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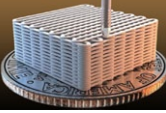

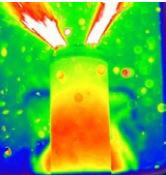




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OPINION

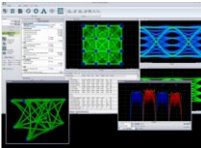
- 4 3D Sound Labs cracks user-centric surround sound
- 50 Industry 4.0 unplugged

NEWS & TECHNOLOGY

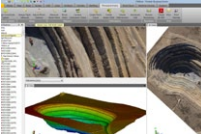
- 6 3D-printing aerogels for energy storage
3D-printed graphene aerogels could enable better energy storage, sensors and nanoelectronics. 
- 6 Foxconn linked to startup's 52-Mpixel camera
- 7 UltraHaptics promises airborne tactile interfaces
Bristol-based startup UltraHaptics relies on a compact array of ultra-sound transducers to blast inaudible sound waves through the air. 
- 8 RealSense 3D camera goes into smartphones
- 8 Exploding lithium-ion batteries: a real-time analysis 
- 10 How the 3 Cs drive IC consumption
- 10 When user interfaces dig into your emotions
EmoSHAPE is about to ship its first EmoSPARK Cubes, home-centric devices with built-in emotionally-aware artificial intelligence. 
- 12 MOST: a gigabit data backbone for future car generations?
At the recent MOST Forum in Esslingen, Germany, the MOST scene proved to be quite lively. 
- 14 McLaren brings simulation technology to mainstream automotive design
- 15 MEMS based lighting control optimises road illumination
- 16 Feeling augmented
The Versatile Extra-Sensory Transducer (VEST) is a new form of wearable haptics that could find many applications. 
- 17 Paper memory ready to roll
- 18 A clean MIPS slate for academia
- 22 MINI giving drivers a peek at 'augmented reality'
Beyond head-up displays, MINI is leapfrogging to the next phase of futuristic motoring, with augmented reality (AR) eyewear. 

DESIGN & PRODUCTS

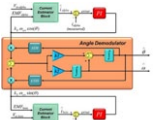


SPECIAL FOCUSES: - TEST & MEASUREMENT

- 24 Testing multi-antenna beamforming transmission systems
- 27 JTAG/Boundary-scan: the development of standards
- 29 Keys to choosing your coherent optical acquisition system
As demand for data grows, network operators continue to search for methods to increase data throughput of existing optical networks. 


- NAVIGATION & GEOLOCATION

- 34 Unmanned aerial solutions come down to Earth
When airborne photography and image processing tie-up with precise GPS coordinates. 

- MOTOR CONTROL

- 38 Make field-oriented motor control affordable
Shaft sensors and their wiring make field-oriented motor control pricey, but sensorless alternatives are available. 
- 40 Designing a temperature ruggedized gate driver
There is a growing demand for ICs able to operate in high temperature environments without compromising on reliability and lifetime. 
- 41 Clamping down on harmful harmonics
The rise of non-linear loads in industrial and commercial applications has brought the debate about harmonic currents to the forefront. 
- 43 Rare earth magnets still optimum choice says motor design expert

READER OFFER

- 46 In this month's reader offer, Analog Devices is giving away five Blackfin Low-Power Imaging Platform (BLIP) Development Systems (ADZS-BF707-BLIP2), worth \$199 each, for EETimes Europe's readers to win. 

49 DISTRIBUTION CORNER

3D Sound Labs cracks user-centric surround sound

By Julien Happich

French startup 3D Sound Labs is now taking pre-orders for its Neoh headphones which it claims produce a truly immersive, 3D spatial sound.

Funded through Kickstarter, the headphones feature advanced 9-axis motion-sensing (comprising gyroscopes, accelerometers, and a magnetometer) to track even the smallest of micro-movements of the user's head.

Movement data feeds the company's binaural algorithms via Bluetooth to the user's sound source (this could be a smart phone, a tablet, a smart TV or even a game console) to process any surround sound formats so that the perceived sound field remains static for the wearer.

This means that when the user looks right or left, he or she can hear and localize the appropriate sounds respective to the original sources, just like in a conventional cinema or home theatre sound system.

Precise motion sensing is critical to bring out the psychoacoustic effects that one perceives when unconsciously moving his/her head. Even a few degrees of orientation shift from micro-movements will give your brain the necessary hints to accurately locate sound sources.

Going far beyond stereo, the audio processing app running with the Neoh headphones virtualizes all the different audio sources to create an immersive audio sphere, offering an even more realistic sound experience than today's best home theatres, claims the company.

In a fun video largely inspired from the Matrix movie, with a pun on Neoh, the company compares mono, stereo, Dolby 5.1 and Neoh's immersive sound experiences.

The company has several patents pending on this surround-sound channel discretization and correction.

"For now, our software is designed to deliver 25 channels, but then we have tricks to process sound up to the 5th harmonic, and in the future we could deliver more channels", told us 3D Sound Labs Co-founder and VP of product & operations, Dimitri Singer.

"Although all the audio processing is done in software, we have a technology that scales much more easily than competition, so the processing power we require is not linearly tied to the number of channels we implement and all can be easily done on today's portable devices' CPUs", Singer said, discarding the need for an ASIC.

Tracking the user's head relative to the sound's source is performed through position averaging, assuming the wearer is generally looking towards a unique screen. This prevents drift from inertial motion units after initial calibration.

For video games or virtual reality environments, such an immersive audio experience naturally improves the user's perception of his/her environment. Adding special reverberation effects is next on the company's roadmap, so users could choose an environmental or architectural

context at the push of a button.

"Using sound tracing algorithms and precise environment models, you could tune the sound rendering to match a particular experience, say for example that you would want to listen to an album from the Beatles exactly as it was played in the Abbey-Road studios", noted Singer.

"We are mostly aiming at consumers, so for a simple user interface, they would have a selection of reverberation effects to choose from. But we are also developing a professional plug-in so audio engineers can create their own content".

Even though most of its IP is in software, 3D Sound Labs is not keen to licence its audio know-how.

"We want to be a consumer company and offer a finished product", said Singer, "also by building the headphone ourselves, we make sure to control the entire sound chain to tune the final audio properly".

"We could licence our IP and we have B2B discussions with virtual reality headset manufacturers, but this would have to be a very good licensing deal for us" he added, "something to be decided case by case".



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3D-printing aerogels for energy storage

By Paul Buckley

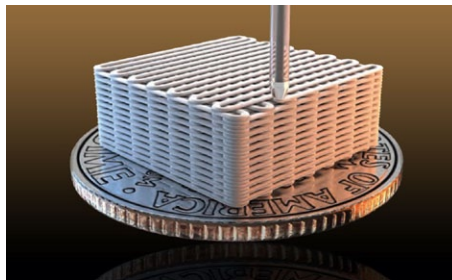
Lawrence Livermore National Laboratory researchers have developed graphene aerogel micro-lattices with an engineered architecture by using a 3D printing technique known as direct ink writing. The 3D-printed aerogels will enable better energy storage, sensors, nanoelectronics, catalysis and separations.

The research is reported in the April 22 edition of the journal, *Nature Communications*.

The 3D printed graphene aerogels have high surface area, excellent electrical conductivity, are lightweight, have mechanical stiffness and exhibit super-compressibility (up to 90 percent compressive strain). In addition, the 3D printed graphene aerogel micro-lattices show an order of magnitude improvement compared with bulk graphene materials and much better mass transport.

Aerogel is a synthetic porous, ultralight material derived from a gel, in which the liquid component of the gel has been replaced with a gas.

Previous attempts at creating bulk graphene aerogels produced a largely random pore structure, excluding the ability to tailor transport and other mechanical properties of the material for specific applications such as separations, flow batteries and pressure sensors.



Lawrence Livermore researchers have made graphene aerogel micro-lattices with an engineered architecture via a 3D printing technique known as direct ink writing. (Photo by Ryan Chen/LLNL)

“Making graphene aerogels with tailored macro-architectures for specific applications with a controllable and scalable assembly method remains a significant challenge that we were able to tackle,” said engineer Marcus Worsley, a co-author of the paper. “3D printing allows one to intelligently design the pore structure of the aerogel, permitting control over mass transport (aerogels typically require high pressure gradients to drive mass transport through them due to small, tortuous pore structure) and optimization of physical properties, such as stiffness. This development should open up the design space for using aerogels in novel and creative applications.”

During the process, the graphene oxide (GO) inks are prepared by combining an aqueous GO suspension and silica filler to form a homogenous, highly viscous ink. The GO inks are then loaded into a syringe barrel and extruded through a micro-nozzle to pattern 3D structures.

“Adapting the 3D printing technique to aerogels makes it possible to fabricate countless complex aerogel architectures for applications such as mechanical properties

and compressibility, which has never been achieved before,” said engineer Cheng Zhu, the other co-author of the journal article.

Foxconn linked to startup's 52-Mpixel camera technology

By Peter Clarke

Imaging startup Light Co. (Palo Alto, Calif.) has revealed some details of its array camera approach and is reportedly close to announcing a licensing and investment deal with Hon Hai Precision Industries of Taiwan, better known as Foxconn.

Light Co. was founded in 2013 as Tinz Optics Inc. but in 2014 benefited from a \$9.7 million venture capital round that included Paul Jacobs, executive chairman of Qualcomm, and Sanjay Jha, CEO of Globalfoundries, among the investors.

The main claim that Light is making is that it will allow smartphones to take photos even closer to digital SLR quality. Even though it is still at a pre-prototype stage it has reportedly said it expects the first light cameras to appear in smartphones in 2016 with the 52-megapixel resolution.

Light's approach is similar to that of array camera pioneers such as Pelican Imaging Corp. and LinX Computational Imaging Ltd. However, Light does not restrict itself to an array of identical sensors but uses multiple sensors with lens set at different fixed focal lengths so that it can simulate a zoom lens after a photo has been taken. It can still use computational effects after a photo has been taken – in reality a series of photos – to get

enhanced resolution similar to other plenoptic approaches.

And to help that happen Light has received backing from Foxconn, the world's largest contract manufacturer of electronics. In addition Foxconn will be licensing Light's technology for use in mobile devices.

“The system will enable people to easily carry a small, single device that offers true optical zoom with no protruding elements – we are currently prototyping 35mm-150mm – capture low-noise images even in low-light situations, and control depth-of-field and focus as part of the editing process,” Laroia told a publication called the *Daily Dot*.

One limitation is that Light's approach still requires a reasonable z height to accommodate its array of cameras, about the same as is used by smartphones today according to a Massachusetts Institute of Technology Review article. That would count against the technology for smartphone vendors who want to go even thinner.

And the technology is being pitched as a premium product with a cost to equipment makers of \$60 to \$80. That compares to \$3 to \$5 for a low-end camera for an entry-level phone and \$20 to \$25 for cameras in smartphones.



UltraHaptics promises airborne tactile interfaces

By Julien Happich

Founded in 2013, Bristol-based startup UltraHaptics relies on a compact array of ultrasound transducers to send inaudible sound waves through the air, using phase-shift techniques to precisely control the focus and intensity of the acoustic radiation pressure into something tangible.

While the ultrasound transducers lay flat in what could look like a thick mouse mat, the air pressure differences created at the focus points (where all sound waves meet at the same time thanks to the phase delays) can be felt like invisible contours projected into the air.

What's more, different textures can be created by varying the modulation frequency or pulsing the feedback effect on the skin.

To make things even more interesting, the company can combine these haptic effects with real-time video tracking of a user's fingers, so as to follow the user's gestures with a consistent feel, for example progressively defining and unveiling the contour of a large virtual object as the user swipes his fingers across it.

"The feedback force that can be felt ranges from 10 to 4Pa, maybe the equivalent of tenths of grams, but that's significant enough for our hands' tactile receptors to resolve", told us Tom Carter, co-founder and CTO of UltraHaptics.

In blind demos (running the haptic effects without any visual cues), the company claims it is now at a stage where it can create invisible, yet easily recognized primitive shapes such as a sphere, a cube, a pyramid or a cone, floating above the mat.

"In a user study, people were asked to come up to the interface and guess primitive shapes, and they guessed right 80% of the time" Carter said.

There are several ways UltraHaptics can create these floating shapes.

"We could always produce haptics in a limited space so people would feel it when they reached where the haptic effect took place, or with gesture tracking, we could adapt in 3D where to produce the effects, at the point of your fingertips", explained Carter.

"To create the entire shape, we need from a hundred to a thousand points at the same time, but with finger-tracking, it is much more effective to create only the points of the object that the hands are intersecting with", he clarified.

With an operating range of about one meter and with a "field



of view" of 60°, the haptic effect can take place within a fairly large dome-like space, and UltraHaptics has put together a 16x16cm hardware evaluation kit to help partners develop new interface concepts.

According to Carter, you could create customizable 3D cockpits. For example in the automotive industry, the central dashboard knob could be entirely user-configurable for different feels such as a slider, a turning knob or a swinging arm, but it could also be adapted to different users' morphologies, with longer or shorter arms.

It would only take little initial training, with guidance through the dashboard's screen to help users getting acquainted with the new feel.

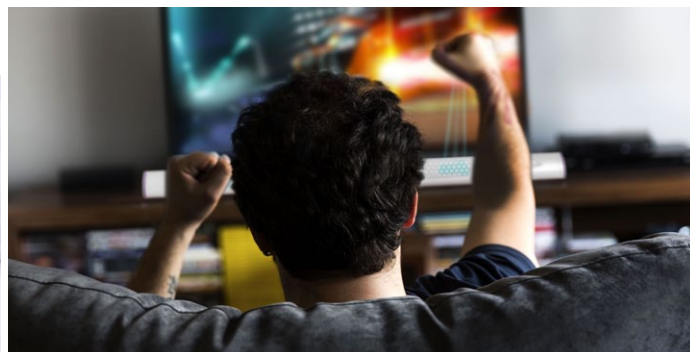
Another promising landscape for UltraHaptics is the realm of virtual reality, where VR headset wearers could actually touch and feel the objects in their digital environment, without having to wear special gloves.

The company has secured seed funding in 2014 and now has a haptic solution that is ready to be packaged into consumer products.

It could take five to seven years before you get to feel such haptics in a car, according to Carter, but the consumer space could adopt the technology a lot faster, realistically within the next 12 to 18 months.



A compact array of ultrasound transducers creates in-air patterns of acoustic pressure points for an invisible yet tangible feel.



Gaming could be another interesting market with a new layer of feedback building on top of kinect-like motion.

RealSense 3D camera goes into smartphone

By Peter Clarke

At an Intel Developer Forum held in Shenzhen, China, Intel CEO Brian Krzanich showed that his company has halved the size of its RealSense 3D camera module allowing it to gain design wins in tablet computers and smartphones. The smaller module could also be more easily integrated in laptop computers, where Krzanich demonstrated the RealSense camera being used to authorize access to the computer using facial recognition.

However it is also being designed into tablet computers and smartphones, Krzanich said.



In Shenzhen Intel CEO Krzanich demonstrates that the RealSense 3D camera module size has been halved. Source: Intel.

A demonstration was given of a RealSense-equipped tablet computer being used to input physical items into a computer database, including dimensions. The application has been developed with a Chinese warehousing and distribution company allowing a reduction in time for data entry from 3 minutes to 5 seconds, Krzanich said.

Krzanich also showed a prototype 6-inch smartphone with a longer-range Intel RealSense camera built into the device. However, he did not demonstrate it in operation.

Exploding lithium-ion batteries: a real-time analysis

By Paul Buckley

Researchers from University College London (UCL), ESRF The European Synchrotron, Imperial College London and the UK's National Physical Laboratory, have shown, using 3D imaging techniques, for the first time what happens when lithium-ion batteries overheat and explode.

The research tracks in real-time how internal structural damage to batteries evolves and can spread to neighbouring batteries.

The results have been released in the same week that international air-safety experts are meeting in Montreal, Canada, under the auspices of the United Nations, to consider proposals to restrict lithium batteries carried as cargo by commercial jets.

Lithium batteries, packed tightly together, can overheat or catch fire if they are damaged or experience short circuits and have been implicated in fires that have brought down two cargo jets in the past decade. Although battery failure is rare, three airlines have already declared plans to no longer carry bulk shipments of lithium-ion batteries in their cargo planes following US Federal Aviation Administration tests found overheating batteries could cause major fires.

The research results have been published in Nature Communications and the first author of the study, UCL PhD student Donal Finegan (UCL Chemical Engineering), said: "We combined high energy synchrotron X-rays and thermal imaging to map changes

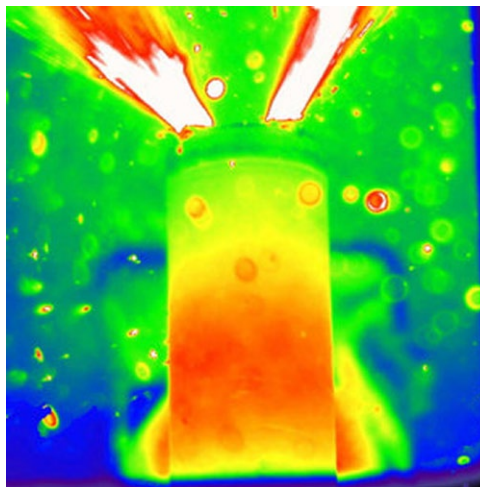
to the internal structure and external temperature of two types of Li-ion batteries as we exposed them to extreme levels of heat. We needed exceptionally high speed imaging to capture 'thermal runaway' – where the battery overheats and can ignite. This was achieved at the ESRF beamline ID15A where 3D images can be captured in fractions of a second thanks to the very high photon flux and high speed imaging detector."

Previously, X-ray computed tomography (CT) had only been

used to analyze battery failure mechanisms post-mortem with static images and to monitor changes to batteries under normal operating conditions.

The team looked at the effects of gas pockets forming, venting and increasing temperatures on the layers inside two distinct commercial Li-ion batteries as they exposed the battery shells to temperatures in excess of 250 degrees C.

The battery with an internal support remained largely intact up until the initiation of thermal runaway, at which point the copper material inside the cell melted indicating temperatures up to ~1000 degrees C. The heat spread from the inside to the outside of the battery causing thermal runaway.



In contrast, the battery without an internal support exploded causing the entire cap of the battery to detach and its contents to eject. Prior to thermal runaway, the tightly packed core collapsed, increasing the risk of severe internal short circuits and damage to neighbouring objects.

Corresponding author, Dr Paul Shearing (UCL Chemical Engineering), said: "Although we only studied two commercial batteries, our results show how useful our method is in tracking battery damage in 3D and in real-time. The destruction we saw is very unlikely to happen under normal conditions as we pushed the batteries a long way to

make them fail by exposing them to conditions well outside the recommended safe operating window. This was crucial for us to better understand how battery failure initiates and spreads. Hopefully from using our method, the design of safety features of batteries can be evaluated and improved."

The team now plan to study what happens with a larger sample size of batteries and in particular, they will investigate what changes at a microscopic level cause widespread

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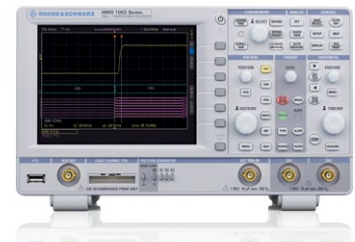
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How the 3 Cs drive IC consumption

By Peter Clarke

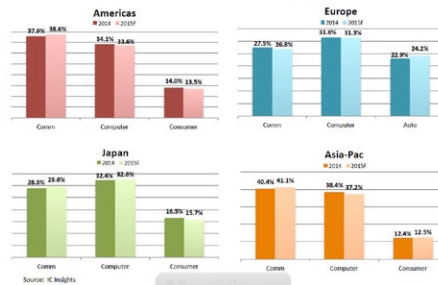
The communications, computers and consumer electronics sectors are set to be responsible for more than 70 percent of IC sales in every geographic region – Americas, Europe, Japan, and Asia-Pacific – in 2015, according to market research firm IC Insights.

Communications and computers lead in all regions with consumer electronics coming third in the Americas, Japan and Asia-Pacific.

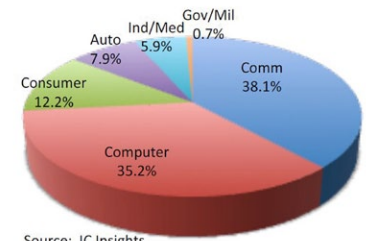
In Europe the third largest sector in 2015 will be automotive, IC Insights forecasts.

Collectively, communications, computers, and consumer systems are projected to account for 85.7 percent of IC sales in the Americas this year compared to 77.9 percent in Japan and 90.8 percent in Asia-Pacific.

Communications, computer, and automotive applications are forecast to represent 82.3 percent of IC sales in Europe in 2015. Computer applications were the largest market for IC sales for three decades but the global communications IC market took



Regional IC consumption by system type: Source: IC Insights



Total IC usage by system type for 2015 (\$310.5 billion forecast). Source: IC Insights.

over the top spot in 2013 due to the strengthening demand for smartphones and weakening demand for personal computers.

IC sales to the automotive market are forecast to represent only about 8 percent of total IC sales of \$310.5 billion in 2015 but the predicted compound annual growth rate of 10.8 percent for the period 2013 to 2018 is highest among all the end-use applications.

When user interfaces dig into your emotions

By Julien Happich

As the London-based startup company EmoSHAPE is about to ship its first EmoSPARK Cubes, EETimes Europe caught up with Brian Fitzpatrick, lead content developer of the device's wake-up and bonding sequence to learn more about the device's emotionally-aware artificial intelligence (AI).

Successfully crowd-funded through an IndieGOGO campaign in March last year, the EmoSPARK Cube is described as the world's first emotionally intelligent home console dedicated to your happiness, no less. Designed to play a central role in the home and to serve as a voice-controlled universal remote for all other Bluetooth or WiFi-connected electronic devices, the 90x90x90mm cube could not only help users access the information they want in a timely manner, but it could also tune into the owner's mood to offer comfort with upbeat conversation or even playful suggestions.

The secret recipe to this new venture resides in the patent-pending Emotion Processing Unit (EPU), in effect a microcontroller programmed to create a synthesised emotional response in AI-enabled machines, based on user input such as facial expressions (through their smartphone or tablet camera), or speech tonality and voice inflexions.

The EPU algorithms enable machines to respond to stimuli in line with one of the eight primary emotions: anger, fear, sadness, disgust, surprise, anticipation, trust, and joy, as identified by Robert Plutchik's psycho-evolutionary theory. As the EmoSPARK Cube interacts with her/his owner, it stores the perceived emotional stimuli within its memory bank, as emotional patterns or fingerprints.

This, claims EmoSHAPE, is possible thanks to the EPU's Computational Emotional Neural Frequency Architecture

(CENFA) and its Emotional Profile Graph (EPG) computation functionality.

Over time, the so-called EPG is used to register and develop a bank of emotional associations for each memory (data) within each Cube.

In principle, this emotional profiling could help the Cube share adequate data with other AI technologies, so the user would experience adequate emotional responses from other AI interfaces.

But why a physical cube when pretty much all of this could be done in software in today's smartphones or at least on the cloud?

"Because we need to establish trust, each cube develops its own emotional intelligence in relation with each specific user, the data connections that are made, the Emotional Profile Graph are very personal", told us Fitzpatrick.

"The EmoSPARK Cube learns a lot about you, it may even figure out emotional states and data about you that you may not actively know and that you may not want to share with everyone. Hence each cube acts like a mini-server where the EPG is securely hosted" he added.

According to Fitzpatrick, having a standalone product makes the interface more tangible, something that users would want to give a name and engage with in small talk.

"The cube can find information from different sources of knowledge such as Wikipedia, Freebase and internet search en-





gine Google, but also social networks, and it is capable of two-way conversation in tune with the owner's mood, so it is much more than just a multimedia servant", continued Fitzpatrick.

EmoSPARK has a conversational engine of more than two million lines of data, the company claims, and every time you chat with EmoSPARK it will learn to develop its own conversational understanding based on past interactions. Even if you were trying to have an argument with the box, it would not get upset but would talk you into a smoother mood.

But the whole idea really is to be able to turn-on and off things more easily around the home, or at least more efficiently than with a remote, with upbeat suggestions lined up or playing emotional tricks to lift the user's mood. In effect, guided by your inputs and past history, the machine will adapt its suggestions and conversation until it can improve your mood and read through a happy face.

Now for the "be happy" part, would the EmoSPARK Cube encourage you to have a glass of wine or frantically eat chocolate cake or even take drugs, if from your history, these were perceived as your best mood enhancers?

Could users sue the company for being encouraged to please themselves beyond socially accepted norms?

"This is a very tricky task, of course we wouldn't want to encourage illegal or unhealthy behaviours", commented Fitzpatrick, short of a clear answer. Adding emotional intelligence to fitness tracking devices could definitely encourage users to build a fitness plan and take action to feel better about themselves, but should an electronic device (be it emotionally intelligent) discourage anyone from boredom or even idle time?

Just for the sake of collecting "happy points" on your face, wouldn't this sort of in-house multimedia assistant push you towards more multimedia content consumption or gaming at the expense of unconnected activities such as outdoor sports or off-screen social events?

The Cube's insatiable quest for your happiness won't stop there. Once a reliable EPG is established, it can also "talk" to other Cubes about its experiences through a specially-designed grid via EmoSHAPE's servers, enabling Cubes with similar affinities to connect and share media bearing similar emotion tags.

More pragmatically, for Fitzpatrick, there is already a number of inanimate objects that people feel close to, such as cars or smartphones, adding emotional artificial intelligence to the interface could make these objects more like friends that can help you do things more naturally.

"In the end, it's all about having a better user experience, but of course it could go much further than that" said Fitzpatrick.

In the future, the company could consider licensing its EPU algorithms to smart TV manufacturers or to telecom providers willing to bundle the EmoSPARK Cube with their Wi-Fi hub. Surely they would want to figure out the viewers' emotional response to the content being served, for adaptive scheduling and content creation (adverts, TV series etc...).

Would they figure out that watching TV news is just a horrible experience most of the time?

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MOST: a gigabit data backbone for future car generations?

By Christoph Hammerschmidt

At the yearly MOST Forum, the number of attendees is constantly dropping. Is this an indicator that the MOST technology succumbs to the attack of Ethernet AVB? At the recent event in Esslingen, Germany, the MOST scene proved to be quite lively.

Since last year's MOST Forum several carmakers announced new models with MOST technology inside. Among them are Volvos latest top-end SUV XC90, BMWs 2 Series Active Tourer and the Audi TT. Actually, in the latter one, A MOST INIC (Intel-igent Network Interface Controller) is used in a somewhat unusual and innovative way: It is part of Audis Virtual Cockpit System and thus in a domain that is not associated unambiguously to the infotainment probably as an industrys first.

Meanwhile, in some 180 vehicle models worldwide, MOST is the underlying networking technology for the infotainment. While MOST networks are found mostly in upmarket and luxury sedans and SUVs from carmakers like Audi, Bentley, BMW, Daimler, and Rolls Royce, the technology has also arrived in the segment of the more affordable vehicles. An example is the Smart Forfour as the first subcompact vehicle with MOST-based infotainment.

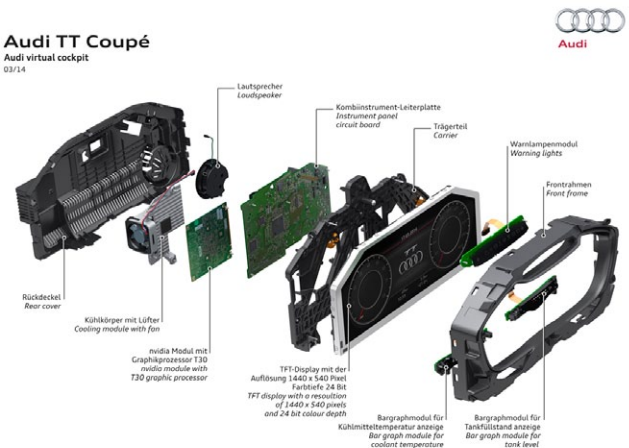
At the MOST Forum, it appeared that the MOST technology has found its niche where it will be difficult to attack by its fiercest competitor, Ethernet AVB. Certainly, Ethernet has a place in the world: where smaller amounts of data with uncritical real-time behaviour need to be processed, packet-oriented technologies like Ethernet have their advantages, said Henry Muyschondt, Administrator of the MOSTCO, the group of companies that have gathered to develop and support the MOST technology.

However, when it comes to transporting large amounts of streaming data for audio, video and camera signals, MOST will continue to be a superior solution.

At the event, techniques to test and evaluate MOST-based systems took centre stage. Also software options to integrate MOST systems into Autosar environments were detailed by experts from Bosch subsidiary ETAS as well as from MOSTCO.

But into which direction will the MOST technology develop in the future? Where are the priorities? Will the MOSTCO put the focus on additional functionality to turn it into a networking

Audi TT Coupé
Audi virtual cockpit
03/14



What Audi did not bother to mention: The Virtual Cockpit (electronics assembly shown) of its TT roadster is connected to the infotainment section through a MOST link.

platform that can be deployed in application fields beyond infotainment? Or will the ever-increasing bandwidth requirements of future applications (camera signal processing for automated driving functions, for example) set the pace for the developers?

"In the short to medium term, users should expect more features and functions" Muyschondt said, "In the current market situation, this is more important than additional bandwidth".

The MOST group rainmaker added that in its current version, the MOST technology also supports multiple concurrent data streams and offers a full-fledged Ethernet channel. It also has a coax physical layer that does away with the cost disadvantages of optical data transmission. Nevertheless, in the more distant future, the bandwidth demand will return and enforce new developments, Muyschondt acknowledged. Though MOST50 (with a bandwidth of just 50 Mbps) is still our bestseller, new applications such as uncompressed camera signals and ultra-high definition video might require data paths in the Gigabit range, he said.

Under this perspective it was no coincidence that some presentations dealt with ways to push the bandwidth limits of future MOST generations. Conrad Zerna from Fraunhofer Institute for Integrated Circuits (Fraunhofer IIS) showcased a prototype version of a 10 Gbps Physical Layer for Single Twisted Pair cabling (and thus the same cost-effective type of wiring as promoted by the Ethernet AVnu Alliance). The goal of the developers is transmitting this this amount of data across a distance of 10 m at a latency of less than 10 microseconds and a power consumption of less than 1 W in the TX/RX combination. Applications could be in-car data backbones or automotive MIMO arrays. At present, the team has devised a bandwidth of 7.9 across a distance of 14 m Gbps; Zerna hopes that through further optimisations it will reach the goal of 10 Gbps by end of May.

Another presentation went far beyond the 10 Gbps solution from Fraunhofer, albeit it was just a mere research project, far from commercialisation. Researchers from the KU Leuven (Belgium) showed an alternative technology to copper and optical



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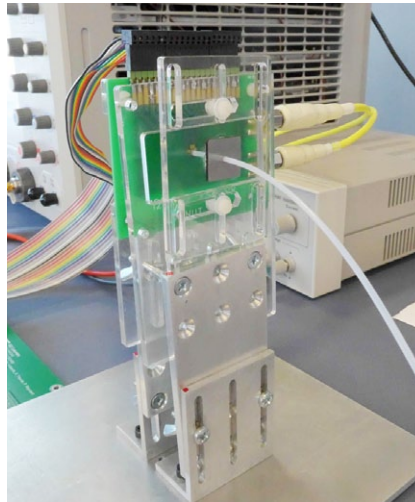
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fibre which enables amazing data bandwidths in the 100 Gbps range. The team around professor Patrick Reynaert and Wouter Volkaerts succeeded in transmitting RF through plastic fibres just the electromagnetic waves, no transformation to optical pulses is required. Instead of LEDs and photodiodes or laser emitters (VCSEL) and PIN diodes, the team uses cost-effective CMOS circuitry and tiny copper antennas to transmit and receive the data. The antennas could easily be implemented at chip or package level, Volkaerts said. Our research shows that a data bandwidth of 100 Gbps is possible, Volkaerts claimed.

“The beauty of this approach is its cost-efficiency. Instead of optical fibre (or even Plastic Optical Fibre) it uses cheap plastic hoses or similar material. We bought ours in the hobbyist store”, Volkaerts smiled. Despite the simple material, the technology exhibits high



Thin hose, high bandwidth: a KU Leuven research team sends electromagnetic waves through a plastic carrier and achieves impressive data rates.

robustness with respect to electromagnetic interference and does not require extremely precise, expensive mechanics to couple the link with the circuitry.

While the Leuven Scientists pointed out that at present this is just a research project, the interest from the Forum attendees was high. Also MOSTCO Administrator Muysshondt said that perhaps this technology could someday the base for a future MOST physical layer.

What else? Talks with attendees showed that perhaps the Ethernet camps much acclaimed cost-effective unshielded twisted pair might fall short of being the best solution for high-bandwidth data networks in the car. “Even a slight strain or kink of such a cable leads to heavy signal distortion”, complained an electronics designer who asked not to be identified. “MOST might be somewhat more expensive, but at least it works reliably”.

McLaren brings simulation technology to mainstream automotive design

By Graham Prophet

Mclaren Applied Technologies (M.A.T.) and MTS Systems Corporation (MTS) have announced a technical agreement to bring simulators and associated technology to the global automotive market.

Under the terms of the agreement, M.A.T. and MTS will create and deliver a next generation Vehicle Dynamics Simulator (VDS), which uses a tightly integrated driver-in-the-loop system for engineering the development of road cars. The technology allows engineers to virtually test a conceptual vehicle design in multiple environments and scenarios, prior to the vehicle actually being produced. The VDS is specifically geared toward commercial road car development, and will be tailored to the individual needs of each client.

Driver in the loop simulation technology allows engineers to virtually test a conceptual vehicle design in multiple environments and scenarios, prior to the vehicle actually being produced. Whilst traditional automotive driving simulators have, says McLaren, tended to focus solely on replicating realistic driving environments to assess driver behaviour, McLaren and MTS simulation system offers a more holistic, complete approach to vehicle development, driven by data and facilitating maximum accuracy and immersion during the design and testing process. It features a proven system of high frequency cueing via steering feedback, vestibular motion cueing, and sustained load mechanisms.

The technology can be experienced today at the McLaren Technology Centre, with a further simulator available to test by prospective customers in 2016.

The agreement between M.A.T. and MTS draws on both companies rich heritage in simulation technology. The Racing arm of McLaren pioneered the use of simulation technology in Formula 1, and has been utilising this approach to car design

for over 15 years. More recently, McLaren Automotive has deployed the technology in its design of the McLaren P1 and McLaren 650S. MTS is known for expertise in mechanical testing and sensing solutions, spanning industries including energy, automotive, aerospace, materials sciences, and civil engineering.

Geoff McGrath, vice president of M.A.T., said: By combining McLaren's vehicle modelling expertise and simulator technology with MTS experience in testing and simulation solutions, we hope to revolutionise mainstream car development on a global scale. McLaren has long been aware of the advantages of simulated vehicle design, including quicker speed to market, less reliance on the development of physical prototypes and reduced environmental impact. These benefits are increasingly pertinent to vehicle manufacturers as legal requirements grow, and customers tastes become ever more exacting. It has never been more complex or costly to bring a road car from initial design to the showroom.

The simulators and associated technologies developed by M.A.T. and MTS deliver unique advantages because they are built on the driver-in-the-loop model. The driver is immersed into a complex simulation of a car, which enables accurate, human feedback to the vehicle engineering team. Car set-up can then be changed, and further tests conducted immediately.

“MTS is very excited about this agreement and the opportunities it presents for both organisations”, stated Dr. Bill Bachrach, senior vice president and general manager of MTS Test. “Our leading edge technology and expertise in real-world simulation, when paired with McLaren's simulation and vehicle design excellence, brings a game-changing solution to automotive OEMs around the world”.



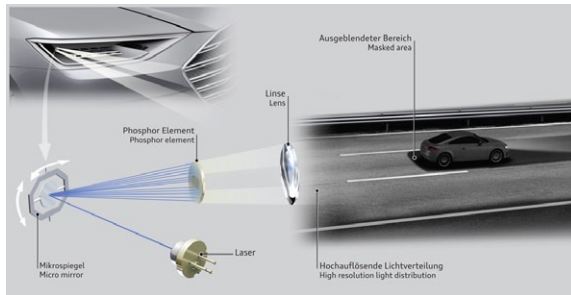
MEMS based lighting control optimises road illumination

By Christoph Hammerschmidt

On the basis of its laser spot high-beam headlight, Audi is developing a system that automatically adjusts the illumination for the speed of the vehicle. The new technology utilises only a single MEMS mirror to deflect the laser beam.

The laser spot technology for the high beam went into series production for the first time in 2014, in the Audi R8 LMX sports car. Progress in the field of laser light generation now made it possible

to integrate the projector technology in a compact yet powerful headlight assembly. The latest iteration uses a single but fast-moving micro mirror that deflects the laser beam. At low speeds, the light is distributed widely across a large area. At higher speed, the aperture angle gets smaller; the intensity as well as the luminous range of the beam is increased. This is of benefit in particular during high-speed rides on motorways. The technology also allows controlling the distribution of the light.



Thus, the beam can illuminate specific sections of the illuminated area, resulting in a highly dynamic and variable overall illumination and, likewise, shading. Another achievement is the intelligent, lighting-fast switching of the laser diodes depending on the mirror position. Similar to today's matrix LED headlights, the new dynamic laser headlight always illuminates the road at high intensity without dazzling other traffic participants. The decisive difference to matrix LED headlamps is that the matrix laser offers a significantly higher resolution and thus a higher utilisation which improves traffic safety. In addition, this technology enables innovative lighting assistance functions.

The new technology employs blue laser diodes (provider: Osram) that feature a light wavelength of 450 nm. The light is directed towards a fast moving mirror with a diameter of 3 mm which deflects the blue light to a converter which generates white light and projects it to the road.

The micro mirror is implemented as a silicon MEMS device (provider: Bosch). The same MEMS is used for acceleration sensors and for electronic stability control (ESP) gear. The development of this intelligent lighting system takes place in the iLaS project along with research partners Karlsruhe Institute of Technology (KIT), Bosch and Osram.

NFC tags check food freshness

By Julien Happich

Late last year, researchers at the Massachusetts Institute of Technology (MIT) had designed simple gas sensors relying on nanotubes-based chemiresistors (electrical circuits whose resistance changes when exposed to a particular chemical).

In their implementation, the carbon nanotubes were chemically modified so that their ability to carry an electric current changed in the presence of a particular gas. This chemiresistive property was then integrated into the powering circuit of commercial near-field communication (NFC) tags. The team first disrupted the electronic circuit by punching a hole in it before reconnecting the circuit with a linker made of the modified carbon nanotubes. Hence, the modified NFC tags could only remain operational and could only be read if the chemiresistors conducted normally, that is without the target chemical in sight.

Now, the researchers have modified the carbon nanotubes with metal-containing compounds called metalloporphyrins, known to be very good at binding to nitrogen-containing compounds such as amines. Of particular interest to the researchers were the so-called biogenic amines, such as putrescine and cadaverine, which are produced by decaying meat.

When the cobalt-containing porphyrin binds to any of these amines, it increases the electrical resistance of the carbon nanotube, which can be easily measured. The researchers tested the sensor on four types of meat: pork, chicken, cod, and salmon. They found that when refrigerated, all four types

stayed fresh over four days. Left unrefrigerated, the samples all decayed, but at varying rates.

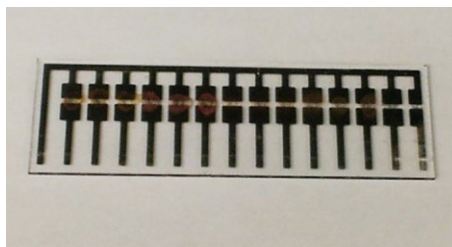
Designed within NFC-readable RFID labels, the sensors could allow consumers to determine whether the meat in their grocery store or refrigerator is safe to eat. Such sensors could be designed in "smart packaging" that would offer much more accurate safety information than the expiration date on the package, according to Timothy Swager, the John D. MacArthur Professor of Chemistry at MIT who had already proven similar

sensors to detect ethylene, a gas that signals ripeness in fruit.

"People are constantly throwing things out that probably aren't bad," says Swager, who is the senior author of a paper describing the new sensor this week in the journal *Angewandte Chemie*.

"There are several potential advantages in having an inexpensive sensor for measuring, in real time, the freshness of meat and fish products, including preventing foodborne illness, increasing overall customer satisfaction, and reducing food waste at grocery stores and in consumers' homes," says Roberto Forloni, a senior science fellow at Sealed Air, a major supplier of food packaging, who was not part of the research team.

The researchers have filed for a patent on the technology and hope to license it for commercial development. The research was funded by the National Science Foundation and the Army Research Office through MIT's Institute for Soldier Nanotechnologies.



Feeling augmented

By Julien Happich

The Versatile Extra-Sensory Transducer (VEST) under development at Rice University and Baylor College of Medicine represents a new form of wearable haptics, one that could find many applications beyond its initial goal of enabling the profoundly deaf to “feel” and understand speech through their body.

Led by PhD student Scott Novich under the supervision of David Eagleman, director of the Laboratory for Perception and Action at Baylor College of Medicine and an adjunct assistant professor of electrical and computer engineering at Rice University, the VEST is the result of a clever mix of electronics and neurosciences.

Eagleman’s research focuses on how the brain constructs perception, and one of his research topics include sensory substitution whereby sensory data is fed through unusual sensory channels.

For decades now, it has been shown that regardless of the sensory channel, our brain is able to adapt and learn to extract meaningful information from unobvious sensory inputs (consider reading braille through touch), and the VEST is expanding on that.

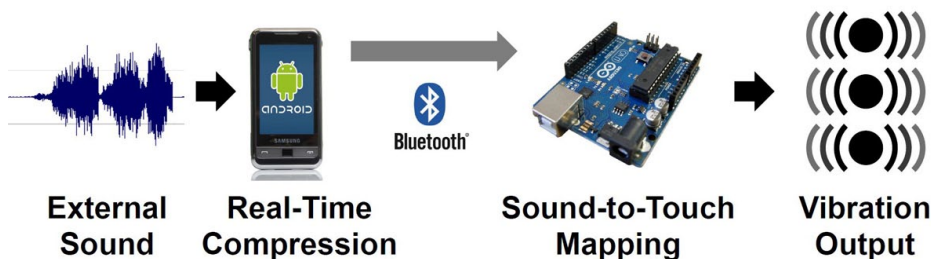
In a poster titled “VEST: A Vibrotactile Sensory Substitution Device for the Deaf” at last year’s Haptics IEEE Symposium in Houston, Novich presented a wearable vest laden with a network of small mass-motors distributed throughout the fabric, 24 in total. As oncoming speech is captured by an Android smartphone, the recording is compressed and streamed as 20ms audio frames to the vest over Bluetooth.

The audio frequencies from 0 to 4kHz are split into 24 bands, each attributed to a particular vibration motor, in effect mapping each audio signal into unique and complex patterns of vibration on the wearer’s torso.

Intuition would have you think that these haptic patterns were designed to relate to actual sound waves as we would perceive them on our torso in front of a very loud speaker. But none of that, the actual physical layout of the mass motors across the torso doesn’t matter either and the overall haptic effect created is something completely new and unexplored, a pattern described as too complicated to translate consciously.

Yet, initial trials with a completely deaf participant showed that within a few hours of training, distinguishable vibration patterns were consistently associated with discrete words.

“There is no underlining rule for designing the network of mass-motors across the VEST”, confirmed Novich during a phone interview with EETimes Europe. “Because we have sensory receptors all over the skin, it doesn’t matter where we put the actuators as long as they are separated far enough to be resolved individually, so they can’t just be packed close to each other.



It may still be the case that a logical layout (i.e tonotopic) makes training much easier or faster. But we transcode the sound in such a way that all the information reaches the brain”.

This last bit is the most important one, as the brain is then able to figure out, though sensory substitution, the meaning of all this. For now, each of the 24 frequency-specific mass motors receives a 3-bit input (8 discrete levels of vibration), not much but enough to have all the discernible speech information (retaining pitch mainly).

“If you do the maths, over 10 to 20ms windows, that’s about 3000 bits/second or the equivalent of a low bitrate speech Codec” told us Novich for a comparison. As for the number of actuators, the researchers settled on 24 as a practical experimental setup that would still yield exploitable results.

“The more you can fit the better, that’s more information and less compression, but then you have to figure out how to wire the thing up and you want to strike the right compromise for energy and weight too”, added Novich.

Now, such a vest could find its way into many other applications, for which it could transcode pretty much any type of data, not just the type of sensory data our body would normally be natively tuned to. In fact, wearing this haptic vest, a person could subconsciously pick up on any sort of machine data and make sense of it according to the patterns he or she would have been trained to identify or interpret, making the VEST a truly universal data-to-brain transcoding machine.

“Instead of focusing visually on many different elements one at a time, an air pilot could receive the entire flight data from the cockpit to feel the entire system in his body and get a general intuition of the flight conditions” said Novich.

With the help of a team of electrical & computer engineering undergraduates at Rice, as part of their senior design project, the PhD candidate is looking at using up to 40 piezo-electric actuators for a lighter and unobtrusive design which could be worn inconspicuously by deaf people. The VEST would have a very competitive price advantage over today’s cochlear implants while benefiting many other applications.

“Our prototypes are already fairly close to something we could hand out to people to use”, Novich said, adding that the lab has just spun out a company, Neosensory, and is currently raising funds to finalize development and bring a product to market.



David Eagleman sporting the inconspicuous VEST underneath a shirt.

Paper memory ready to roll

By Julien Happich

Researchers at the Finish VTT Technical Research Centre have demonstrated they could print memory circuits directly on paper, using simple roll-to-roll printing techniques with a particular mix of commercially available metallic inks. The researchers envisage their cheap paper memories to be used in applications such as sensor data recording, product originality marking, playing cards, interactive packaging and product information cards.

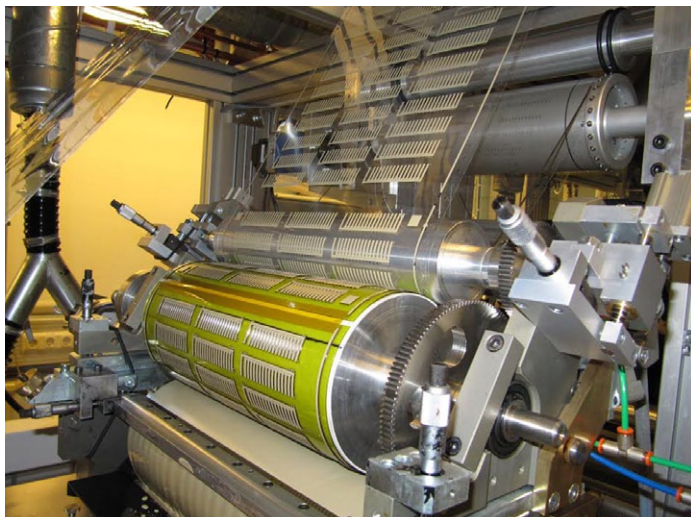
The write-once-read-many (WORM) memories can be fabricated directly on the product or packaging using flexographic or inkjet printing machines, common in the packaging industry. Each writable memory bit, measuring about 0.2x0.3mm each in the researchers' experiments, consist of a mix of two commercially available silver nanoparticle inks, dried after a regular R2R printing process of the actual bits and their associated writing/reading electrodes.

Before writing, each bit is in the 1 state of high resistance. Writing a bit is performed by applying a low voltage (under 10V) across the bit, which in effect sinters adjacent silver nanoparticles and creates a path of least electrical resistance, hence turning the memory bit from a high resistivity '0' state to a low resistivity '1' state.

This sintering step is non-reversible, which means the data content of the memory is only written once, but it supports an unlimited number of read operations.

The VTT lab was able to print a roll length of 150m containing more than 10 000 printed WORM memory banks on a 125um thin heat stabilized PET substrate, but in prior research, it had demonstrated the sintering capability of the memory bits on paper.

Each memory bank consisted of a linear array of bits automatically die-cut on the R2R line. Then each bit could be read sequentially by measuring the resistance across it since there is typically an order of magnitude between the 0 and 1 states (a recent paper discussed a bit resistance dropping from R'0' of 1:4 kOhm to R'1' under 100Ohm during a write time under 5ms).

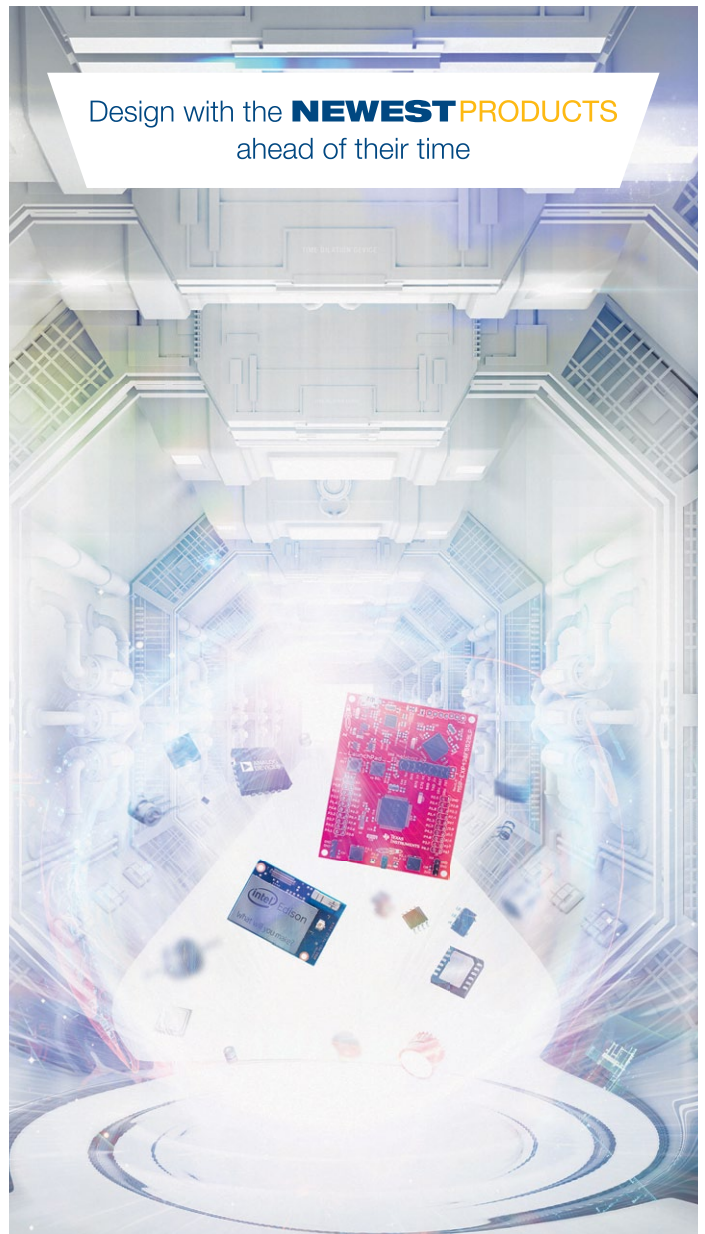


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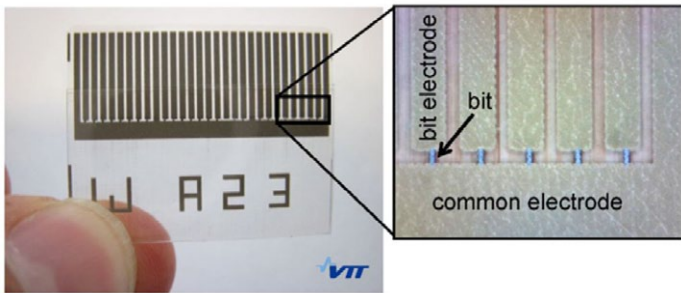
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A printed WORM memory bank with 26 bits (1mm pitch) with contact electrodes and a common electrode. The bit size is approximately 0.2x0.3mm.

“For bigger memories with a need to limit the number of electrical contacts using a two-dimensional matrix structure of the bits, one would need to implement a diode in series with

each bit or utilize a more elaborated readout electronics to cancel cross talk between the bits”, clarified Ari Alastalo, Principal Scientist at VTT in charge of printed and hybrid functionalities, printed sensors and electronic devices.

“In fact, the reading voltage is not limited by the WORM but by the readout electronics” explained Alastalo, “In fact, the WORM is just a resistance to be measured, and its bit size can be very small. It could be read using energy converted from RFID or an NFC reader” he added.

An interesting feature of this resistive WORM memory is that it could be read in a contactless fashion too. Instead of physically contacting the bits to measure their resistance, the bit resistance could be read through a capacitive near-field measurement with a sweep-over reader device.

As it is further testing and demonstrating the memory for different applications, VTT lab is searching for a partner to commercialise its patented process.

A clean MIPS slate for academia

By Julien Happich

By letting universities study its MIPS RTL code and explore a real working MIPS CPU, Imagination Technologies seeks academia’s attention and hopes to nurture a new wave of MIPS-literate graduates into their future engineering roles.

The company is not only opening up its RTL code for all to scrutinize, it has come up with a full teaching package with an FPGA-ready deliverables under the name MIPSfpga.

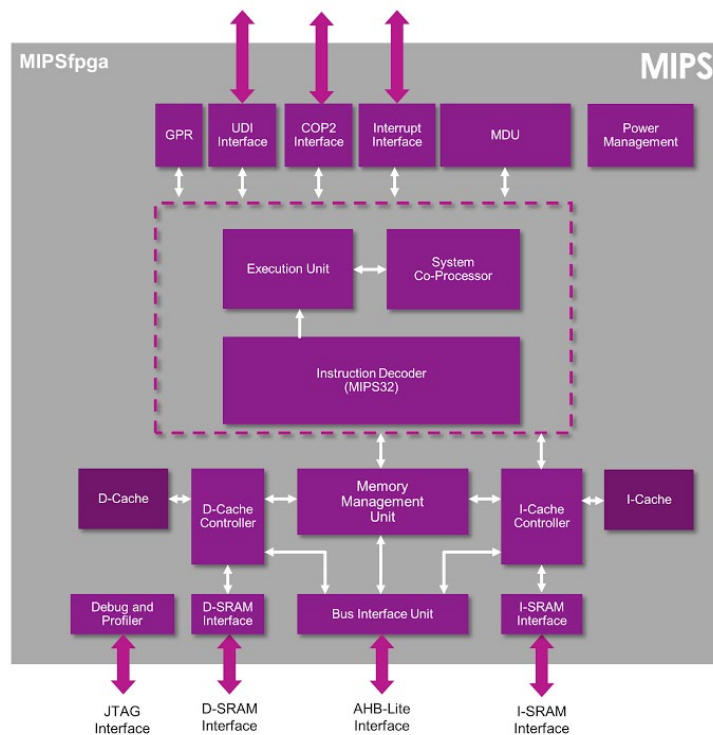
EETimes Europe caught up with Robert Owen, Imagination Technologies’ Worldwide University Programme (IUP) Manager to understand how the company came around this bold decision regarding IP disclosure.

“The MIPS architecture was originally developed at Stanford University in the early 1980s. It has been the teaching architecture of choice for decades because of its elegant true RISC design, epitomized by Dr. David A. Patterson and Dr. John L. Hennessy in their book, ‘Computer Organization and Design’”, likes to remind us Owen.

“Many computer science and computer engineering courses teach CPU architecture based on MIPS which has been much publicized and well documented since its first inception in academia”, noted Owen, “so it is not as closely guarded a secret as

other processors, and in most cases, researchers know what is inside”.

Owen admits it was not an easy decision to take, and that letting free and open access to a fully-validated, current generation MIPS CPU, with non-obfuscated RTL code, yields some risks of fraudulent use.



“Users that sign up our program have to accept a license whereby they are not allowed to turn the code into silicon for commercialization. Because they can get into the core, if they modified it and wanted to use a customized version, they would have to consult us”, clarified Owen. “It is possible that this would trigger some illegal copies, but we’ll monitor foundries closely” he added.

Owen sees this new program as a way to re-energize the use of MIPS in education.

“MIPS has been around in academia for a long time, but its use has been fading slowly”, explains

Owen. “Academics are often disconnected from the commercial world, and most of them are not even aware that MIPS was acquired by Imagination Technologies who is now investing a lot to develop the architecture further with lots of new clever ideas, so it is important that we make a statement, carry-on using MIPS, it has a bright future”.

Through MIPSfpga, Imagination is providing universities with a simplified version of its popular MIPS microAptiv CPU core which has been configured by an academic specifically for academic use. The CPU has all the features (MMU, cache controllers, debug interfaces, etc.) required to run a full blown operating system (e.g. Linux). This is contrast to other university programs where the core is usually encrypted (i.e. a black box) and can only run a simple RTOS.

It is offered as part of a complete free-to-download package for universities, together with a Getting Started Guide, teaching guide for professors, and examples designed to enable students to see how the CPU works and explore its capabilities.

“To be a success, such an initiative much reach two objectives: be useful to teachers, and offer long term commercial benefits for the company”, explained Owen, emphasizing that all the teaching material had be written by academics for academics rather than being sourced from in-house training material.

“This represents a significant investment for a company the size of Imagination Technologies, several hundred thousand dollars, a dozen people involved and myself working full-time on this” he added.

Imagination Technologies will also offer active technical support to ensure teachers start from a known good position rather than from MIPS-like or MIPS-compatible architectures.

With the materials, students can develop a CPU and take it through debug, running on an FPGA platform. The MIPSfpga deliverables were developed by Dr. David Harris and Dr. Sarah Harris, professors who co-wrote the popular book, ‘Digital Design and Computer Architecture’, now in its second edition. Dr. David Harris configured the MIPS CPU at the heart of MIPSfpga, and Dr. Sarah Harris developed the teaching materials.

This MIPS CPU configuration is designed to run on a low-cost FPGA platform, with guides available for the Digilent Nexys4 platform with a Xilinx Artix-7 FPGA, and the Terasic DE2 platform with an Altera Cyclone FPGA.

It could take five to ten years before Imagination really gets a return on its investment, but this is part of the company’s long term strategy to meet a significant growth target with MIPS. Owen expects that when a whole generation of students having studied the real MIPS will move to engineering roles, the sales effort will be significantly eased for a product they already know.

The MIPSfpga CPU and related materials are available for download from the Imagination University Programme website now for first phase users via an application process. Academics should visit <http://community.imgtec.com/university> to register for the IUP and learn more.

Phase two, starting in June, will require only a simple click-through agreement. Additional teaching materials are being developed and will be made available later this year.

Imagination is also working with Xilinx through its University Program to roll out MIPSfpga to universities worldwide, co-sponsoring workshops for professors to get started.



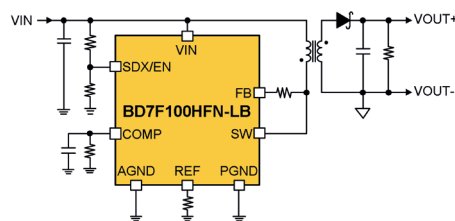
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Specifications and characteristics

Hardware	Specifications
Frequency range	300 kHz to 4, 6.5, 9, 14, 20, 26.5 GHz
Number of ports	2 N ports w/multiple modules
Architecture	Full 2-port, true four-receiver
Dynamic range	> 114 dB at 9 GHz, > 110 dB at 20 GHz
Trace noise	< 0.003 dB
Stability	±0.005 dB/°C at 4 GHz, ±0.020 dB/°C at 26.5 GHz
Sweep speed	18 msec across 401 points
Max leveled power	up to +7 dBm
Power range	+7 to -40 dBm; 0.01 dB resolution
Measurement points	100,001
Size	One slot
Chassis slot compatibility	PXIe, Hybrid

Main features and benefits

Product features	Your benefit
Choice of six frequency ranges up to 26.5 GHz (widest currently available)	Pay for only the frequency range you need
Best PXI VNA speed, dynamic range, trace noise and stability	Improve accuracy, yield and margins
Full 2-port S-parameters in a single-slot PXI	Have more slots available in your PXI chassis
Trusted Keysight measurement science and calibration	Get measurements you can count on
Electronic calibration (eCal) control via USB interface	Perform fast, easy, and accurate calibrations
Cascade multiple modules to address multipoint applications	Test with full N-port correction capability
Simply add modules for multi-site applications	Test with multiple independent VNAs
Cost-effective VNA capability	Achieve lower pricing as compared to other PXI VNAs

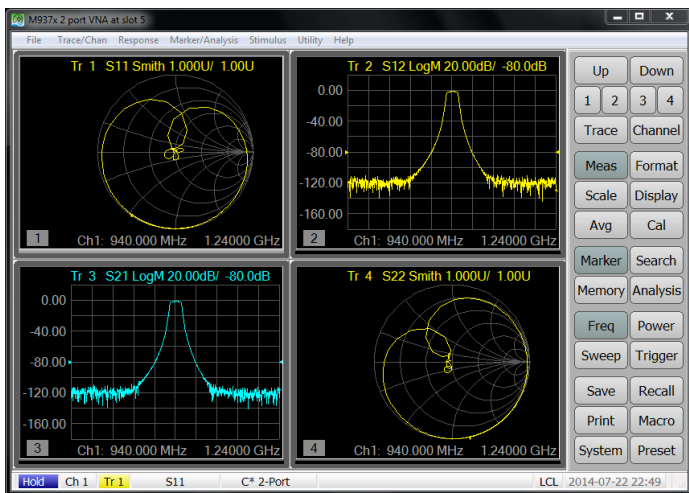


PXI

Software information

The PXI VNA includes instrument drivers, documentation, examples and software tools to help you quickly develop test systems in your application development environment of choice.

Operating systems	Microsoft Windows Vista SP1 and SP2 (32/64-bit) Microsoft Windows 7 (32/64-bit)
Standard compliant drivers	IVI-COM, IVI-C, LabVIEW, MATLAB
Application development environments (ADE)	Visual Studio (C/C++, C#, VB.NET), LabVIEW, LabWindows/CVI, MATLAB, VEE
Keysight Command Expert	Instrument control for SCPI or IVI-COM drivers
Keysight IO libraries (version 16.3.16603.3 or newer)	Includes: VISA libraries, Keysight Connection Expert, IO Monitor
Multiple programmatic interfaces	Easy integration into test environments and reduced development time
PNA look and feel	Same user interface and SCPI programming commands
Calibrated core exchange strategy	Fast repair and turnaround time



The PXI VNA interface guides test engineers using a similar look and feel as Keysight's popular PNA family of network analyzers.

Ordering Information

Model	Description
M9370A	300 kHz to 4 GHz
M9371A	300 kHz to 6.5 GHz
M9372A	300 kHz to 9 GHz
M9373A	300 kHz to 14 GHz
M9374A	300 kHz to 20 GHz
M9375A	300 kHz to 26.5 GHz

Product Options	
010	Time domain
551	N-port calibrated measurement
102	Additional VNA features and capabilities <ul style="list-style-type: none"> – Fixture simulator – Manual and automated port extend – Equation editor
897	Built-in performance test software for inclusive calibration, perpetual license
898	Built-in performance test software for standards compliant calibration, perpetual license

Accessories	
Y1242A	Multiport cable kit
Y1281A	Accessory and tool kit <ul style="list-style-type: none"> – Pull tool for SMB connectors – Custom socket for 3.5/SMA connector nuts
M9018A	PXIe 18-Slot Chassis
M9037A	PXIe High Performance Embedded Controller
Calibration	Electronic and mechanical kits available



MINI giving drivers a peek at 'augmented reality'

By Junko Yoshida

Although most drivers have yet to embrace the idea of head-up displays (HUDs) on windshields, MINI is leap-frogging to the next phase of futuristic motoring, with its unveiling this week of augmented reality (AR) eyewear — powered by Qualcomm.

MINI is offering live demonstrations of its prototype technology both at the Auto Shanghai Show and in San Francisco.

MINI is seeking to fuse HUD and AR directly onto the drivers' vision through AR glasses. Navigation instructions or any other digital information the driver might need will be overlaid directly in the lenses of the driver's eyewear.

To be clear, MINI's Augmented Vision is still a research project. During an interview with EE Times, an executive at the BMW Group Technology Office wasn't willing to predict when the prototype glasses might become products in the commercial market.

Nonetheless, the vision of "connectivity between MINI vehicles and augmented reality glasses" illustrated by MINI (owned by BMW) and Qualcomm offers a glimpse of a future to which AR and connected cars are heading, if not colliding.

X-Ray view

HUD function in AR glasses should be effective and useful if they work. They can project vehicle speed, speed limits and similar relevant information in the driver's primary field of vision. Beyond such functions, an intriguing feature of MINI Augmented Vision is what MINI calls "X-Ray view" — enabled by the combination of see-through display and positional tracking technologies.

When a driver turns his or her head, for example, the glasses provide a view through the sheet metal in the car's door, revealing objects that would be otherwise out of sight — like a child in the street, or a dog, according to Jay Wright, vice president, Qualcomm Vuforia.

"The cameras mounted on the outside of the vehicle capture live images and project them into the glasses in the right context and the correct place by using the Qualcomm Vuforia mobile vision platform," Wright explained. Qualcomm Vuforia offers Augmented Reality SDK for developers to create AR applications.

But how exactly are live images captured by the cameras that transmit to the driver's AR glasses?

Robert Richter, senior advanced technology engineer, BMW Group Technology, explained, "For this research prototype, we use a Wi-Fi connection that connects with the head unit and additional computing units for processing the video signals. We have added two additional cameras [to MINI] to enable the X-Ray Vision and the seeing the curb while parking."

Such a scenario, however, makes Mark Boyadjis, senior analyst & manager, Infotainment & HMI, IHS Automotive, wonder about connectivity.



"Since the display is head-mounted and is not connected [or] powered by the vehicle, you must have a VERY robust wireless connection for data transfer and a reliable and powerful battery to keep the glasses powered, even on long road trips," the analyst said.

"Assuming the exterior camera and the HMD (head-mounted device) have a rich enough data bandwidth," Boyadjis said, "then you could make things like an A-pillar of a vehicle or a hood of a large SUV — virtually — transparent." However, he warned, "This will be VERY expensive to achieve in today's world, not to mention VERY complex to 'perfect' and ensure a seamless user experience."

HMD for cars

MINI isn't jumping on the AR/HUD bandwagon just because of the growing popularity of AR/VR in recent years. BMW has been working for more than a decade on the idea of bringing HUD to goggles — like those worn by an aviator, according to Pat McKenna, manager of product planning & events, MINI USA. AR glasses are an evolution of that idea. Instead of a combiner HU display on the windshield, AR glasses can bring a far wider field of view.

Qualcomm saw BMW's efforts as the perfect opening to pitch AR glasses for cars, instead of AR glasses for everyday



MINI Augmented Vision offers X-Ray vision.

Junko Yoshida is Chief International Correspondent at EE Times

life (a la Google Glass).

Qualcomm Vuforia vice-president Wright acknowledged that existing AR glasses have suffered some backlash in the consumer market. "Their market adoption has been limited thus far because of fashion, privacy and battery life issues," when those HMDs are used "for life."

But what about cars? "Barriers to market adoption will go down," he said, "because drivers are mostly wearing them inside a car. Privacy or fashion won't become big issues." More important, the battery life requirement will be "much more modest, because drivers aren't wearing those AR glasses all day long."

Swimming effect

Both Qualcomm and MINI are pitching MINI Augmented Vision for safer driving. But they are also aware that its safety depends on whether digital content (to augment reality) can be perfectly aligned with the physical world and overlaid on the driver's view without delay.

The biggest issue with AR glasses is said to be the time it takes to register the user's surroundings and the synthetic space. Geometric calibration between tracking and the head-mounted display (HMD) is not instantaneous. Described by experts as a "swimming effect," the delay can cause graphic objects to float freely in synthetic space, foiling the illusion that the synthetic objects are fixed in the environment.

Put simply, moving your head confuses the head-mounted display. One way to minimize the swimming effect is to use predicted HMD positions, instead of measured ones.

"The ideal hybrid solution to align the HMD's perspectives would involve fusing data from sensors (such as accelerometers, gyros and an array of image sensors) with an optical tracking system," Ori Inbar, co-founder and CEO of AugmentedReality.org, explained.

This appears to be precisely what Qualcomm is doing. Through the fusion of very quick processing carried out by Snapdragon 805 apps processor and Qualcomm's Vuforia software platform, Wright said, "We can minimize 'motion-to-photon' processing time – down to 'zero' perceived latency."

AugmentedReality.org's Inbar told us, "The combination of hardware and software advancements have helped perfect the augmented reality experience on smart glasses. In a fast head movement the graphics overlay on some smart glasses is delayed by no more than a fraction of a second."

Inbar, however, cautioned, "Our eyes-brain are very sensitive to this movement. So it's still perceptible. But a clever user interface can avoid any potential safety hazards."

Inbar said he has seen demos performed in a car environment using VR goggles. "It's a very cool and useful experience." He added, "However, it does sound more challenging to provide the live camera feed from the car to the AR glasses."



AR glasses for MINI.



MINI Augmented Vision offers wider FOV.

Especially when trying to avoid dynamic movements such as a pedestrian crossing the street."

AR glasses - pros and cons

A pair of AR glasses can, in principle, be connected to different vehicles, according to MINI. That, however, assumes that non-MINI vehicles also use Qualcomm's Vuforia mobile vision platform.

IHS analyst Boyadjis pointed out the different life cycles of a vehicle and AR glasses could also become an issue. Boyadjis said, "The major disadvantage of MINI Augmented Vision is MINI is not a manufacturer of glasses. They make cars."

He explained, "Whenever an OEM tries to pair a vehicle (with a ~10-year lifespan) with a specific consumer electronic device (with a ~2-year lifespan) the user experience -- while great at the beginning -- is lost only a few years into the product life, unless BMW/MINI adopts a separate product development and maintenance team for its AR goggles."

Boyadjis, however, sees one big upside for AR glasses.

"You can connect an AR experience outside the vehicle with one inside the vehicle in a completely seamless manner."

Inbar, meanwhile, sees the much broader field of view (FOV) as a huge advantage for AR glasses in cars, compared to windshield HUD. A conventional combiner HUD offers a FOV "only in front of the driver like in a pinhole experience," he said. In contrast, "Smart glasses allow drivers to see augmented overlays in any direction they look."

Compared to the 4- to 6-degree FOV prevalent in currently available windshield HUDs, MINI Augmented Vision promises to deliver 26-degree FOV.

Building blocks

MINI Augmented Vision uses Qualcomm's Snapdragon 805 processor for the glasses, and Qualcomm Vuforia mobile vision platform, designed to offer the technology used for determining position of the glasses inside the car.

ODG (Osterhout Design Group), a leading manufacturer of AR eyewear, provided its optical and electronic technology, development and manufacturing support, according to MINI.

Built into the upper section of the casing are: Snapdragon 805 processor, along with inertial sensors and two cameras – one camera is pointed forward, while another upward. These are used for determining "precision location" of glasses in the vehicle, according to Wright.

Further, the glasses include two stereoscopic HD displays (720p) for three-dimensional vision as well as WiFi, Bluetooth and GPS technology.

Testing multi-antenna beamforming transmission systems

By Sheri DeTomas

The rapid growth of consumer demand for wireless communications services continues to push the boundaries of the current wireless standards.

The number of devices being added to the networks is growing exponentially and consumers are requiring higher data rates, improved quality of service, and robust connections from anywhere in the world. There's a lot of talk about 5G and IoT and how these will continue to tax the existing infrastructure. 5G is in its definition phase and still years away from commercial implementation.

Today, LTE 4G cellular networks are becoming mainstream in leading markets, and next generation standards like LTE-Advanced will be the next phase of implementation.

LTE-A and wireless LAN standards like 802.11n, 802.11ac allow for multi-antenna techniques to improve data rate, capacity and quality of service. While adding multiple antennas in the RF design provides significant improvements for the user, the verification of these design becomes quite complicated. This article provides a quick overview of multi-antenna techniques and describes some of the key challenges and critical tests needed to verify multi-antenna designs.

Multi-antenna designs used in cellular and wireless LAN applications

Multi-antenna designs are found in many different industries. In cellular and wireless LAN applications, multi-antenna designs are used to increase peak data rate, capacity and improve the quality of service. How is this achieved?

- In cellular and WLAN, multi-antenna techniques such as diversity, spatial multiplexing MIMO (Multiple Input, Multiple Output), beamforming and Multi-User MIMO (MU-MIMO) use multiple antennas to transmit and/or receive data allowing theoretical peak data rates up to 1 Gbps in LTE-A downlink and 6.93 Gbps in 802.11ac systems. Future enhancements to LTE-A, 802.11ac and even 5G will allow for higher order modulation schemes, denser multi-antenna techniques and wider transmission bandwidths.
- In cellular networks, carrier aggregation combines multiple component carriers (CC) through wider transmission bandwidths up to 100 MHz. When CCs reside in different frequency bands, called inter-band carrier aggregation, multiple antennas are used to transmit the data in each frequency band. 3GPP Release 12 allows CCs to be combined in up to 3 different frequency bands.

Sheri DeTomas is Program Manager for the modular solutions at Keysight Technologies, Loveland, USA – www.keysight.com - She can be reached at Sheri_Detomas@keysight.com

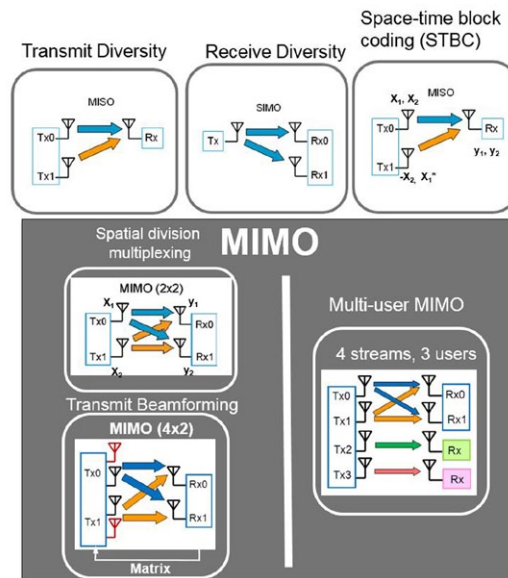


Fig. 1: Summary of multi-antenna techniques.

Enhanced multi-antenna techniques

Figure 1 provides a quick summary of multi-antenna techniques used in cellular and WLAN communication systems.

Path diversity uses multiple antennas at either the transmitter or the receiver to improve the robustness of the signal or the ability for the receiver to correctly receive the transmitted data. **Transmit diversity** uses multiple transmitters with a single receiver (MISO) and **Receive diversity** uses multiple receive antennas and a single transmitter (SIMO). These techniques are used to improve the signal quality under channel fading conditions.

Spatial multiplexing is a MIMO technique to improve the spectral efficiency, increasing either the data throughput for a single user or the system capacity for multiple users. MIMO techniques communicate using two or more transmit and receive chains and include multiple antennas on both the transmitter and receiver. Separate portions of user data are transmitted simultaneously to multiple receivers.

MU-MIMO allows data to be sent to multiple users simultaneously through spatially distributed transmissions in the same frequency spectrum to communicate with multiple devices.

Beamforming uses multiple antennas offsets in phase and magnitude to add directional transmission to the RF signal. The same signal is transmitted from two or more spatially separated transmission points simultaneously. T

The constructive in-phase signal summation results in a coherent power gain at the receiver. Beamforming has an effect similar to diversity in terms of increasing the signal robustness and improving the SNR at the receiver while minimizing interference with other devices in the system. This is very attractive in modern wireless communication systems due to the combined advantages of beam selectivity, interference management and coherent signal gain.

Multi-antenna design test challenges

Validation of multi-antenna designs can be challenging. Designers need to consider the analysis of the multiple transmit or receive chains and channel-to-channel performance in the measurement systems. Adding beamforming complicates these tests even further, typically adding the requirement for phase-coherent test systems to achieve accurate inter-channel magnitude and phase signal generation and measurements. Key test challenges include complicated test set up for higher order MIMO including beamforming applications, the ability to verify and visualize the multi-antenna performance at the RF antenna, cost and footprint of the multi-channel test system

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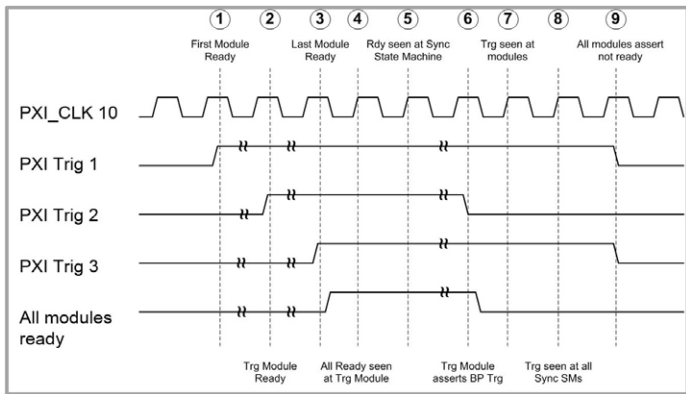


Fig. 2: PXI 10 MHz clock for backplane time synchronization.

Achieving a multi-channel phase-coherent test system

Phase-coherent channels are one key element of a multi-channel test system. Two signals are said to be coherent if they have a constant relative phase at all instances in time:

$$\rho_{XY} = \frac{E\{(X - \mu_X)(Y - \mu_Y)\}}{\sigma_X \sigma_Y} = \frac{\sigma_{XY}}{\sigma_X \sigma_Y}$$

Where:
 ρ = coherence
 E = expected value operator
 μ = average value
 σ = std deviation
 σ_{XY} = covariance of signal X and signal Y
 X = signal X
 Y = signal Y

- ρ = 1 is fully coherent
- ρ < 1 but ρ > 0 is partially coherent
- ρ = 0 is not phase coherent

This may seem simple, but is actually quite difficult to achieve. Modular PXI platforms are ideal for multi-channel synchronized systems due to the scalability, size and precise synchronization that can be achieved. Signals can be time aligned using a locked reference signal. As shown in figure 2, the PXI 10 MHz backplane clock is used to align and start all actions at the same time. Clock synchronization ensures that the waveform playback or waveform capture starts synchronously.

The common reference clock provides some level of time synchronization but not phase synchronization.

For phase alignment, the signals must have a constant relative phase at all instances in time, then coherence is a statistical property between signals. To achieve true phase-coherent measurements, a common local oscillator (LO) can be shared across source or analyzer channels so that all channels share the same phase properties. In figure 3, a single master synthesizer is used to enable a stable phase relationship.

In this example, the synthesizer used in the Keysight M9381A PXI vector signal generator exposes 4 LO connections that can be used with up to 4 different VSG modulators to achieve phase synchronization. For more than 4 channels, a LO distribution network can be used to split and amplify the common LO across the multiple chassis.

Calibration of the phase-coherent system

The offsets in magnitude and phase between channels can greatly impact multi-channel performance. Without calibration,

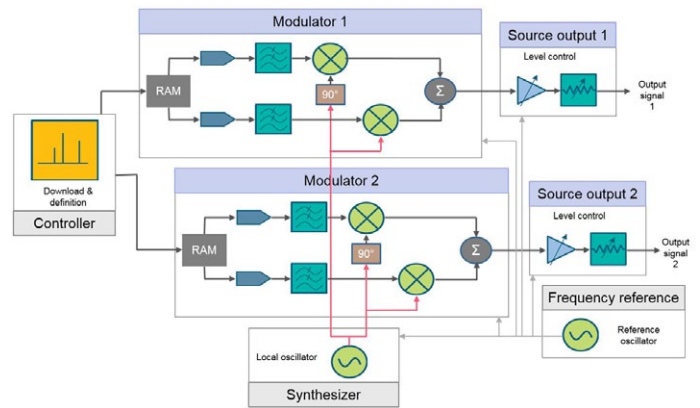


Fig. 3: Multi-channel phase-coherent sources with a common synthesizer.

there will be degraded results in the beamforming signals and the measurement results will be in question. Even when using a shared LO, some static time and phase skew will exist between instrument channels. In addition, there will be fixed magnitude and phase offsets due to cables, connectors, and signal conditioning. Compensating for these offsets will ensure that any measured differences are due to the device under test and not the test equipment.

A common calibration technique for a traditional multiple-channel source uses a multi-channel oscilloscope to measure the channel-to-channel performance of the signal generating system as shown in figure 4. This is typically a manual process and requires multiple steps to calculate the channel-to-channel delay at multiple frequencies, which is time consuming and expensive.

A new alternative method is to perform source channel-to-channel calibration using Keysight's patent-pending automated routine that uses one signal analyzer to extract the signal data and calculate the timing and phase skew between each channel. In this case, a known reference signal is played on each source and fed through a 4-way passive power combiner.

The combined signal is then fed to one signal analyzer for analysis. With the automated routine the corrections are calculated, stored, and ready to be applied during the multi-channel signal generation. With this method, only one analyzer is required and the automated routine makes it easier, faster, and saves cost.

A similar automated routine is used for correction of the multi-channel signal analysis system as shown in figure 4.

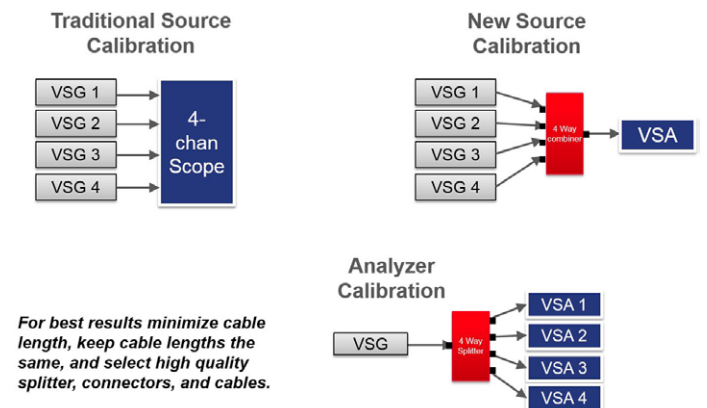
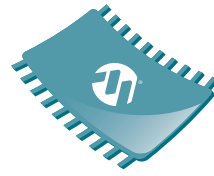


Fig. 4: Multi-channel phase-coherent calibration techniques.

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Overview

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Peripheral integration is key with communication and control peripherals like SPI, I²C™, EUSART, PWM, ADC, DAC, op amps, as well as specialized peripherals for USB, LCD and Ethernet. In addition, Microchip offers Core Independent Peripherals that provide even higher levels of flexibility and integration than have never been possible in previous 8-bit microcontrollers. These new Core Independent Peripherals include Configurable Logic Cell (CLC), Complementary Output Generator (COG), Numerically Controlled Oscillator (NCO), Zero Cross Detect (ZCD) and Hardware CVD (Capacitive Voltage Divider). Customers have made PIC MCUs a worldwide standard, with over one million development systems shipped. PIC microcontrollers are quick and easy to design into a wide variety of applications and have a long history of dependable product delivery.

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To provide customers a low-risk development environment, PIC microcontrollers offer seamless migration within the complete range of products. The 8-bit PIC microcontroller family is pin-compatible within a given pin count as well as code compatible between the architectures. Being able to migrate easily between various PIC MCUs allows flexibility to react to changing design requirements and feature enhancements. When you choose a Microchip solution, you maximize on the options for re-use in future product developments and preserve your investments in hardware, software and tools.

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In an effort to meet the needs of embedded system designers, silicon manufacturers continue to increase functionality and performance while decreasing the physical size and cost. This provides a significant benefit to both the embedded system designer and end consumer. However, as the demand for sophisticated consumer and embedded products continues to expand, so does the challenge of properly designing such applications.

As semiconductor technology continues to evolve to meet the demand for “smaller, faster and cheaper” solutions, the challenge to provide the key features and attributes needed for the latest embedded design grows. Microchip is committed to implementing technology advances that not only increase the performance and reduce the cost of the microcontroller, but do so without sacrificing key features such as:

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- **Analog Integration:** A rich Analog offering available in a low-cost MCU is a must for many of today's embedded designs.
- **High Voltage Variants:** Allow for connection to an application that has high voltage rails without the need of an external regulator.
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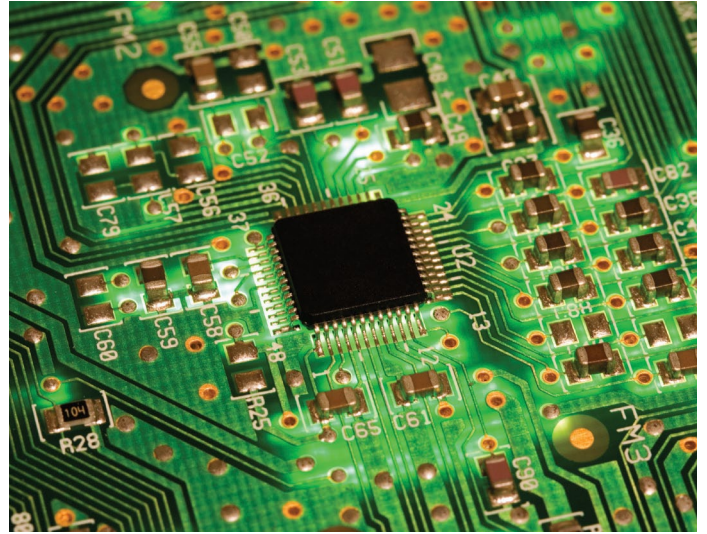
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While MCU core commonality is a trend, there are no “drop in” replacements. The reality of MCU selection is that you are entering into a partnership with your MCU supplier. To ensure success, technology leadership is critical, but it is equally important to work with a partner that is committed to strong business fundamentals such as:

- Financial security to weather any economic downturns
- Industry-leading lead times
- Industry-leading quality and reliability (ISO/TS-16949 qualified)
- Industry-leading EOL policy



8-bit PIC® Microcontroller Key Highlights

Core Independent Peripherals

- Configurable Logic Cell (CLC)
- Complementary Waveform/Output Generator (CWG/COG)
- Numerically Controlled Oscillator (NCO)
- Programmable Switch Mode Controller (PSMC)
- Signal Measurement Timer
- Hardware Limit Timer

Faster Time-to-Market

- Free software
- Pin and code compatibility, easy migration
- Pre-programmed parts via Quick Turn Programming (QTP)
- MPLAB Code Configurator

Intelligent Analog

- Rail-to-rail op amps
- Fast comparators
- 12b/10b/8b ADC
- 9b/8b/5b DAC
- Zero Cross Detect (ZCD)
- Slope Compensation

Design Support

- Free MPLAB X Integrated Development Environment
- Free C Compilers
- Comprehensive technical documentation
- World-class 24/7 technical support and training

Essential Features

- 5V+ operation
- EEPROM
- LCD, mTouch™ Sensing Solutions
- USB, CAN, Ethernet
- Analog Integration
- Peripheral Pin Select

eXtreme Low Power (XLP)

- Active current as low as < 30 μ A/MHz
- Sleep current as low as < 10 nA
- Battery lifetime > 20 years

Small Form Factors

- As small as 8-pin 2 × 3 UQFN and 28-pin 4 × 4 UQFN
- Many other package options available, e.g. 3 × 3 QFN, 5 × 5 UQFN, 0.5 mm z-dimension

Safety Critical Features

- CRC and Memory Scan
- Windowed Watchdog Timer
- Hardware Limit Timer

PIC® MCUs with Core Independent Peripherals

Core Independent Peripherals

PIC microcontrollers with Core Independent Peripherals take 8-bit MCU performance to a new level. With a number of on-board modules designed to increase capability in any control system, these MCUs represent the best value in embedded design. The following Core Independent Peripherals are designed to handle their tasks with no code or supervision from the CPU to maintain operation. As a result, they simplify the implementation of complex control systems and give designers the flexibility to innovate.

- **CLC (Configurable Logic Cell):** Integrated combinational/sequential logic and interconnection/re-routing of digital peripherals
- **COG (Complementary Output Generator):** An extremely configurable waveform generator with programmable rising and falling edge events, precision dead band (5 ns), polarity, auto shut-down and phase control.
- **CWG (Complementary Waveform Generator):** Automated complementary output with control of key parameters such as dead-band and auto-shutdown states.
- **NCO (Numerically Controlled Oscillator):** Precision linear frequency generator with fine step resolution: < 1 Hz up to 500 KHz. Can also be used as a general purpose 20-bit timer/counter.
- **PSMC (Programmable Switch Mode Controller):** 16-bit PWM with dedicated 64 MHz clock source and event triggering. Features automated complementary output with control of key parameters such as phase, dead-band, blanking and auto shut-down states.
- **16-bit PWM:** High resolution 16-bit PWM with edge and center aligned modes for reduced EMI. Can also be used as a general purpose 16-bit timer/counter.
- **SMT (Signal Measurement Timer):** 24-bit precision timer module providing accurate measurement of any digital signal including period, pulse width, frequency, duration and duty cycle. Can also be used as custom digital protocol decoder.
- **HLT (Hardware Limit Timer):** Hardware monitoring timer for missed periodic events and fault detection. Can also be used as a general purpose 8-bit timer/counter with external reset capabilities.



Development Tools

PICkit™ Low Pin Count Development Board (DM164130-9)



- Development board for 8, 14, 20-pin 8-bit PIC MCU
- Populated with PIC16F1829-I/P and ships with PIC18F14K22-I/P (20-pin) MCU
- This board package contains assembled board with area for prototyping circuits and bare board as well
- Software can be rewritten to accommodate new technologies

PIC10F32X Development Board (AC103011)



- Populated with the PIC10F322 6-pin MCU
- Factory programmed with CWG, NCO and CLC demo software
- Prototype area for development purposes
- User's guide and source code available

Featured Core Independent Peripherals Product Families

Superset Device	Pins	Flash/RAM Family Range	Analog (Max)	Timers/PWM (Max)	Comms (Max)	Core Independent Peripherals (Max)	Additional Features
PIC10F322	6	448–896B 64B	8-bit ADC (3)	8-bit (2), PWM (2)	–	CLC (1), CWG, NCO	–
PIC12F1572	8	1.75–3.5 KB 128–256 KB	Comp, 10-bit ADC (4), 5-bit DAC (1)	8-bit (2), 16-bit (4), PWM (3)	EUSART (1)	CWG, 16-bit PWM (3)	–
PIC16F1613	8–14	3.5 KB 256B	Comp (2), 10-bit ADC (8), ZCD	8-bit (4), 16-bit (1), PWM (2)	USB	CWG, SMT (2), HLT (3)	CRC/Scan, WWDT
PIC16F1509	8–14	1.75–14 KB 64–512B	Comp (2), 10-bit ADC (12), 5-bit DAC (1)	8-bit (2), 16-bit (1), PWM (4)	EUSART (1), SPI/I ² C™ (1)	CLC (1), CWG, NCO	–
PIC16F1709	14–20	7–14 KB 256–1 KB	Comp (2), Op amp (2), 10-bit ADC (12), ZCD	8-bit (4), 16-bit (1), PWM (4)	EUSART (1), SPI/I ² C (1)	CLC (3), COG	Peripheral Pin Select
PIC16F1719	28–40	7–28 KB 512–2KB	Comp (2), Op amp (2), 10-bit ADC (28), ZCD	8-bit (4), 16-bit (1), PWM (4)	EUSART (1), SPI/I ² C (1)	CLC (4), COG, NCO	Peripheral Pin Select
PIC16F1789	28–40	3.5–28 KB 256–2 KB	Comp (4), Op amp (2), 10-bit ADC (14), 8-bit DAC (4)	8-bit (4), 16-bit (1), PWM (7)	EUSART (1), SPI/I ² C (1)	PSMC (4)	EEPROM

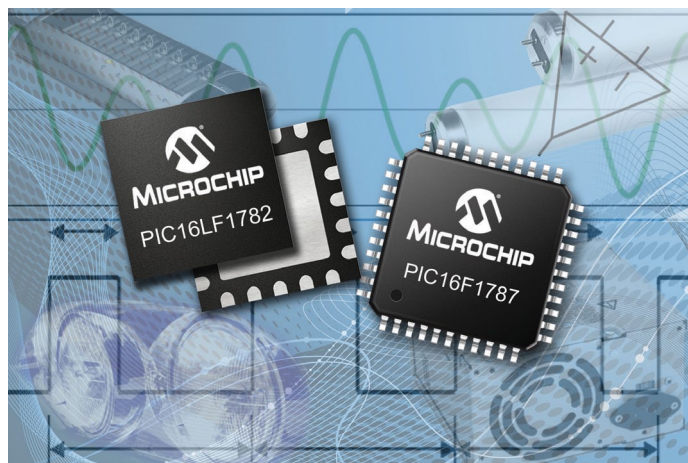
PIC® MCUs with Intelligent Analog

Intelligent Analog

Microchip's Intelligent Analog solutions help you reduce your component count to design smaller, more cost-effective boards. You will benefit from simplified, higher-performance designs and easier procurement of components. In addition, using the MCU's programmable analog interconnects and programmability offers you increased flexibility and analog topology agility.

The following Analog Peripherals have been integrated to simplify your next design:

- **Op Amps:** A basic building block in electronic design. Integrating these basic building blocks into the microcontroller offers increased flexibility and reliability while reducing BOM costs and board space.
- **High Speed Comparators:** Comparators have been available in the PIC MCU lineup for many years. We now offer feature-rich high speed (50 nS) variants to enable faster response and more efficient closed-loop feedback designs.
- **High Current Sink/Source Pins:** High Current Sink/Source pins with the ability to sink/source 50 mA enable direct MOSFET drive from the microcontroller.
- **Conversion (Analog-to-Digital/Digital-to-Analog):** Within the 8-bit portfolio we provide a wide range of resolution and speed grades available to meet most embedded requirements.
- **Zero Cross Detect:** This peripheral is used to detect when an A/C signal crosses ground (0V when referenced to the rest of the system). Common uses include A/C period measurement and TRIAC control applications. It can also be used as part of an algorithm to help determine optimal periods when switching should occur to reduce application EMI.
- **Slope Compensation:** This integrated peripheral performs the slope compensation function for Peak Current Mode power supplies.



Development Tools

F1 PSMC 28-pin Evaluation Board (DM164130-10)



- PSMC development platform using the PIC16F1783
- Break-out headers for application development
- Connect to any F1 motor control add-on
- Prototyping area

PICDEM™ Lab Development Kit (DM163045)



- Development platform for 6 to 20-pin parts
- Works across different architectures
- Includes comprehensive user guide, labs, and application examples
- Support for PICkit 3 and Expansion Headers

Featured Core Independent Peripherals Product Families

Superset Device	Pins	Flash/RAM Family Range	Intelligent Analog (Max)	Timers/PWM (Max)	Comms (Max)	Core Independent Peripherals (Max)	Additional Features
PIC16F527	20	1.5 KB 68B	Comp (2), Op amp (2), 8-bit ADC (8)	8-bit (1)	–	–	EEPROM
PIC16F570	28	3 KB 64B	Comp (2), Op amp (2), 8-bit ADC (8)	8-bit (1)	–	–	EEPROM
PIC16F753	8–14	1.75–3.5 KB 64–128B	Comp (2), Op amp (2), 10-bit ADC (8), 9-bit DAC (1), Slope Comp	8-bit (3), 16-bit (1), PWM (1)	–	–	HV Shunt, High-current I/O
PIC16F1709	25–20	3.5–14 KB 256–1 KB	Comp (2), Op amp (2), 10-bit ADC (12), ZCD	8-bit (4), 16-bit (1), PWM (4)	EUSART (1), SPI/I ² C™ (1)	CLC (3), COG	Peripheral Pin Select
PIC16F1719	28–40	7–28 KB 512–2 KB	Comp (2), Op amp (2), 10-bit ADC (28), ZCD	8-bit (4), 16-bit (1), PWM (4)	EUSART (1), SPI/I ² C (1)	CLC (4), COG, NCO	Peripheral Pin Select
PIC16F1789	28–40	3.5–28 KB 256–2 KB	Comp (4), Op amp (2), 12-bit ADC (14), 8-bit DAC (4)	8-bit (4), 16-bit (1), PWM (7)	EUSART (1), SPI/I ² C (1)	PSMC (4)	EEPROM

Safety-Critical Features

Summary

Engineers are commonly faced with the challenge of complying with safety standards or the need to add a fail-safe operation in their design, while keeping cost and complexity to a minimum. Additionally, Microchip offers a family of 8-bit MCUs which integrates fault-detecting hardware features to assist you in developing your safety-critical applications. This high level of integration makes these MCUs suitable for many applications like home appliances, industrial machinery, RPM indicators and power supplies.

The Window Watchdog Timer (WWDT), Cyclic Redundancy Check with Memory Scan (CRC/SCAN) and Hardware Limit Timer (HLT) help ease implementation of safety standards or fail-safe features. In addition, the higher-memory products include additional peripherals to support control and power management applications. By eliminating code overhead and external components, these features help reduce design complexity and save costs, while also enabling faster time-to-market.

Highlights

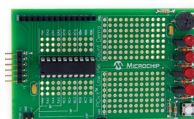
- **Cyclic Redundancy Check with Memory Scan (CRC/SCAN):** Automatically calculates CRC checksum of Program/DataEE memory for non-volatile memory integrity. Additionally provides a general purpose 16-bit CRC for use with memory and communications data. Monitoring is done in hardware with no interruption to the CPU, reducing overall code.
- **Windowed Watchdog Timer (WWDT):** System supervisory circuit that generates a reset when software timing anomalies are detected within a configurable critical window. Gives engineers the flexibility and ease to add monitoring to design.
- **24-bit Signal Measurement Timer (SMT):** Performs high-resolution measurements of any digital signal in hardware, resulting in more precise and accurate measurements. This can be used as a standard timer, ideal for speed control, range finding and RPM indicators.
- **Hardware Limit Timer (HLT):** General purpose 8-bit timer/counter with hardware monitoring capabilities for missed periodic events and fault detection of external hardware.



- **Zero Cross Detect (ZCD):** Detects high-voltage AC signals at the lowest crossing. Simplifies TRIAC and switching control, eliminating the need for additional components.
- **Complementary Waveform Generator (CWG):** Provides non-overlapping complementary waveforms for various inputs including Comparators and PWM, while offering enhanced features like deadband control, auto shutdown, auto reset, phase control, blanking control.
- **Capture Compare and PWM (CCP):** Includes a 10-bit PWM which can be utilized to implement a variety of motor control and lighting applications.

Development Tools

PICkit™ Low Pin Count Development Board (DM164130-9)



- Development board for 8, 14, 20-pin 8-bit PIC MCU
- Populated with PIC16F1829-I/P and ships with PIC18F14K22-I/P (20-pin) MCU
- This board package contains assembled board with area for prototyping circuits and bare board as well
- Software can be rewritten to accommodate new technologies

Featured 8-bit MCUs with Safety-Critical Features

Device	Program Memory (Kbytes)	Data SRAM (bytes)	I/O Pins	8/16-bit Timers	Comparators	10-bit ADC (ch)	Zero Cross Detector	CCP/10-bit PWM	CWG	CLC	SMT/HLT	Angular Timer	Window Watchdog Timer	CRC + Memory Scan	Math Accelerator	PPS	EUSART	I ² C™/SPI
PIC12(L)F1612	3.5	256	6	4/1	1	4	1	2/0	1	0	2/1	0	✓	✓	0	-	0	0
PIC16(L)F1613	3.5	256	12	4/1	2	8	1	2/0	1	0	2/1	0	✓	✓	0	-	0	0

PIC® Microcontrollers with XLP Technology

eXtreme Low Power (XLP) Technology

- Sleep currents down to 9 nA
- Active Mode currents down to 30 μ A/MHz
- Execution Efficiency with more than 80% PIC MCU single cycle instructions
- Execute code smarter, sleep longer, maximize battery life
- Wake-up sources including RTC, WDT, BOR, Interrupts, Reset or POR

Low Power Peripheral Integration

Many of today's low power products need advanced peripherals. Microchip offers low power devices with peripherals like USB, LCD and mTouch capacitive sensing. This eliminates the need for additional parts in the application, which saves cost, current and complexity.

Low Power Reliability

In addition to peripherals, products with XLP have system supervisory circuits specially designed for battery powered products.

- Watchdog Timer down to 200 nA, provides protection against system failure
- Real-Time Clock/Calendar down to 400 nA, provides precise timekeeping
- Brown-out Reset down to 45 nA, protects as batteries are depleted or changed

Battery Life Estimator

The XLP Battery Life Estimator is a free software utility to aid you in developing eXtreme Low Power applications with Microchip's PIC MCUs featuring XLP technology.

- Profile your application Run and Sleep time (duty cycle)
 - Select operating temperature and operating voltage
 - Pre-loaded with most common battery specifications
- www.microchip.com/BLE



Run from a Single Battery

The MCP1623/4 and MCP1640 Synchronous Boost Regulators enable single-cell battery applications, ideal for small, portable and lightweight applications.

- Power any PIC MCU down to 0.35V
- Provides 2–5.5V fixed/stable output voltage

Development Tools

XLP 8-bit Development Board (DM240313)



- Supports PIC16 and PIC18 devices
- LCD and buttons
- Flexible power options
- Expansion connector
- Current measurement points

Featured XLP Product Families

Superset Device	Pins	Flash (KB)	Sleep (nA)	Active (μ A/MHz)	Special Features
PIC16F727	20–44	3.4–14	20	55	–
PIC16F1509	20	7–14	25	30	CLC, CWG, NCO
PIC16F1613	8–14	3.5	50	32	Safety critical and core independent peripherals
PIC16F1709	14–20	3.5–14	50	32	Intelligent analog and core independent peripherals
PIC16F1719	28–40	7–28	50	32	Intelligent analog and core independent peripherals
PIC16F1789	28–40	3.5–28	50	32	Intelligent analog and core independent peripherals
PIC16F1829	8–20	3.5–14	20	55	–
PIC18F1947	28–64	7–28	60	55	LCD
PIC18F46K20	28–40	8–64	50	138	–
PIC18F87K22	20–80	8–128	9	197	–

All numbers are typical values, sleep numbers refer to the lowest power Sleep mode available on each family.

PIC® Microcontrollers with mTouch™ Technology

Touch Sensing

Touch sensing has become an alternative to traditional push-buttons and switches providing:

- Lower cost of manufacturing and assembly
- Elegant and stylish designs
- Increased reliability with fewer moving parts
- Proximity-sensitive human interfaces

Microchip's mTouch Sensing Solutions allow you to integrate touch sensing with application code in a single microcontroller, reducing total system cost. Microchip offers a broad portfolio of low-power, low-cost and flexible solutions for keys/sliders and touch screen controllers. Get to market faster using our easy GUI-based tools, free source code and low-cost development tools.

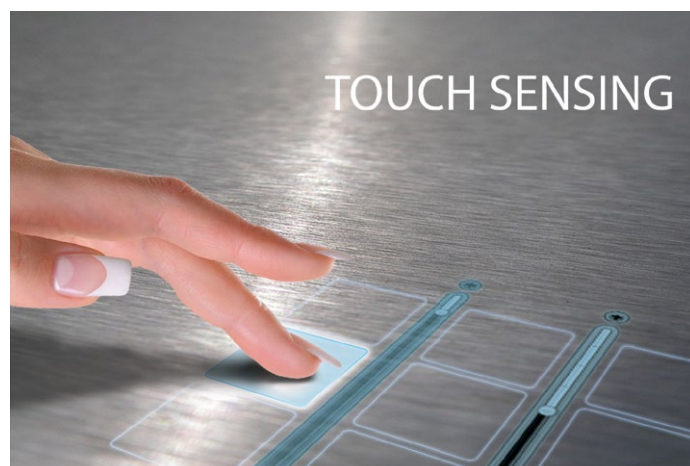
Keys, Sliders, Wheels and Proximity Detection

- Industry's lowest-power touch sense solutions
 - Capacitive sensing in less than 5 μ A
 - Proximity sensing down to less than 1 μ A
- No external components
- Works through plastic, glass and metal surfaces
- Waterproof designs for all weather conditions
- High noise robustness
- Integrated peripherals such as USB, segmented and graphical LCD modules for true human interface system-on-a-chip
- Free software library simplifies implementation and source code puts you in control

Capacitive Voltage Divider (CVD)

CVD is a charge/voltage based technique to measure relative capacitance on a pin using only the ADC.

- Software implementation
- 8, 16, and 32-bit support
- Proximity sensing support
- Low temperature dependence
- Low V_{DD} Dependence
- Minimal hardware requirements
- Low-frequency noise rejection
- Metal over cap compatible



Hardware CVD

Hardware CVD (HCVD) has been implemented on some of our new devices providing automated capacitive touch sampling, thereby reducing code size and decreasing CPU usage.

Development Tools

Enhanced mTouch™ Capacitive Evaluation Kit (DM183026-2)



- Features PIC16F, PIC18F, PIC24F and PIC32F
- Includes 8 buttons, matrix and sliders daughter boards
- GUI for easy configuration and real time data monitoring

Metal Over Cap Accessory Kit (AC183026)



- For use with the DM183026-2
- 1 daughter board featuring stainless steel cover
- 1 daughter board featuring a plastic cover

Featured HCVD Product Families

Device	Pins	Flash/RAM	HCVD	Voltage (V)	Additional Features
PIC12LF1552	8	3.5 KB 256B	✓	1.8–3.6	10-bit ADC (4), SPI/I ² C™
PIC16LF1554	14	7 KB 256B	✓	1.8–3.6	10-bit ADC (11), EUSART, SPI/I ² C
PIC16LF1559	20	14 KB 512B	✓	1.8–3.6	10-bit ADC (17), EUSART, SPI/I ² C

Software CVD available on all PIC MCUs with ADC

www.microchip.com/mtouch

PIC® Microcontrollers with LCD

Segmented Displays

Segmented displays are used in a wide variety of applications, ranging from meters to portable medical devices to thermostats to exercise equipment. PIC MCUs with integrated LCD drivers can directly drive segmented displays with letters, numbers, characters and icons. The main features of Microchip's LCD portfolio include:

- Flexible LCD segments
 - 28 pins: up to 72 segments
 - 44 pins: up to 116 segments
 - 64 pins: up to 184 segments
 - 80 pins: up to 192 segments
 - 100 pins: up to 480 segments
- Variable clock inputs
- Integrated voltage bias generation
- Direct drive for both 3V and 5V powered displays
- Software contrast control for boosting or dimming for different temperature or lighting conditions
- Drive LCD while conserving power in Sleep mode
- Integrated real time clock and calendar for displaying time and date information
- mTouch capacitive touch sensing capability
- Crystal-free USB 2.0 options





Direct Drive for Segmented Displays

The LCD PIC microcontrollers support direct LCD panel drive capability with no external components needed, lowering total system cost. They have integrated voltage bias generation which allows the MCU to generate the different voltage levels that are required to drive the LCD segment pins and provide good contrast for the display. The LCD MCUs support a range of fixed and variable bias options as well as variable clock inputs, giving you the flexibility to work with many different glass vendors.

Contrast Control

Software contrast control is a key feature using firmware to either boost or dim the contrast of the display. Boost the contrast up to V_{DD} or beyond if you are using one of the MCUs with an integrated charge pump. Software contrast control allows you to vary the contrast on the LCD to account for different operating conditions such as temperature, lighting and humidity. Also, software contrast control can be invaluable for portable applications. As the battery level starts to drop, the firmware can apply a boost to the contrast helping extend the battery life while still producing a crisp image on the display.

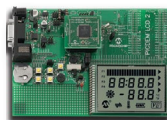
Featured LCD Product Families

Superset Device	Pins	Flash (KB)	Max Segments	Voltage (V)	Additional Features
 PIC16LF1907	28–40	3.5–14	116	1.8–3.6	10-bit ADC, EUSART
 PIC16(L)F1947	28–64	7–28	184	1.8–5.5	10-bit ADC, EEPROM, I ² C™, SPI, Comparators
 PIC18F87K90	64–80	32–128	192	1.8–5.5	10-bit ADC, EEPROM, I ² C, SPI, RTCC, Comparators, ECCP
 PIC18F97J94	64–100	32–128	480	2–3.6	Crystal-free USB, V _{BAT} , 12-bit ADC, ECCP, EUSART, I ² C, SPI, Comparators



Development Tools

PICDEM™ LCD 2 Demo Board (DM163030)



- Illustrates and supports the main features of Microchip's 28-, 40-, 64- and 80-pin LCD PIC microcontrollers
- LCD glass with icons, numbers, alphanumeric and starburst display
- Separate Processor Plug-in Modules (PIMs) are available to evaluate all of the LCD products
- Booster capability for contrast control and dimming

LCD Explorer Development Board (DM240314)



- Supports PIC24 and PIC18 LCD PIC MCUs with XLP technology
- Current measurement terminals, mTouch sensing solutions and expansion connector
- Eight common LCD glass types
- Supports 1/3 biasing
- CTMU switch to showcase touch sensing
- Four switches implemented for software demonstration
- Power the board using 9V power supply, USB connector, two AAA batteries or connector for V_{BAT} current measurement

PIC18F97J94 PIM Demo Board (MA180034)



- Features 100-pin PIC18F97J94 for evaluation of all 100-, 80- and 64-pin PIC18F97J94 LCD/USB/General Purpose MCUs
- Plugs into LCD Explorer Board (DM240314) for additional functionality
- Contains code examples

PIC® Microcontrollers with Integrated USB

USB

USB communication is growing in popularity for remote upgrades, downloading data and other portable serial communication applications. Microchip's USB PIC MCUs bring the benefits of full-speed USB to a broad range of embedded designs that can operate in various environments and locations, enabling easy access to other USB devices such as printers, handheld devices or PCs.

Full-Speed USB 2.0 (Device)

Microchip offers USB solutions capable of full-speed USB operation with the PIC16 and PIC18 family of devices. If USB On-The-Go is a requirement we have solutions in our 16 and 32 bit families.

Crystal-Free USB

USB communication requires 48 MHz with 0.25% accuracy over temperature. This is typically done with an external crystal and an internal USB. We have recently implemented technologies that allow a crystal-free implementation with the following benefits:

- Lower BOM cost
- Tiny PCB footprint
- Simplified design
- More robust solution

Free USB Software

Microchip has software to support USB on 8, 16 and 32-bit MCUs. This software is royalty-free source code and also includes sample projects. The 8-bit family supports USB device mode with full-speed operation. Additional software support includes full C and RTOS development environments. Included within this USB Framework Library is Microchip's USB Framework Configuration Tool.

- Generates configuration files with just a few clicks
- Royalty-free source code
- Firmware projects and USB drivers for the PC

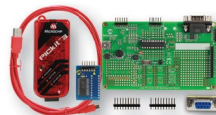
Add USB to any PIC® MCU with EUSART

The MCP2200 is a stand-alone USB to EUSART serial converter that enables full-speed USB connectivity in applications containing a EUSART interface. The MCP2200 has 256 bytes of EEPROM and eight general purpose I/O. It offers a simple plug-and-play solution, allowing USB connectivity with very little design effort.



Development Tools

Low Pin Count USB Development Kit (DV164139-2/DM164127-2)



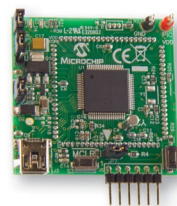
- Development platform for 14 and 20-pin USB MCUs
- For evaluation of PIC16F145X and PIC18F14K50/13K50 20-pin USB MCUs
- Contains hardware, software and code examples
- Self-directed course and lab materials

PICDEM™ Full-Speed USB Demo Kit (DM163025-1)



- Evaluation platform for PIC18F2X/4XK50 family of USB MCUs
- Full speed USB 2.0 device without the need for an external crystal
- Populated with the PIC18F45K50

PIC18F87J94 PIM Demo Board (MA180033)



- Features 80-pin PIC18F87J94 MCU for evaluation of all 80- and 64-pin PIC18F97J94 USB/LCD/General Purpose MCUs
- Can be used with PIC18 Explorer Board (DM183032) for additional functionality
- Contains code examples

Featured Crystal-Free Product Families

Superset Device	Pins	Flash (KB)	Voltage (V)	Crystal-Free	Additional Features
 PIC16(L)F1459	14–20	14	1.8–5.5	✓	CWG, 10-bit ADC, DAC, I ² C™, SPI, EUSART
 PIC18(L)F45K50	28–44	16–32	1.8–5.5	✓	10-bit ADC, Comparators, ECCP, EUSART, SPI, I ² C
 PIC18F97J94	64–100	32–128	2–3.6	✓	V _{BAT} , 12-bit ADC, LCD, ECCP, EUSART, I ² C, SPI, Comparators

www.microchip.com/usb

PIC® Microcontrollers with Ethernet

Embedded Ethernet

Microchip addresses the growing demand for embedded Ethernet products with the ENC624J600, ENC424J600 and ENC28J60 as standalone Ethernet controllers, and the PIC18F97J60 family, which are IEEE 802.3™ compliant and fully compatible with 10/100/1000Base-T networks. Microchip's Ethernet solution also includes a free and robust TCP/IP stack optimized for PIC microcontroller and dsPIC® digital signal controller families (www.microchip.com/tcpip).

Development Tools

PICDEM.net™ 2 Development Board (DM163024)



- Supports ENC28J60 and PIC18F97J60 devices
- Can be developed as web server

PICtail™ Ethernet Daughter Board (AC164121)



- Can be plugged to any of the PIC18 demonstration boards
- Populated with ENC28J60
- Interfaces to RJ-45 female connector

Featured Ethernet Product Families

Superset Device	Pins	MCU + Ethernet	Integrated MAC + PHY	Interface	Hardware Security	Pre-programmed MAC	Additional Features
PIC18F97J90	64–100	✓	✓ (10 Base-T)	–	–	–	IEEE 802.3™ compliant, Auto-negotiation, Configurable buffer
ENC28J60	28	–	✓ (10 Base-T)	SPI	–	–	
ENC624J600	44–64	–	✓ (10/100 Base-T)	SPI/Parallel	✓	✓	

www.microchip.com/ethernet

PIC® Microcontrollers with CAN & LIN

Controller Area Network (CAN)

Microchip offers a complete line of 8-, 16- and 32-bit MCUs to meet the needs of high-performance embedded applications using the CAN bus. On-chip peripherals include A/D converters, comparators, motor control PWMs, USART (RS485, RS232, LIN) and Master I²C/SPI.

Microchip's Enhanced CAN Module

- Supports CAN 1.2, CAN 2.0A and CAN 2.0B protocols
- DeviceNet data bytes filter support
- Standard and extended data frames
- 0–8 bytes data length
- Three modes of operation:
 - Mode 0: Legacy mode
 - Mode 1: Enhanced Legacy mode with DeviceNet support
 - Mode 2: FIFO mode with DeviceNet support
- Six buffers programmable as Rx/Tx buffers

Local Interconnect Network (LIN)

Microchip offers a LIN compatible USART on a wide variety of microcontrollers. We have recently taken our LIN offering to a new level by offering microcontrollers with integrated LIN transceivers.

Featured CAN and LIN Product Families

Superset Device	Pins	Flash (KB)	CAN Tx Buffers	CAN Rx Buffers	LIN Tx Rx	Voltage (V)	Additional Features
PIC18F4685	28–44	16–96	3	2	–	2–5.5	LIN USART
PIC18F66K80	28–64	32–64	3	2	–	1.8–5.5	LIN USART
PIC16F1829LIN	14	8K	–	–	Integrated	2.3–5.5	LIN USART

www.microchip.com/can
www.microchip.com/lin

Support

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

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

Sales Office Listing

AMERICAS

Atlanta
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Austin
Tel: 512-257-3370

Boston
Tel: 774-760-0087

Chandler
Tel: 480-792-7200

Chicago
Tel: 630-285-0071

Cleveland
Tel: 216-447-0464

Dallas
Tel: 972-818-7423

Detroit
Tel: 248-538-2250

Houston
Tel: 281-894-5983

Indianapolis
Tel: 317-773-8323

Los Angeles
Tel: 949-462-9523

New York
Tel: 631-435-6000

San Jose
Tel: 408-735-9110

Toronto
Tel: 905-673-0699

EUROPE

Austria - Wels
Tel: 43-7242-2244-39

Denmark - Copenhagen
Tel: 45-4450-2828

France - Paris
Tel: 33-1-69-53-63-20

Germany - Dusseldorf
Tel: 49-2129-3766400

Germany - Munich
Tel: 49-89-627-144-0

Germany - Pforzheim
Tel: 49-7231-424750

Italy - Milan
Tel: 39-0331-742611

Italy - Venice
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399

Poland - Warsaw
Tel: 48-22-3325737

Spain - Madrid
Tel: 34-91-708-08-90

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800

Training

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

- Technical Training Centers and Other Resources: www.microchip.com/training
- MASTERS Conferences: www.microchip.com/masters
- Worldwide Seminars: www.microchip.com/seminars
- eLearning: www.microchip.com/webseminars

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Hangzhou
Tel: 86-571-87928115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-5407-5533

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Wuhan
Tel: 86-27-5980-5300

China - Xiamen
Tel: 86-592-2388138

China - Xian
Tel: 86-29-8833-7252

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-3019-1500

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Verifying the RF antenna design

Once you have achieved a true phase-coherent system, you can now focus on the critical tests needed to verify the RF antenna design.

When testing multi-antenna transmitter systems, the MIMO recovery involves the separation of the multiple signal components in the presence of noise and interference. Table 1 shows the key measurements to validate the RF antenna design.

It's useful to start by viewing the RF signal from each antenna element to look for any fundamental RF power or timing impairments. Next, view the demodulation results including the IQ constellations, EVM result metrics, detected resource allocations, UE-specific RS weights, cell-specific RS weights and impairments as well as UE-specific and common broadcast antenna beam patterns. A multi-channel VSA system with precise time and phase synchronization allows for analysis of the multiple antenna elements including cross-channel performance and cumulative EVM.

The main objective of receiver testing is to make performance measurements on the entire receiver. There are many factors that can influence the receiver's performance and this can be especially challenging when multiple receivers are used in MIMO tests.

Often simulation of the MIMO transmitter system is needed. A multi-channel VSG system can simulate complex MIMO and beamforming waveforms with cross-carrier scheduling in up to 8x8 MIMO. If inter-band carrier aggregation is combined with 8x8 MIMO, it's possible to have up to 16 synchronized signal generators. Once you have established a multi-channel synchronized signal simulation environment, then the standard measurements can be performed on each receiver chain separately and the MIMO performance can be verified.

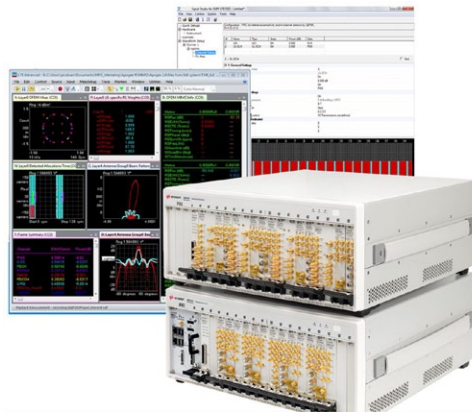


Fig. 5: Example 4x4 modular system with phase-coherent signal generation and signal analysis for verification of multi-antenna designs.

Validate RF antenna designs

- RF performance for up to 8 antenna elements including measurements like occupied bandwidth, spectral emissions mask, power, spurs, adjacent channel power
- Crosstalk/Isolation, Time Alignment Error (TAE)
- Demodulation measurements to verify the IQ constellations and modulation quality with EVM
- Baseband encoded beamforming weighting algorithm correctness
- Beam patterns w/ cell-specific RS power, EVM, timing, phase, symbol clock, frequency error
- Beamforming gain

Summary

As wireless standards continue to evolve, enhanced multi-antenna designs that include MIMO and beamforming will become even more common, placing greater demands on the design verification. New 5G standards will include even tougher requirements such as millimeter-wave frequencies up to 80 GHz, wider transmission bandwidths up to 3 GHz, denser modulation schemes and more antennas to implement techniques like massive MIMO.

These will place more demands on test system designs requiring wideband, multi-channel, phase-coherent test techniques. While configuring multi-channel phase-coherent measurement systems has traditionally been very difficult, today's modular instruments with phase-coherent capability provide the needed synchronization, density, scalability for the future and tools for engineers to gain deeper insight to their designs faster.

JTAG/Boundary-scan: The development of standards

By Peter van den Eijnden

Prompted by a change in device packaging almost 30 years ago (from through hole to surface mount) a group of like-minded test engineers met to consider the impact that these parts would have on testing their forthcoming assemblies – they called themselves JTAG or Joint Test Action Group and were formed from representatives of Philips, BT, TI, IBM, DEC and others.

In most cases PCB testing at that time (mid 1980s) had been accomplished using ICT (In-Circuit Testers) for individual component and PCB testing, or functional testers that could mimic the environment of the UUT (Unit Under Test) to send/receive

stimulus and response signals. The work of the JTAG committee however would change the test landscape dramatically.

The fruits of their labour was the now familiar 'Test Access Port and Boundary-scan Architecture' (aka IEEE 1149.1), and it describes how an embedded serial scan register can access digital signal pins of its host device to either capture an input signal or propagate an output signal through the pin of the device while isolating its regular function.

By applying test patterns across interconnections between devices, assemblies could be tested for open circuits and shorts. Soon after tests were being developed that could stimulate and check the interconnects to RAMs, Flash and other logic parts. A few years after that the JTAG TAP was being used access for configuring/programming PLDs FPGAs and micro-controllers.

Peter van den Eijnden is Managing Director of JTAG Technologies - www.jtag.com

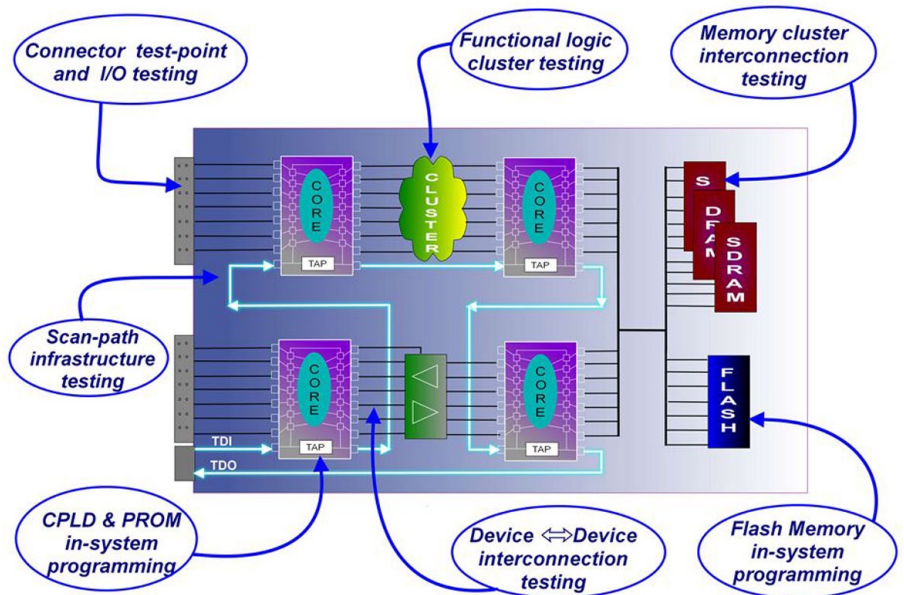
Fast forward 30 years and you can see that JTAG/IEEE 1149.1 usage for both testing and programming has become mainstream, being used extensively in testing of PCB assemblies within Defense, Aerospace, Telecoms Automotive, and Industrial sectors. Yet the need to pre-empt future test issues remains a constant and current wisdom suggests more 'at-speed' testing through use of [device] embedded instruments is to be encouraged

The most recent major update to standard 1149.1 came in 2013 with a sizable addendum to the original work which came about following a period of intense activity around 2010, with two separate groups proposing similar updates to the existing 1149.1 standard, which was by then 20 years old.

As well as 1149.1 2013 there also existed a group working on IEEE 1687. Both groups had identified deficiencies in the existing standard and both groups have addressed these through the introduction of more 'dynamic' IC infrastructures. In the case of 1149.1 2013 the driver for the changes was to standardise some of the design practices that IC vendors had introduced on a unilateral basis, such as initialisation protocols, individual device id codes and power management scenarios. While in the case of 1687 the main driver was to improve board-level 'testability' through the greater use of embedded test cores (BIST IP) accessed via an extended standardised infrastructure.

The now-ratified extension to 1149.1 has more than doubled the size of the descriptive document to 444 pages and includes the syntax of a new procedural description language (PDL) that is used to define the usage of the dynamic register segmentation and device IP hierarchy for a given application. IEEE 1687 meanwhile also features PDL, however there is only a basic level of compatibility between the two PDLs – apparently due to the vastly different focus of each new standard!

PDL is designed to document the procedures for stimulating and observing test data register fields for 1149.1-2013 and in P1687, the procedures for stimulating and observing data to an instrument. Not much of a difference except that in P1687 a second language is required to describe the [embedded instrument] access networks – ICL (Instrument Control Language) while in 1149.1-2013 the access network descriptions are embedded in an extended BSDL model. For complex networks



that make extensive use of embedded instruments P1687s ICL is claimed to be better suited.

See below redrawn block diagrams of the two 'competing' standards so the differences can be made clear.

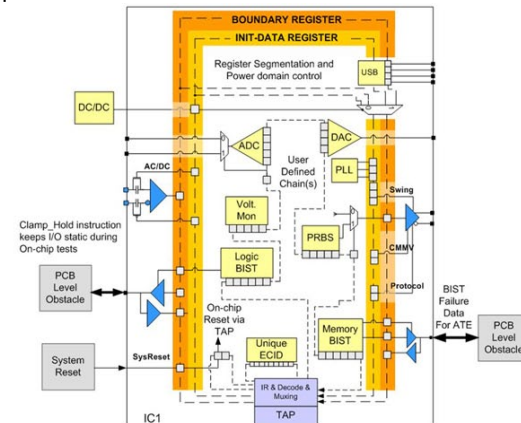
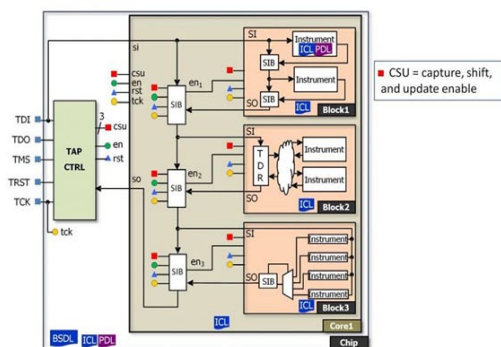
The argument for the continued development of standards are clear. Chiefly these are a) to keep the technology relevant to today's designs and b) to ease the task of tool vendors who rely on standard techniques to achieve maximum levels of automation in application generation. c) expand the market potential of a given methodology.

What else is in store for the future? Well I think we can expect expansion of the features for enabling JTAG to go in two, more or less opposite, directions.

1) More embedded testing at device level (as per IEEE 1687 and IEEE 1149.7) and

2) Extended infrastructures for system-level access and test as espoused by the SJTAG committee (see www.sjtag.org) who's purpose is stated on the web-site as follows – '...to provide an extension of the IEEE 1149.1 standard specifically aimed at enabling the configuration, control, management, and representation of the communications required at the hierarchical system and board levels to perform operations on the IEEE 1149.1 Test Access Port (TAP) of one or more devices or device cores, in a uniform and transportable way across all system modules'.

However, it is a slow process and only time will tell if the 'standard makers' can offer a needed system that is both timely and profitable for the silicon vendors to implement. In the world of test standards much good work has now been put into everyday use while other developments have withered on the vine. There has always been a difficult balancing act in developing viable test methods that can be standardised and used profitably.



Keys to choosing your coherent optical acquisition system

By Dean Miles

As demand for data grows, network operators continue to search for methods to increase data throughput of existing optical networks. To achieve 100Gb/s, 400Gb/s, 1Tb/s and beyond, complex modulation formats have become prevalent. These modulation formats present new challenges for the designer when it comes to choices of test equipment.

The typical coherent optical acquisition system consists of three major building blocks: the coherent receiver, a digitizer – typically an oscilloscope – and some form of algorithmic processing. Certain performance parameters such as the coherent receiver bandwidth or oscilloscope sample rate have an obvious impact on the measured signal quality. However, there are a number of other aspects to the choice of a coherent optical acquisition system that may be less obvious but can play an equally key role in a successful test system.

Achieving low EVM

Low Error Vector Magnitude (EVM) and Bit Error Ratio (BER) are basic requirements for any coherent optical acquisition system. There are a wide range of system impairments and configurations issues that can affect the final optical EVM.

Within the Optical Modulation Analyzer (OMA) – the receiver – EVM can be impacted by a number of receiver issues such as: IQ phase angle errors, IQ gain imbalance, IQ skew errors, and XY polarization skew errors. The good news about these types of errors is that they can be precisely measured and their impacts calibrated out in the algorithmic processing that typically follows coherent detection. The primary impacts of the OMA on EVM measurements can also be corrected.

Once the signal is received, the next step is digitization on the electrical signal paths by a multi-channel oscilloscope. With the oscilloscope, a number of instrument factors affect EVM, the most fundamental being oscilloscope bandwidth and sample rate. Most engineers testing 100G coherent optical signals use 4-channel oscilloscopes with bandwidth in the 23 GHz to 33 GHz range and sample rates in the range of 50 GS/s to 100 GS/s. 400G system evaluation requires oscilloscopes with 70 GHz bandwidth at 200 GS/s sample rates.

Assuming an oscilloscope with appropriate bandwidth and sample rate is utilized, and all OMA impairments are being corrected algorithmically, the lowest measurable EVM comes down to a function of the effective number of bits (ENOB) of the oscilloscope.

EVM definition

EVM was recently defined by the IEC in IEC/TR 61282 101. In this article, EVM is defined as follows. The error vector is simply the vector that points from the actual measured symbol to where that symbol was intended in the signal constellation

Dean Miles is Technical Marketing Manager at Tektronix – www.tektronix.com

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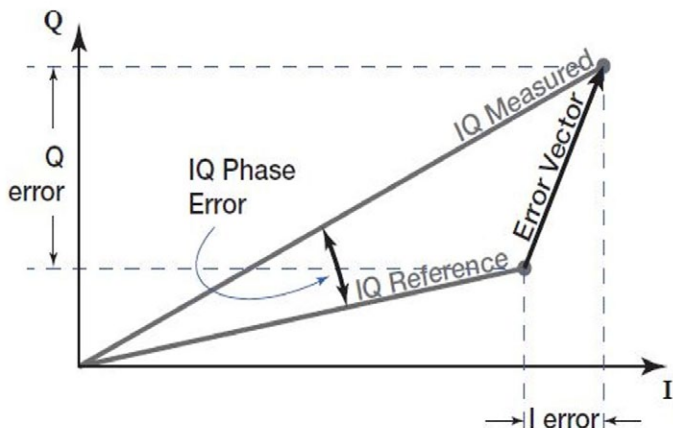


diagram. The ‘reference’ or intended symbol location is defined by the modulation type except for the overall signal magnitude. For a group of symbols, the reference magnitude is taken to be that which results in the lowest EVM for the group. Once this magnitude is determined, both the signal and the reference symbols are divided by the magnitude of the largest reference symbol to normalize the data.

Normalizing the data in this way has the effect of presenting EVM as a fraction of the largest reference symbol magnitude. This makes comparisons between QPSK and QAM EVM more difficult. Wireless standards have chosen to use square root average symbol power for the normalizing factor. It may be that the optical standard will change to this method over time. The Tektronix OM4000 software allows the normalizing factor to be customized for this reason. The default definition follows the TR – see figure 1.

These considerations provide the following formula for EVM when expressed as a percent, shown in equation 1:

$$EVM_{rms} = \sqrt{\frac{1}{N} \sum_{n=1}^N EVM(n)^2}$$

Where EVM(n) is the normalized error-vector magnitude of each symbol and N is the number of symbols in the group. As stated above, the TR assumes normalization by the largest reference symbol.

EVM accuracy and reproducibility

There are several factors that limit EVM accuracy and reproducibility. These can be generally categorized as systematic or random noise contributions. Systematic error is primarily a function of coherent receiver imperfections. Receiver imperfections include I-Q phase error, I-Q amplitude mis-

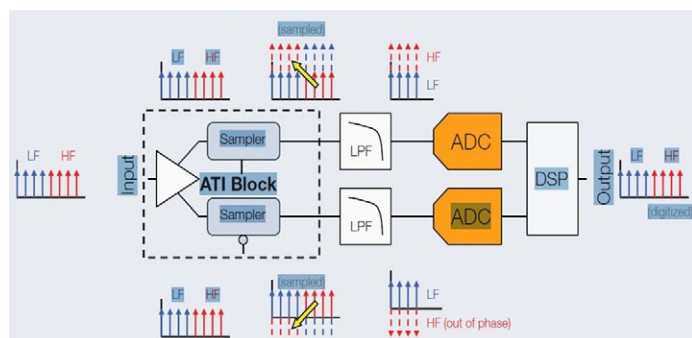


Fig. 2: Tektronix’ patented ATI architecture delivers the lowest noise.

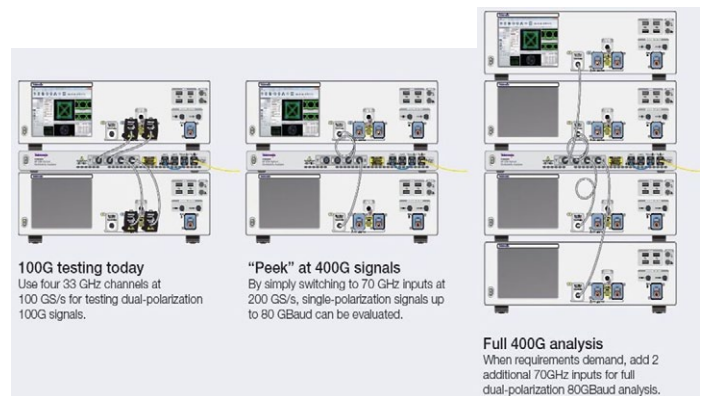


Fig. 3: Transitioning from 100G test to 400G test

match, skew, cross-talk, and frequency response. These errors are corrected in data post-processing, but a residual error remains since there will be some uncertainty in measurement of the imperfections.

The random EVM noise contribution is the input-referred rms noise divided by the largest symbol magnitude. Increasing the signal power thereby reduces this random-noise contribution until the digitizer dynamic range limit is reached. Digitizer instantaneous dynamic range is usually measured by effective number of bits or ENOB which is the number of bits required for an ideal digitizer to have the same noise level as the actual digitizer. Digitizer ENOB can usually be improved with a digital low-pass filter if the entire digitizer bandwidth is not required. Low ENOB, then, is key to achieving the lowest possible EVM.

Asynchronous time interleaving

Interleaving is not a new technology in oscilloscopes. As soon as the bandwidth requirements extend beyond the sample rate capability of the commercially available analog-to-digital converter (ADC) components, it becomes necessary to find other techniques to utilize available components to meet those extended requirements, or design a new generation ADC. Both LeCroy and Keysight deploy in their oscilloscopes frequency interleaving techniques that extend bandwidth, but do so at the cost of increased noise in the measurement channel. For many applications, the degraded signal fidelity provided by frequency interleaving is problematic, and as a consequence, Tektronix has chosen to take a different approach.

The limitation of the frequency interleaving approaches lies in how the various frequency ranges are added together to re-construct the final waveform, a step which compromises noise performance. In traditional frequency interleaving, each ADC in the signal acquisition system only sees part of the input spectrum. With Tektronix’ patented ATI technology – see figure 2- all ADCs see the full spectrum with full signal path symmetry. This offers the bandwidth performance gains available from interleaved architectures while preserving signal fidelity and ensuring the highest possible ENOB.

Future proof for next generation 400G and 1Tb testing

As technologies progress and testing requirements evolve, it’s common to re-deploy instruments from one lab or development team to another within the company or institution. Here again, the modularity of the Tektronix ATI Technology offers a significant benefit.

Systems can easily be scaled down with multiple units divided and redeployed to other projects as needed, maxi-

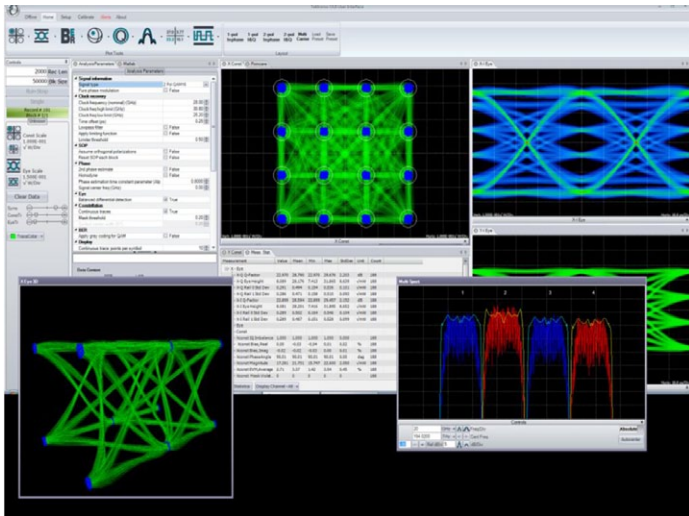


Fig. 4: Automated tests can be accomplished by connecting to the OUI or by connecting directly to the MATLAB workspace.

zing the use of a capital investment. For instance, when a project requiring four 70 GHz channels comes to an end, a lab has the ability to easily redeploy the oscilloscopes to other labs. A four-unit configuration can be divided in half to create two systems or further subdivided into single-unit stand-alone instruments by simply removing UltraSync cables, allowing four projects to each use one instrument.

The ATI system-based dual-polarization 400G system described above is built up from four individual instruments tied to a common 12.5 GHz sample clock via Ultra-Sync. Each of the four instruments can be operated as a complete stand-alone oscilloscope without any other hardware required. This provides the ultimate flexibility when it comes time to re-deploy the instruments from the original lab to another.

Other multi-instrument oscilloscope architectures employ a master control instrument controlling multiple acquisition instruments. The drawback to this approach is that the acquisition instruments cannot be used on their own. Separating this system into individual oscilloscopes without investing in additional control hardware is simply not possible.

Analysis for conclusive evaluation

Test and measurement coherent receivers typically come with analysis and visualization software. However, it is not uncommon for designers or researchers to need a particular type of measurement or visualization that is not present in the software from the coherent receiver manufacturer. Or, for example, perhaps the researcher is evaluating the quality of a new phase recovery algorithm. The ideal optical modulation analysis software will provide not only the basic building blocks for measurements, but also allow complete customization of the signal processing.

The Tektronix OM1106 software for example provides a complete applications programmatic interface (API) to these algorithms. Using these APIs to provide a substantial feature set is the OM Series User Interface (OUI). The OUI provides a complete coherent optical tool suite allowing any user to conduct detailed analysis of complex modulated optical signals without requiring any knowledge of MATLAB, analysis algorithms, or software programming.

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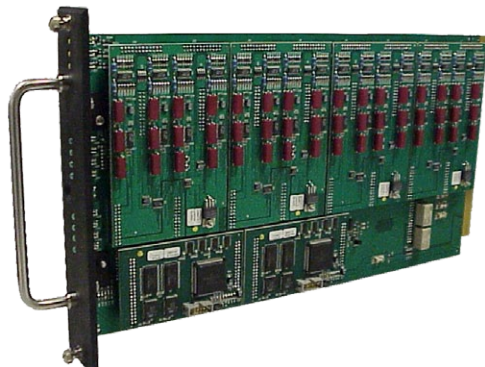
Interaction between OUI and MATLAB

The OUI takes information about the signal provided by the user together with acquisition data from the oscilloscope and passes them to the MATLAB workspace as shown. A series of MATLAB scripts are then called to process the data and produce the resulting field variables. The OUI then retrieves these variables and plots them. Automated tests can be accomplished by connecting to the OUI or by connecting directly to the MATLAB workspace. At each step the best algorithms are chosen for the specified data type, requiring no user intervention unless desired.

Complex modulation formats used in the latest 100G and 400G communication technologies present new challenges for the designer when it comes to choices of test equipment. Certain performance parameters have an obvious impact on the measured signal quality while others may not be immediately apparent.

Multipurpose module captures IC failure

Cascade Microtech has launched a new Multipurpose Electromigration (MPEM) module featuring an intuitive, full-featured test suite for predicting the lifetime and reliability of copper interconnects in modern integrated circuits. Forward-



looking research indicates a fresh approach is needed for evaluating the reliability of copper lines and vias in advanced semiconductor processes. New test techniques, such as constant voltage EM (CVEM), show great promise in complementing the traditional method of constant current EM (CIEM) stress. With MPEM, Cascade Microtech now provides the first commercial EM test to support this intriguing new CVEM evaluation method. The new MPEM module provides multiple stress bias types for testing copper interconnects, typically with geometries of 32 nm or less. With MPEM, the company added constant voltage electromigration (CVEM) and low frequency pulsed current electromigration (LFPEM) applications to its existing lineup of constant current electromigration (CIEM) and stress migration capabilities. Offering versatility by providing three types of EM tests in one convenient platform, customers can compare multiple test methods. Additionally, the MPEM module effectively leverages the traditional advantage of Cascade Microtech's EM solutions: a fully parallel, high-speed measurement system that is uniquely capable of capturing momentary, self-healing voids. The system offers a broad measurement range, with set points as low as 10uA or 10 mV.

Cascade Microtech
www.cascademicrotech.com

Test adapter addresses SMARC computer-on-modules

Yamaichi Electronics has developed a test adapter for the Smart Mobility ARCHitecture (SMARC) computer-on-module standard that ensures a perfect alignment of the contacts and allows for 100% contacting reliability up to 50k mechanical cycles. Using spring probe pins, the adapter supports very high contact cycles. It is volume test ready and reduces the cost per tested module. Operation is easy and secure. This test adapter within Yamaichi Electronics' YED900 test adapter series can be used for the evaluation of bench tests and for reliability testing from -50°C up to +150°C. The socket is designed with compression mount technology (CMT), requiring no soldering and making it "plug and play". For contacting the module pads, a conical type plunger tip is commonly used. By using such a tip it can be assured that only a very small witness mark is formed on the module contact pad. The fine-pitch pins are available for pitches starting from 0.3mm. Kelvin type pins are also available.



Yamaichi Electronics
www.yamaichi.eu

I/O module enhances testability of assemblies

GOEPEL electronics has added the SFX-5296LX module to its JTAG/Boundary Scan hardware platform SCANFLEX, a mixed signal I/O unit that turns even non-scannable partitions testable through

boundary scan. The SFX-5296LX is equipped with diverse dynamic test resources for each channel, such as a frequency counter, an event detector, an arbitrary waveform generator and a digitizer. With a total of 96 single ended channels the



Boundary Scan test can be extended to non-scannable components such as connectors, clusters or analog interfaces. To increase flexibility, each channel can be configured as input, output and tri-state and can be easily programmed using many available parameters. These include switchable pull up/pull down or selectable slope steepness for the driver. The SFX-5296LX uses the parallel I/O bus and therefore enables much faster data transfer than with serial, via TAP driven I/O modules. Based on the test resources available per channel, both static and dynamic at-speed tests are feasible, allowing a significant improvement of the structural fault coverage along with more flexible test strategies. Thereby only one SFX slot is needed. To increase the number of channels, several modules can be operated simultaneously. The module is based on the ASIC CION-LX, a multifunctional mixed signal tester on chip (ToC) developed by GOEPEL electronics.

GOEPEL electronics
www.goepel.com

Mixed-signal scopes gain in-vehicle CAN FD/SENT bus options

Yokogawa has added trigger and analysis options to its DLM2000 (4-channel) and DLM4000 (8-channel) mixed-signal oscilloscopes (MSOs) for testing the latest generation of in-vehicle serial buses. The new options are specifically designed to address the measurement challenges posed by the CAN FD (CAN with Flexible Data Rate) and SENT (Single Edge Nibble Transmission) bus systems. CAN FD is a higher-speed version (up to 8 Mbit/sec) of the original CAN Bus designed to provide a faster, more reliable and cost-effective solution to the challenge of the increased amount of data traffic in automotive applications such as firmware updating for ECUs (electronic control units). SENT is a point-to-point scheme for transmitting signal values from a sensor to a controller. It enables high-resolution and composite data transmission with a lower system cost in applications such as angle sensors for power steering and mass air flow sensors for engine control. SENT can replace existing analogue or PWM signal transmission, and is considered to be cost-effective compared to other serial buses such as CAN/LIN. When equipped with the new serial bus options, the Yokogawa MSOs will decode the bus signals and display the results in real time. A wide variety of dedicated triggers and search functions is available to aid analysis and troubleshooting on parameters that can affect the bus signals.

Yokogawa
<http://tmi.yokogawa.com/scopes>

High-speed 5 Gsample/s LXI digitisers

For applications where fast electronic signals in the GHz range need to be remotely acquired and analysed, Spectrum has extended its digitizerNETBOX series of LXI based instruments and released eight new models. Available with



two, four or eight fully synchronous channels the units feature sampling rates up to 5 Gsample/sec, bandwidth in excess of 1.5 GHz and on-board acquisition memory up to 8 Gsamples. The combination suits the digitisers to capturing long complex high-

frequency signals and for characterising fast timing events that go down to the nano- and sub-nanosecond ranges. Fully LXI compliant, the digitizerNETBOX products allow remote control and data transfer over fast GBit Ethernet. Connect them directly to a Notebook or PC, or in fact to anywhere on a company LAN, and automated data acquisition becomes easy. Offering significant advantages in measurement speed, flexibility, size and channel density the products can be used to replace conventional bench instruments such as oscilloscopes, spectrum analysers, multi-meters, counters, timers and older generation digitiser products. The digitizerNETBOX instruments include Spectrum's powerful SBench 6 software that allows full instrument control, graphical display, data storage and analysis.

Spectrum
www.spectrum-instrumentation.com



Second Call for Experiment Proposals and R&D Proposals for Public end-user Driven Technology Innovation (PDTI)

Opening: **May 4th 2015** Deadline: **June 23rd 2015, at 17:00** (Brussels time)

The competitive **call for experiment proposals** is related to the EU-funded project ECHORD++ (FP7-ICT-601116). In the context of ECHORD++, small-scale projects, "experiments", will be conducted, which will use state-of-the-art robotic equipment, addressing one of the following scenarios: Cognitive tools and workers for cognitive factories, general purpose robotic co-workers, cognitive logistics robots for industry, medical robotics, agricultural and food robotics, and urban robotics. Each experiment has a maximum duration of 18 months, the funding of an experiment is expected to be about € 300.000. The total indicative funding for this call is € 4.8 Mio.

The competitive **call for PDTI R&D proposals** addresses healthcare, more specifically Comprehensive Geriatric Assessment. The indicative funding for these PDTI activities amounts to 1.2 Mio. €.

Find more information at: <http://www.echord.eu/pdti>

The research community, enterprises, and robot manufacturers are asked to submit experiment proposals, written in English only. Please note that FP7 only offers part-funding of research activities.

More information and the full call documents, including the guide for applicants and an electronic submission system, can be found on the web site.

<http://www.echord.eu>
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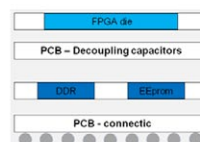
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Unmanned aerial solutions come down to Earth

By Phil Sawarynski

Advances in airborne photography and image processing have produced new solutions well suited for applications in open pit mining and large earthwork grading projects. Mine engineers and geologists use digital terrain models (DTM) to determine production volumes and manage the movement of ore and overburden.

Because the mine landscape changes constantly, the best results come when measurements used to create the terrain (or surface) models are taken at regular intervals. The work to obtain this data is complicated by sheer size (large pit mines can be several kilometers across), difficult terrain, weather and safety concerns. The problems can be addressed by systems comprised of compact, low-cost unmanned aerial systems (UAS) together with new approaches for image processing and photogrammetry.

The measurements needed by mine engineers are traditionally obtained by terrestrial surveys or aerial imagery. Terrestrial measurements produce accurate results, but the technique is slow and the presence of surveyors on the ground can interrupt normal mine operations. Aerial imagery is less disruptive, but longer lead times and higher costs can force mines to take measurements only once or twice per year, which results in suboptimal data. A better solution comes in the form of small UAS, which can be dispatched on short notice and are less susceptible to weather.

A fixed-wing UAS such as the Trimble® UX5 Unmanned Aircraft System carries a high-resolution digital camera, GNSS navigation system, flight controls and communication equipment. Weighing roughly 2.5 kg and with a wingspan of one meter, the battery-powered UX5 can be carried and operated by one person. When on site, the operator defines and loads the flight plan into the aircraft's onboard systems and then deploys and monitors the flight. Flight planning is based on requirements for scale and resolution of the final data, which controls parameters including flight altitude above ground level (AGL) as well as along- and cross-path image overlap.

Launched from a small catapult, the aircraft autonomously executes the flight plan and collects images along specified flight lines before landing at a designated location. For projects that require multiple flights, the turnaround time to download images, upload a new flight plan, replace the battery and re-launch is roughly 10 minutes. The aircraft can operate for up to 50 minutes, with a cruise speed of 80km/h and a range of 60km.

Typical flight altitude is 75 to 200m AGL, based on project requirements and subject to local air safety regulations. While the UX5 operates autonomously, it is always in sight and radio communication with the operator. Automatic or user-initiated failsafe procedures can divert the UX5 to a safe landing in the event of changing conditions or loss of communications.

The aircraft is equipped with a 24MP digital camera operating in RGB spectra. For applications in forestry or agriculture, it can be configured to operate in near-IR wavelengths. The camera produces ground resolution of 2.6 cm at 100 m AGL.

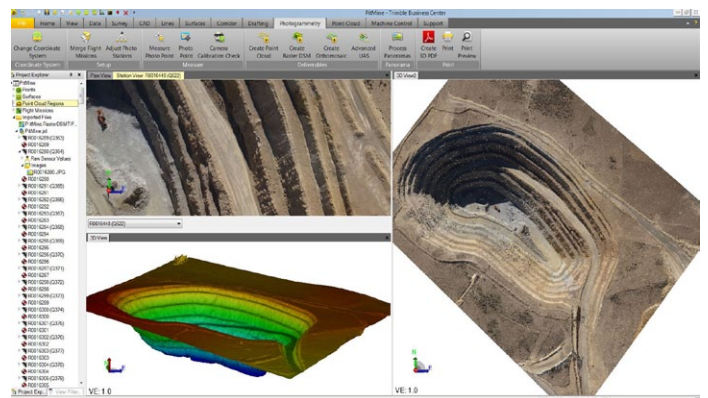
Phil Sawarynski is Business Area Director of the Survey and Engineering Geospatial Division at Trimble – www.trimble.com

Digital images from the UX5 are processed using Trimble Business Center (TBC) software. Traditional photogrammetry calculations are based on the known location of the camera. But because the aircraft is moving rapidly during data capture, the raw images may contain significant geometric errors. To correct this, the software adjusts the photo stations to remove error in location, orientation and camera calibration. The software first uses computer vision algorithms to identify common tie points in overlapping images. Then the photo stations undergo a simultaneous adjustment to produce a best fit over the complete project area.

With the photo stations resolved, the next stage is to connect the photographic models to the ground. Mines typically use a coordinate system that is tied to geodetic horizontal and vertical reference frames. While the UX5 onboard GNSS system provides navigation and flight control, it is not sufficient for precise geo-referencing. Prior to the flights, ground control points are placed in locations where they can be readily identified in the photos. They are then observed using precise GNSS or optical survey instruments and methods. These measurements are processed and adjusted in the Trimble Business Center to produce accurate coordinates in the designated geographic reference frame. Once the ground control targets are identified and registered in the photos, the software performs a final adjustment to produce georeferenced solutions for the photo stations.

For quality control, a subset of ground control targets is purposely omitted from the adjustment. The targets' known positions can be compared to their positions derived from the imagery to confirm the overall accuracy of the solution. Using a desktop computer, the image adjustment is completed automatically and requires roughly 10 seconds per image, including refinement of the camera photo stations. The average re-projection error is roughly 1 pixel.

With the adjustment complete, the software uses conventional photogrammetric algorithms to compute the 3D coordinates of any pixel in an image. Typical deliverables include orthomosaics, 3D digital surface models and point clouds. The surface models and point clouds are produced automatically



The Trimble Business Center software produces orthographic images, point clouds and photorealistic 3D surface models. Integrated processing of aerial and terrestrial imagery combined with GNSS and optical terrestrial data produces georeferenced models for design and analysis.

based on user inputs for resolution and data density. To provide additional detail, a raster digital surface model (developed from the generated point cloud) can be refined by using interpolation routines, noise filtering, edge modeling and outlier detection. The filtering algorithms are tuned to eliminate noise in the digital surface model while preserving small or subtle vertical features.

Mine engineers and geologists use 3D models to verify production quantities (comparing to truck counts and other methods) and to plan and design excavation and construction. These activities, common to mine operations, often require specialized analytic tools such as draping orthomosaics over the 3D surfaces as well as profiling, contouring, point cloud editing and volume computations. By blending these functions with the rigorous photogrammetric computations, the Trimble Business Center software reduces overall time to result and reduces risks related to data transfer among multiple external packages.

Design information such as new excavations, slopes and haul roads can be loaded into computers onboard mine machinery. The georeferenced 3D data supports GNSS-based automated machine control for bulldozers, excavators and drilling equipment. The circle is closed when the UAS takes flight to measure the result of the next round of production and construction.

In addition to mining and earthworks, the combination of UAS and photogrammetric technologies is attractive in applications where frequent, high-resolution measurement of large or difficult-to-access areas is required. Industries including agri-



The Trimble UX5 UAS captures images over a quarry. The aerial solution can provide temporally dense imagery at low cost and minimal disruption to normal production activities. Imagery is combined with ground control to produce georeferenced 3D surface models.

culture, energy, transportation, civil infrastructure and natural resources are looking with interest at the rapid emergence and adoption of unmanned solutions.

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Standalone IMU unit has on-board Kalman filter

OxTS and Colibrys jointly announced the xOEMcore IMU/INS, integrating high-grade MEMS inertial sensors from Colibrys in a small board package. The xOEMcore is the first standalone IMU on offer from OxTS, although the custom built system has been a major part of existing products like the xNAV series. The unit not only packs 6-axis gyros and accelerometers on a miniature OEM board, it also houses an on-board processor running the Kalman filter. This enables users to get the raw IMU measurements like a standard IMU, or they can pair the raw measurements with an external aiding device such as GNSS receivers so the xOEMcore takes care of the sensor data fusion.



OxTS
www.oxts.com

Radio modules and extended API supports swarm location services

Offering significant extensions, the latest swarm API version 2.1 from Nanotron directly supports the ability to extract precise individual positions from a completely mobile swarm of radio devices in real-time. It allows users for the first time to write their own location engine based on time of flight ranging which is also known as collaborative location. For machine to machine (M2M) applications the latest API version now provides both text-based and binary host interface formats, extended control of general purpose I/O pins and an wireless extension for remote configuration and management of the swarm bee LE module allowing fully autonomous wireless configuration without the need for a local host controller. Dr. Thomas Foerste, Vice President Sales and Marketing of nanotron, points out that “customers want to further cost-reduce and simplify how location-awareness can be utilized and leveraged. This has been the driver for a very much enhanced API.” Swarm bee LE radio modules together with the new swarm API create a platform for tags and location-aware wireless sensors. By using both products customers obtain all the necessary functionality for a stand-alone solution. If required extra application intelligence might be added through a host controller deployed along with the swarm bee LE module. “API v2.1 enhancements facilitate customers to very rapidly use the swarm bee LE platform to develop their own customized products with any form factor and with any required functionality” said Thomas Foerste. Nanotron’s swarm products pave the way for exploring swarm intelligence to increase safety and productivity. Swarm bee LE is an autonomous swarm radio module with very low energy (LE) consumption. Nanotron utilizes its proven Chirp radio technology for this device. Chirp radios provide robust and reliable radio links required in industrial applications. The company’s patented SDS-TWR ranging method allows for concurrent communication and positioning without infrastructure. The swarm bee LE device combines accurate and precise location information with 3D acceleration sensing in a low-cost wireless module. The module supports collaborative location required for collision avoidance solutions (CAS) and high-throughput positioning needed for tracking.

Nanotron
www.nanotron.com

Bluetooth Smart beacon integrates tri-axial accelerometer

A few months after releasing the EMBC01, a multi-protocol proximity beacon, EM Microelectronic has released the EMBC02, a Bluetooth Smart beacon that integrates a 3-axis accelerometer in a sleek, weatherproof (IP-64) housing. By attaching EMBC02 to objects or people, both, proximity and motion, can be monitored by a smartphone or tablet application. The EMBC02 can be programmed to transmit proximity and identification data, like standard beacons, but it can also provide motion data (movements, vibrations, acceleration) as well as specific motion-based alarms based on accelerometer data, originating from shock, free-fall or taps. The accelerometer allows to maximize battery life by “beaconing” data only when required, e.g. while in motion, or when an alarm condition occurs. While the EMBC01 Bluetooth Smart proximity beacon can operate for more than 12 months on a single CR2032 coin cell, the EMBC02 offers even longer battery life with optimized usage scenarios where the beacon sleeps (or transmits infrequently) until the accelerometer detects movement. The device is FCC/CE/IC certified, includes a multi-function button for input and two LEDs for user feedback.



EM Microelectronic
www.emmicroelectronic.com

Colibrys launches vibrational gyroscope

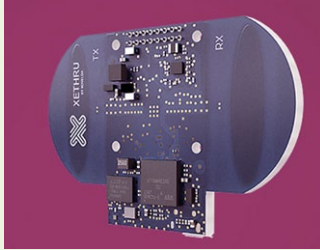
Swiss MEMS manufacturer Colibrys SA has launched a gyrometer based on vibrating technology that can achieve low noise and short-term stability. The GS1000 gyrometer, based on a resonant system that is an alternative to a fiber optic gyroscope (FOG), offers a noise figure of 0.015 degrees per second from 0.1Hz to 100Hz. In addition, Colibrys said that in June 2015 it plans to offer a vibration sensor that will surpass all existing MEMS for low frequency sensing. In general Colibrys provides high-end capacitive accelerometers and gyros resistant to harsh environments. Since its spin off from CSEM (Neuchatel, Switzerland) in 2001, Colibrys has delivered more than 8 million MEMS devices. The company moved to Yverdon-les-Bains, Switzerland in 2013 as it became a wholly-owned subsidiary of Sagem, now Safran. During the relocation Colibrys acquired a 6-inch wafer fab. The company announced that it was in production at Yverdon-les-Bains in September 2014. “We are ready to speed-up our growth and to address the new market needs on the long term,” said Patrick Gougeon, CEO of Colibrys, in a statement. “These two last years, we have managed to implement strong structural changes in a record time. Thanks to a clear product development roadmap, we are confident to ensure and reinforce our position as a leader of high performances MEMS sensors.”



Colibrys SA
www.colibrys.com

Novelda aims radar modules at smart-home sensing

Novelda AS (Kvitesied, Norway), a developer of CMOS impulse radar transceivers, has announced two modules based on its X2 transceivers intended for use in home automation, sleep monitoring, baby monitoring and elderly care applications. The so-called XeThru technology is a microwave radar system integrated on a CMOS chip that can act as ground-probing radar, a sensor for human vital signs monitoring, personal security, environmental monitoring, industrial automation and robotics. The two sensor modules



are the X2M200 respiratory module and the X2M300 presence module both can work at distances of up to several meters and do not require line of sight. The X2M300 module is intended for smart home automation where its capability for detecting human presence while being integrated into a building's structure enables hidden, tamper-proof sensing. It has a range of up to about 4.8 meters and an acquisition time of about 1s. The X2M200 sensor module is designed for respiration monitoring of people of all ages for health and welfare purposes. The X2M200 has a sensor range from 0.5m up to 2.8m. The acquisition time is about 10s.

Novelda AS

www.xethru.com

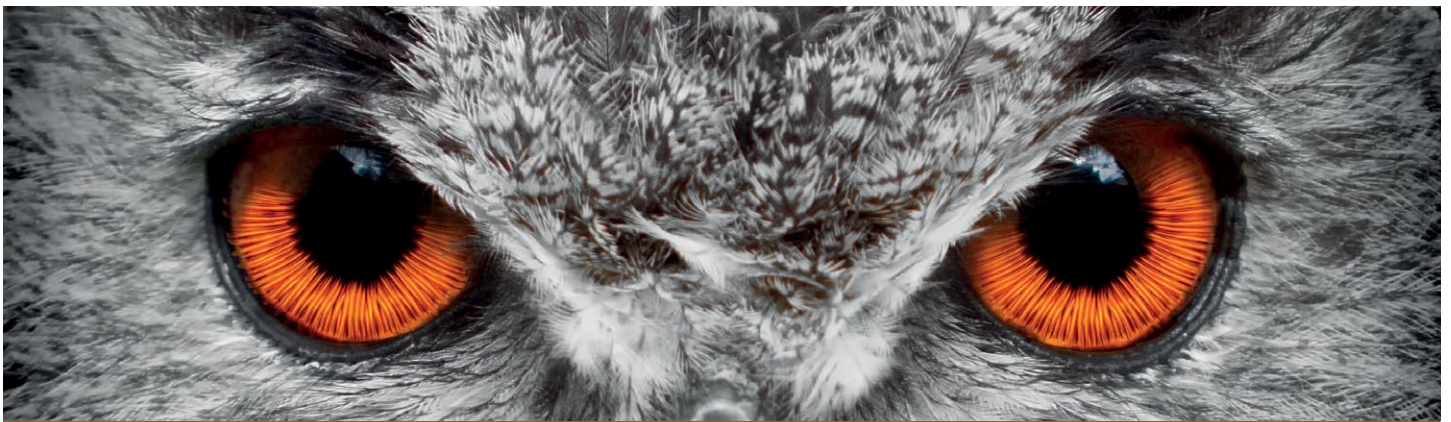
L1 L2 GPS GLONASS active antenna

Maxtena Inc., developer of wireless antenna designs, has the L1 L2 GPS GLONASS active helix antenna for GNSS satellite applications. This L1 L2 GPS GLONASS active antenna, M1227HCT-A2-SMA, updates and replaces the M1227HCT-A-SMA antenna which appeared in 2010. The design has been mechanically upgraded and is packaged in a durable IP67/68 sealed radome housing; it is terminated with a gold plated SMA connector for RF feed/input and DC bias/power, typically powered from the applications' GNSS RF module. The M1227HCT-A2-SMA active helix design features Maxtena's compact and light weight Helicore Quadrifilar antenna technology and a built in dual-stage-LNA and filtering, offering up to 30 dB gain, for GNSS applications that utilise GLONASS and GPS, in one radome housing with a single 50-Ohm SMA connector. With robust antenna construction and small size of the helix antenna it is a solution for applications across various markets such as UAV's, GIS and Wearable GNSS.



Maxtena

www.innovelec.co.uk



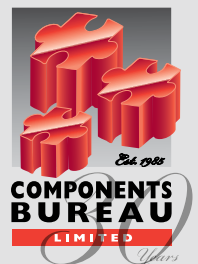
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Make field-oriented motor control affordable

By Dave Wilson

Shaft sensors and their wiring make field-oriented motor control pricey, but sensorless alternatives are available. Field-oriented control (FOC) has permanently changed the way engineers think about motor control. But in order to work, it needs to know the angle of the rotor flux axis. If you are willing to pay the high cost of a motor shaft sensor, painstakingly mount that sensor on said motor shaft, connect the long cable between the sensor and the control electronics, and deal with the noise susceptibility and intermittent connections of said cable, then there's no problem. But, if like most people you prefer a more economical and robust solution, then we need to find another way to get flux angle information.

Most techniques to eliminate the shaft sensor depend on measuring other signals within the motor that are related to the flux signal. In some cases, these signals just naturally occur in a spinning motor and all we have to do is listen for them. Such algorithms fall into the category of passive techniques. Other signals only become visible if we actively stimulate the motor with higher-frequency signals.

Regardless of which technique you use, the signals of interest are often buried deep inside the motor and cannot be directly measured at the motor terminals. In such cases, we must employ a special algorithm called an observer to extract the desired signal(s) from other signals that we can observe outside the motor. There are far too many sensorless techniques to cover in one article, but we can investigate one of the most popular algorithms to provide an example of how sensorless control works. This technique is based on recreating the back-EMF signals inside the motor.

Consider the three-phase permanent magnet motor shown in figure 1. If we perform a forward Clarke transform on the three windings and write the voltage equations for the resulting alpha and beta windings, we get the equations in figure 1. This is simply the result of summing up the voltage drops across the windings' parametric elements and equating them to the applied voltage at the motor's terminals.

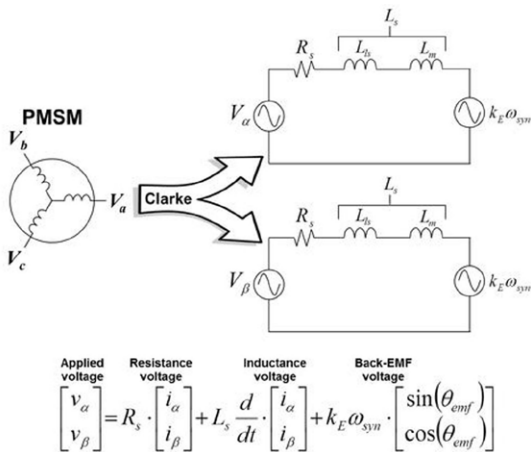


Fig. 1: Stationary frame voltage equations for permanent magnet synchronous motor.

Dave Wilson is Senior Industrial Systems Engineer for the C2000 Microcontrollers at Texas Instruments – www.ti.com

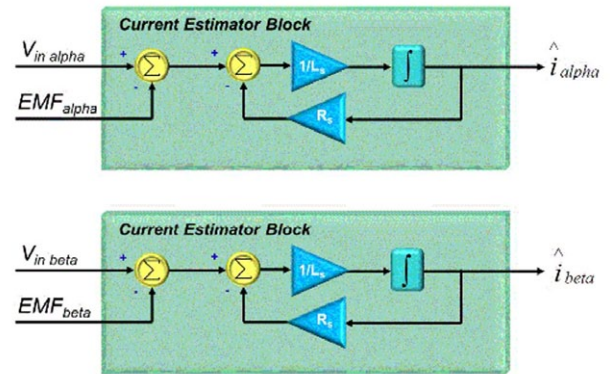


Fig. 2: Phase current estimator blocks.

From the expression in figure 1, can you find the angle information? Sure enough, it's hiding in the back-EMF signals. It would be great if we could somehow stick two voltage probes down inside the motor to measure these signals. Unfortunately, the back-EMF signals do not exist in a specific location within the motor. These signals are distributed throughout the stator coils and only appear on the motor terminals when the motor current is zero and isn't changing.

Using the differential voltage equations in figure 1, we can create block diagrams for calculating i_{α} and i_{β} , as shown in figure 2. The required inputs are the applied motor voltage, the back-EMF voltage, the stator resistance (R_s) and the stator inductance (L_s).

Unfortunately, we don't have the back-EMF voltages. But we can measure the motor phase currents! Let's try to leverage this information to extract the missing back-EMF signals. Initially we will just assume the back-EMF voltages in figure 2 are zero.

As a result, the estimates of i_{α} and i_{β} will likely be wrong. To determine the quality of these estimates, we compare them to the actual measurements of i_{α} and i_{β} , and generate error signals, as shown in figure 3.

Now what we do with these error signals borders on magic! If there was a "Motor Control Wizard's Book of Spells," this little trick would certainly be in it. In figure 4, we supply the error signals to PI controllers and wrap the controller outputs around to the Back-EMF inputs.

This may not be intuitive at first, but consider this. If we take

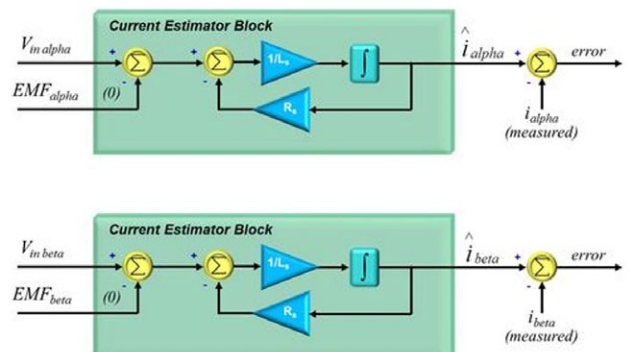


Fig. 3: Comparing current estimates to actual values.

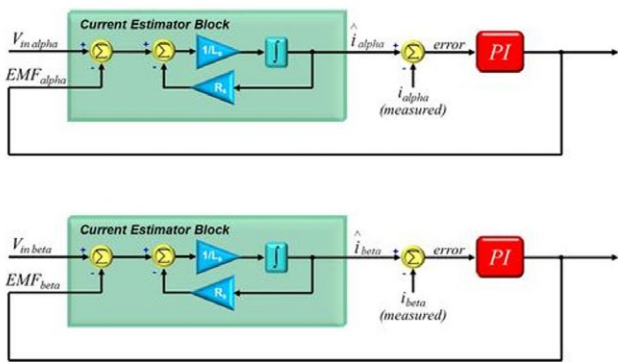


Fig. 4: Stationary frame back EMF estimators.

any closed-loop system utilizing negative feedback, we can drive the error signal to nearly zero if we have high enough loop gain. In this case, an error of zero means the phase current estimate is equal to the measured value of phase current.

But this can only be true if the signal at the back-EMF input actually equals the missing back-EMF voltage (assuming L_s and R_s estimates are accurate). In other words, the PI controller's high gain serves the error signal to zero by forcing the controller's output to become the back-EMF signal.

One can use a Spice simulation of a single-phase back-EMF observer running at 10 kHz. The back-EMF signal inside of the motor block is unknown to the observer. But once the simulation starts, the observer output quickly converges on the back-EMF signal as shown in figure 5. Even when you change the back-EMF waveform to different wave shapes, the observer morphs its output to match it!

From figure 4, we can create the back-EMF waveforms for the alpha and beta coils, but just having the back-EMF signals doesn't mean we are done. The angle information is still embedded in these sinusoidal waveforms, and we have to figure out how to extract it. One way is to use the arc tan function:

$$\theta = \tan^{-1} \left(\frac{EMF_{\beta}(t)}{EMF_{\alpha}(t)} \right)$$

Besides requiring floating point capability to calculate this value, you will also need to trap for the singularity when $EMF_{\alpha}(t) = 0$. But consider another technique (borrowed from the world of resolvers) shown in figure 6. Not only does it solve the problems associated with the arc tan function, it offers another very nice perk: a filtered speed signal!

Now that we have solved for the angle, I need to tell you that we solved for the wrong angle.

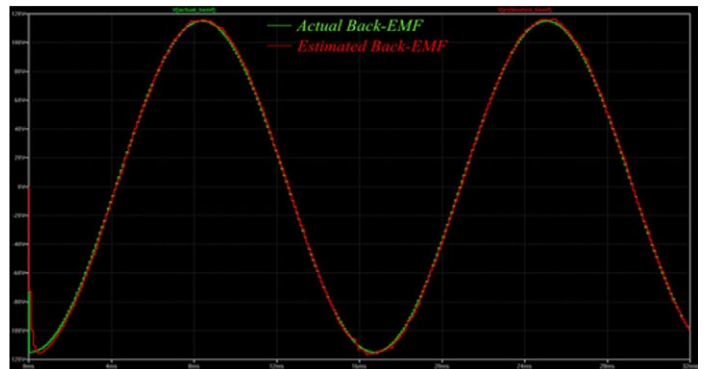


Fig. 5: Simulation output showing observer performance.

What we wanted was the angle of the rotor flux vector. What we get is the angle of the back-EMF vector.

Before you close your browser in disgust, you should also know that the back-EMF vector always lies on the quadrature axis, so we are very close! All that remains is to determine the polarity of the back-EMF vector on the q-axis in order to know exactly where the rotor flux vector is. This is where the frequency signal from figure 7 can help. If the frequency is positive, we subtract 90 degrees from the back-EMF angle. If it is negative, we add 90 degrees instead. Now that we have the angle of the rotor flux, we can proceed with the four steps of FOC.

Wow! All these calculations, just to find the angle of the rotor flux vector! But considering the low cost of embedded MIPS compared to the high cost of a motor shaft sensor, it is still way worth the effort in most cases.

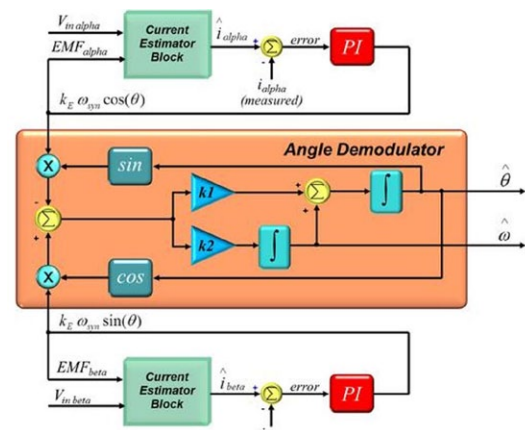


Fig. 6: Angle demodulator using the relationship: $\sin(\theta) \cos(\theta_{est}) - \cos(\theta) \sin(\theta_{est}) = \sin(\theta - \theta_{est})$.

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Designing a temperature ruggedized gate driver

By Pierre Delatte

There is a growing demand for integrated circuits (ICs) able to operate in higher temperature environments without compromising on reliability and lifetime.

For years, the Oil & Gas Drilling industry has been pushing the limits of semiconductor components by developing electronic systems able to operate in the harshest environments in terms of temperature, in excess of 200°C, pressure, shocks or vibrations. Automotive electronic components have been progressively pushed towards operating temperatures approaching 175°C, but with carefully selected mission profiles to their reliability during the vehicle lifetime.

Specialized semiconductor processes, e.g. based on Silicon-on-Insulator (SOI) technology, can help with the development of ICs able to operate reliably at extreme temperatures. However, selecting the appropriate semiconductor manufacturing process is not the only answer. Device modelling, circuit design techniques, IC packaging, characterization and reliability testing are other key expertise's required to build reliable IC's for these highly demanding applications. Also, choosing the right trade-off between operating temperature, reliability, lifetime, cost and production volumes is essential. This is why part of CISSOID components targeting industrial and automotive applications are rated from -55°C up to 175°C, while we address markets requiring extreme temperatures or ultimate lifetime such as Oil & Gas Drilling or Aerospace with products rated from -55°C up to 225°C.

With the advent of fast switching Silicon Carbide (SiC) and Gallium Nitride (GaN) transistors and the race for high power

In 2011, HADES® isolated gate driver was the first high temperature driver dedicated to SiC power switches. Since then, HADES® has been used in first SiC power converters for Oil & Gas Drilling, Aerospace and Railways applications, as well as for EV battery charger prototypes. High temperature operation, dedicated protection functions and robustness to high dV/dt were crucial to support the design of reliable and efficient power converters – see figure 1.

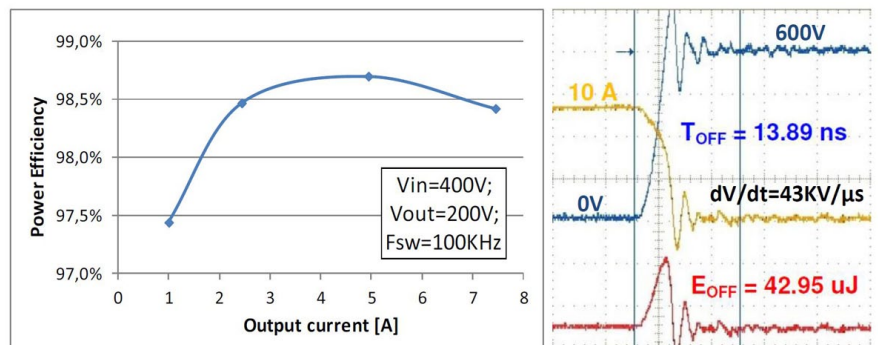


Fig. 1: (a) Efficiency of a 1.5KW DC-DC Converter using SiC JFET driven by HADES® Gate Driver (b) turn-Off waveforms.

Based on first generation users' feedback, a new chipset has been developed and was released in March 2015. This second generation (HADES® v2) is more powerful, with output drive current up to 12A, and offers higher level of integration.

For systems requiring extended lifetime and where the junction temperature doesn't exceed 175°C, one primary side (HADES2P) and two secondary side (HADES2S) ICs, both packaged in a plastic QFP44, are required to build a power leg.

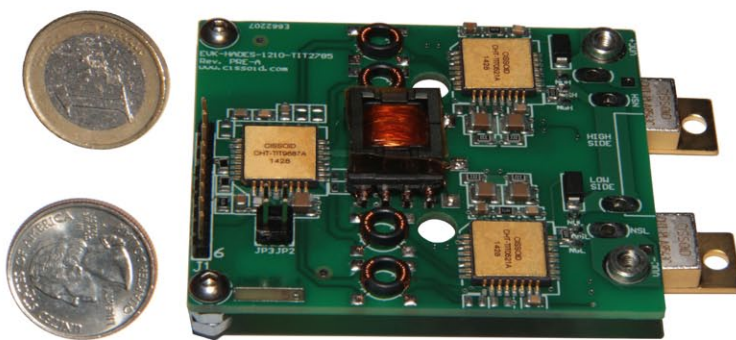
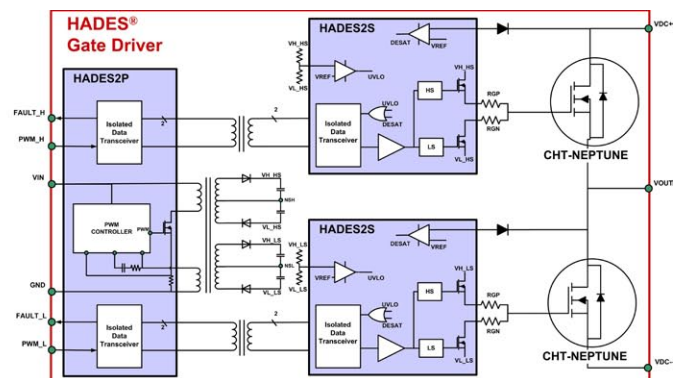


Fig. 2: HADES® v2 Isolated Gate Driver Board rated at 175°C. density, a new market is emerging for high temperature electronics. Indeed, these new devices can operate at higher temperatures, reducing cooling requirements, and have very low switching energy, enabling higher switching frequency while dramatically reducing the size of filters and transformers. Reduced cooling and higher switching frequencies mean higher temperatures for the power switches but also the proximity gate drivers. In 2009, CISSOID started the development of gate drivers for the first generation of SiC transistors.



For extreme temperatures up to 225°C, these chips are assembled in a hermetic ceramic QFP32 package. A gate driver board has been developed to demonstrate a half bridge built on the HADES® v2 gate driver chipset. The 60x55mm board has been designed for operation at 175°C, with short excursions possible up to 225°C. It also includes two CISSOID "NEPTUNE's" 10A/1200V SiC MOSFET's. For SiC MOSFET's, the gate is typically driven between -5V and +20V. These voltages can easily be adapted to drive SiC JFET's, Si MOSFET's, Si IGBT's or GaN transistors by modifying the power transformer.

The primary side IC – see figure 3 - embeds a current-mode fly-back DC-DC controller together with an integrated 0.8Ohm/80V switch, providing all the active functions to

Pierre Delatte is CTO of CISSOID – www.cissoid.com

implement an isolated DC-DC converter able to supply both high- and low-side floating gate drivers. Under-Voltage Lockout (UVLO) and Power Good functions ensure the proper power-up of the driver. Configurable non-overlapping logic either generates half-bridge dead time internally or uses two complementary PWM signals from the controller. It also includes a four channels isolated signal transceiver (2 Tx and 2 Rx) for PWM and fault signals transmission towards or back from secondary sides through tiny pulse transformers.

The secondary side IC (figure 4) includes a push-pull driver delivering 10A at 125°C and 8A at 225°C, suited to drive 300A/1700V SiC MOSFET modules. It also includes UVLO, Desaturation and Over Temperature Protection (OTP) fault detection circuits, as well as a two channels isolated signal transceivers. Note that having a fast Desaturation detection protection is fundamental when driving SiC MOSFET's as their robustness to short circuits is limited to about 10µs at 600V. This means that the short-circuit protection, i.e. the desaturation protection, must react in few µs. In HADES2S, the desaturation blanking time can be programmed between 0.2µs and 8µs by an external capacitor. In case of such an event, the push-pull stage is put in high impedance and the gate of the power transistor is smoothly discharged through the internal soft-shutdown transistor to avoid high di/dt during turn off.

For fast switching devices like SiC and GaN transistors, temperature ruggedized gate drivers brings the benefit of putting them very close to power switches and hence minimizing the gate loop parasitic inductance. This allows for fast switching, resulting in low switching losses, while avoiding ringing that could impact system performances or the reliability of the power transistor. The ultimate objective is to locate the gate driver inside the power module to build SiC-based Intelligent Power Modules (IPM's). Two kind of SiC MOSFET's IPM's are currently in development embedding

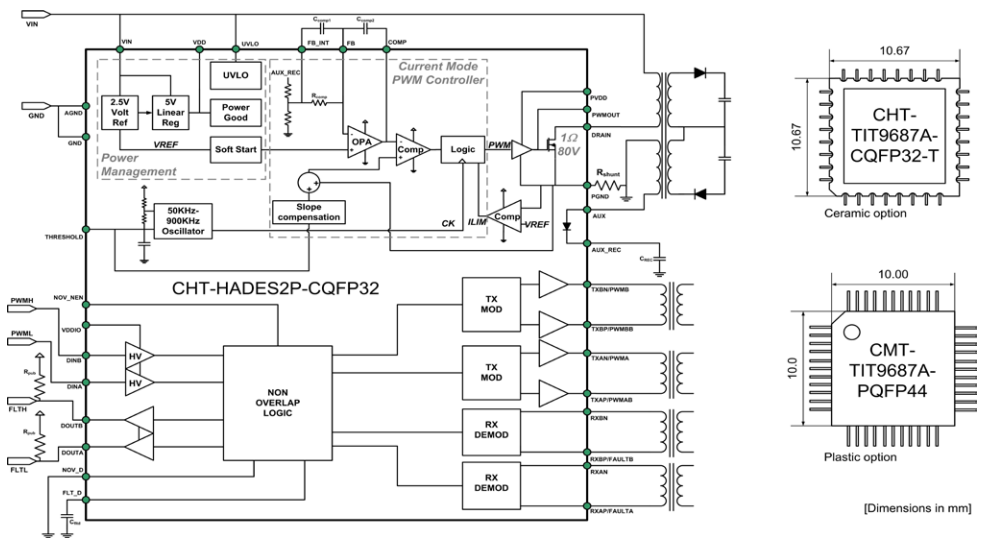


Fig. 3: HADES® v2 Primary Side IC (HADES2P): DC-DC Controller & Isolated Signal Transceivers.

HADES® gate driver: an extreme temperature 600V/25A module, assembled in a hermetically sealed packages and rated up to 225°C (Ta), and a high reliability 3-phases 1200V/100A power module for operation in excess of 200°C (Tj). The first module targets the most stringent temperature environments found in Oil & Gas Drilling and in Jet Engines. The second module is aimed at high power density applications. In both cases, IPM technology provides users with a compact, efficient, reliable and easy-to-use solution to start their power converter design.

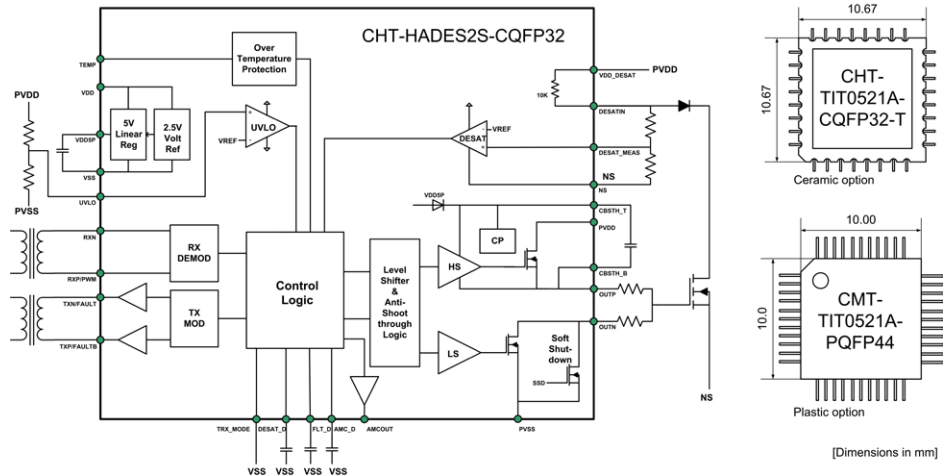


Fig. 4: HADES® v2 Secondary Side IC (HADES2S): Driver & Protection Functions.

Clamping down on harmful harmonics

By Steve Hughes

The rise of non-linear loads in industrial and commercial applications has brought the debate about harmonic currents to the forefront. We already know they cause damage to equipment, consume more energy and raise costs in the long term, but now the European parliament is taking action to introduce minimum targets. This article explores how

harmonics often go unnoticed, the damage they cause and what you can do about it using harmonic filtering techniques.

It seems that human-kind has an insatiable appetite to dominate every aspect of our environment. At home, in the car or at the office, we demand complete control. Traditionally, our electronic devices have helped us to achieve this and have, over time, become the centre of our world.

Whether it's personal, commercial or industrial, the electrical systems that power everything around us, actively or passively

Steve Hughes is managing director of REO UK - www.reo.co.uk

enable almost anything we do.

Your mobile phone charger, your computer's power supply, your office ventilation system, photocopiers, UPS power, even the 250kW variable speed drive (VSD) controlling the motorised manufacture of your everyday goods, all undergo a process of AC to DC power conversion.

The increased use of smaller and more compact power supplies in electronic devices and controlled motors has largely been made possible through the use of switch-mode power supplies (SMPS) in personal usage and VSDs in commercial and industrial usage. This is achieved by manipulating the mains power supply using components in rectifier and chopper circuits in a process of high frequency switching, or pulse width modulation (PWM). Although PWM achieves very low power losses, the process introduces harmonic currents into the supply. Harmonics are essentially multiples of the fundamental 50Hz frequency and are responsible for numerous problems, particularly in industrial environments.

Damage

The most immediate problem is increased energy consumption. The distortion caused by harmonics results in a non-linear, non-sinusoidal waveform. For example, if the fundamental current drawn is 70A, this capacity may consist of 20A of harmonic frequencies, meaning that the total current the system has to supply is actually 72.8A.

This increased consumption is often taken for granted and widely goes unchallenged. It's only when harmonic currents lead to more noticeable component damage that concerns are raised.

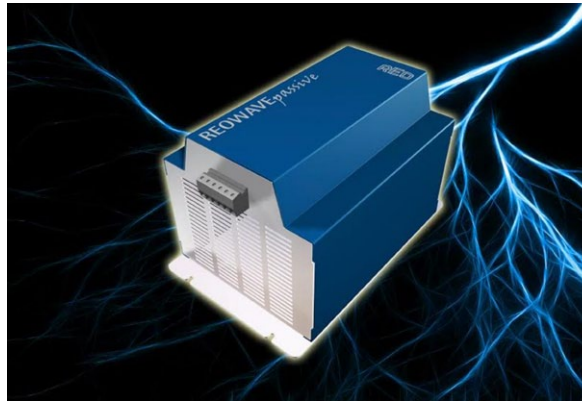
The most common damage caused by harmonics includes the overheating of transformers and windings. As the problem spreads throughout an interconnected system, bearings can begin to arc at high frequencies, resonance can cause power-factor correction capacitors to oscillate, resulting in overvoltage spikes. As well as this, hysteresis - the unwanted magnetisation of an inductor core, can lead to energy losses and eddy currents in motors.

Collectively, these problems can begin to affect both the local system internally and the wider supply system externally. Internally, electromagnetic interference (EMI) can begin to affect telecommunication equipment and metering apparatus. Significant distortion of the current waveform locally can begin to distort the voltage supply externally, creating symptoms such as flicker on public low voltage networks.

And it's not just at the material level. The prevalence of harmonics can cause operational problems too. System design and equipment purchasing decisions can become more difficult for managers. When the time comes to expand the system it's quite possible that the power capacity of equipment will have been reached prematurely, meaning that drives, conductors, transformers and fuses may need to be sized larger than necessary to accommodate the harmonics.

Directives

Even on existing systems, shielded cable becomes mandatory to comply with electromagnetic compatibility (EMC) requirements. Continuous and problematic levels of EMI can constitute EMC issues, rendering some equipment unsafe to use.



Standards set at European level, dictate the minimum requirements for safe usage of VSDs in power drive systems (PDS). IEC/EN 61800-3 directives apply to manufacturers, panel builders and systems integrators.

This only serves to add further cost to any given configuration as typical distances between drive and motor can exceed 50m. Here, shielded cable becomes even more necessary as signal attenuation

becomes a greater problem over longer distances.

The European parliament argues that 70% of all industrial electricity use can be attributed to motor driven systems and that if energy use is not curbed, it could reach 1,252TWh by 2020. The eco design directive covering electric motors, EC 640/2009, goes on to explain that energy use can be reduced by 20-30% and mandates that from January 1, 2015, all new motors not already capable of IE3 efficiency must be equipped with a variable speed drive (VSD).

Halting harmonics

So what can be done to overcome harmonic currents? Depending on the total harmonic distortion (THD) level of the system and the amount of mitigation required, users can opt for various solutions. For legacy setups that require a high level of redesign, active front end (AFE) or multipulse units can be installed to inject opposing frequencies into the supply, effectively cancelling out the harmonics. The benefit of these systems is that they also provide additional features such as regenerative braking.

The downside is that AFE systems may require considerable planning and expense as well as technical expertise and regular maintenance costs. An alternative and much cheaper solution is to use passive filtering.

Easily retrofitted into the system, these filters are a quick and effective method of substantially reducing harmonics - to less than 5% THD. Targeting the input and output, various filters offer differing levels of mitigation. From motor chokes and sinus filters to line chokes and dedicated harmonic filters.

In recent tests done by REO for a well-known UK manufacturer of drives, the rms current drawn by a 22KW variable speed drive at full load was 42.4A. When a harmonic filter was fitted between the three phase supply and the drive, the same 22KW drive output power was achieved with a 32A supply current; almost a 25% reduction. How was this achieved? By reducing the THD level from 67% down to just 7.6%.

Assuming the motor and drive system was running at full load for eight hours a day for 200 days a year and that the price per unit of electricity is 12.7p - the annual saving that could be achieved in the first year, including the cost of the filter, could be £1,099. Even with the labour and downtime costs required to fit the filter, given the increased life of the motor and costs saved by not needing shielded cable, this is an incredible return on investment (ROI).

Under the rug

For too long the issue of harmonics has been swept under the rug. It seems that the increasingly aggressive EU stance combined with the UK Government's target to achieve 20% reduction in CO2 emissions by 2020 could be a wake-up call for the industry to take action.

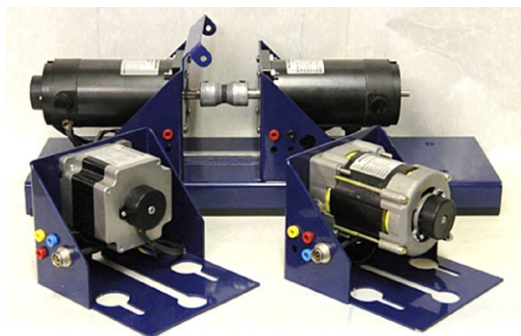
Rare earth magnets still optimum choice, says motor design expert

By Graham Prophet

Promoting a workshop to be held at the forthcoming CWIEME Berlin event, by Motorsolver president and IEEE life fellow Jim Hendershot, the organisers have released a preview of some of his findings regarding current industry practice in the selection of traction motors. At the conference, Hendershot will explore the pros and cons of hybrid and electric vehicle motor designs, encompassing performance, manufacturing methods and cost.

Amid concerns over the price, supply and hazardous extraction of rare earth metals used in permanent magnet motors, many members of the motor manufacturing community, especially those in the automotive sector, are carrying out extensive research into eliminating or reducing their use. Visitors to the 2015 CWIEME Berlin exhibition will have heard about several initiatives in this area, such as the EU-funded MotorBrain project and work of the Karlsruhe Institute of Technologys Helmholtz Center for hybrid and electric vehicles, in the seminar programme.

Practically speaking, however, rare earth permanent magnets still remain the number one choice in hybrid and electric vehicle motors, according to leading design expert Jim Hendershot running the workshop at the exhibition. Mr. Hendershot, based in Kentucky, USA, has over 40 years experience in the design of permanent magnet and brushless switch-reluctant motors for computer disc drives, servo systems, traction drives, and hybrid vehicles, as well as micro-turbine and diesel generators. He has co-authored two of the leading design books on permanent magnet motors and generator design and has worked for some of the worlds most influential manufacturers, including General Motors.



There are several types of electric motors for engineers to choose from for hybrid and electric vehicle traction drives: induction (or asynchronous), permanent magnet synchronous, switched-reluctance synchronous or reluctant synchronous. A couple of large front-end loaders [earth-moving machines] use switched-reluctance wheel motors and some large dump trucks and [bull]dozers use AC induction

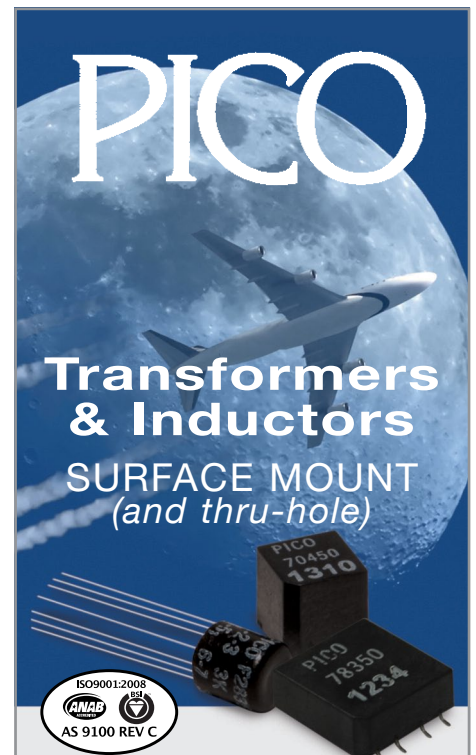
motors for traction, as well as newer forklift trucks. But all major hybrid electric vehicles currently in production use rare earth permanent magnet synchronous traction motors, he says.

When BMW were beta testing their new i3 model, they ran them around for a few years with induction motors in them. But when it came to high volume production, they changed it to a permanent magnet motor. Similarly, it has been reported that Toyota is investigating motors with no magnets, such as AC induction, but so far there is no clear indication that Toyota will switch over to AC induction motors now that magnet prices have subsided somewhat, he adds.

The principle reason for popularity of the permanent magnet machine is that all other machine types without magnets require more mass and are less efficient. These are very important features for transportation vehicles, aircraft and ships.

The maximum performance of any machine type is based upon the magnetic and electrical properties of the machine materials and all machine types tend to utilise the same electrical steel grades and copper conductors. Machines without magnets must be magnetised by supply current from their power source, whereas permanent magnet machines require zero magnetising current so their efficiency is always higher than machines such as AC induction and reluctance machines with no magnets.

AC Induction machines have rotor slip losses, rotor Ohmic losses and they are limited to four pole designs, compared to permanent magnet synchronous machines that utilise higher pole numbers, making them smaller. Even with the best materials in the world an AC induction motor will still be less efficient as it requires power from the batteries to magnetise the magnetic circuit, he says.



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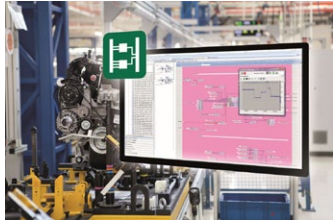
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Online signal processing benefits from graphical programming

iba AG has released extended its PC based measurement and automation system ibaLogic with numerous new functions and an even more intuitive user interface. At the core of the system



is a completely new development, the so called runtime system based on a Programmable Automation Controller (PAC). This architecture commonly used in modern PLC systems was enhanced with properties typical of a measurement system. Typical application for ibaLogic include online signal processing in measurement systems, such as condition monitoring, process model implementation for production optimisation, and system interfacing. Perfectly suited for use in automatic test benches, the new ibaLogic version is available in different performance classes: a license-free entry-level version ibaLogic-V5-Lite or a full version with complete connectivity to iba's OPC server. The fifth versions offers a very intuitive handling, allowing users to develop his solution using the graphic user interface almost without any prior knowledge to see the results immediately with animated connectors and an integrated multichannel recorder, ibaPDA-Express.

iba AG
www.iba-ag.com

32-Bit MCU offers on-chip floating point unit for better control

Renesas Electronics's RX23T Group of microcontrollers is based on the fast RX core, making the new 32-bit MCUs well suited for building high-performance inverter control systems for applications such as DC motor control in energy-efficient electric home appliances. By incorporating an on-chip floating point unit (FPU) without increased costs, the new chip eliminates the need to implement the decimal position shifting required when using a fixed-point arithmetic unit. This simplifies the software configuration and can reduce code size and development time by as much as 30 percent, claims the manufacturer. The on-chip peripheral functions are also optimized for single inverter drive, boosting the cost-to-performance ratio and making it possible to add high-precision inverter control to mid-range and entry-level products. The RX23T MCUs feature the RXv2 core (4.55 CoreMark/MHz target) and a DSP functionality, allowing operation processing to be maintained with no loss of real-time responsiveness when performing inverter control (sensor-less vector control), even when the CPU is not running at high speed. In addition, current consumption in low-power mode (data retained in RAM) is only 450nA, typical.



Renesas Electronics
www.renesas.eu

Easy to program 3-phase brushless motor drive

Haydon Kerk Motion Solutions has added the PBL4850E programmable 3-phase brushless motor drive to its IDEA drive line of motor controllers. A graphical user interface



enables the automatic population of motion profile parameters based on entry of just a few motor characteristics. Complex parameter calculations or in-depth motor knowledge are completely unnecessary. Furthermore,

Haydon Kerk's IDEA software makes programming motors even easier through the use of intuitive, on-screen buttons, instead of complicated command sets or proprietary programming languages. The PBL4850E is a 4-quadrant brushless controller that utilizes sinusoidal commutation to produce smooth motion. The smooth torque produced by sinusoidal commutation minimizes torque ripple. The drive further refines motion by incorporating two motion profiles: trapezoidal and s-curve. The drive offers programmable current control of up to 5.6A peak with an optional current boost during ramping of up to 6.5A peak. With an input voltage of 12-48 VDC, the drive can accommodate a wide range of brushless motors. Hall cell signals are used for phase initialization, and an encoder provides positional feedback. Other features include 8 opto-isolated general purpose inputs and outputs. Each input is rated for 5 to 24 VDC, 8 mA maximum per input. The outputs are open collector, 5 to 24 VDC, 200 mA maximum per output. The PBL4850E IDEA drive communicates via a USB to mini USB.

Haydon Kerk Motion Solutions
www.haydonkerk.com

Hall current sensor comes in high-isolation package

ACS722 and ACS723 Hall-effect current sensor ICs from Allegro MicroSystems Europe are now available in a high-isolation SOIC16 package. The low-profile surface-mount package is suitable for space constrained applications yet provides a 4800 VRMS isolation rating: the highest available from Allegro's family of surface-mount current sensor ICs. These high-accuracy devices provide economical and precise solutions for AC or DC current sensing in industrial and commercial applications. In addition to their small size and high accuracy, the ACS722 and ACS723 have low power consumption and a wide operating temperature range with near zero magnetic hysteresis. Each device consists of a precise, low-offset, linear Hall sensor circuit with a copper conduction path located near the surface of the die. Applied current flowing through this copper conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage. Device accuracy is optimised through the close proximity of the magnetic field to the Hall transducer. A precise, proportional voltage is provided by the low-offset, chopper-stabilised BiCMOS Hall IC, which includes Allegro's digital temperature compensation technique, resulting in accurate performance over temperature.



Allegro MicroSystems
www.allegromicrosystems.com

Harmonic Drive to support academia in search of future talents

Gearing specialist Harmonic Drive UK is calling for universities and academic partners as part of a concerted effort to tackle the graduate skills shortage. One of the recommendations from Lord Perkins' review of engineering skills urges collaboration between the Government, employers and academics. It explains that, "engineering employers should encourage their staff to share their skills and knowledge." The use of high precision gears is often critical in robotics, aeronautics and aerospace applications. Here, lightweight and compact gears, featuring zero backlash and high reduction ratios, improve the efficiency and cost effectiveness of development. However, teaching it is not always mandatory on relevant degree syllabuses. For instance, The Guardian recently highlighted the importance of gearing in the field of robotics, featuring comment from Graham Mackrell, managing director of Harmonic Drive



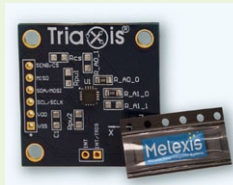
UK. The industry has already taken the manufacturing world by storm and is now diversifying for future use in public and home applications. "The most direct way of addressing this issue is by directly talking to and informing young people face-to-face," explained Graham Mackrell, managing director of Harmonic Drive UK. "To make sure that the engineers of tomorrow are equipped with the knowledge and expertise required to face these new challenges, we're currently developing material to be delivered during a series of guest lectures and campus visits. "If any universities, lecturers or organisers are interested in enhancing the delivery of their course modules with the latest developments in the robotics, aeronautics or aerospace industry, we urge them to get in touch." Harmonic Drive specialises in high precision gears and servo actuators for mission critical industries including offshore oil and gas, aerospace, defence, industrial automation and defence applications. Interested parties are invited to contact gail.softley@harmonicdrive.co.uk.

Harmonic Drive

<http://harmonicdrive.de/en>

Programmable magnetic sensor IC in kit

Melexis is now supporting its MLX90393 programmable magnetic sensor IC with an evaluation board (EVB), only 30 by 30mm, which gives engineers a platform for testing a wide variety of human machine interfaces. Applications go all the way from relatively simple slide, push/pull and linear swipe switches right through to more complex 3D sensing systems, such as joysticks or rotary knobs with push functions included. Relying on Melexis' proprietary Triaxis® technology, the 16-bit resolution MLX90393 sensor IC on each EVB has the capacity to deliver a digital output proportional to the detected magnetic flux density along 3 perpendicular axes (X, Y and Z). In addition, there is also provision for thermal measurement.



The IC acts like a building block for position sensing systems in a broad spectrum of applications. It presents engineers with a wide array of configurable parameters, allowing them to optimize their system for either high speed measurement, elevated signal integrity or low power consumption. Both SPI and I2C interfaces are featured on the EVB, making it easy to integrate with an external microcontroller. There is also a pad incorporated onto the board for the connection of a decoupling capacitor if required, as well as pads for optional pull-up and pull-down resistors for I2C addressing and bus line supply. An operational temperature range spanning from -20°C to +85°C is supported. The EVB is supplied with a MLX90393 IC soldered directly to the PCB, along with 3 extra ICs to accompany it. A QR code link printed on the underside of the board permits immediate access to all the relevant documentation available on the Melexis website.

Melexis

www.melexis.com

PICO

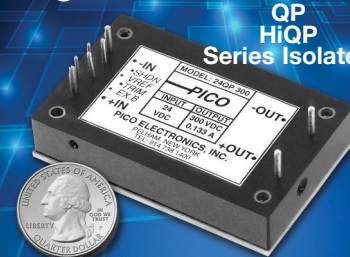
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Ruggedized tire pressure sensor raises bar

Tire pressure monitoring is now mandated by the governments of many countries around the world, making passenger cars and light trucks the biggest market for microelectromechanical systems (MEMS) that go inside the tire to monitor pressure and



transmit it wirelessly to the dashboard of the driver. Freescale says it already has the world's smallest MEMS tire pressure monitor for consumer vehicles, but now its upping the ante by offering the world's highest pressure sensor for heavy trucks, buses and construction vehicles. Many tire pressure monitors use bulk machining of silicon blocks to realize tire pressure MEMS monitors, but Freescale uses standard inexpensive surface machining to realize a tire pressure monitor that uses capacitance to be much more accurate than the bulk-machined or even other surface machines tire pressure sensors, according to Freescale. Its system-in-package (SiP) also contains a two-axis accelerometer, an S08 8-bit processor with 512 bytes of RAM, 16-kbytes of flash (8k for Freescale library, 8k for applications), dedicated state machines for reduced power consumption, six general-purpose input/output (GPIO) ports — including two analog-to-digital (A/D) inputs — a low-frequency (125-kHz) receiver for programming user-defined functions and making periodic resets, and a high-frequency (315-to-434 MHz) RF transmitter supporting rolling encryption to issue warnings to the fleet manager and to read out a “prognosis” of each tire’s condition. The built-in accelerometer turns off the device when the vehicle is sitting still, but can also record the acceleration while in motion and also includes a temperature sensor to include in the correlations.

Freesc

Freescale

www.freescale.com

Power multiplexer ICs for mobile devices

Toshiba Electronics has added three power multiplexer ICs that are capable of switching between two different power sources, for mobile device charging applications. The TCK32xG series features small package size with improved protection features for power supplies. TCK321G, TCK322G and TCK323G are intended for applications in the charging circuits of mobile devices that use dual-input power supply systems, consisting of AC adapters, USB or wireless



charging inputs. Power source selection is possible through the ICs external signal control and through a built-in auto selection mode function which switches sources automatically according to priorities programmed in advance. Making use of a reverse blocking circuit and thermal shutdown, these new ICs have built in protection features. Additional protection is offered by the integrated over voltage lockout (OVLO) feature with OVLO presets between 12 and 15V for the different devices. All three ICs are contained in a WCSP type package, measuring 1.9 x 1.9 mm, with 0.5 mm pitch, featuring a maximum output current of 2A and a maximum input voltage of 36V.

Toshiba

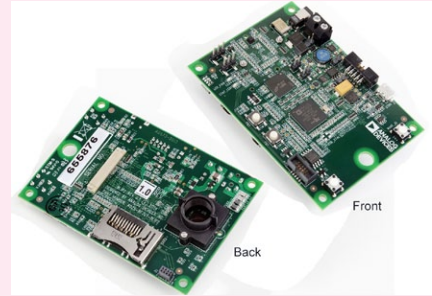
www.toshiba.semicon-storage.com

Real-time video analysis at the tip of your lens



In this month's reader offer, Analog Devices is giving away five Blackfin Low-Power Imaging Platform (BLIP) Development Systems (ADZS-BF707-BLIP2), worth 199 dollars each, for EETimes Europe's readers to win. Targeting demanding ultra-low-power, real-time applications for image sensing and advanced audio, the development platform leverages the company's ADSP-BF707BBCZ-4

Blackfin processor as well as ADI's optimized software libraries for video occupancy sensing. Measuring 63.5x89mm and



drawing under 1W from a 3.2 to 15V supply voltage, the board comes preloaded with an occupancy software module optimized to detect the presence and behaviour of humans or vehicles within indoor and outdoor environments, including for people counting and face detection use cases. An intuitive configuration GUI enables real-time analysis of captured video, as well as video output/display through an on-board USB port. Major elements on the board include the ADSP-BF707BBCZ-4 Blackfin processor with more than 1-Mbyte of internal SRAM and LPDDR, Omnivision's OVM7692 VGA SoC sensor with an integrated lens, 256MB of DRAM and 32MB of Flash, as well as power management ICs. The USB powered platform comes complete with ICE-1000 and CrossCore Embedded Studio development tools.

Check the reader offer online at

www.electronics-eetimes.com

AMC module packs dual DAC at 5.7 GSPS with Virtex-7 FPGA

Designed for RADAR signal processing and jamming applications, VadaTech's AMC529 combines the functionality of the company's FPGA Carriers and digitizing FMCs. Providing excellent dynamic performance, the board has dual Digital to Analog Converters (DAC) that are 14-bit at 2.85 GSPS (5.7 GSPS in mix-mode). The AMC529 includes a clock jitter cleaner and on-board clock generation.

The on-board Virtex-7 FPGA has 3 banks of 144 Mbit QDR-II memory that is 36-bit wide plus 1 Gbit of 16-bit DDR3 memory. The board includes an IPMI controller, and clock holdover stability is also standard on the AMC529 with XO and TCXO crystal oscillator options.

VadaTech

www.VadaTech.com



Snap-action switch evaluation kit harvests energy

Cherry Industrial Solutions has unveiled a revised Evaluation Kit 2.0 to demonstrate its energy harvesting technology. The kit contains an inductive-based energy harvesting generator, rocker



switch and a snap-action switch and provides users with the opportunity to carry out initial application tests. In addition, a compatible receiver with antenna is also included. A detailed manual, drivers and software for the receiver are available for download from Cherry's website. The Evaluation Kit 2.0 allows users to measure the switching performance, range and signal strength, as well as the environmental influences of the radio transmission in various applications such as building and industrial automation. The addition of a (non-functional) energy harvesting generator means that mechanical design considerations, including mounting position etc., can also be simulated. The inductive generator transforms energy created by mechanical actuation into an electrical energy pulse which is then transformed into a constant supply voltage to power the radio electronics. The housed switches and the receiver are available for European and North-American frequency bands (868MHz or 915MHz). A ready-for-installation energy harvesting wireless light switch module for the KNX-RF standard will be available in summer 2015.

ZF Friedrichshafen AG Electronic Systems

www.zf.com

4 Mbit asynchronous SRAMs have on-chip ECCx

These 4Mb SRAMs improve data reliability by three orders of magnitude over SRAMs without ECC, while helping to conserve battery life in handheld systems. Cypress Semiconductor's 4Mb asynchronous SRAMs with ECC can provide the highest levels of data reliability, without the need for additional error correction chips—simplifying designs and reducing board space. The devices ensure data

reliability in industrial, military, communication, data processing, medical, consumer and automotive applications. Soft errors caused by background radiation can corrupt memory content, resulting in a loss of critical data. A hardware ECC block in Cypress's new asynchronous SRAM family performs all error correction functions inline, without user intervention, delivering Soft Error Rate (SER) performance of less than 0.1 FIT/Mb (one FIT is equivalent to one error per billion hours of device operation). The new devices are pin-compatible with current asynchronous fast and low-power SRAMs, enabling you to boost system reliability while retaining board layout. The 4Mb SRAMs also include an optional error indication signal that indicates the correction of single-bit errors. The Cypress 4 Mb asynchronous SRAMs are available in three options—Fast, MoBL and Fast with "PowerSnooze"—an additional power-saving Deep Sleep mode that achieves 15 µA (max) deep-sleep current for the 4 Mb SRAM.

Cypress

www.cypress.com

Capacitive starter kit accelerates touch-based HMI deployment

With its touch sensing starter kit (part# Y-RX113CAPT01), Renesas Electronics is offering extra support for its RX113 Group of 32-bit microcontrollers which incorporate capacitive touch sensor IP. The kit offers systems designers greater flexibility in developing human-machine interface (HMI) applications for home appliances, industrial machinery, and others that require touch capability in rugged environments. The capacitive touch sensor IP delivers both high sensitivity and high noise tolerance, allowing touch recognition even when the operator is wearing gloves, for instance with industrial applications such as numerical control machine tool control panels. It also provides excellent water resistance, making it suitable for use in a wide variety of product categories, including electric kitchen appliances that may be exposed to water spills, such as induction heating cooking devices or dishwashers, or products designed for wet environments, such as remote controls for bath water heaters or water-resistant TV sets. The kit also provides automatic tuning functionality that solves a key problem for capacitive touch interface development: the trade-off between touch sensitivity and noise tolerance. The starter kit is bundled with four touch sensing evaluation boards, making it simple to create suitable environments for testing panel materials, proximity or position sensing, and more.



Renesas Electronics

www.renesas.eu

Vision server supports up to eight individual GigE ports

Designed to be used in harsh environments, MPL AG's Vision Server comes with up to eight individual GigE ports on RJ45 or M12, of which four are available with PoE+. The units integrate Intel mobile CPUs and Intel LAN chips to ensure long time availability (10 years and more) and repair-ability (typically 20 years and more after introduction). The CPU as well as the ECC DDR3 memory chips are soldered on-board, allowing to mount them direct to the housing for the best cooling and to avoid heat pipes. The new PIP30 Family is designed such, that the Fit & Form still remains the same as when the first PIP was introduced in 1996. Inputs are reverse polarity and load dump protected, for a power range from 9 to 36VDC. Galvanic separation can be added internally. Up to four mass storage devices can be integrated that can also be configured as RAID. WLAN or GPS are available as options.



A large set of interfaces include up to seven USB (3.0 and 2.0), up to four serial lines (RS232/485), PS/2, external SATA port, and as specialty an external PCI-E or eSATA port. Internally available are two SATA interfaces. What's more, the unit can easily be expanded over various expansion ports like; up to 6 miniPCIE, PCI-104, PCI/104-Express, or PCI-Express x 16.

MLP AG

www.mpl.ch

Box PC reduces cost of ownership in automation

Arbor Technology's IEC-3300 is a very small boxed chassis system based on the new Intel Celeron SoC & Atom processors E3800 family (formerly codenamed "Bay Trail").

Successfully handover for QC station



Measuring 163x109x39mm, the robust IEC-3300 is well suited for a multitude of space/cost critical applications within industrial applications and digital signage. This ultra-reliable reliable system has an extended temperature range and is constructed from only the finest industrial components thus giving users the benefit of long-term support and a low total cost of ownership.

The turn-key, go-anywhere solution suits customers looking for out-of-the-box CE/FCC certification, or for customers with demanding digital signage projects. The processor is capable of driving HD multimedia, and the system offers HDMI and VGA ports for dual displays. The dustproof design and a -20 to 55°C temperature range make the IEC-3300 fit for use within warehouses, train stations, factories and multiple other locations. The standard IEC-3300 is available with on-board N2807 CPU, but systems configured with the J1900 and E3825 are also available upon request.

Arbor Technology
www.arbor-uk.com

COB LED arrays lower the cost of industry-leading efficacy

Lumileds has launched what the company claims is most cost effective line of chip-on-board (CoB) LED arrays with industry-leading efficacy. The LUXEON CoB Compact Range



aims to strengthen Lumileds' lead in the CoB category by enabling the most cost competitive

solutions for PAR, GU10 and MR16 lamps. The line of arrays is also distinct in that the same optic can be used for both a 35 W equivalent and a 50 W equivalent GU10 or MR16 lamp, thereby reducing system cost and development effort to the manufacturer. The LUXEON CoB Compact Range is designed to deliver unsurpassed center beam candle power (CBCP) making it the ideal choice for designers of PAR lamps and other compact directional lamps. The range of 5 W, 7 W and 9 W CoBs produce between 600 and 1100 lm at 110 lm/W, making 100 lm/W GU10, MR16, PAR 16 and PAR30 equivalents a reality. The COB LED arrays offer high efficacy, high flux, and a small LES (light-emitting surface) of 6.5 mm to enable high punch at low beam angles. In a GU10 lamp, the LUXEON CoB 109 achieves 70,000 candelas and 1,500 lumens with a 10° beam angle. The LUXEON CoB Compact Range 109 will also be available with CrispWhite Technology. Lighting designers are using LUXEON CoB Compact Range arrays to produce their most cost competitive retrofit and directional lamps for retail, home and hospitality applications. Lumileds has worked with several key ecosystem partners, for the CoB family, to release compatible drivers, optics and holders to help speed the time-to-market of all lamps.

Lumileds
www.lumileds.com

Audio DSP chip embeds AfterMaster's HD technology

Together with AfterMaster HD Audio Labs, ON Semiconductor has released the BelaSigna 300 AM audio DSP chip embedded with AfterMaster technology, all in

a 3.63x2.68x0.92mm size WLCSP package. The chip will operate at 4mA from a 1.8V source while running AfterMaster HD's algorithms to offer high-fidelity, studio-quality sound to audio-enabled devices and services. Using real-time mastering and re-mastering processing technology as well as proprietary Adaptive Intuitive Response mechanisms, AfterMaster HD preserves original sound quality while introducing greater depth, clarity and richness to any listening experience. Product distribution of BelaSigna 300 AM with AfterMaster HD will be available through ON Semiconductor's global channel and distribution network



ON Semiconductor
www.onsemi.com

Wireless data logger targets agriculture applications

The GL 100-WL is a wireless data logger that transfers measurement data via peer-to-peer, LAN or WiFi connections to downstream processing units such as PCs. The device is offering users particular benefits in outdoor usage, claims vendor Althen GmbH. Examples are measurements in agriculture, photovoltaic installations or environmental projects. With sensor modules for temperature, humidity, carbon dioxide content as well as general and ultraviolet illumination intensity the data logger is directly supporting measurements associated to growth conditions in agriculture. The vendor also offers specific software for the evaluation of these measurements on a PC. The GL 100-WL can communicate with downstream nodes in multiple ways through routers, independent of the provider. The measurement data can be transferred directly to smartphones, tablets or PCs. They also can be connected to a local area network or a WiFi network. Likewise it is possible to connect multiple data loggers to a terminal across the internet. Farmers and gardeners among the GL 100 get a fast overview at their respective locations over the parameters relevant for plant growth. A software that is optimised for these dimensions enables users to quickly detect current conditions and trends. If the measured values exceed the permitted range, warnings are issued. The data logger will be showcased at the upcoming Sensor + Test exhibition (Nuremberg, May 19 through 21).



Althen GmbH.
www.althen.de

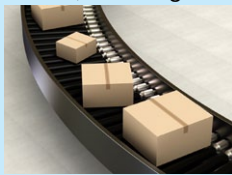
SILICA and Avnet Memec merge for EMEA

Avnet Electronics Marketing EMEA, a business region covered by electronic distributor Avnet, Inc has decided to enhance the selling strength of its two semiconductor distribution organizations SILICA and Avnet Memec by combining the sales forces of both distributors into one. The change to be effective June 29, 2015 are described as the logical conclusion to a long time collaboration with shared IT, finance, operations and assets. Although the two entities become one to extend close sales collaboration to all of EMEA, the demand creation activities, technical marketing and application support will remain separate. The Memec name will be retained to help drive specific marketing and demand creation (design-win) efforts. "This collaboration has evolved over a long period and proven to be very effective both at the sales side in some smaller countries and the operational side of the business across Europe. Making SILICA and Avnet Memec one company across Europe with two distinctive demand creation forces will help us drive scale and focus for many exclusive manufacturer relationships" said Miguel Fernandez, president of Avnet EM EMEA in a statement.

Avnet Electronics
www.avnet.eu

Anglia partners with Everspin on MRAM

Anglia Components is to take the industry's fastest non-volatile memory technology to design engineers in the UK and Ireland, following its appointment as distributor for Everspin



Technologies. Commenting, David Potts, Divisional Marketing Manager Semiconductors at Anglia said, "Anglia FAEs love to be in a position to give our customers a real edge in their design, and Everspin MRAM is a technology

that allows them to do just that. Customers can have the best of both worlds. MRAM is a non-volatile memory technology without the access speed penalties associated with Flash."

Anglia Components
www.anglia.com

Nohau to resell Icon Labs' security portfolio in Scandinavia

Strengthening its presence in Europe, embedded networking and security technology provider Icon Labs has selected Nohau as the exclusive reseller of its Floodgate Security Framework



in the countries of Denmark, Finland, Sweden and Norway. "Worldwide, today's modern industrial automation, utilities, and embedded devices are complex connected systems performing critical functions," says Alan Grau, CEO of Icon Labs. "Including

security in these devices is a critical design task. Cybersecurity is a global problem and OEMs, regardless of their location, need to consider security features early in the design process to ensure the device is protected from advanced cyber-threats, and can meet varying regulatory requirements. Enhanced security increases the value for all end users. Partnering with Nohau adds an important dimension to our worldwide presence".

Nohau
www.nohau.se

Rutronik founds Subsidiary for North American Market

Rutronik Elektronische Bauelemente GmbH has founded the new subsidiary Rutronik Inc. with its headquarters/sales office in Cleveland, Ohio, and with future expansion planned in key markets throughout the US, Canada and Mexico. Rutronik Inc. is positioned to serve the North American market under the expert supervision of Vice President Jeff Shafer, operating independently and flexibly within the global Rutronik Group. The new office has opened its doors for business on April 20th with the inauguration of the headquarters in Cleveland. The internal sales and product management staff along with the technically oriented field sales engineers that are positioned in key markets across the United States, will support both the global and North American customers, employing decentralized development and procurement processes that Rutronik already supports in Europe and Asia.

Rutronik
www.rutronik.com

WSTS marks America up for 2015 boom

The market for semiconductors in the Americas region will grow by 15 percent in 2015, according to a revised estimate from the World Semiconductor Trade Statistics (WSTS) organization. This, together with strength in the market in the Asia-Pacific region, has led WSTS to increase its annual growth estimate worldwide for 2015. WSTS now forecasts the market for semiconductors in the Americas region will enjoy 15.0 percent annual growth in 2015, a mark up from 5.3 percent growth figure given in December 2014. Forecasts for the other main geographic regions have also been altered with a more pessimistic view taken for Europe and Japan and a higher growth figure plugged in for the Asia Pacific region. Europe has been marked down to a contraction in dollar terms of 2 percent compared with growth of 1.5 percent. Japan's chip market is expected to contract by 3.7 percent while the Asia-Pacific market is expected to grow by 4.2 percent.

WSTS
www.wsts.org

Plessey expands European GaN-on-Silicon LED distribution network

Plessey Semiconductors has entered into a sales representative agreement with ROM Elektronik Ltd., an electronics distributor and provider of complete solutions headquartered close to Istanbul, to expand its European network with coverage in the Turkish market for GaN-on-Silicon LED products. Resat Erunsal, Director of ROM Elektronik, said: "Being the leading, demand creation minded, specialised distributor, ROM Elektronik is proud to have been selected to represent Plessey. Following the rapid growth of the LED industry in recent years, our customers are now more focused in reducing manufacturing costs when selecting an LED for their lighting projects. "Plessey's MaGIC process is an innovative approach to LED production that offers potential cost savings in terms of wafer size scaling and improved binning over conventional LEDs".

ROM Elektronik Ltd.
www.plesseysemiconductors.com

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LAST WORD

Industry 4.0 unplugged

By Steve Hughes

Buzzwords fly around in industry like wasps at a picnic. Industry 4.0 is one of these hugely popular concepts, particularly when it comes to manufacturing. The term originated at the Hannover Messe a few years ago, when it was defined as the computerisation of manufacturing, including a transition to higher levels of interconnectivity, smarter plants and communication between machines and equipment.

The first industrial revolution was the development of mechanisation using water and steam power. The second paradigm shift was the introduction of electricity in manufacturing environments, which facilitated the shift to mass production. The digital revolution happened during our lifetime, using electronics and IT to further automate manufacturing.

Industry 4.0 is the fourth in this series of industrial revolutions. Although it is still, relatively speaking, in its infancy, the idea relies on sophisticated software and machines that communicate with each other to optimise production.

In Industry 4.0, strong emphasis is placed on the role of intelligent factories. They are energy efficient organisations based on high-tech, adaptable and ergonomic production lines. Smart factories aim to integrate customers and business partners, while also being able to manufacture and assemble customised products.

Furthermore, tomorrow's smart plants will most likely be expected to take more autonomous decisions regarding production efficiency and safety. Industry 4.0 is more about machines doing the work and interpreting the data, than relying on human intelligence. The human element is still central to the manufacturing process, but fulfils a control, programming and servicing role rather than a shop floor function.

The Siemens (IW 1000/34) Electronic Works facility in Amberg, Germany, is a good example of the next generation of smart plants. The 108,000 square-foot high-tech facility is home to an array of smart machines that coordinate every-

thing from the manufacturing line to the global distribution of the company's products.

The custom, built-to-order process involves more than 1.6 billion components for over 50,000 annual product variations, for which Siemens sources about 10,000 materials from 250 suppliers to make the plant's 950 different products. This means the amount of data the system has to work with is truly overwhelming.

Despite the endless variables within the facility, a Gartner industry study conducted in 2010 found that the plant boasts a reliability rate of more than 99 per cent, with only 15 defects in every million finished products.

Thanks to the data processing capacity of Industry 4.0-ready devices, it is possible to generate the information, statistics and trends that allow manufacturers to make their production lean and more fuel efficient. If you work in the food manufacturing industry, you probably know that many production lines today operate at less than 60 per cent, which means there is considerable room for improvement. Saving electricity and water are also key requirements for modern plant managers, who can achieve their eco-friendly goals by using smart plant connectivity.

The shift in manufacturing

In Germany and the US, governments have already allocated funds for strategic research and the implementation of Industry 4.0. Germany has dedicated €200 million for projects like BMBF's it's OWL or RES-COM. Similarly, the USA has launched several initiatives like the Smart Manufacturing Leadership Coalition.

Other countries, including the UK, are showing a lot of enthusiasm on the subject. Manufacturers and trade bodies like GAMBICA and the CLPA, have already endorsed the trend. Although no major official initiatives have been made public yet, there is definitely strong support for a move in the general direction of Industry 4.0. The great news is that a lot of the technology associated with Industry 4.0 already exists. The not so great news is that implementing it will probably cost your company a pretty penny, especially if you aim to be an early adaptor.



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www.automotive-eetimes.com



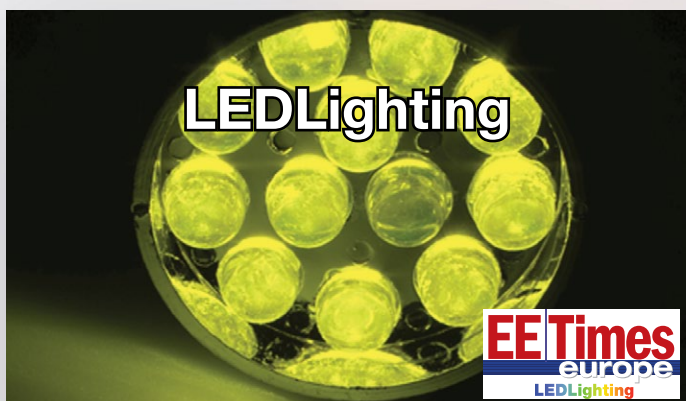
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