in the design.

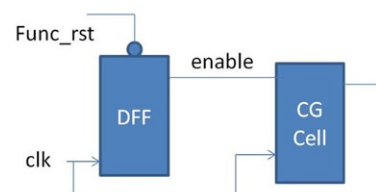


Fig. 4: Glitch due to reset crossing.



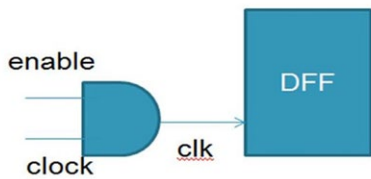


Fig. 5: Using combinational gates for clock gating.

### Use of combinational logic at CDC Path

In an ideal situation, there should be no combinational logic present at the CDC Interface. If such logic is present it may lead to a glitch. Also the glitch may get sampled in the destination domain and may lead to erroneous behaviour. Here again designer needs to review all the paths at the interface. We may waive the structure shown in figure 6 if all the other inputs to this combo logic are static when used. Such structures can easily be caught with any CDC tool or in gls.

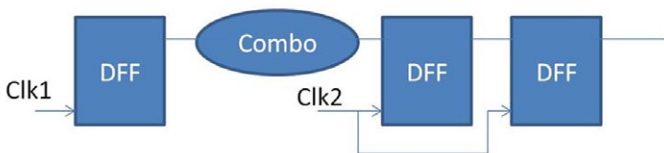


Fig. 6: Combinational logic at CDC Path.

### Glitch at converging paths through an analogue block

Referring to figure 7, we have two inputs A and B which are combined through an “and” gate and fed to analogue IP. There is also another “and” gate which has B and the output of an analogue IP as inputs. The output of the second “and” gate is fed back to the analogue IP. Consider a case where B toggles and A = 1 we may observe glitches at the output of the second “and” gate. This kind of design which is purely combinational (with some hard macros) is always glitch prone. The glitch may get sampled in the design and may lead to unexpected behaviour. Such cases need the attention of designer and needs to be fixed in design.

It is very important to make our design free of any clock or data glitches to ensure correct functioning of the design. There are cases where such issues have not only caused functional failure but increased execution cycle time by adding some extra debug time and effort. Hence it is very important for a designer to take care of such issues at very early stage of design once flagged by tool or gls.

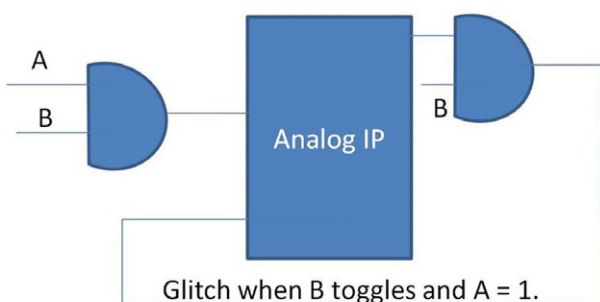


Fig. 7: Glitch at converging paths through an analog block.

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## Lowering the cost of ownership of PoE

By Alison Steer and Heath Stewart

**POWER OVER ETHERNET (POE)**, defined by the IEEE 802.3at specification, is a method to safely deliver application data and power over a single CAT-5 Ethernet cable. It has been increasing in popularity due to its flexibility for installing equipment almost anywhere, without the constraint of AC-power proximity or requiring installation by an electrician. The original IEEE 802.3af PoE specification limited the power delivered to the powered device (PD) to just 13W, which in turn limited the scope of applications to devices such as IP phones and basic security cameras. In 2009, the IEEE 802.3at specification increased this available power to 25.5W. However, this was still insufficient to satisfy the growing number of power-hungry PoE applications, such as picocells, wireless access points, LED signage and heated pan-tilt-zoom (PTZ) outdoor cameras.

In 2011 Linear Technology released a new proprietary standard, LTPoE++™, which extends the PoE and PoE+ specifications to 90W of delivered power, while maintaining 100% interoperability with the IEEE PoE standards. Four different power levels are available (38.7W, 52.7W, 70W, 90W), allowing the power supply to be sized according to the application's requirements.

LTPoE++ PSEs employ a clever PSE isolation architecture to minimize component count and enable the use of less expensive external components. Comprehensive cable discharge protection and 80V abs max pins ensure high reliability in the field. Use of external FETs allows thermal performance to be matched to the application requirements, improves the efficiency of the system, and increases long-term reliability. The LTPoE++ architecture requires only one PSE (power sourcing equipment) and PD controller to deliver up to 90W over 4-pair 100m CAT-5e cable.

### System isolation requirements

Implementation of Power over Ethernet requires careful architecture and component selection to minimize system cost, while maximizing performance and reliability. A successful design must adhere to IEEE isolation requirements, protect the Hot Swap™ FET during short-circuit and overcurrent events, and otherwise comply with the IEEE specification. The PoE specification clearly lays out isolation requirements, guaranteeing ground loops are broken, maintaining Ethernet data integrity and minimizing noise in the PD application circuit.

Traditional PSE isolation architectures isolate the digital interface and power at the host-to-PSE controller interface. Digital isolation elements such as opto-couplers are inherently expensive and unreliable. ICs capable of performing the isolation function are cost-prohibitive or do not support fast I2C transfer rates. In addition, isolated DC/DC converters needed to power the PSE logic increase board space and system cost.

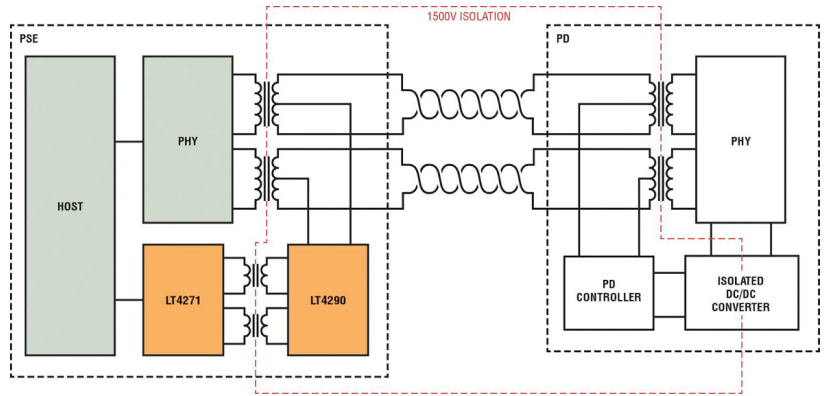


Fig. 1: The LTC4290/LTC4271 chipset achieves isolation without any opto-isolators and eliminates the need for a dedicated isolated DC/DC converter.

### Isolation made easy

Linear Technology's 12-port (LTC4270/LTC4271) and 8-port PSE (LTC4290/LTC4271) chipsets take a different approach to PSE isolation by moving all digital functions to the host side of the isolation barrier – see figure 1. This significantly reduces the cost and complexity of required components. There is no longer the need for a separate, isolated DC/DC power supply; the LTC4271 digital controller can use the host's logic supply. The LTC4271 controls the LTC4290 or LTC4270 using a transformer-isolated communication scheme. An inexpensive and ubiquitous Ethernet transformer pair replaces six opto-couplers. I2C communication including port management, reset and fast port shutdown are encoded in a protocol designed to minimize radiated energy and provide 1500V of isolation.

### Robust cable discharge protection

It is important to consider the robustness of your PoE design, especially when dealing with high cable counts, high voltages, high currents or high temperatures. Linear Technology has a lot of experience in this area and has designed a low cost, well thought-out, circuit protection scheme that is scalable to match IEC61000 cable discharge voltage requirements. Only a single TVS is required to protect the high voltage analog supply while a pair of inexpensive clamping diodes is used on each output port – see figure 2. The diodes at the ports steer harmful surges into the supply rails, where they are absorbed by the surge suppressor and the VEE bypass capacitance. The surge suppressor

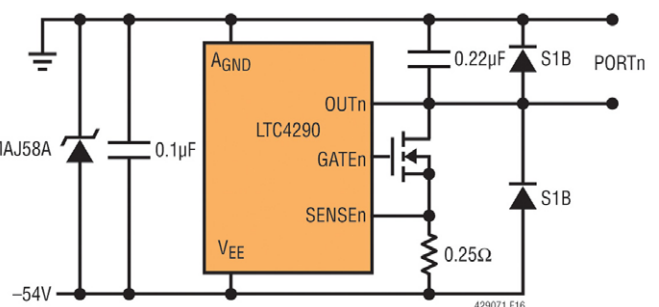
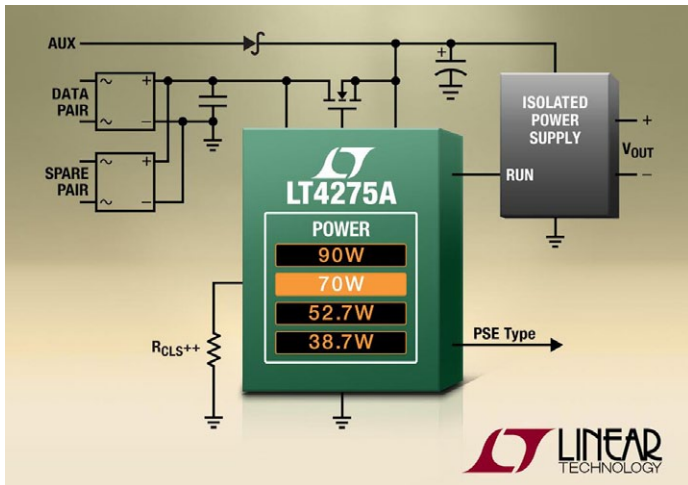


Fig. 2: Robust cable discharge protection.

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Heath Stewart is Senior Design Engineer for Mixed Signal Products at Linear Technology.



**Fig. 3: LTPoE++ PD controller uses external MOSFET for increased power efficiency.**

tor has the additional benefit of protecting the PSE controller from transients on the VEE supply. Linear's PSE controllers also have an 80V abs max rating on all analog pins to provide native protection against transients.

### Reduced power dissipation

Linear Technology's fourth generation PSE and PD controllers support fully compliant IEEE 802.3at operation in addition to LTPoE++ power levels of up to 90W, while minimizing heat dissipation through the use of low RDS(ON) external MOSFETs and 0.25Ω sense resistors. This is important in high power systems where thermal design and power loss can be extremely costly, as well as in power-limited applications where the application needs to maximize the delivered power to operate within the application's power budget.

PSE and PD controllers with integrated MOSFETs have higher RDS(ON) characteristics, making thermal design more difficult as the heat is dissipated inside the device. Damage to a single port can bring down the whole chip.

The LT4275 as shown in figure 3 is the only PD controller on the market that controls an external MOSFET to drastically reduce overall PD heat dissipation and maximize power efficiency, which is especially important at higher power levels. This novel approach allows users to size the MOSFET to meet the application's exact heating and efficiency requirements, enabling the use of low RDS(ON) MOSFETs on the order of 30mΩ. The LT4275 can support any power level up to 90W.

A single TVS and 100V abs max port pin provides more than enough protection against cable discharge events. The LT4275 operates over a wide -40°C to 125°C temperature range and is equipped with overtemperature protection that protects the device during momentary overload conditions. With this much protection, it's easy to see how rugged applications can benefit.

### How LTPoE++ works

LTPoE++ uses a 3-event classification scheme to provide mutual identification handshaking between the PSE and PD while maintaining backward compatibility with the IEEE 802.3at standard. The LTPoE++ PSE determines if a PD is a Type 1 (PoE), Type 2 (PoE+), or LTPoE++ device by the PD response to the 3-event classification scheme. The LTPoE++ PSE uses the 3-event classification scheme result to update the ICUT and ILIM thresholds. The PSE uses the ICUT threshold to police the PD current consumption. ILIM is used as a hard current limit to

protect the PSE power supply during serious current faults.

On the other end, the LTPoE++ PD uses the number of classification events it receives to determine whether it is connected to a Type 1, Type 2, or LTPoE++ PSE. If the LTPoE++ PSE measures the PD's 1st classification event current as Class 0, Class 1, Class 2, or Class 3, the LTPoE++ PSE will proceed to power on the port as a Type 1 device. Otherwise if Class 4 is identified in the 1st classification event, the LTPoE++ PSE will continue with a 2nd classification event, as defined in the PoE+ specification. This informs the PD that it is connected to either a Type 2 or LTPoE++ PSE. The absence of the 2nd classification event indicates the PD is connected to a Type 1 PSE that is limited to Type 1 power.

The Type 2 PD physical layer classification is defined by IEEE as two consecutive Class 4 results. An LTPoE++ PD must also display two consecutive Class 4 results in the 1st and 2nd classification events, making an LTPoE++ PD appear as a Type 2 PD to a Type 2 PSE.

The LTPoE++ PSE will move on to the 3rd classification event after valid Class 4 measurements in the 1st and 2nd classification events. After two successful Class 4 measurements, a 3rd classification event is performed. The 3rd classification event must switch to a class other than Class 4 to recognize the PD as LTPoE++ capable. A PD that maintains Class 4 during the 3rd classification event is considered by the LTPoE++ PSE to be a Type 2 PD.

The IEEE 802.3at standard requires compliant Type 2 PDs to repeat Class 4 responses for all class events. The 3rd classification event informs the LTPoE++ PD that it is connected to an LTPoE++ PSE. Table 1 shows the class events permutations for the various PD power levels.

PD INPUT POWER (W)	CLASS PULSE		
	1st Event	2nd Event	3rd Event
13	0	-	-
4	1	-	-
7	2	-	-
13	3	-	-
Invalid	4	0-3	-
25.5	4	4	4
38.7	4	4	0
52.7	4	4	1
70	4	4	2
90	4	4	3
Invalid	Overcurrent*	-	-
Invalid	4	Overcurrent*	-
Invalid	4	4	Overcurrent*

\*Class current  $I_{CLASS}$  exceeds that specified for an overcurrent.

**Table 1: Class events permutations for the various PD power levels.**

### LTPoE++ plug-and-play solution

LTPoE++ provides a safe and robust plug-n-play solution that dramatically reduces engineering complexity in power sourcing equipment (PSEs) and powered devices (PDs). The benefit of LTPoE++ over other power-extending topologies is that only a single PSE and PD is required to deliver up to 90W over a single CAT-5e cable, resulting in significant space, cost and development time advantages.

The LTPoE++ solution significantly lowers the cost of ownership not only by reducing the bill of materials and associated component cost, but also by providing the most power efficient end-to-end solution available today, maximizing the power delivered to the application while minimizing heat dissipation and costly heat sink design.

One important distinction for LTPoE++ is that it does not require the use of the Link Layer Discovery Protocol (LLDP) that was mandated in the IEEE PoE+ specification for software-level power negotiation. LLDP requires extensions to standard Ethernet stacks and can represent a significant software development effort. LTPoE++ PSEs and PDs autonomously negotiate power level requirements and capabilities at the hardware level

while remaining fully compatible with LLDP-based solutions. This gives LTPoE++ system designers the choice of whether or not to implement LLDP. Proprietary end-to-end systems may choose to forgo LLDP support. This creates time-to-market advantages while further reducing BOM costs, board size and complexity.

### Advanced fourth generation features

Linear's Power over Ethernet PSE controller family incorporates a wealth of PoE experience and expertise backed by well over 200 million shipped ports. New fourth generation features include field-upgradable firmware for future-proofing designs. Also new is optional 1-second current averaging, which simplifies host power management.

Advanced power management includes prioritized fast shutdown, 12-bit per-port voltage and current read back, 8-bit programmable current limits and 7-bit programmable overload current thresholds. A 1MHz I2C interface allows a host controller to digitally configure the IC or query port readings. "C" libraries are available to reduce engineering costs and improve time to market.

### Thermocouple interface IC for automotive powertrains

Increasing environmental concerns and ever more stringent legislation are driving the demand for more



energy efficient vehicles. Increasing the operational effectiveness and decreasing the environmental impact of the powertrain necessitates higher working temperatures which must be strictly controlled and monitored at all times. Melexis now announces the MLX90327, a high performance sensor interface IC which enables accurate and reliable monitoring of high operating temperatures, thus addressing this key requirement for next generation powertrains. The device can cope with operating temperatures of from -40°C to 155°C without any compromise in accuracy being witnessed. The MLX90327 comes with a digital SENT interface for advanced powertrain electronic control units (ECUs). In addition a PWM output is available for general-purpose automotive and non-automotive applications.

**Melexis**  
[www.melexis.com](http://www.melexis.com)

### Automotive-grade buck regulator delivers 3A

This 3.0A device features low input-voltage dropout and enhanced idle/stop/start recovery operation; the A8590 buck

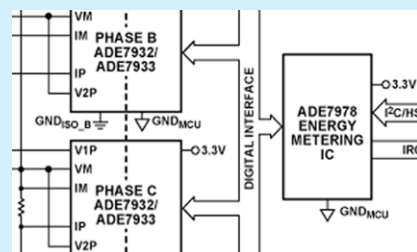


regulator joins Allegro MicroSystems' range of automotive-grade AEC-Q100 qualified regulator ICs. The device has been designed to provide the power-supply requirements of next-generation car audio and infotainment systems, and provides all the control and protection circuitry for a 3A regulator which will withstand the rigours of a wide automotive battery input voltage range. The A8590 can also be used in cluster and centre stack applications and in advanced driving assistance systems. The device employs pulse frequency modulation to draw less than 50 µA from a 12V input while supplying a 3.3V/40 mA output. After startup, the A8590 operates down to an input voltage (falling) of at least 3.6V, and maintains ±1% output voltage accuracy. Other features of the A8590 include PWM/PFM mode control and the ability to synchronise PWM frequency to an external clock.

**Allegro MicroSystems**  
[www.allegromicro.com](http://www.allegromicro.com)

### Chipset measures 3-phase AC power parameters

Analog Devices has posted details of a chipset specifically designed for measuring 3-phase electrical energy,

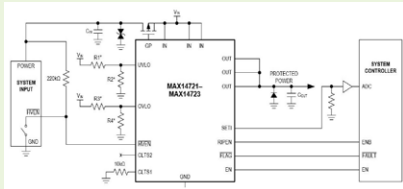


using shunts as current sensors. The chipset comprises the ADE7978, the ADE7933/ADE7932, and ADE7923. The ADE7933/ADE7932 are isolated, 3-channel sigma-delta analogue-to-digital converters ( $\Sigma$ - $\Delta$  ADCs) for poly-phase energy metering applications that use shunt current sensors. The ADE7923 is a nonisolated, 3-channel  $\Sigma$ - $\Delta$  ADC for the neutral line that uses a shunt current sensor. The ADE7932 features two 24-bit ADCs, and the ADE7933 and ADE7923 feature three 24-bit ADCs. One channel is dedicated to measuring the voltage across the shunt when a shunt is used for current sensing. This channel provides a signal-to-noise ratio (SNR) of 67 dB over a 3.3 kHz signal bandwidth. Up to two additional channels are dedicated to measuring voltages, which are usually sensed using resistor dividers.

**Analog Devices**  
[www.adi.com](http://www.adi.com)

## High-accuracy, adjustable, dynamic power limiters

Maxim has posted data sheets for a series of dynamic power limiters with thermal controlled current foldback, describing them as the first parts available with this combination of



features MAX14721–MAX14723 are adjustable overvoltage, undervoltage, and overcurrent protection devices that guard systems against

overcurrent faults in addition to positive overvoltage and reverse-voltage faults. When used with an optional external p-channel MOSFET, the devices also protect downstream circuitry from voltage faults up to  $\pm 60V$ . The MAX14721–MAX14723 embody a  $76\text{-m}\Omega$  on-resistance integrated FET. During startup, the devices are designed to charge large capacitances on the output in a continuous mode for applications where large reservoir capacitors are used on the inputs to downstream devices. The devices feature a dual-stage, current-limit mode in which the current is continuously limited to 1x, 1.5x, and 2x the programmed limit, respectively, for a short time after startup.

**Maxim Integrated**

[www.maximintegrated.com](http://www.maximintegrated.com)

## Precision op amps are aimed at IoT

On Semiconductor (Phoenix, Arizona) has introduced a family of “zero-drift” low-voltage CMOS precision operational amplifiers, for use as front-end amplifiers and in power management. The NCS325 and NCS333 are suitable for use in precision applications in industrial, consumer, wireless and the Internet of Things (IoT) where strong stability across wide operating temperature ranges is mandated. These devices are complemented by the NCV333 automotive-qualified (AEC-Q100 grade



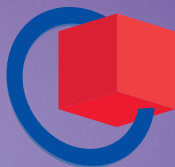
1) op amp offering similar functional performance for power train, braking, electronic power steering, valve controls, fuel pump and fuel injection system applications. Featuring high DC precision parameters, such as the 10 microvolts maximum input offset voltage at ambient temperature and the  $30\text{ nV}/^\circ\text{C}$  of offset temperature drift, make these amplifier devices extremely well optimized for low side current sensing and voltage differential measurement on front-end sensor functions. Minimal voltage variations over temperature along with close to zero offset ensure the efficiency of systems exposed to wide operating temperature ranges without the need for complex software calibration algorithms.

**On Semiconductor**

[www.onsemi.com](http://www.onsemi.com)

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**NÜRNBERG MESSE**

# Tiny spectrometer targets IoT

By Jessica Lipsky

**STARTUP COMPANY NANOLAMBDA** has developed a \$10 spectrometer-on-a-chip that's suitable for use on a wide range of consumer devices. The Spectrum Sensor measures individual wavelengths and is accurate to 1nm with 10nm resolution, allowing NanoLambda to selectively pass light through nanostructures to determine their makeup.

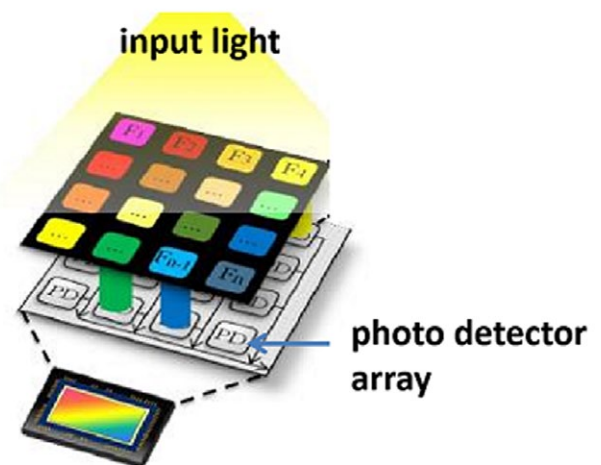
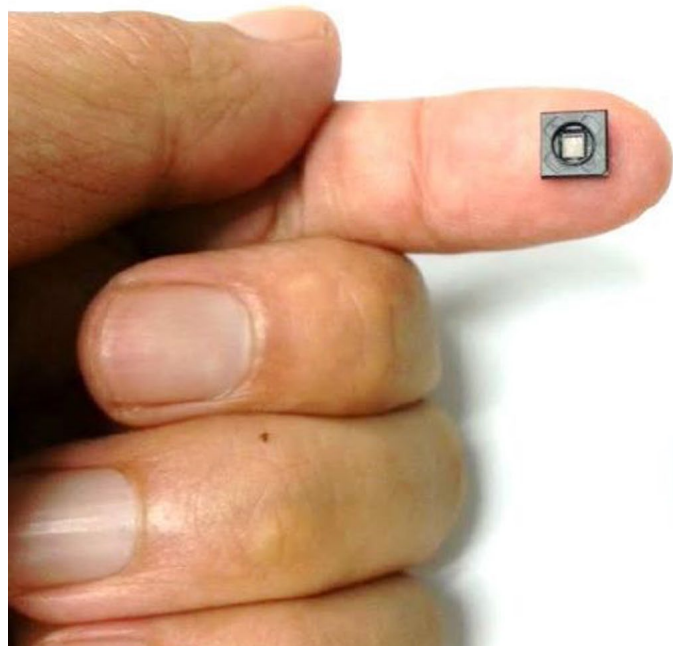
The company used traditional wafer processes to create 5x5x2mm thin nanofilter arrays. Nine hundred of these arrays can be stacked to create a millimeter-scale chip that can be embedded into various Internet of Things devices.

"Every material has its own spectral fingerprint, which means, when certain very flat white light shines on to the target material, its material absorbs light differently, making, specific patterns or shapes," NanoLambda CEO Bill Choi told us. "Each filter will detect different wavelengths. Then, collectively, the sensor can figure out" the material's characteristics.

Spectrometer technology has been used to analyze biochemicals for several decades, but it was previously too bulky and expensive to use at a consumer scale. NanoLambda's nanoarrays have brought the chip's price point down to \$10. Choi expects the small size and price to allow for the technology to be embedded in everything from chopsticks to medical devices.

Sweet red apples would exhibit a specific color that users could identify with ripeness, or a spectrometer could be used to identify the freshness of milk. Choi said consumers could monitor drinking water from kitchen faucets; certain colors would show whether water is contaminated or safe to drink. Requests for this particular kind of analysis have been commonplace in China, where people want to identify fake whiskey and wine.

"The chemical composition of real wine and fake wine will be different," he said. "You could add additional color, but the chemical fingerprint itself is different. When you shine light on to the target whiskey, the transmitted light will have a slighter different absorption pattern."



A spectrometer-on-a-chip could also conduct noninvasive medical monitoring. Choi has received suggestions for tongue monitoring, as well as monitoring change in organ color over time, though that app is invasive. He hopes his technology will become the basis of a health testing consortium.

"Fusion or multi-mode sensing abilities will definitely bring the solution to next-generation healthcare," he said. "I don't think one single sensor technology will solve all the problems. I think collaboration among companies is very important."

Those collaborations will also help solve NanoLambda's biggest challenge: creating a database of spectral fingerprints for comparing food freshness, organ color, or other biochemical materials.

"The sensor itself is useless without an algorithm," TSensors Summit chairman Janusz Bryzek said at a San Diego conference last month. "You are trading transistors and processing power for optics. It requires a lot of post-processing."

Choi used milk tests as an example of database collaboration:

*If we want to have some kind of database for milk, you want to measure all kinds of milk's spectral fingerprints from different companies and different flavors. Of course, at the beginning you can start with a very baseline database from [your own experience], NanoLambda, or milk companies. As we move on, then maybe the consumers can participate by measuring the milk using this very simple device and uploading the data on to the system. Those won't be scientifically measured, but have some value. Who will get the database service later is open for question.*

The fabless NanoLambda hopes to deliver the spectrometer and interface software IP to OEMs such as Samsung and Apple, which will build final devices. Choi could not speak about any partnerships, but he said the company will release a software developer kit in the first few months of 2015. He expects applications to be created in three months to one year after that.

The company's software runs on both Linux and Windows systems, he said.

# Fiber-in-textile turns clothes into motion sensors

By Peter Clarke

**CAMBRIDGE CONSULTANTS LTD.** (Cambridge, England) has gone back to some well-known optical sensing methods to develop fiber optic sensors that can be woven in to fabrics that can act turn washable garments into active motion sensors.

The XelfleX technology can be used to make robust, washable clothing that can be used to gain body motion information from sports, fitness and medical rehabilitation and for gaming, film making and virtual reality creation.

Most attempts at body motion capture in recent times have been addressed by applying inertial motion sensors with wireless communications at key points of the body, usually through wearing a specialized suit. And despite the increased miniaturization of MEMS sensors this has involved cumbersome electronics and electronics that could not be put in the washing machine.

The XelfleX uses fiber-optic thread as the sensor. It requires a single electronics pack that clips on to the fiber – in a pocket for example – and communicates wirelessly with a smartphone. The pack disconnects when the garment needs to be washed.

XelfleX works on the principle that when a pulse of light is transmitted down an optical fiber, a well-defined amount of light is scattered continuously along its length. Bending the fiber

results in increased scattering and reflection, which can then be measured.

By integrating the fiber into a close-fitting garment, the movement of a joint can change the amount of bending

at a defined sensor point in the fiber. Up to 10 sensors are possible along each fiber – with the initial light pulse sent by an LED in the electronics pack. Algorithms then turn the results from the sensors into guidance that users can easily understand, giving feedback on their posture and movement, and coaching them on how to improve.

“Our aim was to create wearables that people actually want to wear,” said XelfleX inventor Martin Brock, of Cambridge Consultants. “XelfleX demonstrates the benefits of our cross-fertilization of technology between very different sectors – it’s at the intersections between industries that innovation often happens,” said Brock.



# BASF develops simple 3D image sensor

By Peter Clarke

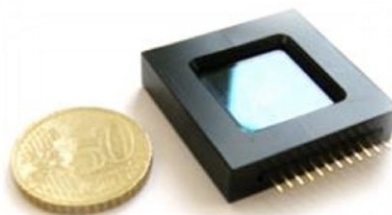
Chemicals giant BASF SE (Ludwigshafen, Germany) has developed a single-lens passive optical sensor that can measure distance to an object and thereby 3D position detection and 3D imaging.

The company hopes to develop the sensor for a broad range of applications from consumer electronics such as cameras and smartphones to automotive, transportation, medical and machine vision and security and surveillance.

The sensor is based on a “new physical effect” enabled by the use of specially developed dye-sensitized organic light sensitive chemicals. The effect is complex and described in patent WO 2012110924 A1.

It appears to hinge on methods to measure the amount of light falling on a sensor surface and the direction from which it is falling while the light is chopped at two different modulation frequencies and with specific knowledge of the focal depth of lens. One key statement in the patent is that “The sensor signal, given the same total power of the illumination, is dependent on a geometry of the illumination, in particular on a beam cross section of the illumination on the sensor area.”

However, it is a novel method that could be simpler than established methods. These are two or multi-lens triangulation to determine 3D position, which is computationally intensive, and time-of-flight measurements of light which depends on a modulated optical source, typically infrared, and is therefore not



**BASF's single-lens passive optical 3D sensor.**



**Prototype 2:0 cameras for position and color detection. Source: BASF**

suitable for long range measurements where the transmitted beam can be blocked or dissipated by atmospheric effects.

The combination of chemistry, materials science and physics has produced a system capable of tracking and imaging objects in three dimensions at about twice the speed of the human eye and brain, BASF claims. The system is able to detect and image over distances ranging from microns to kilometres dictated only by the lens. The sensor works passively and only needs ambient light. In darker surroundings the sensor can be operated with active visible or infrared light sources.

The sensor size is comparable to CMOS image sensor chips and so the BASF 3D sensor can be integrated into consumer or professional cameras, mobile phones, tablet computers and could be integrated with a conventional 2D image sensor. With the addition of appropriate software the sensor can be used for purposes beyond imaging, such as autofocus, object, gesture, facial and body expression recognition.

### Infrared makes multi-finger gesture control affordable

By Christoph Hammerschmidt

**GESTURE CONTROL, ALREADY** commonplace in consumer electronics, is also finding increasingly acceptance in the automotive environment. So far however, deployment is restricted to upmarket vehicles - for the affordable market segment, the technology is too expensive. Continental now has developed a technology to tap this market segment too.

With what Continental calls an "infrared curtain" the company can offer a cost-effective alternative to capacitive touchscreens. In 2011 the company showcased a system that allowed designers to turn any desired surface in the car into a user interface by means of such an infrared curtain. In the meantime, the system has been further developed to recognise and interpret typical multi-finger gestures like swiping, zooming and pinching. Unlike capacitive touch screens, the infrared technology permits operation if the user wears any type of gloves.

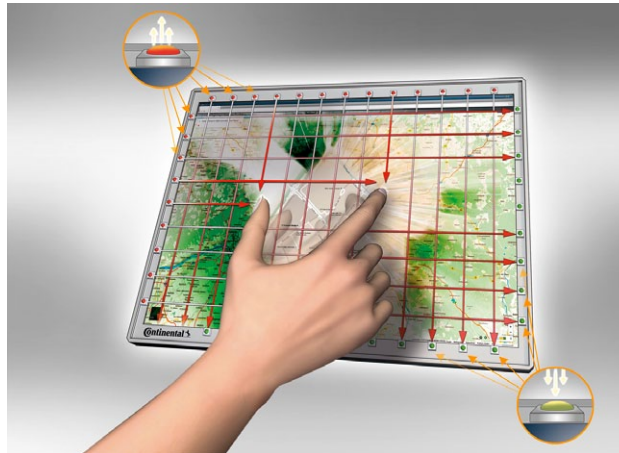
The infrared curtain consists of a row of infrared diodes at

the edge of the display. While in one-finger gesture HMI concepts, a single row of LEDs was sufficient, recognising multi-finger gestures requires multiple

interconnected rows of infrared light sources. In order to detect a multi-finger gesture, the HMI electronics interprets the blocked light beams as the finger position.

In large-scale production this technology is more cost-effective than current capacitive touch screen displays, says Continental developer Fook Wai Lee from the company's Singapore R&D branch. "The challenge lies in the integration: Our goal is designing IR light source that protrudes only very little over the display surface while being recognising reliably the multi-finger gestures."

The technique will enter series production in 2017. As usual, Continental did not reveal the customer, but usually this kind of announcement takes place only when at least one carmaker has designed the respective product into a series vehicle.

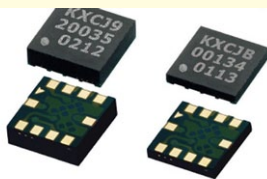


### Tri-axis accelerometers go thinner

Kionix Inc. (Ithaca, New York), the MEMS subsidiary of Rohm Co. Ltd., has announced to thin full-functional tri-axis accelerometers: the KX112 (2.0mm by 2.0mm 0.6mm) and the KXCJB (3.0mm by 3.0mm by 0.45mm). At 0.45mm thick the KXCJB is half the thickness of its predecessor. The model KX112 offers 8bit or 16bits of resolution and 2048bytes of FIFO/FILO buffer. The unit includes digital algorithms for detecting motion for power management, free fall for device protection or warranty monitoring, an orientation engine for portrait/landscape detection, and tap/double-tap for

user interface functionality. Model KXCJB, measuring 3 x 3 x 0.45 mm thick, supports the move towards thinner smartphones, tablets, PCs, and HDDs as well as activity monitors and smartwatches. It offers 8, 12 or 14bit resolution acceleration selectable between +/-2g, +/-4g or +/-8g. "Among the many innovations and numerous firsts in the company's history, Kionix was first to develop the tri-axis accelerometer in 2004, followed by introduction of the first 'thin' 0.7mm tri-axis accelerometer in 2013," said Nader Sadrzadeh, President and CEO of Kionix. "We're constantly pushing physical and technological barriers. Our proprietary technology has allowed us to break boundaries once again to introduce a new lineup of full-featured 'ultra-thin' low-power accelerometers. While these initial products (the KX112 and KXCJB) are suited primarily for mobile, PC/tablet and wearable applications, we'll continue to expand the portfolio to include automotive and heavy-duty industrial applications as we enter into 2015."

**Kionix Inc.**  
[www.kionix.com](http://www.kionix.com)



**KXCJ9**  
3X3X0.9MM

**KXCJB**  
3X3X0.45MM

### PNI Sensor offers wearables development kit

PNI Sensor Corp. (Santa Rosa, Calif.), a subsystem company that integrates sensors and integrated circuits from third parties and adds value with data fusion software, is offering SENtrodé, a smartwatch-sized development kit. The platform is intended to allow the development of wearable equipment and products for the Internet of Things (IoT). The

SENtrodé includes inertial, pressure and magnetic sensors, an optical heart rate sensor, a sensor hub SoC and an STMicroelectronic F4 microcontroller, sensor fusion algorithms, programmable processor and wireless capabilities into a bracelet-sized form factor. Users can select Bosch, ST or InvenSense inertial sensors. The Bluetooth capability is provided by ST's Blue/NRG transceiver. On development kit comes in the form of a smartwatch enclosure and is suitable for the development of smartwatches, activity and wellness monitors. A second version comes in a box-shaped housing suitable for IoT development such as home appliances and connected sensor networks.

**PNI Sensor Corp.**  
[www.pnicorp.com](http://www.pnicorp.com)







International Conference and Exhibition  
on Integration Issues of Miniaturized Systems  
– MEMS, NEMS, ICs and Electronic Components

## Multi-function MEMS sensor includes integrated gas sensor

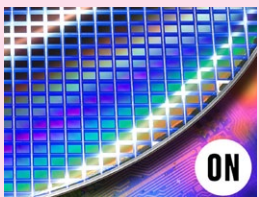
This environmental sensor from Bosch Sensortec combines pressure, humidity, temperature and indoor air quality measurement parameters. You can use it to equip mobile devices and wearables with indoor air quality measurement, with its low power consumption and small package BME680 integrates a gas sensor with full-specifications air pressure, humidity and ambient air temperature sensing functions in a single 3.0 x 3.0 mm footprint. The environmental sensor enables new capabilities for portable and mobile devices such as air quality measurement, personalised weather stations, indoor navigation, fitness monitoring, and home automation. The gas sensor within the BME680 can detect a broad range of gases in order to measure indoor air quality for personal well-being, including Volatile Organic Compounds (VOC) from paints (such as formaldehyde), lacquers, paint strippers, cleaning supplies, furnishings, office equipment, glues, adhesives and alcohol. With its combination of four sensors in one package, the BME680 provides the accurate, detailed real-world data required for many IoT applications. Expected uses include smart homes, smart offices and buildings, smart energy, smart transportation, HVAC, elderly care and sport/fitness applications.



**Bosch Sensortec**  
[www.bosch-sensortec.com](http://www.bosch-sensortec.com)

## 13 Mpixel CMOS image sensor maximises sensitivity: and stacked-dice sensors

The AR1335 delivers 18% better sensitivity than previous generation sensors and provides low-light imaging performance for functions such as smartphone cameras ON



Semiconductor's next-generation 13 megapixel (MP) image sensor, the AR1335 is based on 1.1 micron (m) pixel technology; it sets a new benchmark in sensitivity along with increases in quantum efficiency (QE) and linear full well capacity.

Designed specifically for smartphone camera applications, this image sensor delivers near-digital-still-camera quality with power consumption and footprint that are optimised for mobile devices. ON Semiconductor has developed its 1.1 m pixel technology for performance smartphone sensors with pixel and colour filter array (CFA) processing advancements, which has increased the sensitivity by nearly 20% compared to the previous generation. Image quality is significantly improved, especially in low light. 13-MP resolution supports high-quality zoom, and sharp reproduction of scene details. Professional quality video is supported through 4K Ultra-High Definition (UHD) and Cinema formats at 30 frames per second (fps) and Full HD 1080P at 60 fps. The high 32-degree Chief Ray Angle (CRA) supports low z-height applications. The AR1335 is in mass production in die format and has already been designed into several smartphone models.

**ON Semiconductor**  
[www.onsemi.com](http://www.onsemi.com)

Copenhagen, Denmark,  
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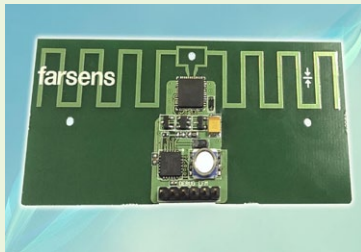
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+49 711 61946-292  
[smart@mesago.com](mailto:smart@mesago.com)

**mesago**  
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### Pressure monitoring RFID tag takes 0 bar to 30 bar

Built in a compact PCB format, the Cyclon-05BA is a passive RFID tag that integrates a MS5803-05BA sensor from Measurement Specialties to monitor pressures up to 6 bar. It



also integrates a temperature sensor with a range from -30°C to +85°C and an accuracy of  $\pm 1^\circ\text{C}$ . Another part from Farsens, the Cyclon-30BA integrated a MS5803-30BA to cover ranges up to 30 bar. These RFID pres-

sure monitor tags are compatible with commercial UHF RFID readers (EPC C1G2). With a 2W ERP setup the battery-less pressure sensor can communicate to over one meter and a half. The tags come in a variety of antenna designs and sizes to adapt the performance to the required application in the 860-960 MHz band. Such tags could be used in Tire Pressure Monitoring Systems to monitor wheel pressure, removing the need for batteries embedded inside the tire, hence reducing weight and possible imbalances.

**Farsens S.L.**  
[www.farsens.com](http://www.farsens.com)

### UHF RFID sniffer operates in real time

CISC Semiconductor has released a new software module for its CISC RFID Xplorer unit, that records and analyzes the communication between the tag and reader in real-time. This new



module turns the CISC RFID Xplorer Sniffer in a tool to analyze RFID reader and tag signals. The detection and decoding of reader commands and tag responses is done in real-time. The CISC RFID Xplorer Sniffer lets the user to trigger on reader commands. It logs the communication between the reader under test and tags into a TXT file.

Complex waveform signals can be recorded and saved on the hard-drive in a stream file to make them available for further analysis both in the time and frequency domain. This includes message parsing, waveform analysis, frequency spectrum and link timing analysis. The instrument delivers high precision result and premium receiver sensitivity that covers the RF band from 50 MHz to 2.2 GHz. The sniffer mode of the CISC RFID Xplorer supports multiple standards including GS1 EPC Gen 2, ISO/IEC 18000-63, RAIN RFID and upcoming ISO/IEC 29167 crypto suites.

**CISC Semiconductor**  
[www.cisc.at/xplorer](http://www.cisc.at/xplorer)

### Aito offers touch sensors with haptic feedback

A developer of software-enhanced piezoelectric touch sensors, Aito BV has announced the availability of ATH220 and ATH222 controller ICs that enable touch sensors to also provide haptic feedback. With these devices, it is now possible to sense the touch of a finger on a flat panel surface and immediately confirm operation with a physical sensation created by haptic vibration. The ATH220 controller has 10 channels that allows for various combinations of piezoelectric input and haptic, LED indicator and buzzer outputs, supporting a maximum of five haptic piezoelectric touch buttons when configured without buzzer and LEDs. The ATH222 has 18 configurable channels allowing up to six haptic piezos, 5 LEDs and a buzzer simultaneously. Both devices have the ability to apply multiple haptic, LED and audio feedback waveforms so that each touch key can provide a distinct response. So, while it is possible to mimic the 'click' sound and feel of a mechanical button, more sophisticated responses can also be devised to communicate other control functions.

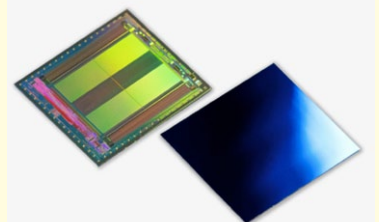


These latest controllers are being targeted at home appliances and mobile devices that can also benefit from the other advantages of Aito's touch technology, such as the ability to work with metal surfaces and use seamless, sealed panels. In common with previous AitoTouch controllers, the ATH22x devices also enable different piezoelectric sensing parameters to be set for each key - to determine sensitivity, detection area, and to cope with different overlay stiffness, materials or mechanical integration conditions.

**Aito BV**  
[www.aitochip.com](http://www.aitochip.com)

### Espros launches QVGA 3D ToF sensor

Espros Photonics AG (Sargan, Switzerland) has announced the EPC660 is a 3D time-of-flight QVGA imager that offers backside illumination and high sensitivity to near-infrared light. The image sensor has a 320 by 240 CCD pixel field and includes control logic to operate the device. Some 66 full frame ToF images are delivered which can be increased to more than 1,000 ToF images. All configuration is done via an I2C interface and an integrated EEPROM



holds factory settings and production and configuration data. The sensor includes an integrated LED driver capable of driving more than 200mA peak current..

Depending on the system design the sensor can provide millimeter resolution of distance at up to 100 meters. The high sensitivity of the optical front end allows for reduced IR illumination and thereby reduces overall power consumption. The CCD pixel architecture can tolerate ambient light levels of up to 130kLux making the sensor suitable for use outdoors.

**Espros Photonics AG**  
[www.espros.ch](http://www.espros.ch)

## SSL/TLS secure-socket code for embedded devices

Segger's emSSL is a ground-up implementation of secure sockets that are the backbone of secure communications on the Internet today. Written to run on single-chip embedded devices, emSSL integrates seamlessly with embOS/IP or, alternatively, any IP stack that supports plain sockets, or any bidirectional communications channel. emSSL supports TLS version 1, 1.1, and 1.2 out of the box and provides modern cipher suites that offer robust authentication, confidentiality, message integrity, and forward secrecy. Whilst being compact, it is also efficient in terms of RAM, ROM, and processor load. emSSL's highly flexible and straightforward configuration targets small devices by linking only what's necessary, and at the same time avoids a sea of preprocessor defines that drown other source code products. emSSL is delivered as a set of source files, for complete transparency, ready to integrate into customer applications, and includes plain-English documentation. The flexible stack supports all popular protocols such as ACD, ARP, AutoIP, DHCP, DNS, FTP, HTTP, ICMP, IPv4, Multicast, NetBIOS Name Service, PPP/PPPoE, SMTP, SNMP, TCP, UDP, UPnP, VLAN, and many more. embOS/IP is fully compliant to all related RFCs.

Segger

<http://Segger.com/emSSL.html>

## Inductive linear position sensor aims factory automation

These are contactless devices designed for factory automation and a variety of heavy duty industrial or commercial applications. The LR-27 sensors feature contactless operation to prevent wearout from dither or cycling, and come in four ranges from 50 to 200 mm. The 27mm diameter anodized aluminium housing is sealed to IP-67, with radial cable exit versions delivered with swivel rod eye ends.

The axial termination versions come with either an M-12 connector or a one-meter cable. Operating from a variety of DC voltages, the LR-27 series offer a choice of four analog outputs, and all units include ASG's proprietary SenSet field scalability feature.

Alliance Sensors Group

[www.alliancesensors.com](http://www.alliancesensors.com)



## Cortex-M7 MCUs are structured for real-time tasks

Atmel has introduced ARM-based microcontrollers that feature an optimised memory architecture and connectivity for automotive, IoT and industrial markets; they join the company's Atmel | SMART MCU portfolio and achieve a 1500 CoreMark score. With a memory architecture optimised for real-time deterministic code execution and low



latency peripheral data access, they are Auto-qualified Cortex-M7-based MCUs with Ethernet AVB and Media LB Peripheral capabilities for Automotive Connectivity and Audio Applications. Four series of devices allow users to scale-up performance

and deliver SRAM and system functionality, while keeping the Cortex-M processor family ease-of-use and maximising software reuse. The devices contain advanced memory architectures with up to 384 kB of multi-port SRAM memory out of which 256 kB can be configured as tightly-coupled memory delivering zero wait state access at 300 MHz. With over four times the performance of current Atmel ARM Cortex-M based MCUs running up to 300 MHz, larger configurable SRAM and higher bandwidth peripherals, they offer a connectivity, SRAM and performance mix for industrial, connectivity and automotive designs. All devices come with high-speed USB On-the-Go (OTG) and on-chip high-speed USB PHY and Flash memory densities of 512 kB, 1 MB and 2 MB. Broadening the Atmel | SMART ARM Cortex-M based MCU portfolio, the new SAM E70 and the SAM S70 are suitable for connectivity and general purpose industrial applications, while the auto-grade SAM V70 and SAM V71 target in-vehicle infotainment.

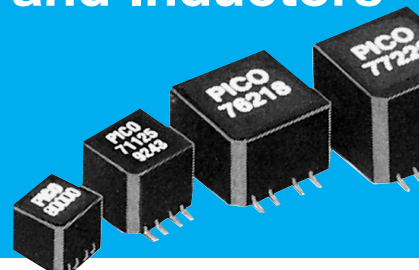
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Fax: 0044 1634 290904

## Module extends HiL testing and rapid prototyping to CAN FD

Along with a new plug-on module for its Hardware-in-the-loop test and rapid prototyping systems, dSpace's test software release 2014-B now supports CAN FD, the automotive



data bus with extended bandwidth. An FPGA in the plug-on module enables this device to shoulder future requirements. The DS4342 CAN FD Interface Module can be integrated into

dSPACE RCP systems such as MicroAutoBox and the company's modular hardware for HIL systems. The module features two CAN FD channels that can also be used for communication across the standard version of the CAN bus. For large numbers of CAN FD channels, up to 4 DS4342 modules can be integrated on a DS4505 carrier board, which is also used for FlexRay communication. It is possible to combine FlexRay and CAN FD interface modules on the same carrier board. This enables users to add CAN or CAN FD to existing systems, thereby protecting their investment. Similar to current CAN applications, CAN FD communication is configured via the RTI CAN MultiMessage Blockset with its graphical user interface. Familiarity with this configuration software will enable developers to quickly add CAN-FD-specific information to their application. The CAN FD bus standard offers higher bandwidth than the established CAN protocol. The higher payload data packet size of 64 bytes also increases the bus system's efficiency without sacrificing the benefits of a classic CAN such as flexibility and affordability.

**dSpace**

[www.dspace.com](http://www.dspace.com)

## InvenSense adds multicore CPU to motion sensor

Fabless MEMS company InvenSense Inc. (San Jose, Calif.) has announced its next motion sensor with integrated processing, the ICM-30630 which includes a multi-axis inertial MEMS

sensor and multi-core processor. The sensor hub integrates 3-axis accelerometer with 3-axis gyroscope MEMS sensors together with tri-core CMOS microcontroller, embedded flash and SRAM and software. It does this in a package that measures 3mm by 3mm

by 1mm. The processor cores are a Cortex-M0 and two digital motion processors of InvenSense own design, the DMP3 and DMP4. The DMP3 offloads all motion processing tasks from the CPU and provides physical and virtual sensor output at low power. The DMP4 takes on more computationally intensive tasks, again relieving the host CPU and reducing power consumption. The Cortex-M0 performs sensor management via an integrated RTOS and provides an "open platform" that is programmable allowing custom features. The result improves acquisition and processing of sensor data from internal and external sensors and reduces "always on" power consumption. The ICM-30630 is compliant with Android Lollipop, and other operating systems, while supporting multiple application processor platforms. The ICM-30630 will sample 1H15.

**InvenSense Inc.**

[www.invensense.com](http://www.invensense.com)

## UHF RFID development platform operates sensors and actuators

Farsens' Medusa development platform allows developers to design components driven by RF energy harvesting through the use of UHF RFID battery-free devices. The Medusa includes an ANDY100 chip with EPC C1G2 communication and a MSP-G2233IPW20 microcontroller from Texas Instruments for communication with developers' circuits. Users can now develop their own wireless sensors or actuators without requiring batteries on the tag. The Medusa harvests energy from the RF field created by the RFID reader to power up the ANDY100 IC, the microcontroller and the circuitry and devices attached to it. The ANDY100 chip included works under standard EPC C1G2 commands so no proprietary or custom commands are needed. Any commercial UHF RFID reader can be used just by programing with the correct standard commands.

**Farsens S.L.**

[www.farsens.com](http://www.farsens.com)



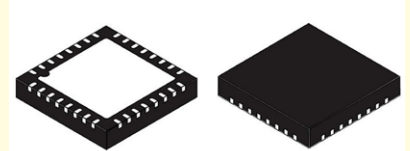
## Bluetooth 4.1 network processor shrinks to 2.6x2.6mm

STMicroelectronics has released the latest version of its BlueNRG Bluetooth SMART network processor, which supports the latest Bluetooth version 4.1 enhancements and introduces 1.7V operation for longer-lasting battery-powered applications. The device integrates a complete Bluetooth PHY and 2.4GHz radio, ARM

Cortex-M0 microcontroller running the Bluetooth 4.1 protocol stack, and dedicated AES-128 security coprocessor. The API, power management, and Flash are already integrated, allowing direct connection to the application host controller using a simple SPI bus leveraging clear software partitioning between network processor and host microcontroller. The new Bluetooth 4.1 specification further increases energy efficiency and supports dual-mode topologies containing devices operating as both master and slave. The new Low-Duty-Cycle Directed Advertising minimizes energy consumed when connecting to known devices. In addition, Bluetooth 4.1 introduces Logical Link Control and Adaptation Protocol (L2CAP), which enables flexible data exchanges leveraging multi-channel communications and quality of service. ST's BlueNRG-MS network processor can power devices such as a hub capable of collecting sensor data and subsequently acting as a peripheral to transfer the data to a smart phone. It can also allow very large sensor networks with unlimited communication range, controlled by a single smartphone. Moreover, BlueNRG-MS supports the latest moves towards IP-based connectivity added to Bluetooth 4.1, which enables developers to target future opportunities in the Internet of Things. BlueNRG-MS is available now in a 5x5x1mm QFN32 package, but will soon be available in a chip scale packaging option measuring only 2.6x2.6x0.56mm.

**STMicroelectronics**

[www.st.com](http://www.st.com)



## Universal debug engine 4.4 for heterogeneous multicore SoCs

PLS Programmierbare Logik & Systeme's Universal Debug Engine (UDE) 4.4 has been designed with enhanced debugging procedures for complex system-on-chips (SoCs) with heterogeneous controller cores, optimized data visualization in system-level debugging as well as dedicated support of a wide range of state-of-the-art 32-bit multicore SoCs of different manufacturers. Control of the respective multicore SoCs and their debugging is carried out with the UDE 4.4 within a specifically optimized user interface. Various colours determinable by the user and even definable groups of views for individual function units ensure a fast overview and simple navigation, also in complex devices. Both separate and synchronized control of the active units is optionally possible. The different on-chip debug logic of the chip architectures is fully supported and the UDE offers the user a vendor-independent, and at the same time, a consistent user interface. Among other things, with the UDE 4.4 trace data streams can now be stored in a databank and thus used for later offline analysis.

PLS Programmierbare Logik & Systeme GmbH  
[www.pls-mc.com](http://www.pls-mc.com)



## Automotive-qualified diodes enable higher power densities

Very low forward voltages and reverse currents are the common denominator of six new diodes from Vishay. With these properties, these AEC-Q 101 qualified components help reducing power losses and improving energy efficiency in automotive applications. A further benefit is their small package (SMF / DO-219AB / eSMP),



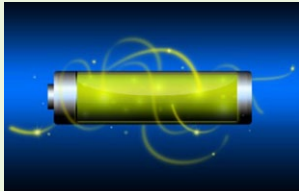
enabling designers to reduce the board space required. One of the new components is a standard diode, two are Schottky diodes and two are hyper-fast FRED Pt diodes for applications like RF DC/DC converters, flyback diodes, and reverse polarity protection in systems such as engine control units, ABS controllers and LED lighting. Thanks to its small footprint and low height, the SMF package requires

significantly less board space than standard SMA, SMD or SMC packages. It also allows higher power densities, which in turn lowers the total costs. The SS1FLHM3, SS1FH6HM3 and SS2FH6HM3 Schottky types feature reverse voltages of 40V and 60V as well as low forward voltages down to 0.37V at 1A and a temperature of 125°C.

Vishay  
[www.vishay.com](http://www.vishay.com)

## 10 W wireless power for smartphones & mobile accessories

Toshiba Electronics Europe has launched a wireless power receiver IC, TC7765WBG, and a transmitter IC, TB6865AFG Enhanced Version, as a 10-W-class wireless power system for smartphones, tablets and mobile accessories using the Qi Standard Low Power Specifications version 1.1, defined by the Wireless Power Consortium (WPC). With increasing awareness of the use of wireless power supplies to charge portable devices,



such as smartphones, tablets and their accessories, demand is growing for higher-power wireless charging systems that shorten charge times. The TC7765WBG receiver IC increases power by boosting the output voltage from 5V/1A to 7-12V/1A. The TB6865AFG Enhanced Version transmitter IC realizes a 10-W-class wireless power system based on a revised peripheral circuit configuration and new software. The TC7765WBG's built-in protocol authentication logic circuit for power supply control eliminates the need for set makers to develop software. The TB6865AFG Enhanced Version also supports the software necessary for the higher power supply operation, allowing makers to easily incorporate 10-W-class solutions into their products.

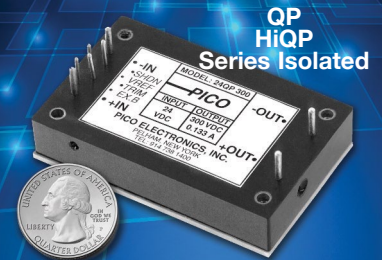
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## Position data via CAN bus

Developed for applications in areas like intralogistics, factory automation or vehicle testing, the PCAN-GPS sensor platform from PEAK-System Technik GmbH determines position and orientation of a carrier and transfer these data across a CAN bus interface to a data logger, server or other type of downstream data processing device. Alternatively, these data can be stored internally. Available sensors for the PCAN-GPS are a navigation satellite receiver, a magnetic field sensor, an acceleration sensor and a gyroscope. The satellite receiver can handle signals from the GPS, Galileo, Glonass, QZSS and SBAS systems. For on-device data processing the platform is equipped with an NXP LPC4000 microcontroller. By means of the software library provided by the vendor and by the GNU/ARM tool chain, users can develop their own application-specific firmware. At delivery, the PCAN-GPS comes with a demo firmware whose source code is provided along with further programming examples.



**PEAK-System Technik GmbH**  
[www.peak-system.com](http://www.peak-system.com)

## 200 MHz scope for service, education roles

Rohde & Schwarz is expanding its RTM bench oscilloscope family with a model with features for the education sector. The instrument features a 200 MHz bandwidth and an education mode that deactivates special measurement tools



to help students quickly learn how to work with an oscilloscope. A digital voltmeter and frequency counter option also supports users in development, manufacturing and service with fast, precise results. The RTM

is suitable for general T&M applications in development, manufacturing and service. Using the RTM B200, B201 and B202 bandwidth upgrade options, the 200 MHz models can grow with future requirements and be expanded to 500 MHz. The RTM-K32 digital voltmeter option has AC, DC, peak and crest factor measurements with three digit accuracy regardless of the oscilloscope's triggering. A seven digit frequency meter has also been integrated into the scope. The education mode was also developed for test and measurement lab teaching and makes it possible to disable all analysis tools (e.g. Autoset and QuickMeas) and automatic measurements. This improves the learning effect as students and learners have to calculate measurement results on their own. The mode is password protected. With a sampling rate of 5 Gsample/sec and a memory depth of 20 Msamples, the RTM's functional range can be further expanded with additional options, including triggering and decoding serial buses (RTM K1 to K7). With 460 Msample memory depth, the RTM-K15 history and segmented memory option supports seamless analysis of data sequences with long rest periods, such as pulsed signals and serial bus data packets. The RTM-K31 power analysis option provides specialised measurement functions to automatically verify the quality of all components of switching power supplies.

**Rohde & Schwarz**  
[www.scope-of-the-art.com](http://www.scope-of-the-art.com)

## Build your Tower for free

To ensure you have a good start in 2015, Freescale is giving away five of its QorIQ TWR-LS1021A Tower system modules, worth USD269 each, for EETimes Europe's readers to win. The module is the most feature-rich and high-performance Tower system offered by Freescale, enabling compatibility and interoperability with the growing list of Tower expansion modules, offering an easily accessible and interchangeable suite of capabilities and features to support rapid prototyping as well as software development programs. Built around the QorIQ LS1021A



processor, incorporating dual ARM Cortex-A7 cores running up to 1GHz and delivering more than 5,000 Coremarks of performance, the TWR-LS1021A is engineered to enable a wide range of applications, from IoT gateways to industrial controllers, secure access points and asset management systems. The board comes with HDMI, SATA3 and USB3 connectors and a complete Linux software developers' package. Safeguarding the device from the point of manufacture to the point of deployment, security features includes support for secure boot, Trust Architecture and tamper detection, in both standby and active power modes.

**Check the reader offer online at**  
[www.electronics-eetimes.com](http://www.electronics-eetimes.com)

## Thin, fused, undertab tantalum SMD chip capacitors

AVX has added a series of fused high CV tantalum SMD chip capacitors with undertab terminations. F98-AS1 Series capacitors feature a proprietary lead-frame-less structure with precise dimensions and low stress packaging, an internal thin film fuse that protects against short circuits, and undertab termination technology which enables high volumetric efficiency and high PCB assembly density. Currently available in a 0805 (2012 metric) S case with four ratings (22 $\mu$ F/10V, 33 $\mu$ F/10V, 10 $\mu$ F/16V, and 1 $\mu$ F/35V) and a 0.9 mm maximum height, the F98-AS1 Series is positioned as the smallest and thinnest SMD fused tantalum product currently available. The series is suitable for use in a wide variety of applications in which safety and size are a primary concern. The F98-AS1 Series capacitors are rated at 85°C and are designed for use in temperatures spanning -55°C to +125°C. The series is also lead-free compatible and RoHS compliant. Series extensions currently in development include a 0805 (2012 metric) case 47 $\mu$ F/10V capacitor and 10 capacitors packaged in 0603 (1608 metric) M cases: a 1 $\mu$ F/25V component, a 1 $\mu$ F/20V component, 10V components rated for 2.2 $\mu$ F, 4.7 $\mu$ F, 10 $\mu$ F, 22 $\mu$ F, and 33 $\mu$ F, and 16V components rated for 1 $\mu$ F, 2.2 $\mu$ F, and 4.7 $\mu$ F.



**AVX**  
[www.avx.com](http://www.avx.com)



## Next generation 200-Gigabit network processor now in production

EZchip Semiconductor Ltd has advanced its latest network processor, the 200-Gigabit NP-5, to full production. Following extensive testing and qualification, the NP-5 is now being delivered in quantity to customers for deployment in Tier-1 carrier and data-center networks. The NP-5 has secured design wins among leading carrier router vendors as well as other network equipment vendors and provides a natural scale-up path for customers that use the company's leading NP-4 100-Gigabit processor. The NP-5 sells at roughly a 50% higher ASP (average selling price) and enables vendors to double and triple the port density of their line cards. With the NP-5, customers can now deliver higher port-density line cards with multiple 40-Gigabit and 100-Gigabit ports, while continuing their offering of NP-4 based line cards for 10-Gigabit ports. "The largest of EZchip's router vendor customers are now providing NP-5 based line cards to their customers, and the NP-5's exceptional performance and integration has enabled our Tier-1 customers to secure new large data-center customers which we believe should result in a significant increase in NP-5 business," said Eli Fruchter, CEO of EZchip Semiconductor. "Furthermore with the recent completion of the Tileria acquisition, we are well underway in developing a radical new class of multi-core processors that will bring significant new opportunities with the advent of NFV and SDN and in evolving carrier, cloud and data-center networks." The NP-5 drives line cards and appliances that feature multiple 100 and 40-Gigabit ports as well as numerous 10-Gigabit ports. Through its versatility and rich feature set, the NP-5 serves a wide variety of carrier and data center applications.

**EZchip Semiconductor Ltd**  
[www.ezchip.com](http://www.ezchip.com)

## VCO delivers best-in-class phase noise performance

The model V480MEM2-LF RoHS compliant voltage controlled oscillator (VCO) from Z-Communications operates at 445 to 480 MHz with a tuning voltage range of 0.5 to 2.5 Vdc. This high performance VCO features a spectrally clean signal of -113 dBc/Hz at 100 kHz offset and a typical tuning sensitivity of 25 MHz/V. The V480MEM2-LF is designed to deliver 0 dBm of output power into a 50Ω load while operating off a 3.3 Vdc supply and drawing typically 12 mA of current. It operates over the industrial temperature range of -40 to 85°C and features typical second harmonic suppression of -12 dBc. The low noise V480MEM2-LF comes in Z-Comm's standard, low profile MINI-16M-L package measuring 1.27x1.27x0.33cm. It is available in tape and reel packaging for production requirements making it ideal for automated surface mount assembly and reflow. The VCO is ideal for UHF radios and portable satellite modem applications that require low phase noise performance.

**Z-Communications**  
[www.zcomm.com](http://www.zcomm.com)



## Flexible flying probe PCB tester

High throughput or flexibility - this was hitherto the alternative; electronics manufacturers had to choose which property was more important to them. With the A8a test system, they can have both, claims atg Luther & Maelzer. Designed for electrical



tests of HDI products for smartphones, tablets and PC motherboards in the first place, the A8a offers cost advantages over fixture testers for small and medium batches. According to atg,

the A8a ensures productivity and efficient operation at high test quality and accuracy. Equipped with eight test heads and four cameras for optical alignment, the A8a can be used to test pad sizes down to 35 micron. Testing HDI products for smart phones, tablet and PC motherboards up to a test area of 18.0" x 12.0" on the A8a, it also eliminates limitations of test point density or fine-pitch contacts. The system features embedded component test or a 4-wire Kelvin measurement with an accuracy of +/- 0,025 mΩ. It comes with a separate good and bad board stacker. The bad boards can be optionally labeled by a 2D-Code which indicates the reference between the boards and the corresponding fault file, effectively eliminating manual handling failures.

**atg Luther & Maelzer GmbH**  
[www.atg-lm.com](http://www.atg-lm.com)

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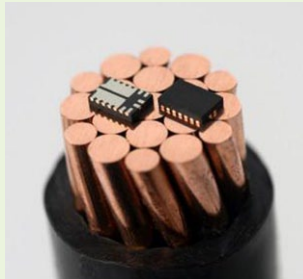
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## Low resistance 10A power switch has accurate current sensing built-in

Silego Technology's 2.0 x 3.0 mm CurrentPAK SLG6M6001V enables high accuracy current measurement in a configurable and programmable 10A, 3.8 mΩ RDS(ON) load switch.



CurrentPAK is a family of configurable mixed-signal ICs, or CMICs. A high performance load switch that has efficient, high accuracy current measurement, CurrentPAK is claimed as the first load switch to have advanced programmable features. Using non-volatile memory (NVM), designers can

control several aspects of the device including enable logic, slew rate, current limiting, over-temperature protection, and integrated discharge rate. "The ability to measure instantaneous power consumption is a given in today's high performance computation and telecommunications equipment," said John McDonald, VP of Marketing. McDonald continued, "The designers of these systems need to provide a mechanism to report current consumption for intelligent power and thermal management. Typically, designers will use an external sense resistor to measure current consumption. This has the unfortunate side effect of significantly decreasing system power efficiency. Using CurrentPAK in this same application, the current sense resistor and other external components are eliminated, thereby reducing cost and making CurrentPAK the highest efficiency solution in its class." The first device in the CurrentPAK family, the SLG6M6001V, has a current rating of 10A continuous, an ultra-low RDS(ON) value (3.8 mΩ), and comes in a 2.0 x 3.0 mm, fully encapsulated, plastic package.

**Silego Technology**  
[www.silego.com](http://www.silego.com)

## Barely-visible discrete transistors reduce PCB space

Claimed as the first DFN0606-packaged NPN and PNP transistors, and occupying a board space of 0.36 mm<sup>2</sup>, the transistors are 40% smaller than directly competing DFN1006 (SOT883) parts and deliver the same or better electrical performance.



With an off-board height of 0.4 mm, they are suited for wearable technology as well as other space-constrained consumer products. Diodes Incorporated's initial DFN0606 bipolar transistor offerings are two NPN and PNP devices with power

dissipation up to 830 mW. The 40V-rated MMBT3904FZ and MMBT3906FZ boost power density and also provide a 200 mA collector current; while the 45V-rated BC847BFZ and BC857BFZ provide a collector current of 100 mA. All devices switch on at a base-emitter voltage of less than 1V, enabling them to be fully turned on under conditions of very low portable power.

**Diodes Inc**  
[www.diodes.com](http://www.diodes.com)

## Step-down micromodule regulator minimises board space

LTM4625 is a 5A, 20 VIN step-down μModule (micromodule) regulator in a 6.25 x 6.25 x 5.01 mm BGA package which, with a few passive components, fits into 0.5cm<sup>2</sup> on a double-sided PCB. Like other μModule regulators, the LTM4625 includes the DC/DC controller, power switches, inductor and compensation components in a single package. Two external ceramic capacitors (1206 case size) and a resistor (0603 case size) are required for operation. The LTM4625 operates from a 4V to 20V input supply, delivering a regulated output adjustable between 0.6V to 5.5V with ±1.5% accuracy over line, load and temperature. LTM4625 operates at a user-adjustable switching frequency from 800 kHz to 4 MHz or can be synchronised to an external clock from 700 kHz to over 1.3 MHz. The module also provides a clock-out signal at the same frequency with selectable phase shift (90°, 120° or 180°), for current sharing multiple LTM4625 modules for higher output current. With the addition of an external bias supply above 4V, the LTM4625 can operate from an input voltage as low as 2.375V. Output overvoltage, overcurrent and over-temperature fault protection are included in the regulator. The LTM4625 is available with guaranteed operation over the -40°C to 125°C internal temperature range.



**Linear Technology**  
[www.linear.com](http://www.linear.com)

## Integrated runtime analysis for ARM finds errors in running code

IAR Systems is promoting its runtime analysis add-on product C-RUN by marking 30,000 evaluation downloads – which the company interprets as revealing significant need in the user base for such a combination. The add-on is integrated with the complete IAR Embedded Workbench for ARM development toolchain. C-RUN is sold as an add-on product and performs runtime analysis by monitoring application execution directly within IAR Embedded Workbench. Developers can make runtime analysis a natural part of the day-to-day workflow. No additional applications or integrations are needed. Runtime analysis can find real and potential errors in the code while executing the program. To do this, the analysis needs to insert test code into the application. In C-RUN, analysis instrumentation is performed completely integrated in the build chain. This reduces memory requirements and execution speed penalty to a minimum, enabling efficient testing on actual hardware. Runtime analysis helps find vulnerabilities early in the product development process. IAR adds that the product comes with flexible settings to enable single or multiple checks in each test run. Developers can select the desired checks, rebuild their project and run it in the debugger. C-RUN will give direct feedback on what went wrong and where. IAR Embedded Workbench for ARM is a compiler and debugger toolchain that incorporates a compiler, an assembler, a linker and a debugger into one completely integrated development environment. C-RUN is available as an add-on product to version 7.20 or later of IAR Embedded Workbench for ARM.

**IAR Systems**  
[www.iar.com/crun](http://www.iar.com/crun)



## NFC tags use FeRAM and on-chip AES-128

Distributor Farnell element14 now has Panasonic's NFC tag ICs and their accompanying evaluation boards: the tags have built-in FeRAM (ferroelectric RAM) and AES-128 encryption. Panasonic's NFC tags provide a number of value added connectivity



features including high security, high speed Near Field Communication and data storage, high radiation resistance using 4kbit Non-Volatile FeRAM Technology and have ultra low power consumption. The products are compliant with NFC forum standards and support ISO/

IEC14443 TypeB & FeliCa RF Interfaces. The tags and evaluation boards support a wide variety of applications including Internet of Things, energy harvesting (battery-less operation possible), latest consumer electronics.

**Farnell element14**

<http://uk.farnell.com/>

## 5000 lumen LED module simplifies design-in for lighting manufacturers

Distributor Silica (Avnet) has a simple-to-install LED module by Sharp that helps solid-state luminaire manufacturers reduce the cost and complexity of manufacturing high-performance LED lighting, minimising inventory. Sharp Intermod LED modules simplify inventory by combining three LED lighting components in one: a chip-on-board (CoB) emitter, holder and thermal interface. Solderless assembly means plug-and-play simplicity: manufacturers simply attach the module to its heat sink by two screws and push-fit electrical connections. The integrated thermal interface material (TIM) eliminates adhesives and grease.



**Silica**

[www.silica.com](http://www.silica.com)

## Silicone rubber inserts as retrofit EMI protection

Astute Electronics has launched a new EMI filter technology that can be designed-in or retrofitted into existing connectors very simply, even in the field, providing an effective EMC solution that will survive extreme environmental abuse.



The EESeal FilterSeals from Quell are formed from resilient silicone rubber. The inserts are easily and quickly inserted into standard connector bodies, without the need for any special tooling, forming an effective EMI filter and environmental seal.

The inserts can be custom-manufactured in as little as seven days and will fit into many different hi-rel connector formats.

**Astute Electronics**

[www.astute.co.uk](http://www.astute.co.uk)

## Richardson RFPD announces Hittite Microwave products from ADI

Richardson RFPD has announced the availability and full design support capabilities for Hittite Microwave products from Analog Devices, Inc. Following the July, 2014 acquisition, Hittite Microwave products have been fully integrated into Richardson RFPD's portfolio of ADI products. That combined portfolio now covers the entire signal chain, from antenna to bits and back, across the entire frequency spectrum up to 110 GHz. Complemented by its industry-leading data converters, ADI's RF, microwave and millimeter-wave portfolio now includes more than 2,000 high-performance products, from functional blocks to highly-integrated solutions, development platforms and modules. Serving the industrial, aerospace and defense, automotive, and communication infrastructure markets, the combined ADI and Hittite results in augmented levels of design tools, technical support and manufacturing capability to customers designing RF, microwave, and millimeter wave systems.

**Richardson RFPD**

[www.richardsonrfpd.com](http://www.richardsonrfpd.com)

## Foremost to distribute full colour OLED display pushbuttons

Essex based specialist distributor of electromechanical components Foremost Electronics is now stocking the latest full screen OLED pushbutton from NKK Switches. This OLED switch may be used to display a variety of graphics in addition to words and symbols and also provides simple video playback. The full screen design allows larger displays to be assembled from a number of switches providing an interactive video + HMI display and control panel. The OLED display interface uses SPI Protocol enabling high-speed synchronous communications. The buttons feature the world's smallest class of OLED with 96x64 display dots, a 50,000 hour lifetime and 16-bit 65,536 colours.



**Foremost Electronics Ltd**

[www.4most.co.uk](http://www.4most.co.uk)

## Embedded IoT gateway from Mouser

Mouser Electronics is stocking the MIO 2263 Embedded IoT Gateway from Advantech, a single-board computer (SBC) equipped with either an Intel® Celeron or Intel Atom™ CPU. These embedded Internet of Things (IoT) gateway SBCs feature a 1GbE interface for Ethernet connectivity up to 1,000 Mbps, up to 8 GBytes of RAM, multiple I/O and communication interfaces, high-definition audio, and a half-size Mini PCI Express expansion slot. The Advantech MIO 2263 Embedded IoT gateway can be ordered with either a 2.0 GHz Intel Celeron J1900 CPU with 2 MBytes of L2 cache, or a 1.33 GHz Intel Atom E3825 CPU with 1 MByte of L2 cache. The Advantech MIO 2263 SBCs support up to 8 GBytes of DDR3L DRAM in a single 204 pin SODIMM slot, with one SATA II and one mSATA interface available for hard drive expansion.



**Mouser Electronics**

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# LAST WORD

## How the 'LED lighting backlash' could be good for the industry

By Ralph Weir

**THE POTENTIAL OF LEDs** is obvious. LEDs offer a low Total Cost of Ownership (TCO), strong environmental credentials, extraordinarily long lifetimes, and have become roughly twice as efficient since 2012. Early issues concerning light quality have largely been solved in all but the cheapest LED products and the (relatively high) initial purchase cost of LED bulbs has been literally decimated in the last six years. As a result the LED lighting market, which was worth \$4.8bn in 2012 is predicted to grow by 45% per year to \$42bn by 2019.

Regardless, all technologies will have their detractors. As a recent example, Scott Elder of Linear Technology stated that, although LEDs claim a lifetime of tens of thousands of hours, most will actually fail well before this. This, he claims, is the 'big lie' of LED lighting. It's an alluring argument. However, in my estimation, it just doesn't add up.

If you look at his working-out Scott assumes that the 'circuit elements' in traditional bulbs and LEDs fail at an equivalent rate. More 'circuit elements' (such as the separate components of a driver circuit) lead to a higher failure rate, he claims. However, it's hardly sensible to compare the 'circuit element' of a piece of tungsten (heated to the point that the wire evaporates) with relatively cool-running silicon connected by copper circuits. According to this same working out I'm pretty certain that a standard PC would fail almost as soon as you got it home!

The rest of Scott's 'proof' is purely anecdotal. 'Seven out of twelve' of his wife's expensive LEDs, he says, have failed, though he makes no reference to brand, the timeframe over which the LEDs have failed, or the conditions in which they were operated. My own anecdotal riposte is that I have only had one LED out twelve in my house fail over a number of years, and that was from a batch of extremely cheap, low-end LEDs.

However I think Scott's right on one point: It may be beneficial to look at the 'total circuit solution'. Perhaps we should ask manufacturers to put their money where their mouth is in terms of guaran-

teeing an overall package lifetime?

Thermal management is the most critical element in maintaining an LED's lifespan. This is especially true as you start to move into High Brightness LEDs (such as those used in automotive headlights, warehouses, spotlights, UV, etc). Early LED designs were often hampered by a poor understanding of the thermal requirements of electronics and would often run unacceptably hot, drastically affecting lifetime. Components would wear out due to heat stress, or simply 'pop out', leading to unacceptably short lifespans.

Nowadays thermal management has improved enormously. Today it is not uncommon for both domestic and HB LEDs to be rated at 50,000 hours, and with higher-intensity UV lights to achieve up to 30,000 hours, much higher than was ever previously possible, and LEDs are being used in some of the most demanding and high-reliability applications. What's more, better thermal management can allow manufacturers to use fewer, but brighter, LEDs in a design, reducing the overall cost and allowing them to afford better-quality driver components.

However, as the price war heats up across the LED market, it's very possible that cheaper bulbs across the industry might cut corners on elements such as thermal design or other components, adversely affecting the overall 'real' lifetime of their product. This, in turn, would erode confidence amongst customers.

In order to avoid this, this might be an opportunity for the industry to improve how it describes the lifespan of its products. At the moment many LEDs come with a guarantee of a couple of years, and the EU is stipulating that any domestic LED bulb must last a minimum of 6000 hours. Perhaps the industry could go further? Whether we're talking about domestic or HB LEDs, perhaps the industry should be called upon to guarantee whatever lifespan is stated for the overall bulb package? Standardized guarantees of this sort could lead to more trust amongst customers and should ensure that the reputation of LEDs in future is not affected by any 'rush to the bottom' in terms of price and quality.

Ralph Weir is CEO of Cambridge Nanotherm - [www.camnano.com](http://www.camnano.com)

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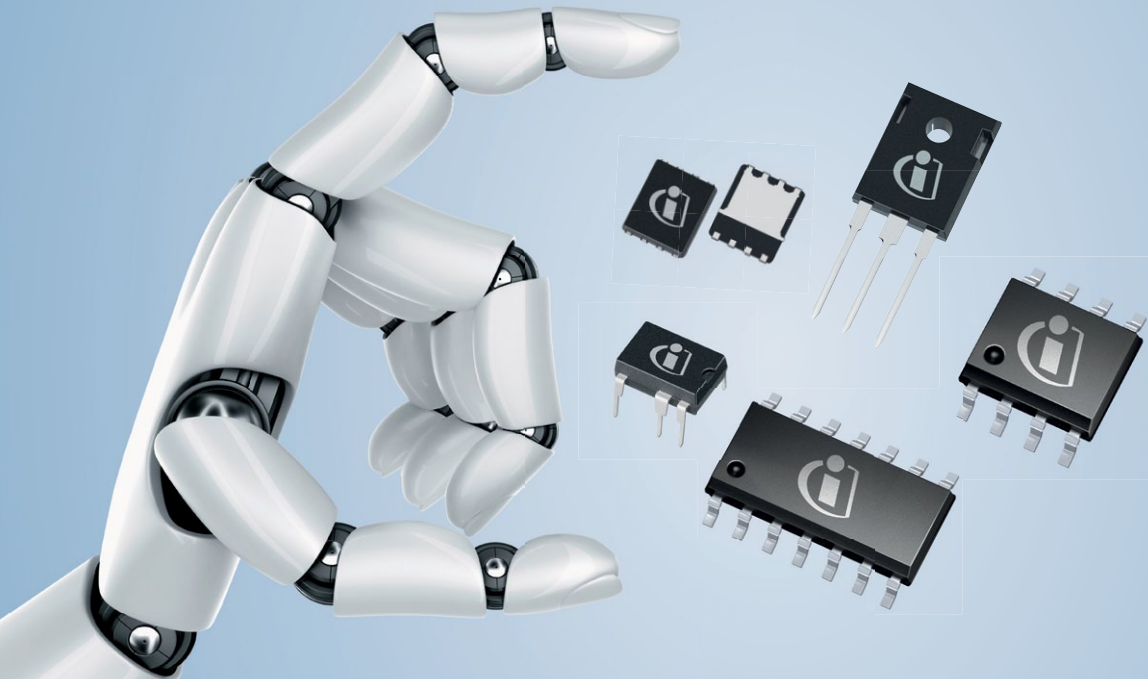
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