

# New-Tech

## Magazine

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June  
2017

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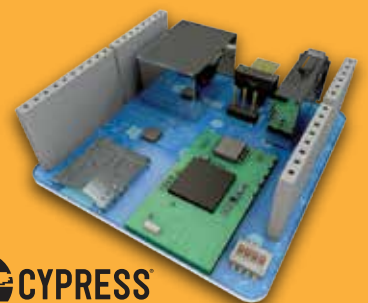


**ARROW**

## THE ARROW QUADRO IoT Wi-Fi Kit

a faster route to success in the Internet of Things market

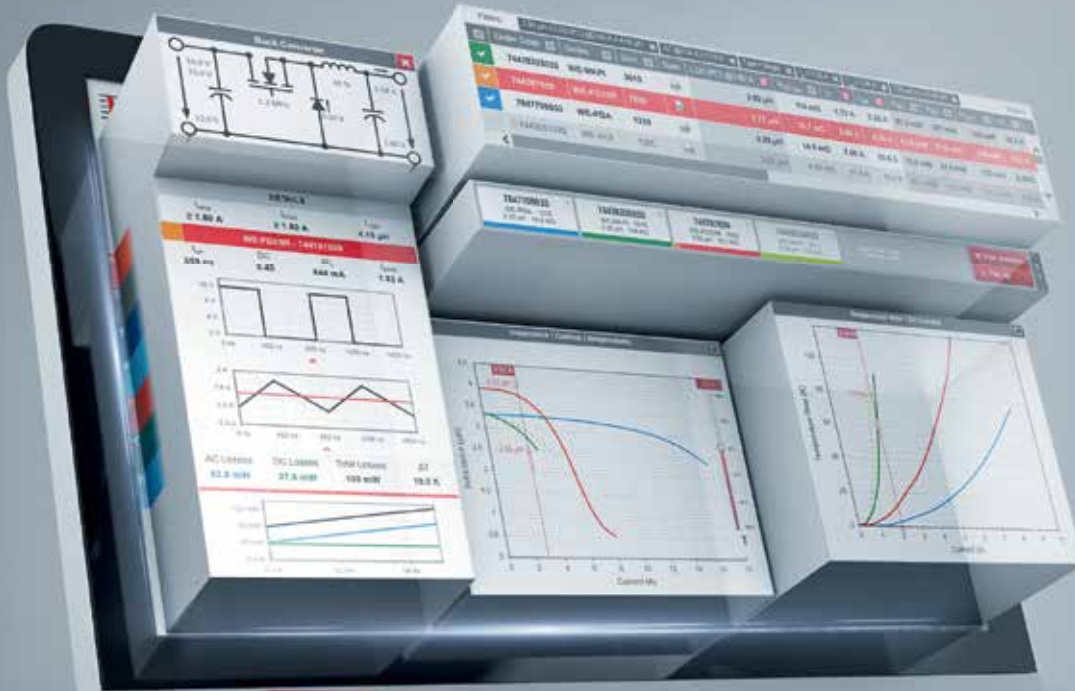
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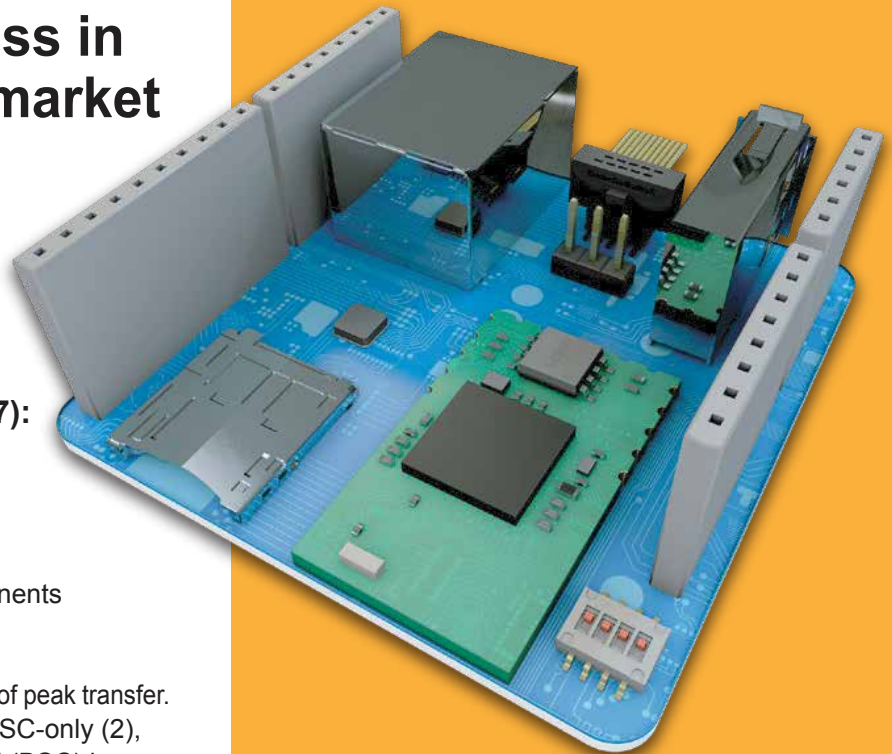
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# THE ARROW QUADRO IoT Wi-Fi Kit

A faster route to success in  
the Internet of Things market



## Features (Based on Cypress CY43907):

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- Dedicated fractional PLL for audio clock (MCLK) generation.
- USB 2.0 host and device modes.
- SDIO 3.0 host and device modes.

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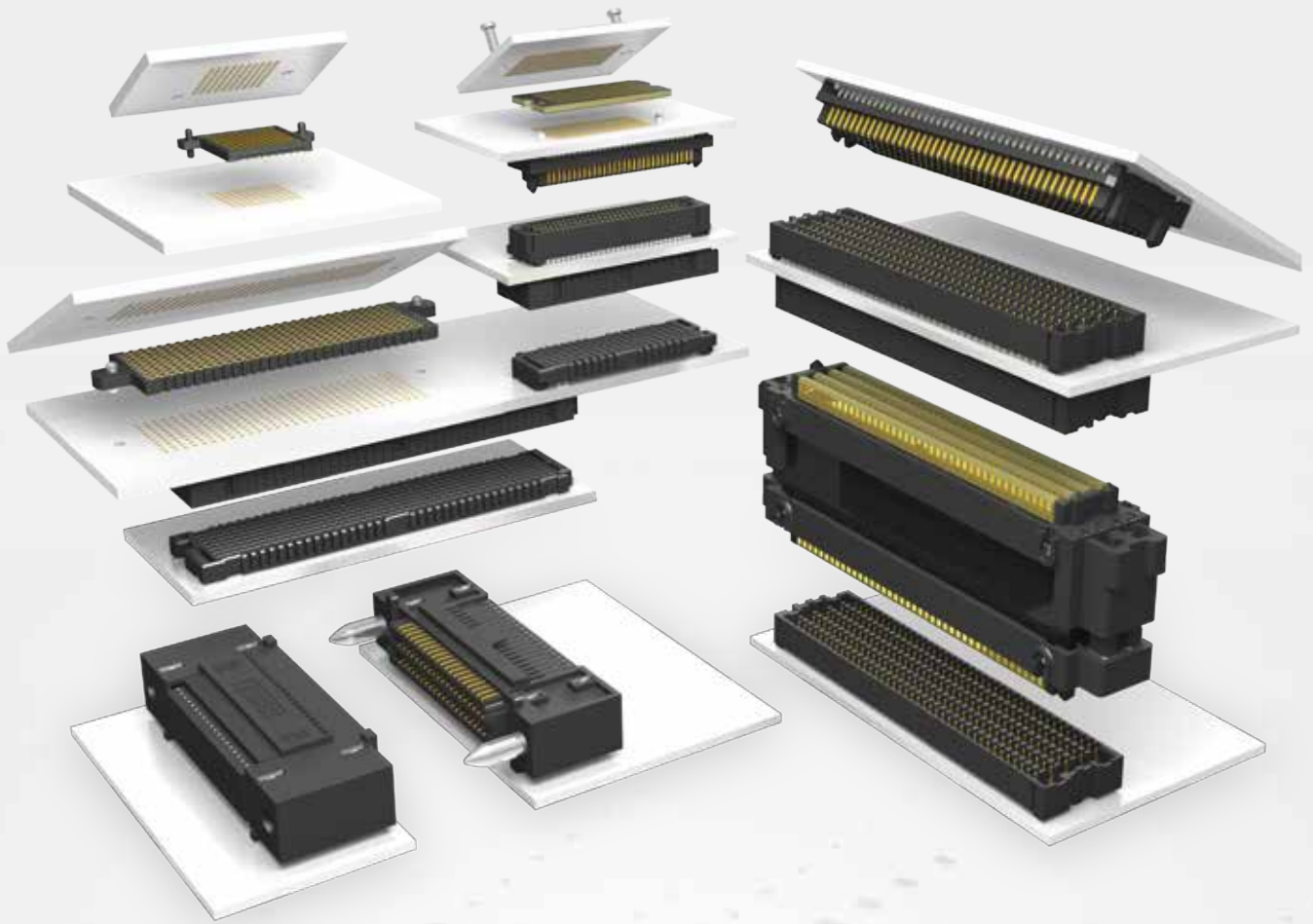


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# New-Tech Europe

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NI AWR DESIGN ENVIRONMENT

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FILTER DESIGN

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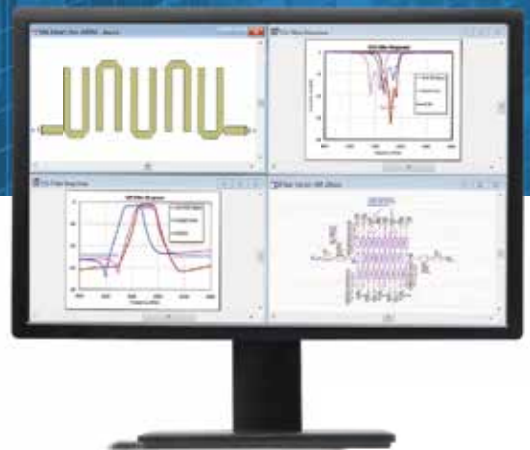
NI AWR Design Environment is one platform integrating system, circuit, and electromagnetic analysis that addresses all stages and types of filter development. From lumped-element or distributed filters to more complex multiplexed, high-power, and high-Q cavity filters, the software supports the latest materials and topologies, enabling filter designers to meet challenging performance metrics and size, cost, and time-to-market goals.

Simply smarter filter design.

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# New-Tech Europe

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2017

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Our specialized target audiences prefer **New-Tech Europe** because they know that our publications are a reliable source of the latest information in their respective fields. Our multidimensional editorials, news items, interviews and feature articles provide them with a full, well-rounded picture of the markets in which they operate - an essential asset for every technological leader striving to stay ahead, make the right decisions, and generate the next global innovation.

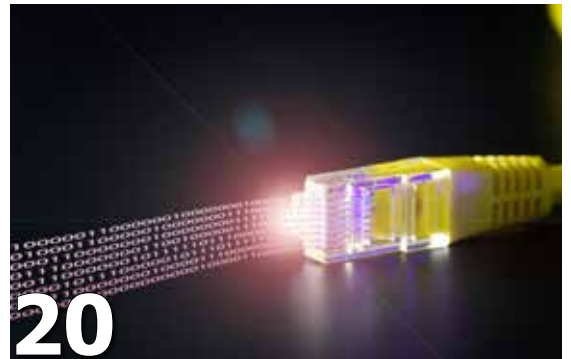
Moreover, as an attractive platform for advertisers from around the world, **New-Tech Europe** has become a hub for bustling international commercial activity. Here, through ads and other promotional materials, Israeli readers obtain crucial information about developers and manufacturers worldwide, finding the tools, instruments, systems and components they need to facilitate their innovative endeavors.

Targeting the needs of both the global and european industries and global advertisers, **New-Tech Magazines Group** constantly expands and upgrades its services. Over the years, the company has been able to formulate a remarkably effective, multi-medium mix of offerings, combining magazine publications with useful online activities, newsletters and special events and exhibitions.

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## VTT participates in developing new 5G technology and business opportunities based on smart light pole networks

Our cities face great challenges to improve safety, energy efficiency, air quality, effectivity of transportation and quality of living. In smart cities, there is a growing need for a new generation digital service infrastructure, which enables improved data capacity for citizens and new service and business opportunities for companies. The ever growing need for more data capacity in mobile telecommunications networks is a great challenge.

LuxTurrim5G projects answers the challenges by taking into use small cell radio frequency (RF) technologies and higher frequencies to provide higher data capacity. The small cell solution needs a dense network of antennas setting new requirements for the network infrastructure. LuxTurrim5G will develop and demonstrate concrete technical solutions for smart light pole based 5G infrastructure, and business and service innovations based on that. The smart light poles will include integrated miniaturized 5G antennas and base stations, different sensors, screens and other devices enable the realization of a novel smart city infrastructure bringing not only energy-efficient smart LED lighting but especially big data capacity and a variety of new smart city services available for

all users.

LuxTurrim5G will be carried out by Finnish companies and research institutes: Nokia Bell Labs, Sitowise, Exel Composites, Premix, Lammin Ikkunat ja Ovet, Vaisala, Teleste, Indagon, C2 Smart Light, VTT, Tampere University of Technology, Aalto University and Spinverse.

Together with its partners, VTT will develop fast high data capacity 5G radio and antenna solutions, which is the key for the smart light pole based telecommunications network. VTT participates also in producing suitable small cell architectures and open interfaces enabling, for example, the integration of a various sensors into the poles by the industry partners in LuxTurrim5G. Furthermore, VTT helps to develop positioning solutions for the smart light pole network and participates in studies for finding suitable materials improving mobile signals transport in modern smart buildings.

In addition to 5G technology development, new service infrastructures, digital ecosystems and related new business models and methods are central to LuxTurrim5G. The business development experts in VTT will work together with the consortium partners to create such models and methods.

## Envision a World with Thunderbolt 3 Everywhere

Intel has a long history of leading the industry in I/O innovation. In the late 1990s, Intel developed USB, which made it easier and faster to connect external devices to computers, consolidating a multitude of existing connectors. Intel continues its I/O innovation leadership with Thunderbolt™ 3, one of the most significant cable I/O updates since the advent of USB.

Intel's vision for Thunderbolt was not just to make a faster computer port, but a simpler and more versatile port available to everyone. We envision a future where high-performance single-cable docks, stunning photos and 4K video, lifelike VR, and faster-than-ever storage are commonplace. A world where one USB-C connector does it all – today, and for many years to come. With this vision in mind, Intel is announcing that it plans to drive large-scale mainstream adoption of Thunderbolt by integrating Thunderbolt 3 into future Intel CPUs and by releasing the Thunderbolt protocol specification to the industry next year.

With Thunderbolt 3 integrated into the CPU, computer makers can build thinner and lighter systems with only Thunderbolt 3 ports. For the first time, all the ports on a computer can be the same – any port can charge the system and connect to Thunderbolt devices, every display and billions of USB devices. Designs based on Intel's integrated Thunderbolt 3 solution require less board space and reduce power by removing the discrete component needed for existing systems with Thunderbolt 3.

In addition to Intel's Thunderbolt silicon, next year Intel plans to make the Thunderbolt protocol specification available to the industry under a nonexclusive, royalty-free license. Releasing the Thunderbolt protocol specification in this manner is expected to greatly increase Thunderbolt adoption by encouraging third-party chip makers to build Thunderbolt-compatible chips. We expect industry chip development to accelerate a wide range of new devices and user experiences.







→ "Apple and Intel have collaborated on Thunderbolt from the beginning, and as the industry leader in its adoption, we applaud Intel's efforts to integrate Thunderbolt technology into its CPUs and open it up to the rest of the industry," said Dan Riccio, Apple's senior vice president of Hardware Engineering.

Microsoft has enhanced Thunderbolt 3 device plug-and-play support in the now available Windows 10 Creators Update. Intel and Microsoft plan to continue to work together to enhance the experience in future versions of the Windows operating system.

"Microsoft and Intel are working together to enable Thunderbolt 3 on Windows PCs to deliver on the 'if it fits, it works' potential of USB-C," said Roanne Sones, general manager, Strategy and Ecosystem for Windows and Devices at Microsoft. "The Windows 10 Creators Update enhanced plug-and-play support for Thunderbolt 3 devices, with additional enhancements planned for future OS releases."

In addition to support from Apple and Microsoft, Thunderbolt 3 has already gained significant adoption with more than 120 PC designs on systems with 7th Generation Intel® Core™ processors, the latest MacBook Pros and dozens of peripherals – expected to ramp to nearly 150 by the end of 2017.

Well on our way to achieving our vision, let's explore a few scenarios where Thunderbolt 3 is changing the PC experience and creating new expectations for what's possible.

#### State-of-the-Art Single-Cable Docks

Mobile platforms continue to get thinner, lighter and more powerful. The challenge? A simple and universal way to unleash the full performance of these mobile devices when docked. Today, business and home users are forced to choose between performance and mobility.

Thunderbolt 3 docks enable mobility without compromise. Some



people are more productive with a large high-resolution monitor, and others with multiple monitors. Only Thunderbolt 3 docks support both, while simultaneously transferring large files and charging the notebook. Other people want a simple way to play and create, and Thunderbolt 3 docks can connect to any compatible peripheral or display, avoiding confusion. The power Thunderbolt 3 brings to docking is speed and simplicity. Some of these

products are available now for less than \$200.

#### Faster-than-Ever Storage

The amount of data the average person creates, uses and saves these days is exploding. For example, taking 1,000 high-resolution photos can quickly create over 20GB of data. Likewise, shooting an hour of 4K video from a drone can generate a jaw-dropping 1.5TB of data. It could take hours to transfer this data to storage via conventional methods.

In order to speed up data transfer, storage makers are shifting from slower Serial ATA (SATA) drives to non-volatile memory (NVMe) SSDs for higher speed and lower latency storage solutions. For any media lover or YouTuber generating large amounts of data, there is often a great need for external storage that is as fast as the internal SSD to expand capacity. Since only Thunderbolt can connect NVMe SSDs to your PC, Thunderbolt 3 storage fulfills this need and enables people to save time with data transfers that happen in a snap. A full 4K movie can be transferred in less than 30 seconds.

Gaming desktops will continue to offer best-in-class performance for the ultimate gaming experience. And gamers who want to combine mobility and performance gaming in one device can use Thunderbolt 3 to do so.

Chris Walker is vice president of the Client Computing Group and general manager of the Mobility Client Platform at Intel Corporation.

## Plessey CEO mentors University of Plymouth student as part of Tamar Engineering Project

Michael LeGoff, Plessey's CEO, has played a pivotal role in a successful pilot project providing one-to-one mentoring and financial support to high-performing students from disadvantaged socio-economic backgrounds. Other influential mentors include

Paul O'Brien, Director, BT Service & Operations Lab; Nick Ames, Group Chief Executive at SC Group; Jon Benton, Regional Director at Dawnus; and Stephen Ball, former CEO of Lockheed Martin UK and the first captain of industry to champion the scheme. →



# Latest News

➔ Introduced by the University of Plymouth, the Tamar Engineering Project (TEP) is a mentoring and financial award programme developed to help remedy a technical skills shortage in the UK. The Royal Academy of Engineering estimates that British industry will require 100,000 new graduates in science, technology, engineering and mathematics (STEM) subjects every year until 2020 if it is to meet its growth aspirations. However, the UK higher education sector has been producing fewer than 90,000 STEM graduates each year.

The high achieving students chosen for the TEP pilot were selected from courses in computer science, computer systems and networks, civil engineering and mechanical engineering. Further mentors will be recruited before the project launches fully in September, to coincide with students starting their first semester of 2017-18. Students interested in applying need to return completed TEP application forms downloadable from University before the closing date of 31st May. Guidelines for applicants are also available online here while general information is available via the University's website: [www.plymouth.ac.uk/campaign/tamarapply](http://www.plymouth.ac.uk/campaign/tamarapply)

"A mentoring and access programme operating in collaboration with industry, like the Tamar Engineering Project, can reach into those socio-economically vulnerable sections of society and offer them the resilience they need to be successful in higher education. If we can help those with a passion for science and engineering to be successful, then we can make progress to close the technical skills gap."

Michael LeGoff, Plessey's Chief Executive Officer added: "I was first



**Brian Viviers, a participant in the Tamar Engineering Project (left), alongside his mentor, Michael LeGoff, CEO of Plessey**

introduced to the Tamar Engineering Project by Stephen Ball. He outlined his own personal journey, making his way from a disadvantaged background to leading one of UK's largest and most critical engineering-based defence organisations, Lockheed Martin. Once Stephen explained what he was trying to achieve with the scholarship programme and described how he had already been mentoring a University of Plymouth student during the past year, it was a straight forward decision for me to commit my support to the project."

Professor Kevin Jones, Dean of the Faculty of Science and Engineering, the University of Plymouth, said: "The Tamar Engineering Project responds to the latest recommendations from the Higher Education Funding Council for England (HEFCE) about underprivileged groups accessing higher education. But more than that, our hope is that it will help with retention of students, and through the mentoring side, provide a springboard for personal and career development. It is very rare that students have an opportunity to gain such advice and guidance from senior figures in industry."

The TEP programme covers 29 degree courses at Plymouth across engineering, computing and robotics, and is aimed at students who are high-performing but also meet certain socio-economic criteria, such as coming from a low-income family, those who are a carer, a care leaver, or are from an area designated as 'low participation' in higher education. Students who apply and are successful will each receive an annual bursary (including a £1,500 course fee waiver and £3,000 living costs per year of study), as well as mentoring from an industry professional.

## Renault reinforces its development in connected vehicles, with the planned acquisition of Intel's French embedded software R&D activity

Groupe Renault today announced the signature of a final agreement on acquisition of Intel's French embedded software R&D activity based in Toulouse and Sophia-Antipolis, France. With this acquisition, Groupe Renault will be bringing in a full spectrum of skills to reinforce developments in next-generation

embedded vehicle software. This brings valuable experience in areas such as personalized services and remote, autonomous, realtime updates with no outside intervention.

"This acquisition is right in line with Groupe Renault's strategy of offering new connected services and improving ➔

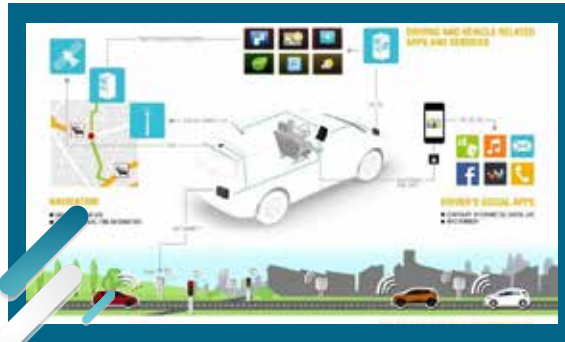


# Latest News

→ the experience of its customers.

The Intel employees joining Renault hold highly relevant skills in what is a strong competitive technical field, where the Alliance is one of the world leaders. Groupe Renault thereby continues to support French innovation and economic development in France," said Carlos Ghosn, Chairman and Chief Executive Officer of Renault.

Intel's French R&D teams hold established software development expertise complementary to Renault's. They'll be bringing Renault expertise, advanced methods and tools, plus access to a sound network of suppliers, laboratories and partner companies. Some teams already



have automotive-specific skills in multimedia and connectivity.

The acquisition operation will proceed by Groupe Renault purchasing a company formed by Intel to take in the embedded software R&D activity at the Toulouse and Sophia Antipolis sites in France. The new company will be attached to the Groupe Renault

Alliance Systems Engineering Department.

Finalization of the acquisition is pending on the conditions normally applicable to this kind of operation, and should be completed by the second half of 2017.

## NVIDIA Launches Revolutionary Volta GPU Platform, Fueling Next Era of AI and High Performance Computing

Volta-Based Tesla V100 Data Center GPU Shatters Barrier of 120 Teraflops of Deep Learning

NVIDIA today launched Volta™ — the world's most powerful GPU computing architecture, created to drive the next wave of advancement in artificial intelligence and high performance computing.

The company also announced its first Volta-based processor, the NVIDIA® Tesla® V100 data center GPU, which brings extraordinary speed and scalability for AI inferencing and training, as well as for accelerating HPC and graphics workloads.

"Artificial intelligence is driving the greatest technology advances in human history," said Jensen Huang, founder and chief executive officer of NVIDIA, who unveiled Volta at his GTC keynote. "It will automate intelligence and spur a wave of social progress unmatched since the industrial revolution.

"Deep learning, a groundbreaking AI approach that creates computer software that learns, has insatiable demand for processing power. Thousands of NVIDIA engineers spent over three years crafting Volta to help meet this need, enabling the industry to realize AI's life-changing potential," he said.

Volta, NVIDIA's seventh-generation GPU architecture, is built with 21 billion transistors and delivers the equivalent performance of 100 CPUs for deep learning.

It provides a 5x improvement over Pascal™, the current-generation NVIDIA GPU architecture, in peak teraflops, and 15x

over the Maxwell™ architecture, launched two years ago. This performance surpasses by 4x the improvements that Moore's law would have predicted.

Demand for accelerating AI has never been greater. Developers, data scientists and researchers increasingly rely on neural networks to power their next advances in fighting cancer, making transportation safer with self-driving vehicles, providing new intelligent customer experiences and more.

Data centers need to deliver exponentially greater processing power as these networks become more complex. And they need to efficiently scale to support the rapid adoption of highly accurate AI-based services, such as natural language virtual assistants, and personalized search and recommendation systems.

Volta will become the new standard for high performance computing. It offers a platform for HPC systems to excel at both computational science and data science for discovering insights. By pairing CUDA® cores and the new Volta Tensor Core within a unified architecture, a single server with Tesla V100 GPUs can replace hundreds of commodity CPUs for traditional HPC.

Breakthrough Technologies

The Tesla V100 GPU leapfrogs previous generations of NVIDIA GPUs with groundbreaking technologies that enable it to shatter the 100 teraflops barrier of deep learning performance. They include:

Tensor Cores designed to speed AI workloads. Equipped →





# Latest News

➔ with 640 Tensor Cores, V100 delivers 120 teraflops of deep learning performance, equivalent to the performance of 100 CPUs.

New GPU architecture with over 21 billion transistors. It pairs CUDA cores and Tensor Cores within a unified architecture, providing the performance of an AI supercomputer in a single GPU.

NVLink™ provides the next generation of high-speed interconnect linking GPUs, and GPUs to CPUs, with up to 2x the throughput of the prior generation NVLink.

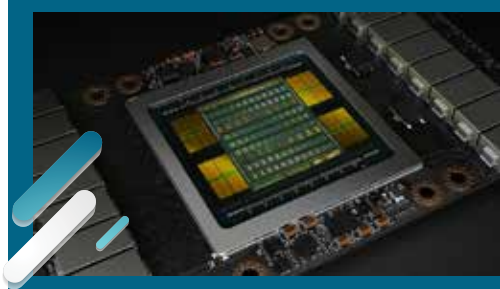
900 GB/sec HBM2 DRAM, developed in collaboration with Samsung, achieves 50 percent more memory bandwidth than previous generation GPUs, essential to support the extraordinary computing throughput of Volta.

Volta-optimized software, including CUDA, cuDNN and TensorRT™ software, which leading frameworks and applications can easily tap into to accelerate AI and research.

## Ecosystem Support for Volta

Volta has received broad industry support from leading companies and organizations around the world:

"NVIDIA and AWS have worked together for a long time to help customers run compute-intensive AI workloads in the cloud. We launched the first GPU-optimized cloud instance in 2010, and introduced last year the most powerful GPU instance available in the cloud. AWS is home to some of today's most innovative and creative AI applications, and we look forward to helping customers continue to build incredible new applications with the next generation of our general-purpose GPU instance family when



Volta becomes available later in the year."

— Matt Garman, vice president of Compute Services, Amazon Web Services  
"We express our congratulations to NVIDIA's latest release of Volta. From Baidu Cloud to Intelligent Driving, Baidu has been strengthening its efforts in building an open AI platform. Together with NVIDIA, we believe we will accelerate

the development and application of the global AI technology and create more opportunities for the whole society." - Yaqin Zhang, president, Baidu

"NVIDIA and Facebook have been great partners and we are excited about the contributions NVIDIA has made to Facebook's Caffe2 and PyTorch. We look forward to the AI advances NVIDIA's new high-performing Volta graphics architecture will enable."  
-Mike Schroepfer, chief technology officer, Facebook

"NVIDIA's GPUs deliver significant performance boosts for Google Cloud Platform customers. GPUs are an important part of our infrastructure, offering Google and our enterprise customers extra computational power for machine learning or high performance computing and data analysis. Volta's performance improvements will make GPUs even more powerful and we plan to offer Volta GPUs on GCP." -Brad Calder, vice president of Engineering for Google Cloud Platform, Google

"Microsoft and NVIDIA have partnered for years on AI technologies, including Microsoft Azure N-series, Project Olympus and Cognitive Toolkit. The new Volta architecture will unlock extraordinary new capabilities for Microsoft customers." -Harry Shum, executive vice president of Microsoft AI and Research Group, Microsoft

## Daimler lays foundation for one of the biggest and most modern battery factories in the world

By laying the foundation for one of the biggest and most modern battery factories, Daimler AG is setting new standards in the international automotive industry, thereby taking the next strategic step in its electric offensive.

At the wholly-owned subsidiary ACCUMOTIVE in Kamenz, the second factory for lithium-ion batteries is built with an investment of around 500 million euros. Guests of honour at the ceremony were Federal Chancellor Dr. Angela Merkel and Stanislaw Tillich (Minister President of Saxony), who, together with Dieter Zetsche (Chairman of the Board of Daimler AG and Head of Mercedes-Benz Cars), Markus Schäfer (Member of the Divisional Board of

Mercedes-Benz Cars, Production and Supply Chain), Frank Deiss (Head of Powertrain Production and Site Manager Mercedes-Benz Plant Untertürkheim) and Frank Blome (Managing Director Deutsche Accumotive GmbH & Co. KG), laid the casing of a vehicle battery as the foundation stone.

"The automotive industry is facing a fundamental transformation and we see ourselves as the driving force behind this change," says Dieter Zetsche.

The investment of Daimler strengthens the region as a major innovation hub for the German automotive industry and offers employees good prospects in a future-oriented technology ➔



field. The Federal Chancellor and the Saxon Minister President were able to get an impression during a tour through the existing battery factory with two employees working in production.

Daimler invests an overall amount of around one billion euros in a global production compound for batteries. The new production facility, which is situated approximately 50 kilometres from Dresden, is scheduled to go into operation in mid-2018. Covering an area of around

20 hectares, the site is in the direct vicinity of the existing battery factory. The new plant will quadruple the production and logistics area in Kamenz to a total of around 80,000 square meters. In the next few years ACCUMOTIVE will gradually increase the number of employees at the site. By the end of the decade, ACCUMOTIVE will have a total of over 1,000 employees and thus more than double the number compared to today's level.

"The German Chancellor's visit at ACCUMOTIVE underlines the importance of electric mobility in Germany and the good perspectives for the future location in Kamenz. For our workforce, this is a great signal acknowledging their know-how and top quality performance in the last years. To date, we have delivered more than 80,000 batteries based on lithium-ion technology," says Frank Blome. The second battery factory has been designed as a CO2-neutral factory with an energy balance of zero: Daimler's approach to electric mobility is an integrated one, attaching key importance to sustainability already at the production stage. The production facilities will be supplied with energy from a combined heat and power plant and a photovoltaic plant in combination with stationary battery storage units. With state-of-the-art facilities and technologies, the new battery factory will also set standards regarding Industry 4.0.

With the Concept EQ, Mercedes-Benz Cars is presenting a new generation of electric vehicles. More than ten new electric passenger



cars are scheduled to be launched by 2022: in all segments from smart to large SUVs. Ten billion euros will be invested in the expansion of the electric fleet in the next few years. The new electric vehicles will be produced within the global, highly flexible and efficient production network of Mercedes-Benz Cars with plants on four continents. The first EQ series model will roll off the line at the Mercedes-Benz plant in Bremen at the end of the decade. In addition to that, luxury-class EQ models

will be produced at the plant in Sindelfingen. The company assumes that the proportion of electric vehicles in the total unit sales of Mercedes-Benz will be between 15 and 25 percent by 2025. In addition to traction batteries, ACCUMOTIVE will produce batteries for Mercedes-Benz energy storage units and 48-volt-systems. The pioneering 48-volt on-board power supply is celebrating its premiere in the new generation of the S-Class and will be gradually introduced in various model series.

Daimler's commercial vehicle divisions are also consistently driving forward the electrification of their portfolio. After the Vito E-CELL from the year 2011, Mercedes-Benz Vans will go into series with electric transporters beginning next year. Both Vito and Sprinter will be equipped with drive batteries from Kamenz. Daimler Trucks will launch a small series of the Fuso eCanter later this year. This is the third generation of the world's first purely electrically-driven light truck. Fuso also uses the batteries from Kamenz for the eCanter. Depending on the design, load and application profile, the 7.5-tonne truck has a range of more than 100 km without stationary loading. The Fuso eCanter will be delivered in small series from 2017 onwards. The first 150 units go to customers in Japan, Europe and the US. Mercedes-Benz Trucks is also starting the customer testing of the Urban eTruck, the world's first full-electric heavy-duty truck. Daimler Buses is launching a full-electric Mercedes-Benz city bus in series production next year. Prototypes are already on the road.

## SK Telecom and Samsung Win "Infrastructure Innovation Award" at Global Telecoms Business (GTB) Telecoms Innovation Summit

SK Telecom and Samsung Electronics jointly won the "Infrastructure Innovation Award" at the Global Telecoms Business (GTB) Telecoms Innovation Summit 2017 for their successful verification of 5G mobile handover in an urban outdoor environment – a world first.

SK Telecom and Samsung teamed up to research and verify technical feasibilities of using mmWave frequency (28GHz) for super-fast and real-time 5G mobility services. In September 2016, the companies announced they successfully completed the 5G mmWave handover by



connecting base stations to operators' fiber optic networks. Besides 5G handover, the companies successfully tested 3D (Dimension) beam forming and confirmed the accuracy of the ray tracing RF design solution, which are considered to be the key enablers to make 5G mmWave commercially ready.

"SK Telecom is delighted to receive these global prestigious awards as they recognize our relentless efforts to introduce innovative network technologies," said Jin-hyo Park, Senior Vice President and Head of Network Technology R&D Center. "SK Telecom will continue to develop advanced technologies to launch the 5G network, which will play a pivotal role in the Fourth Industrial Revolution."

"It is a pleasure to be jointly recognized as key players for turning 5G into reality. The result signifies the opportunity of mmWave which will create new 5G business models requiring wide bandwidths," said Paul Kyung-whoon Cheun, Executive Vice President and Head of Next-Generation Communications Business Team of Samsung Electronics. Global Telecoms Business (GTB) is a UK-based magazine that specializes in Telecommunication and IT industries. Since 2007, it has presented its Telecoms Innovations & Technology Awards every year to five entities for their most innovative achievements in Telecom Infrastructure, Software & Application, Enterprise Service Consumer Service and Wholesale Service.

## Battery-free implantable medical device draws energy directly from human body

Researchers from UCLA and the University of Connecticut have designed a new biofriendly energy storage system called a biological supercapacitor, which operates using charged particles, or ions, from fluids in the human body. The device is harmless to the body's biological systems, and it could lead to longer-lasting cardiac pacemakers and other implantable medical devices.

The UCLA team was led by Richard Kaner, a distinguished professor of chemistry and biochemistry, and of materials science and engineering, and the Connecticut researchers were led by James Rusling, a professor of chemistry and cell biology. A paper about their design was published this week in the journal *Advanced Energy Materials*.

Pacemakers — which help regulate abnormal heart rhythms — and other implantable devices have saved countless lives. But they're powered by traditional batteries that eventually run out of power and must be replaced, meaning another painful surgery and the accompanying risk of infection. In addition, batteries contain toxic materials that could endanger the patient if they leak.

The researchers propose storing energy in those devices without a battery. The supercapacitor they invented charges using electrolytes from biological fluids like blood serum and urine, and it would work with another device called an energy harvester, which converts heat and motion from the human body into electricity —




in much the same way that self-winding watches are powered by the wearer's body movements. That electricity is then captured by the supercapacitor.

"Combining energy harvesters with supercapacitors can provide endless power for lifelong implantable devices that may never need to be replaced," said Maher El-Kady, a UCLA postdoctoral researcher and a co-author of the study. Modern pacemakers are typically about 6 to 8 millimeters thick, and about the

same diameter as a 50-cent coin; about half of that space is usually occupied by the battery. The new supercapacitor is only 1 micrometer thick — much smaller than the thickness of a human hair — meaning that it could improve implantable devices' energy efficiency. It also can maintain its performance for a long time, bend and twist inside the body without any mechanical damage, and store more charge than the energy lithium film batteries of comparable size that are currently used in pacemakers.

"Unlike batteries that use chemical reactions that involve toxic chemicals and electrolytes to store energy, this new class of biosupercapacitors stores energy by utilizing readily available ions, or charged molecules, from the blood serum," said Islam Mosa, a Connecticut graduate student and first author of the study.

The new biosupercapacitor comprises a carbon nanomaterial called graphene layered with modified human proteins as an electrode, a conductor through which electricity from the 





➔ energy harvester can enter or leave. The new platform could eventually also be used to develop next-generation implantable devices to speed up bone growth, promote healing or stimulate the brain, said Kaner, who also is a member of UCLA's California NanoSystems Institute.

Although supercapacitors have not yet been widely used in medical devices, the study shows that they may be viable for that purpose.

"In order to be effective, battery-free pacemakers must have supercapacitors that can capture, store and transport energy,

and commercial supercapacitors are too slow to make it work," El-Kady said. "Our research focused on custom-designing our supercapacitor to capture energy effectively, and finding a way to make it compatible with the human body."

Among the paper's other authors are the University of Connecticut's Challa Kumar, Ashis Basu and Karteek Kadimisetty.

The research was supported by the National Institute of Health's National Institute of Biomedical Imaging and Bioengineering, the NIH's National Institute of Environmental Health Sciences, and a National Science Foundation EAGER grant

## 18-Year-Old Engineer Constructs Fuel-Efficient, Stable 'Flying Wing' Aircraft Prototype

Ivo Zell, 18, of Lorch, Germany was awarded first place for designing and constructing a remote control prototype of a new "flying wing" aircraft at this year's Intel International Science and Engineering Fair, a program of Society for Science & the Public and the world's largest international pre-college science competition. The competition featured nearly 1,800 young scientists selected from 425 affiliate fairs in 78 countries, regions and territories.

Flying wings are inherently more efficient than traditional aircraft designs, but also less stable in flight because they have little or no fuselage or tail. Zell's working prototype aircraft addresses this issue, using an unusual bell-shaped lift profile for improved stability and using telemetry to demonstrate its stability. The modified shape of Zell's aircraft allows it to operate smoothly and safely in challenging flight situations without the need for a complex electronic stabilization system and without significantly sacrificing fuel efficiency. Potential applications range from drone delivery systems to larger aircraft design. Zell received the Gordon E. Moore Award of US\$75,000, named in honor of the Intel co-founder and fellow scientist.

Amber Yang, 18, of Windermere, Florida received one of two Intel Foundation Young Scientist Awards of US\$50,000 for her innovative approach to predicting the locations of clouds of space debris that



**Amber Yang (from left), Ivo Zell and Valerio Pagliarino take the stage on Friday, May 19, 2017, at the 2017 International Science and Engineering Fair, a program of Society for Science & the Public and the world's largest international pre-college science competition. Zell, of Lorch, Germany, was awarded first place for designing and constructing a remote control prototype of a new "flying wing" aircraft. Yang, of Windermere, Florida, and Pagliarino, of Castelnuovo Calcea, Italy, received Intel Foundation Young Scientist Awards. (Credit: Matt H. King)**

move in low Earth orbit. An estimated 500,000 space trash objects now pose a potential hazard for spacecraft. Yang adapted an algorithm to train her own artificial neural network to recognize space objects in a specific debris cloud and predict their future locations.

Valerio Pagliarino, 17, of Castelnuovo Calcea, Italy received the other Intel Foundation Young Scientist Award of US\$50,000 for his prototype of a novel laser-based, wireless, high-speed network. Motivated by the lack of reliable Internet access in his rural locale, Pagliarino designed his new system using off-the-shelf components and then built and tested a small version of the network.

"Intel congratulates this year's winners. Ivo Zell, Amber Yang, and Valerio Pagliarino and all of the participants inspire us with their talent and passion for changing the world," said Rosalind Hudnell, Intel vice president of

Corporate Affairs and president of the Intel Foundation. "As a diverse and inclusive group developing groundbreaking solutions to global challenges, these young people represent the next generation of innovators. We're proud to support all of the finalists as they endeavor to improve the world around them."

In addition to the top winners, approximately 600 finalists ➔



→ received awards and prizes for their innovative research, including 22 “Best of Category” winners, who each received a US\$5,000 prize. The Intel Foundation also awarded a US\$1,000 grant to each winner’s school and to the affiliated fair they represent.

“The breakthrough ideas presented at the Intel International Science and Engineering Fair by Ivo Zell, Amber Yang and Valerio Pagliarino truly have the capacity to change our world for the better,” said Maya Ajmera, president and CEO of Society for Science & the Public and publisher of Science News. “As our world grows increasingly complex, we need innovative, transformative ideas to identify new solutions to our world’s most intractable challenges. Congratulations to all our finalists as well as our top three winners on their extraordinary research projects.”

The Intel International Science and Engineering Fair encourages

millions of students to explore their passion for developing innovations that improve the way we work and live. All finalists are selected by an affiliated, local competition and receive an all-expenses-paid trip to the Intel International Science and Engineering Fair. At the competition, finalists are judged by hundreds of science, engineering and industry professionals who have a Ph.D. or equivalent (six years of related professional experience) or are senior graduate students with doctoral-level research in one of the 22 scientific disciplines listed above.

A full listing of finalists is available in the event program. The 2017 Intel International Science and Engineering Fair is funded jointly by Intel and the Intel Foundation with additional support from dozens of corporate, academic, government and science-focused sponsors. This year, approximately US\$4 million was awarded.

## Imec Presents Highly Accurate Model for Energy Yield Prediction of Photovoltaic Modules

imec, the world-leading research and innovation hub in nano-electronics, energy, and digital technology, and partner in EnergyVille, will introduce simulation software that accurately predicts the daily energy yield of solar cells and solar modules under varying meteorological and irradiation conditions. Imec’s model combines optical, thermal and electrical parameters to provide detailed insight on thermal gradients in the solar module. The

model integrates the effect of these gradients, resulting in a significantly better accuracy (root mean square error of only 2.5 percent) than commercially available software packages for energy yield estimation.

Solar cell efficiencies and photovoltaic module performances are typically only measured under standard lab conditions. However, in reality, photovoltaic modules are operated in the field under conditions that are substantially different from these standard lab conditions. They are exposed to varying meteorological conditions in terms of irradiation, temperature and wind, which, in addition, all vary during the course of the day. In contrast to most existing models for energy yield calculation, imec’s model starts from the physical parameters of the solar cells and the used materials, and includes on top of that their variations due these changing external conditions.



In this way a ‘closer to reality’ model is obtained, enabling a more precise assessment of the effects of solar cell and module technology changes on the energy yield of these photovoltaic cells and modules.

Imec’s simulation software features a coupled optical-thermal-electrical approach and provides detailed insight on thermal gradients in the solar module and their effect on

energy yield. The incorporation of wind and thermal transient effects produced a highly accurate calculation of daily energy yield with a root mean square error of only 2.5 percent, under strongly varying meteorological conditions (e.g. clouds passing by, changes in wind speed, ...) compared with the actual measured output. This is significantly better than energy yield calculations that could be obtained using commercial software packages under these varying weather circumstances.

“This record accuracy was obtained thanks to validation tests under controlled circumstances, such as wind tunnels, as well as from detailed data series with fine time granularity from PV modules in the field,” stated Hans Goverde, researcher at imec.

“It is an excellent tool to make a rapid assessment of material and technology changes at the cell and module level →



→ and their influence on the levelized cost-of-electricity,” noted Jef Poortmans, scientific director photovoltaics at imec. “Moreover, it is also the ideal starting point to come up with significantly improved short-term energy yield forecasting, which will lead to lower lost opportunity costs and better energy management systems for PV power plants as well as residential

solar systems. This means that our model could e.g. become very useful for PV plant operators and electricity grid operators, enabling them to better forecast the short-term varying output of PV power plants, in this way limiting curtailment situations and grid balancing issues, and hence create more value across the full renewable energy value chain.”

## Silicon Labs Wins Prestigious Somfy Supplier Innovation Award

Climeworks launches world’s first commercial plant to capture CO2 from air

- Direct Air Capture plant near Zurich filters 900 tonnes of CO2 from atmosphere to supply to greenhouse, replacing fossil industrial CO2

- Historic moment for negative emissions technology deemed crucial to stay below two degrees of global warming
- Climeworks aims to capture one per cent of global CO2 emissions by 2025

Hinwil (Canton of Zurich, Switzerland) / May 31st, 2017 Today Climeworks has launched the world’s first commercial plant that captures atmospheric CO2 for supply and sale to a customer.

The Swiss direct air capture company launched the commercial-scale Direct Air Capture (DAC) plant, featuring its patented technology that filters carbon dioxide from ambient air.

The plant is now supplying 900 tonnes of CO2 annually to a nearby greenhouse to help grow vegetables.

The plant is a historic step for negative emissions technology – earmarked by the Paris climate agreement as being vital in the quest to limit a global temperature rise of 2 °C. Founded by engineers, Christoph Gebald and Jan Wurzbacher, Climeworks developed its technology to capture atmospheric carbon with a filter, using mainly low-grade heat as an energy source.

In Hinwil the DAC plant has been installed on the roof of a waste recovery facility – operated by the municipal administration union KEZO – with its waste heat powering the Climeworks DAC plant. During the Climeworks capture process, CO2 is chemically deposited on the filter surface. Once the filter is saturated, the CO2 is then isolated at a temperature of about 100 °C.

The pure captured CO2 gas can then be sold to customers in key markets, including: commercial agriculture, food and beverage industries, the energy sector and the automotive industry.

In Hinwil, Climeworks provides a continuous supply of CO2 through an underground pipeline to a greenhouse 400m away,



operated by Gebrüder Meier Primanatura AG, to assist with growing vegetables such as tomatoes and cucumbers. By securing this supply agreement, Climeworks has ensured the Hinwil operation is the world’s first direct air capture plant with a commercial customer – an important step for the future of negative emissions technologies.

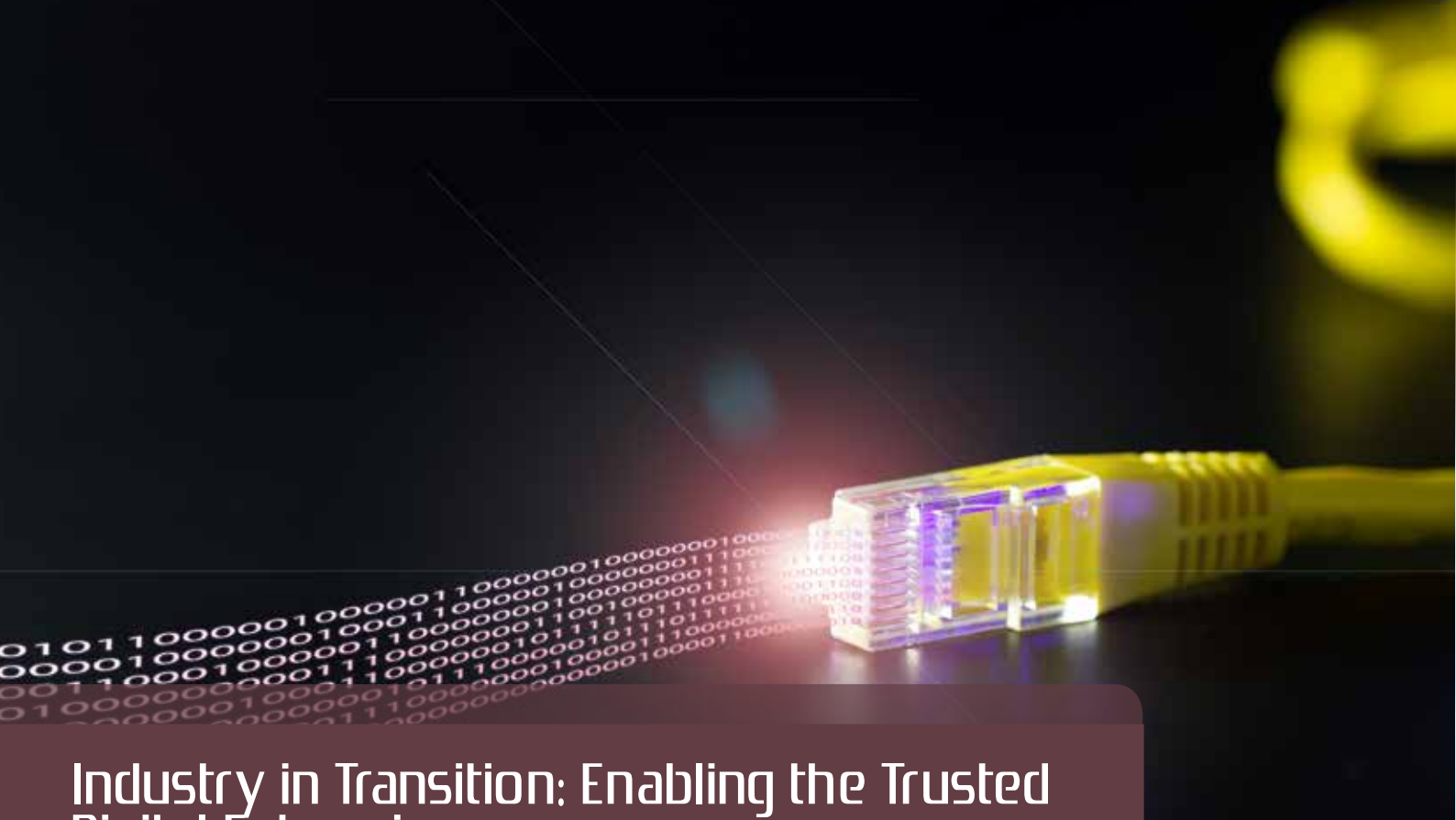
The Hinwil plant will operate as a three-year demonstration project in co-operation with the partners Gebrüder Meier and KEZO, and with a contribution towards non-amortisable costs by the Swiss Federal Office of Energy (SFOE). Negative emissions to meet the two-degree target “Highly scalable negative emission technologies are crucial if we are to stay below the twodegree target of the international community,” says Christoph Gebald, co-founder and managing director of Climeworks. “The DAC-technology provides distinct advantages to achieve this aim and is perfectly suitable to be combined with underground storage. We’re working hard to reach the goal of filtering one per cent of global CO2 emissions by 2025. To achieve this, we estimate around 250,000 DAC-plants like the one in Hinwil are necessary.

“Raw material for beverages, fuel and materials The CO2 captured by Climeworks can be used to carbonate beverages or produce climateneutral fuels and other materials. Capturing CO2 locally for industrial uses enables customers to reduce their emissions and lessen their dependence on fossil fuels, as currently most industrial CO2 is transported from fossil point sources via truck to industries on site.

In comparison to other carbon capture technologies, a modular Climeworks plant can be employed almost anywhere.

In coming months Climeworks plans to launch additional commercial pilot projects in key target markets and wants to test its technology’s potential to deliver negative emissions by combining it with underground storage.





# Industry in Transition: Enabling the Trusted Digital Enterprise

## > Kevin Carlin, Analog Devices

The manufacturing industry is on the cusp of a 4th wave of transformation that holds the promise of a step change in productivity. Industrial IoT business models are being defined with increased flexibility, cooperative human-machine interaction and the use of data analytics to discern trends and dynamic system relationships previously hidden or inaccessible. Advances in Industrial Automation technology realizes the ambition of Industrial IoT and promises great opportunities for manufacturers to compete in the global economy through increased productivity, safety, and reliability while reducing emissions. In fact, the manufacturing sector represents the most significant and largest Industrial IoT opportunity today. It is estimated that over the next 10 years IoT & the Digital Transformation is

currently estimated at ~\$20 Trillion of which Manufacturing represents the largest at ~\$6.5T. Unsurprisingly, Automation equipment makers are trying to capture more value with additional IIoT related software and services.

While the opportunity is attractive, there are significant headwinds. For example, adoption of new technology in this traditionally conservative moving industry can be slow. Automation plants today are often a mix of newer and legacy systems with the associated complexity in inter-system communications. Capturing and communicating data securely from the edge of the network remains largely out of reach with the existing infrastructure. In short, factories and process plants will not transform overnight and a transition is required. To enable and accelerate this

transition, Automation vendors are turning to technology partners and suppliers like Analog Devices to provide more system domain expertise and solutions.

### **The transition required for the Connected Enterprise and in particular, Ethernet and Security**

Industrial Ethernet is already widely used in control applications and continues to expand as the preferred communication medium as industries transition towards greater connectivity and the realization of the Industrial Internet of Things (IIoT). Many Industrial protocols solve the problem of determinism over Ethernet using proprietary layer 2 solutions which can cause significant interoperability issues when

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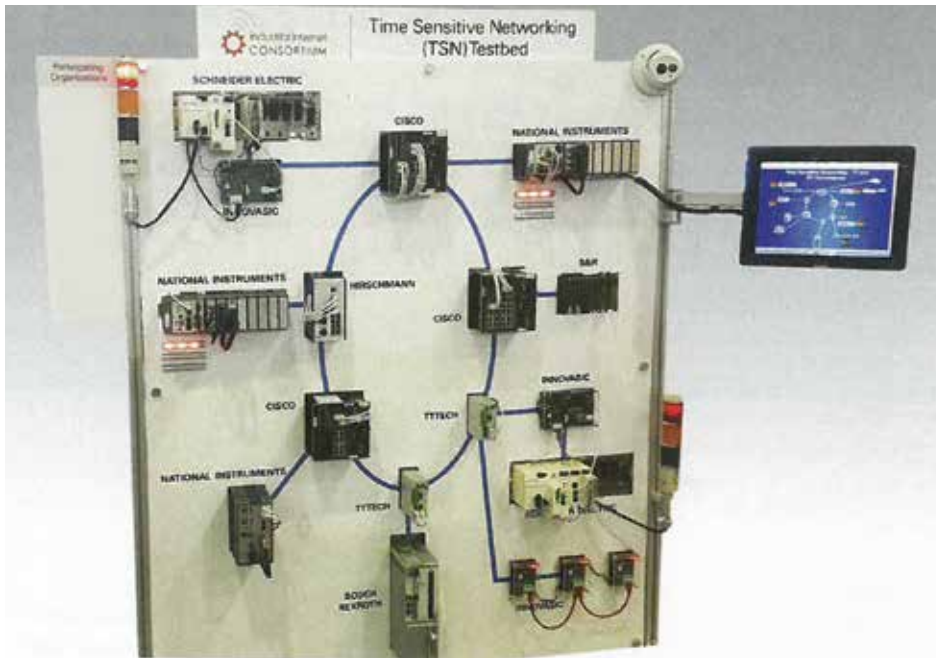
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**Fig 1. The image shows a TSN (Time Sensitive Network) testbed courtesy of National Instruments and the IIC**

attempting to extract relevant data for usage at the higher levels of the enterprise network or coordinate between disparate manufacturing nodes. The new IEEE 802.1 TSN standards are aimed at the same class of problems encountered in industrial control and promise to enable a transition from proprietary solutions in favor of a standards-based approach.

Ethernet has traditionally been a "best-effort" network. To allow Ethernet to be deployed in mission critical applications, it is necessary to add specific features including time synchronization, scheduled traffic, ingress policing, seamless redundancy and others. The goal behind these emerging IEEE TSN standards is to achieve a truly converged network where all classes of traffic can seamlessly coexist. This would allow mission critical real-time traffic to coexist on the same network as streaming traffic and best-effort

traffic. These features allow network designers to ensure that certain classes of traffic can be delivered on time, every time throughout the entire network topology. Unlike proprietary layer 2 solutions, these features are designed to be scalable to gigabit line rates and beyond.

Connecting edge devices to the converged Trusted IIoT Connected Enterprise networks, enabled by TSN, raises many challenges. Current communication technologies in edge devices (e.g. Fieldbus and 4-20mA current loops) work and they work reliably. However, getting their data to the cloud (local or remote) is often obfuscated by the many layers of communication along the path from the factory floor to the front office. Gateways are often needed to translate from one format or protocol to another and the data may be stored on multiple servers on its journey to where data analytics actually happen. The total

ownership cost to get data from a simple sensor to the cloud not only involves the equipment necessary for data delivery, but also the software, processing and manpower necessary to ensure data integrity along the way.

While it may seem contradictory to bring Ethernet to such a simple device like a temperature transmitter, it isn't about the simplicity of the device or the relatively small amounts of data produced or consumed by the device. It's about the ability to cost effectively extract the data from the device on a converged network and then using that data for actionable results. For example, a Distributed Control System (DCS) might use temperature data from the temperature transmitter to ensure its part of the process is running in control in real-time. However, there could also be implications of this specific temperature on the overall process. With a temperature transmitter seamlessly connected to the cloud, analytics can be performed considering all process parameters in near real-time to ensure the overall process is running. Adjustments can be made so production can be optimized or energy efficiency can be increased.

ADI views these challenges as key to our customers' success and the motivating factor for our investment in cutting edge technologies to drive Ethernet to the edge. One key enabling technology we call "Low-complexity Ethernet" is a driver for bringing simple industrial devices like a temperature transmitter directly to an Ethernet network. Low-complexity Ethernet solves the traditional size, power, and cost issues of today's standard layer 2 Ethernet implementations in order to bring down the total ownership cost of getting data to the cloud.

The transition to a converged



## Disciplines of Security: Identity Is the Base



### Sciometrics™ Silicon based Identity-Proves the Root of Trust

industrial Ethernet network also needs innovation at the physical layer to deliver a solution that matches some of the inherent capabilities of the incumbent systems. Many of the most widely deployed Ethernet physical layer standards are limited to 100 meter cable length and require multiple twisted pair cables to implement. By contrast, much of the existing installed base of factory automation network infrastructure is built on single twisted pair cabling that can extend beyond 1000 meters in length at a data rate of 31.25kb/s. To help address this, ADI is working with key industrial partners under the auspices of the IEEE to develop a new Ethernet standard, 10SPe that will operate over a single twisted pair cable, up to 1000m and at a data rate of 10 Mb/s. By taking a collaborative, standards-based approach to solving this problem, ADI is assisting in the lowering of barriers to adoption of

this new capability and shortening the timeframes in which the goal of a converged, plant-wide network can be achieved.

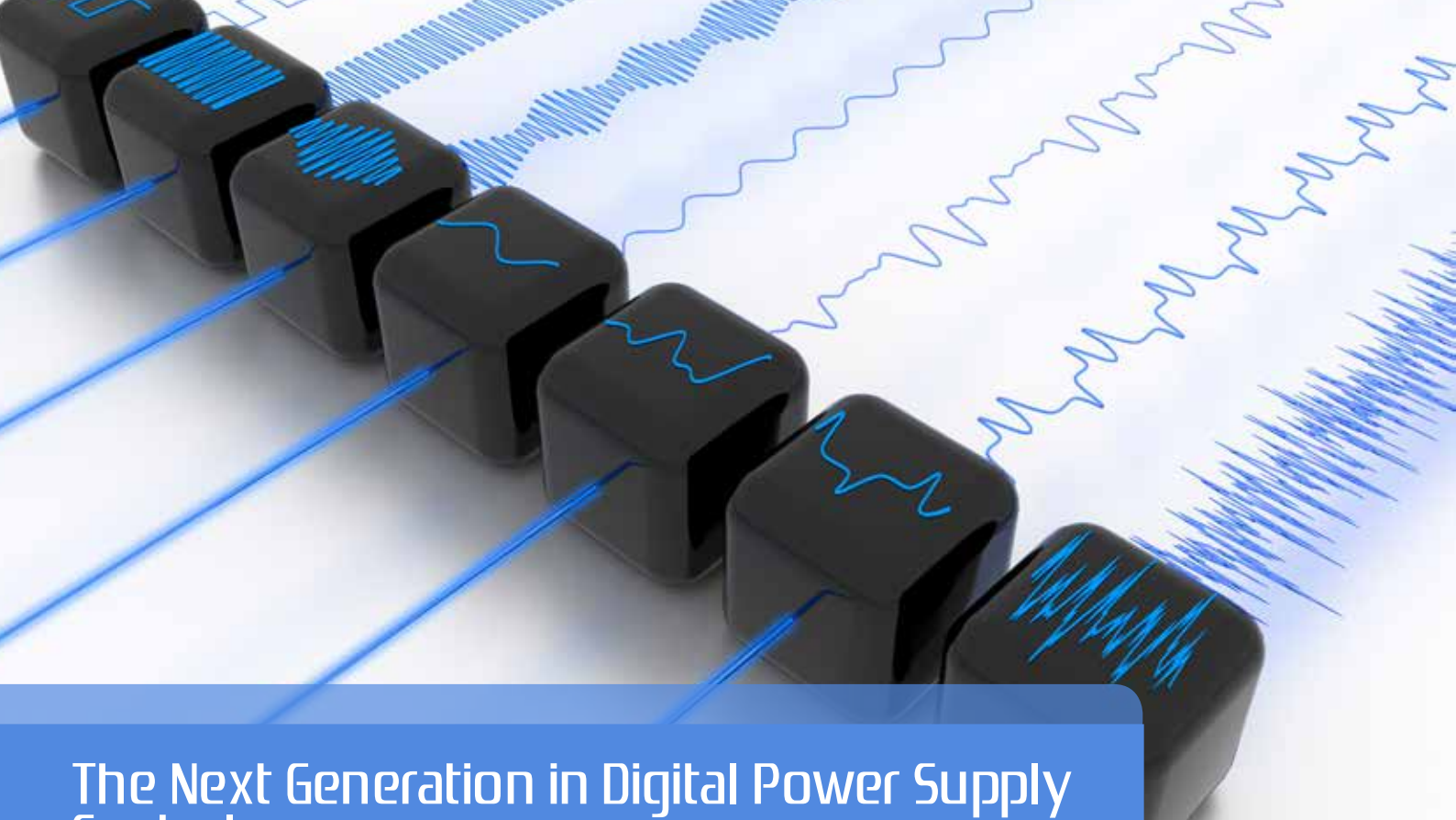
In addition to the development of new capabilities to enable Ethernet convergence, other applications that have a more established usage of deterministic Ethernet at 100Mb/s are pushing the limits of bandwidth and performance. Applications such as robotics are demanding an ever increasing number of coordinated axes, controlled at greater precision than previously possible. Transitioning the control network to gigabit speeds helps satisfy these requirements and represents another major trend in the industrial Ethernet market.

Ethernet's meteoric success has often left users of Ethernet technologies struggling to address security concerns associated with its application. The anticipated

increase in demand for data and sensing at the edge of the Industrial network may be hampered by the perceived risks related to security. Further, the requirements for low latency and jitter in industrial control applications can be in direct conflict with the requirements for security. It is incumbent upon users of these technologies to address concerns regarding performance and security in these applications sooner rather than later.

Cyber Security Risks in the Industrial space are getting more attention every day. Due to the emergence of Industry4.0 and IIoT, the Industrial space is moving to an unprecedented environment of widely distributed devices, dynamic information flows, and connectivity across environments to provide new capabilities. However, it is no surprise that along with creating new capabilities, it also creates new security threats previously unthought-of, but more REAL than ever.

If one imagines the sheer number of devices that must be securely connected to the network, it becomes clear that establishing the identity of these devices becomes problematic. Physically distributed shared encryption keys quickly becomes impractical and management of certificates-exchanges a logistics nightmare. Keyless establishment of identity is vital if the vision of the Trusted IIoT Connected Enterprise is to be realized. Likewise, lightweight encryption techniques, with low, fixed latency, and a small hardware and/or software footprint will be needed to securely connect the highly constrained devices at the edge of the network. ADI has invested heavily in technologies like Identity Authentication and security solutions for resource constrained devices and lightweight block cryptography to address these important issues.



## The Next Generation in Digital Power Supply Control

› Tom Spohrer, Microchip Technology

**Digital control in power conversion continues to develop, thanks to the latest improvements in both the analog and digital domains.**

The continued adoption of digital control in power conversion and distribution is accredited to the flexibility and increased efficiency it delivers. However, these gains do not come free; they are the result of complex and sophisticated algorithms working at increasingly higher processing speeds in order to optimize the efficiencies of switching power supplies.

The optimisation of switch-mode power supplies is increasingly seen as a significant opportunity for manufacturers to deliver more efficiency in end-products. The

challenge, however, is maintaining that efficient operation across a wide and varying array of load conditions. The introduction of Power Factor Correction introduced a new age of efficiency targets — both regulatory and market-driven — and it has become a major focus for semiconductor providers, striving to continually improve their solutions to digital power control. Software-based algorithms provide the potential for more flexible and efficiency solutions, when coupled to the right hardware.

### Digital Control

Power conversion invariably starts with an AC source, which is then rectified to DC and further stepped down through various intermediate voltages until eventually reaching the

Point of Load (POL). The Power Factor of a system is the ratio between the true and apparent power; the closer to unity the ratio the more efficient the system. Power Factor Correction (PFC) is the method employed to restore the ratio to unity (or as close as possible) and may be achieved using capacitors, but it is increasingly viable to apply PFC using Buck, Boost or Buck/Boost conversion under digital control. Moving between the analog and digital domains typically adds additional latency; the control loop delay, and it describes the total time taken to apply a change to the conversion and measure the effects of that change. Under steady-state conditions this would be relatively simple but under variable loads the speed with which the control loop executes directly influences the PFC



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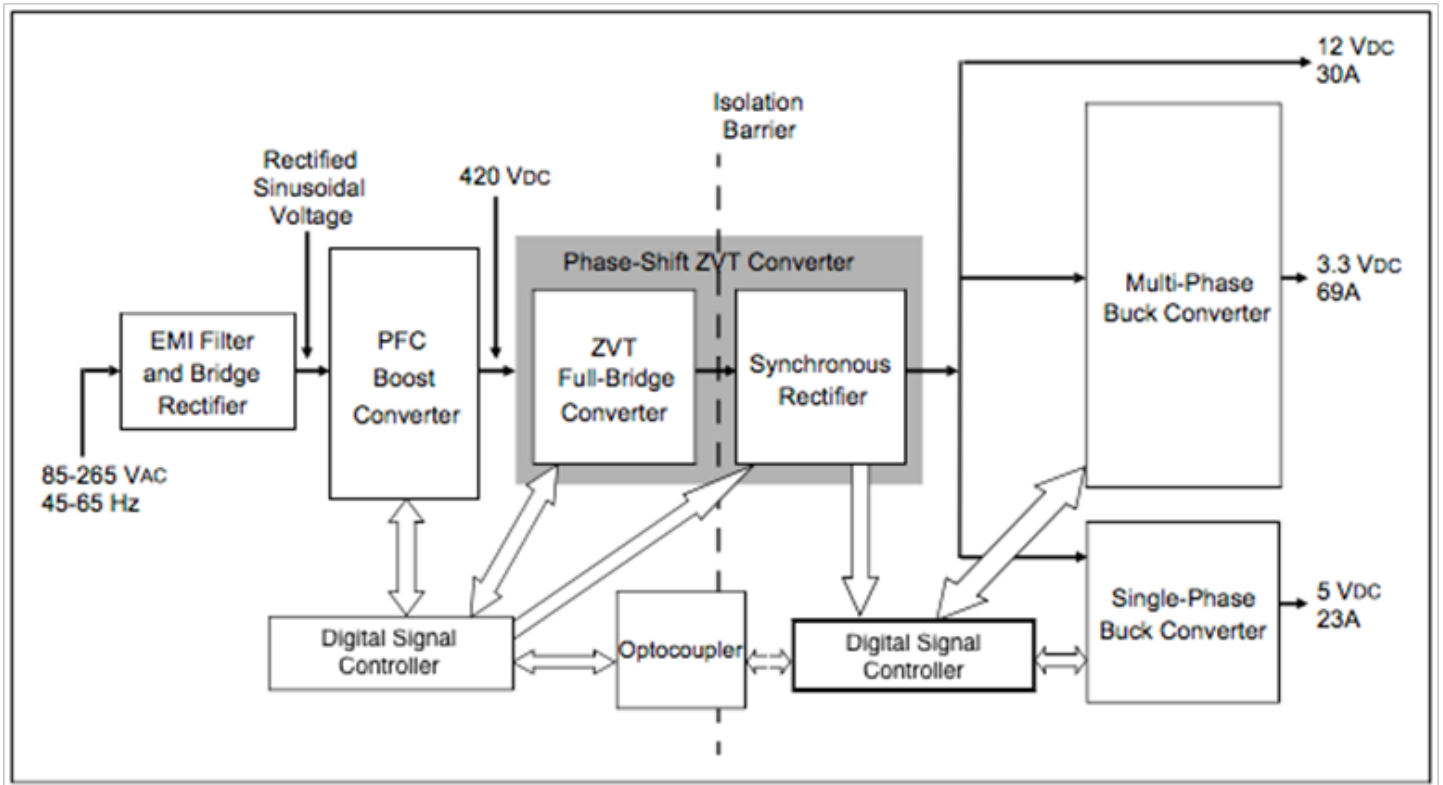


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and overall efficiency.

The challenge increases when the POL stage requires low voltage but high current levels, as is often the case in modern embedded systems. Today, microprocessors, FPGAs and ASIC invariably operate from low voltages - 3.3V and below - but require much higher current in order to meet their overall power demands. Furthermore, the demands will vary significantly based on the operating requirements. As shown in Figure 1, the use of digital control can be applied throughout the entire power conversion flow in order to introduce not only greater efficiency but the flexibility to sustain that efficiency across a wide range of loads.

This is enabled through the continued development of sophisticated algorithms, including adaptive algorithms that can react to changes in load levels, and non-linear and predictive algorithms that can

improve the dynamic response under transient conditions. And as semiconductor technology develops, manufacturers are able to employ this to increase the performance of digital control solutions, allowing higher switching frequencies that result in not only greater efficiency but higher power density.

### Digital Signal Controllers

The emergence of digital control in areas such as power conversion, motor drives and similar applications where adaptive control is advantageous, has led to the development of Digital Signal Controllers (DSCs). These devices merge the benefits of a Digital Signal Processor (DSP); extensively used in audio and video processing, and the venerable Microcontroller (MCU), to create a new class of device perfectly tuned to executing control algorithms that would be too complex for a

traditional MCU, with the peripherals and interfaces not typically present in a DSP.

There is an increasing number of DSCs on the market, all of which strive to deliver on these demands. Those that best deliver exhibit a continued roadmap of architectural improvement, which allow developers to further improve the speed and accuracy of the control loop in their application, and enable them to take full advantage of the latest developments in control algorithms. DCSs are essentially the definitive mixed-signal solution; they must combine digital processing with analog peripherals. Achieving an overall solution requires both domains to function together seamlessly, which is why fully integrated devices offer the best approach. Combining both analog and digital technology on a single device can, however, introduce design compromises, but

improving performance in both domains in a balanced way is critical in delivering better solutions. The essential components of a DSC are a core capable of efficiently executing signal processing algorithms, coupled with signal conversion in the form of one/multiple Analog/Digital Converters (ADCs), along with some form of Pulse Width Modulation (PWM) output used to drive power transistors such as MOSFETs in the Buck/Boost conversion circuit(s). Bringing these elements together in a single architecture that supports fast control loops is the key to building a successful DSC, which in turn is the heart of efficient AC/DC and DC/DC power conversion.

### Mixed Signal Solution

The Third Generation of Microchip's dsPIC33 GS family, the dsPIC33EP GS, delivers increased performance in these critical areas over the Second Generation. The core now delivers 70MIPS (up from 50MIPS) but also includes features such as context-selected working register sets that further increase performance for digital power applications beyond what the increased raw MIPS rating might suggest. By adding two additional working register sets the core now supports almost instantaneous context switching. The performance of the analog peripherals has also been improved relative to previous generations. For

example, products in this family offer up to five 12-bit ADCs, with the ADC conversion latency reduced from 600ns to 300ns. Together, these improvements enable a three-pole-three-zero compensator latency to be reduced from around 2 $\mu$ s to less than 1 $\mu$ s thereby reducing phase erosion to improve stability. Faster control loops also allow for higher switching frequencies and better transient response. The resulting efficiency gains made possible by the increased performance also lead to increased power density; power supplies can be designed to be smaller, using fewer and smaller discrete passive components.

A further architectural improvement in the 'GS' is the introduction of dual Flash partitions, supporting a feature known as Live Updates. This allows a control algorithm, or any other software executed by the DSC, to be updated in the field while the power supply remains fully operational; the new software is loaded in to the second, non-operational, Flash partition and, when verified, the core switches to executing from the second Flash partition. This is a feature that is particularly welcome in high-availability applications, such as server power supplies, where even small efficiency gains can result in large reductions in operational costs. Without the live update feature, such applications would be left with either updating

the software during scheduled (or unscheduled) maintenance breaks in operation, or leaving the code unmodified and missing out on the potential benefits. Both of these options would be unwelcome in the server environments, of course.

### Conclusion

The digital control of power conversion continues to develop, progressively replacing analog control due to the flexibility and potential efficiency gains it presents. While the complexity is undoubtedly a consideration for developers, the benefits can be persuading. Regulatory requirements aside, the use of digital control can clearly deliver better power conversion solutions and, with the introduction of Live Update, offer an upgrade path for solutions already deployed - even in high availability applications. DSCs represent the pinnacle of digital control in this and many other applications where complex algorithms meet high performance analog peripherals. The 'real world' of mixed signal solutions continue to offer an opportunity for performance gains at every level; fully integrated, advanced programmable solutions like the dsPIC33EP GS family represent the leading-edge of DSC technology, and will provide power supply developers with the next generation in control.

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## Accelerating RF Component Selection with Yoni2<sup>®</sup> Advanced Search Engine for RF Components

### › Brandon Kaplan, Mini-Circuits

Selecting RF components for a system design can be one of the more time-consuming tasks in the development cycle. To begin with, a designer may have to sift through hundreds of possible options for a suitable model. Each model represents a matrix of features and parameters with varying degrees of form, fit, and function compatibility with the design requirements. Evaluating the options may take hours or even days, and once a suitable part is identified, there's still an element of uncertainty as to whether another model may have achieved better system performance. It's the proverbial needle-in-a-stack-of-needles problem.

Naturally, some RF component suppliers have built databases of product information and developed search engines to speed up the

"plug-and-chug" task of product selection. This technology represents an innovation in customer support in the RF component space, but as with many things, the devil's in the details. Component search engines give engineers the speed and efficiency of computing horsepower, but because most simply search supplier specs against customer criteria, they come with inherent limitations, often generating false positive and false negative results, and failing to accurately and completely identify the ideal parts for a given application.

To address this problem, Mini-Circuits developed Yoni2, an advanced, patented search engine for RF components. Its purpose is not only give customers a much faster way to identify parts that meet their design requirements, but also to ensure that

search results reflect an accurate and realistic evaluation of product performance within the customer's application bandwidth. This article will clarify the distinction between Yoni2 and other RF component search engines and explain the advantages associated with the more sophisticated search methodology of the Yoni2 program.

### **Supplier Specs – A Convenient Reduction**

Suppliers provide performance specs as a quick, convenient way to evaluate "ballpark" product performance for a given parameter of interest. These are single values that the manufacturer can conservatively guarantee the product will meet within a reasonable margin across its operating frequency range. This



information is widely available on product datasheets and supplier websites, and most parametric search engines for RF components match customer performance criteria against these figures.

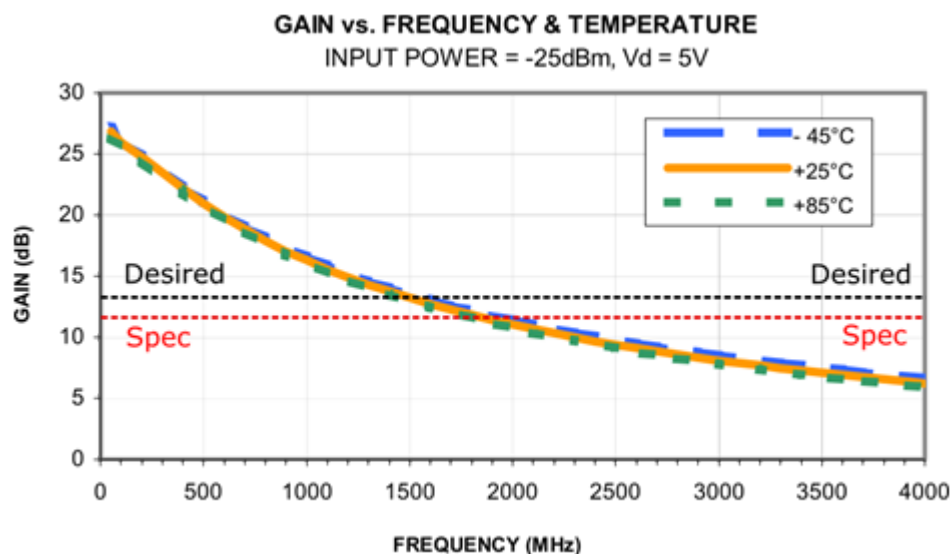
The problem with this approach is that in reality, electrical performance is not a single value but a variable dependent on frequency. For products

specified over a wide frequency range, the spec may understate or overstate performance within a particular band to better approximate performance over the product's full rated frequency range. If the customer only intends to use the product within a specific band, searching by performance specs alone may reject a part that actually provides ideal performance for the

customer's intended application – or worse, it may include a part that achieves marginal performance relative to the requirement.

For example, a published spec table shows 11 dB typical gain for Mini-Circuits' PGA-103+ high-dynamic-range MMIC amplifier, which is specified from 50 to 4000 MHz. In reality, the model's gain curve exhibits a negative slope when plotted over frequency as shown in figure 1.

Notice that characteristic gain performance is greater than the 11 dB spec up to 1500 MHz. Therefore a customer working in an application at lower frequencies with a 13 dB minimum gain requirement may falsely dismiss this model as a viable option if he bases his search on the spec alone. Specs may offer a convenient general point of reference, but they are, by nature, reductive. Nevertheless, this is the methodology most RF component search engines employ. Such search engines may still be preferable to manually poring over dozens of datasheets, tables, and charts, but they should be approached with healthy skepticism toward the accuracy and completeness of the results they return.



**Figure 1: Characteristic gain performance for Mini-Circuits PGA-103+ high-dynamic-range MMIC amplifier.**

<b>Package Style *</b>	<input type="radio"/> Plug-In	<input checked="" type="radio"/> Surface Mount	<input type="radio"/> Connector	
<b>Frequency (MHz) *</b>	Low *	<input type="text" value="50"/>	High *	<input type="text" value="1000"/>
<b>Gain (dB)</b>	Min.	<input type="text" value="13"/>	Max.	<input type="text"/>
<b>Min. Return Loss (dB)</b>	Input	<input type="text"/>	Output	<input type="text"/>
<b>Noise Figure (dB)</b>	Max.	<input type="text"/>		
<b>Isolation (dB)</b>	Min.	<input type="text"/>		
<b>Power Output (dBm) (@1dB Compression)</b>	Min.	<input type="text"/>		
<b>Output IP3 (dBm)</b>	Min.	<input type="text"/>		
<b>DC Supply Voltage(V)</b>	Min.	<input type="text"/>	Max.	<input type="text"/>
				<input type="button" value="Clear"/> <input type="button" value="Search"/>

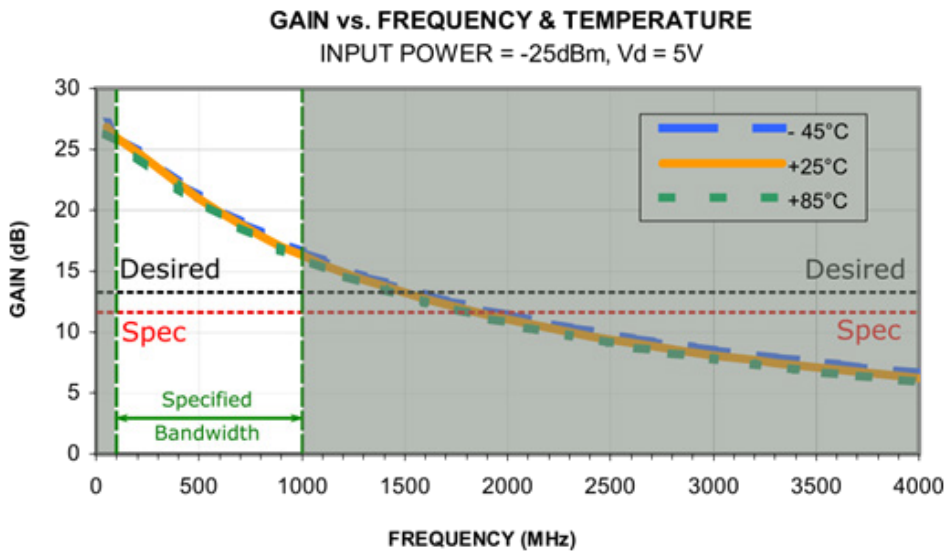
**Figure 2: Yoni2 Search for a surface mount amplifier with 13 dB minimum gain from 50 to 1000 MHz**

## Yoni2 - Smarter than Specs

Mini-Circuits' absolute commitment to quality includes an extensive program

of testing and characterization for every part we sell. As a result, in addition to product specs, we maintain an vast library of complete

characteristic performance data swept over frequency for the parameters of interest of every model in our catalog and engineering database. We've always provided test data as a resource to customers evaluating parts for their designs, and the accumulation of this data is what ultimately enabled our development of a more sophisticated product search tool. Mindful of the limitations of specs alone, Mini-Circuits developed Yoni2, a patented search engine that searches customer performance criteria against millions of points of measured characteristic performance data rather than single-value specs. The program bounds the search to data points that fall within the customer's defined application band, so the search only includes performance relevant to the customer's application bandwidth, and omits data over extraneous frequencies, producing search results more tailored to the customer's specific needs.



**Figure 3: Yoni2 includes PGA-103+ in search results based on characteristic performance within the customer's specified bandwidth**

Model Number	Case Style	F Low (MHz)	F High (MHz)	Gain (dB)	Max Power Output at 1 dB Compression (dBm) Typ.	NF (dB) Typ.	IP3 (dBm) Typ.	Input VSWR (-1) Typ.	Output VSWR (-1) Typ.	DC Voltage (V)	DC Current (mA) Typ.
CMA-5043+	DL1721	50	4000	18.4	19.8	0.75	33.5	1.7	1.5	5.0	58
CMA-545+	DL1721	50	6000	14.2	20.0	0.8	35.0	2.3	1.5	3.0	80
PGA-103+	DF782	50	4000	11.0	22.5	0.9	44.6	1.6	1.2	3.0/5.0	60/97
PGA-105+	DF782	40	2600	15.1	20.5	1.9	39.3	1.5	1.5	5	63
PMA-545+	DQ849	50	6000	14.2	20.3	0.8	36.4	2.3	1.3	3.0	80
PMA-5451+	DQ849	50	6000	13.7	16.8	0.8	30.8	2.6	1.3	3.0	30
PMA-5452+	DQ849	50	6000	14.0	18.3	0.7	34.1	2.6	1.3	3.0	40
PMA-5453+	DQ849	50	6000	14.3	19.64	0.7	36.8	2.6	1.3	3.0	60
PMA-5454+	DQ849	50	6000	13.5	14.6	0.9	28.1	2.9	1.3	5.0	20
PMA-5455+	DQ849	50	6000	14.0	19.1	0.8	32.7	2.6	1.3	5.0	40
PMA-5456+	DQ849	50	6000	14.4	21.5	0.8	36.0	2.6	1.3	5.0	60
PSA-545+	CA1389	50	4000	14.9	20.2	1.0	36.2	2.1	1.5	3.0	80
PSA-5451+	CA1389	50	4000	14.0	16.2	1.0	30.2	2.6	1.2	3.0	30
PSA-5453+	CA1389	50	4000	14.7	19.4	1.0	36.8	2.6	1.2	3.0	60
PSA-5454+	CA1389	50	4000	13.6	14.0	1.1	26.3	2.6	1.4	5.0	20
PSA-5455+	CA1389	50	4000	14.4	18.5	1.0	32.2	2.3	1.3	5.0	40
PSA-5043+	MMM1362	50	4000	18.4	18.8	0.75	33.5	1.7	1.5	3.0/5.0	33/58

**Figure 4: Search results for surface mount amplifier with 13 dB minimum gain from 50 to 1000 MHz, including PGA-103+. Not all search results pictured**



**Figure 5: Rank ordering of search criteria when no exact match exists for all criteria**

Taking PGA-103+ as an example again, we know the model has a gain spec of 11 dB, but we already know that actual gain is higher than this at the low end of the frequency range. Say a customer has a 13 dB minimum gain requirement for an application band from 50 to 1000 MHz. The customer would enter search criteria into Yoni2 on the Mini-Circuits website as shown in Figure 2

A search based on the 11 dB gain spec would reject PGA-103+, since the customer has specified a 13 dB minimum. However, since the characteristic gain performance of the part exceeds 13 dB within the customers specified bandwidth of 50 to 1000 MHz as shown in figure 3, we expect Yoni2 to include PGA-103+ in the results.

The search returns many models which meet this customer's requirement, but as we expect, PGA-103+ is included among those results, shown in Figure 4. The user interface displays a complete spec table for all valid models as a convenience to the customer for easy browsing and comparison. But notice that while the spec table shows a gain value for PGA-103+ that falls beneath the 13 dB minimum requirement, Yoni2 includes this model because its characteristic performance is quite suitable for the customer's needs. The search is smarter than the specs.

For simplicity, this example presented in this article only involves one simple search criterion, but Yoni2 allows users to refine their search and

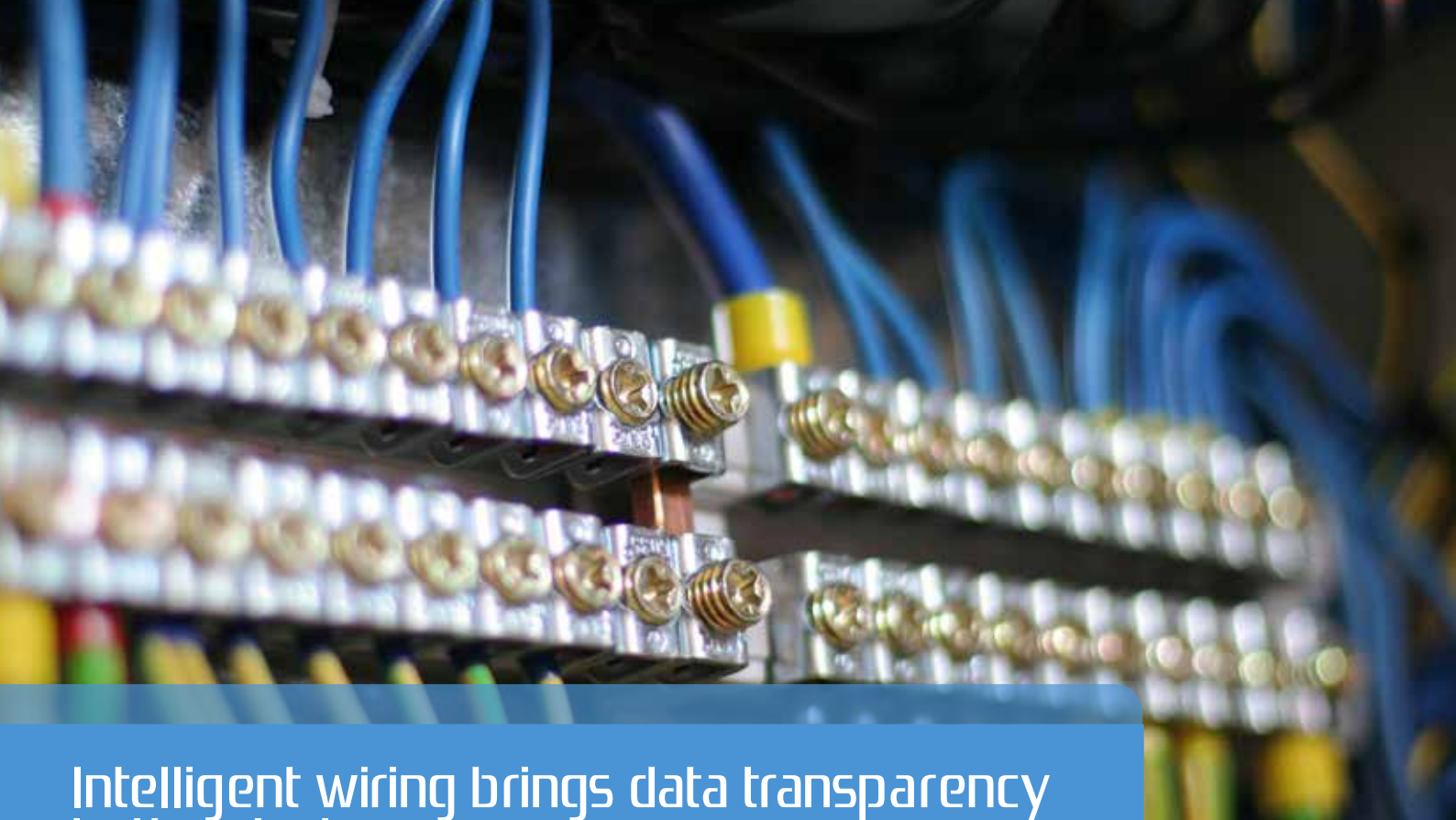
narrow results by employing the same methodology on multiple performance criteria simultaneously. In cases where no exact match exists for all specified criteria, Yoni2 prompts the user rank her top two search criteria by priority to produce the closest possible match. Just as this example illustrated how Yoni2 includes a model whose spec understates actual performance within a particular bandwidth, it may also exclude models with specs that meet a design requirement but characteristic performance that underperforms at certain frequencies. This is less likely to be the case, as specs are always conservative, but it should instill confidence in the accuracy of the search results Yoni2 generates.

### **Better Search Tool, Faster Design Cycle**

The Yoni2 advanced search engine uses a more sophisticated search methodology than other RF component search engines. By searching based on characteristic performance, comprising millions of points of actual measured test data, Yoni2 is less prone to false positive and false negative results inherent to searches based on simple supplier specs.

This gives designers a tool that dramatically speeds up their design cycle in two ways. Yoni2 reduces the time and effort required for component selection by orders of magnitude by generating model lists that meet the specified performance criteria in seconds. Further, because the search produces candidate models whose actual performance is more certain to conform to the requirements of a system design, Yoni2 reduces false starts with products that don't perform as expected on the test bench. The bottom line is that a faster, easier component search process with more accurate results means a faster transition from evaluation stages to working designs.





## Intelligent wiring brings data transparency to the plant

### > Heribert Einwag

#### Today's requirements

Ever-growing cost pressure and increasingly tougher competition, internationalization and globalization affect engineering just like many other sectors. In the production and processing industries, these challenges increasingly throw operating costs under the spotlight, as machines are generally operated over decades rather than just a few years. As a result, operating costs quickly outweigh procurement costs: over an observation period of ten years, operating costs are often found to be already five to ten times higher than investment costs.

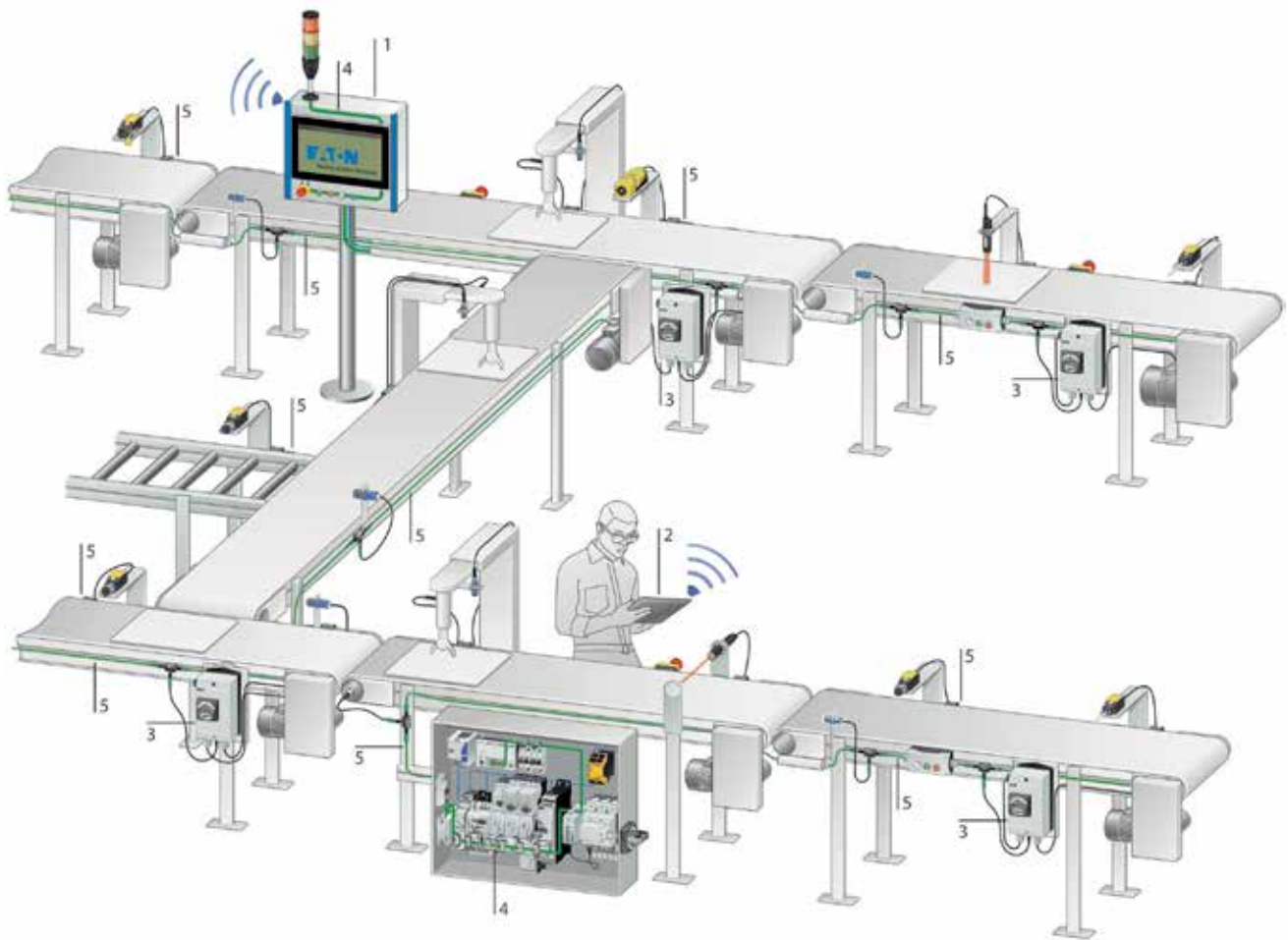
Considering costs in their entirety To achieve a cost-efficient machine, machine builders and operators should therefore consider the costs incurred over the machine life cycle in their

entirety. This approach includes not just procurement and installation costs, but also energy costs. Reducing energy consumption is not just practical for commercial reasons, but also for compliance considerations: legal regulations are increasingly focusing on this subject. Furthermore, increasing energy efficiency protects available environmental resources. In order to achieve the aim of reducing energy consumption and increasing energy efficiency, the energy flows to the entire machine and the energy consumption in the individual machine parts and components should be recorded, analyzed and then optimized. An important instrument in this respect is a systematic power management system.

#### Preventing downtimes

Another considerable cost factor in the

life cycle of a machine is the cost of servicing and maintenance – and in the worst case, the costs of production downtimes. As a result, condition monitoring (or status monitoring) is becoming increasingly important. This approach can not only ensure the reliable operation of the machine, but can also sometimes increase efficiency. The monitoring is based on recording the machine status at regular intervals or on a continual basis by measuring and analyzing physical parameters such as motor current, temperature, fill levels or ambient data. But in today's competitive environment, it is usually no longer enough to simply react to faults. For just one machine, the costs of production downtime, troubleshooting and fault correction add up quickly. Predictive (or preventative) maintenance therefore plays an ever more important role in



### Intelligent Wiring Concept

machine operation. Storing, analyzing and evaluating data on the operating statuses of a machine form the basis for predicting potential defects in machine parts and components, so that maintenance can be scheduled and carried out even before a failure occurs and results in machine downtime. By minimizing unexpected downtimes and therefore production shortfalls, machine availability and productivity increase while servicing and maintenance costs decrease. Modernization and upgrades ensure productivity Requirements can always change over the long operating period of a machine. Regular adjustments and upgrades are essential to ensure that the machine continues to meet demands. It is

therefore beneficial to have a machine concept that allows for easy integration of new modules and components. Furthermore, as the components age, machine performance reduces, the frequency of errors increases and servicing and maintenance costs rise. For this reason, it is advantageous when modernization measures, such as replacing old drives and controls, can be implemented with minimal downtimes. With new components, even a 15 or 20-year-old machine can keep up with a new installation in terms of productivity and downtimes. Transparency right down to the sensor Growing requirements for power management, condition monitoring and predictive maintenance increase the process monitoring and analysis

workload. An ever-growing amount of data is required to facilitate confident decision-making and predictions about the machine status: information on energy consumption, machine statuses, temperatures, switching times and much more should provide as comprehensive a view of the machine as possible. Only by considering the entire chain of processes is it possible to quickly identify critical machine statuses and deviations from the normal condition and prevent downtimes. However, this approach requires a great amount of data that has been recorded previously as a matter of course – not just status data for more complex electronic components, such as controls or drives, but also information from

sensors, switchgears, pushbuttons or other field equipment.

This level of transparency for a machine, which goes right to the sensor, also meets Industry 4.0 criteria. Machines of the future will consist of 'smart' products that transmit relevant data, take local decisions, can establish communication with other machine assemblies and are ultimately connected to the Internet of Things. By exchanging information as seamlessly as possible between global production sites on the one hand and commercial entities and supply chains on the other, machine operators will be able to design all their commercial procedures more efficiently and operate the machine with maximum economy. This will provide a clear advantage in the global competitive environment.

However, the need for a high-grade networked machine structure with a large number of smart, communication-enabled components must not result in longer project timeframes. On the contrary: in a globalized world, time and cost pressure increases even during the project design phase. New machines must be designed, installed and commissioned within shorter and shorter timeframes.

### **Current situation: expensive wiring and insufficient depth of data**

In today's machines, automation is often only implemented in one, but sometimes multiple programmable logic controllers (PLCs). These devices are then connected to motor starters, variable frequency drives, soft starters, pushbuttons and modern control systems installed in the field or in switch cabinets. All of these components are usually installed via industrial fieldbus systems or complex, expensive point-to-point control wiring, both of which are prone to error both during installation and

commissioning and during operation. Designing and implementing this type of technology still demands a relatively high cost both inside and outside of the switch cabinet.

### **Data transparency routes to even the simplest device**

Generally, only the more complex equipment has its own electronics, which can be used to record data and sometimes even pre-process it. Variable frequency drives and servo drives, for instance, provide a versatile range of motor data, can communicate via virtually every fieldbus system and often already have externally usable memory and computing capacity. In the process they bring with them all the requirements for high data transparency of a machine and are already potentially in a position to respond as 'smart components' within an Industry 4.0 environment. It is a different situation with a large number of components that have previously been connected via classic control wiring to digital or analogue inputs/outputs of the control system in use. In this case, as well, it would be desirable to receive more data, but this is often not possible due to high costs, or is only possible with a great amount of effort. For example, if an operator wishes to process differentiated information on the reason why a manual motor starter or circuit breaker has tripped (overload or short circuit), auxiliary switches and digital inputs for the control system must be installed and wired for each type of data. More information only available through additional equipment To increase availability and reduce operating costs, machines must be equipped to offer comprehensive process monitoring and analysis options. Additional equipment is required for this, which can record or generate the desired data and

forward it. This means a significantly upgraded infrastructure with additional components that must be connected to the control system. As a result, planning becomes more complicated, the overall design of the machine becomes more complex and the potential for error increases. Such upgrades also result in a greater need for input/output modules for the control system being used – for which there is not necessarily enough space reserved in the switch cabinet. If no smart, communication-enabled variant is available for 'simple' devices, the machine operator may have to make a decision between either modernizing the entire automation system or not being able to carry out comprehensive analysis of all machine parts, despite the high costs associated with this.

### **An intelligent wiring and communication system**

Technology that offers a solution to the above challenges must meet multiple criteria:

- Local intelligence for recording and pre-processing information
  - Ability to communicate in order to convey this information
  - Minimal dimensions in order to be used even in compact devices such as pushbuttons or auxiliary switches
  - Universal applicability thanks to integration into existing industrial fieldbus systems
  - Reasonable price in order to justify its use even in the simplest switchgear
- Smart devices do not require complex point-to-point wiring, nor do they need to be connected to the control system via expensive fieldbus circuitry. The intelligent wiring system allows for direct integration of connected devices to the central control system or into the machine's existing communication environment. Frequently used pushbuttons as well as contactors and manual motor starter or circuit breakers are involved



here. But this technology is not limited to the connection of simple digital components: even devices that provide a larger amount of digital and analogue process data can be easily connected, such as manual motor starters with measurement electronics, soft starters or variable frequency drives. The data recorded by all of these devices can be easily transmitted to the superordinate control level. An intelligent wiring and communication system can also supply the equipment with power at the same time, eliminating the need for an additional 24 V power supply. Continuous monitoring of the communication connection also provides information as to whether the components are ready for operation – information that today is not available at all for many simply switchgear devices.

The advantages of this type of intelligent wiring system can be seen outside of the switch cabinet in particular: up to 99 devices can be easily integrated, with a maximum branch length of 600 meters. Even extensive machines with hundreds of sensors can be quickly wired. The benefit of this is clear: instead of laying control lines from central or decentralized control cabinets to the sensor, the sensor itself is directly connected to the communication system on site. If upgrades are required later, a new module is simply integrated into the communication line and the new sensor is installed. Smart components such as motor starters or circuit breakers with electronic tripping units, soft starters or variable frequency drives, with a high degree of protection or a corresponding compact housing, are connected directly to the intelligent wiring system. In both cases, however, the devices must be positioned in the field exactly at the point where they form a functional assembly with the motor. The use of expensive fieldbus

components with a high degree of protection can be almost completely eliminated, and conventional cross-wiring can be significantly reduced or even completely replaced.

### Added value over the entire life cycle

Using this technology produces tangible added value throughout the machine's life cycle. In engineering, for example, planning of logical units is easier and better, reducing the project design workload by up to 70%. During commissioning, the machine manufacturer benefits from significant time savings when wiring the system. The wiring, testing and commissioning workload can be reduced by up to 85%. At the same time, connection errors can be virtually eliminated thanks to the simple setup of the system. The workload for upgrades and modernization also drops significantly with this type of intelligent wiring and communication system. The new devices are simply connected to the line via a plug connector and configured with the press of a button – almost a plug-and-play process. This approach minimizes the engineering workload and downtimes, both of which often end up being significantly reduced compared to methods involving conventional point-to-point wiring. Even during running operation, the formation of 'functional assemblies' in the field brings significant advantages when it comes to machine servicing and maintenance. If a fault occurs, the active parts of the assembly (drive and motor) are located right next to each other. The long routes between the switch cabinet and motor are eliminated. The drive can be secured against being switched on again directly on site, lowering the risk of accidents for the service technician. In total, an intelligent wiring system can provide a reduction of up to 30% in the life cycle costs of the electrical

installation from project design to servicing and maintenance.

### The basis for Industry 4.0

An intelligent wiring and communication system turns simple components such as switches and control units in machines into communication-enabled devices. Via the Internet of Things, they are capable of providing the necessary data in real-time using cloud services such as power management or condition monitoring. If these components also have their own intelligence, either integrated or in combination with the communication system, these devices become 'smart devices' that are even able to take over decentralized, independent tasks – the basis for introduction to Industry 4.0. Cost-effective distribution of this technology to even the most simple components is crucial to achieving the aim of Industry 4.0: significant simplification of production processes through the universal (i.e. not dependent on specific manufacturers) provision of production capacities within the 'smart factory'.

To facilitate the greatest possible degree of freedom for machine and plant manufacturers in the development of their application, Eaton has placed special importance on cultivating an open architecture for its solution. The intelligent wiring system can be connected via gateways to any established industrial fieldbus, from Profibus DP, Profinet, CANopen and Ethernet/IP to Modbus TCP, Powerlink and EtherCAT. Even if the machine manufacturer changes their control concept in the future, the field devices or the wiring system do not have to be redesigned, as replacing the gateway is usually sufficient. Thus new communication standards such as OPC UA are supported even today.

### Practical experience

The intelligent wiring and



**automated potato sorting plant - Schaltanlagenbau Gormanns**

communication solution has already been tried and tested in many applications, including those presented in the following examples:

### **Motor protection - reliable detection of operating statuses**

In upgrading their sand and gravel machine for the Lorüns crusher and screening plant, Keckeis from Rankweil, Austria, used the SmartWire-DT intelligent wiring system with the PKE electronic manual motor starter from Eaton. When used in combination with PKE manual motor starters, advanced drive monitoring is realized: the ongoing motor current can be continuously mapped and analyzed without cost-intensive analogue I/O technology. Using conventional motor control with a manual motor starter and circuit

breaker, the switching statuses of the two components (ON) are used as a basis for making indirect assumptions about operation or detecting a shutdown. For real, reliable feedback, a hardware solution is additionally required, with a speed sensor, load shedding relay etc. Furthermore, the drive is switched off without advance warning in the event of an overload caused by the set current value being exceeded, and a fault is signaled in order to protect the motor from damage. This leads to unplanned interruptions to operation, impacting time and cost considerations.

It is exactly at this point that the great benefit of the intelligent wiring and communication system becomes apparent: by evaluating the ongoing operating current at the Lorüns crusher and screening plant, SmartWire-DT makes it possible to

differentiate between the various operating statuses: 'motor switched off', 'idling', 'operation', 'overload' and 'fault'. The individual load thresholds and time behavior can be freely programmed and individually configured for each drive task. In this way, the machine operator can identify upcoming faults promptly and intervene in the production process in time, before it is interrupted unnecessarily.

### **Process monitoring – remote diagnostics**

Acque del Basso Livenza S.p.A in Italy operates one of the largest wastewater treatment plants in Portogruaro and the entire province of Pordenone on a continuous, fully automatic basis. Faults with motors or pumps in the plant are reported to remote technicians, who must

be on call 24 hours a day. This fault correction procedure often impaired the productivity of the treatment plant in the past and incurred significant personnel costs as well as causing disruptive downtimes. For this reason, the company chose to implement the PKE electronic manual motor starter from Eaton in combination with SmartWire-DT.

Thanks to this technology, the technicians now receive detailed information on the plant by text message or email. They can then interact with the machinery remotely using a remote connection via virtual network computing (VNC) and monitor the current consumption of each motor in real time, for example. If the cause of an overload or a technical fault is determined and corrected, the drive can be recommissioned via the touchscreen of a tablet or smartphone.

Installing this solution has greatly simplified plant operation for Acque del Basso Livenza. Today, most problems can be resolved remotely and the technicians have time to concentrate on other tasks. The result: increased efficiency and productivity.

### Modernization – quick installation and flexible upgrades

At Germany's oldest gold and silver refinery, Heimerle + Meule, a new automation concept for the refining process was implemented after a fire. Six Eaton control units with touch panels (HMI/PLC) from the XV-102 and XV-152 series were used. These units communicate via SmartWire-DT with switchgears such as the PKZ motor starters, the DIL contactors or the DS7 soft starter, as well as various pushbuttons from the RMQ Titan series. The network comprises a total of about 300 SmartWire-DT devices. All HMI/PLCs can be accessed directly via Ethernet from a central PC.

Amongst other things, a check can be carried out to determine whether each connected component is ready for operation. If an error occurs, target troubleshooting eliminates the previous need to search for the cause of the fault on site.

Thanks to the simple wiring, it took just three months to modernize the entire system. Conventional wiring alone would have taken at least one month. Thanks to SmartWire-DT, however, all the components were installed within just a week. Tedious troubleshooting was eliminated, since a large part of the potential sources of error during installation and commissioning were prevented from the start by the plug-and-play technology of the wiring system. Using automation components with an integrated interface to the intelligent wiring system makes it possible to reduce the number of components and interfaces overall and integrate hardware and software quickly, effectively and without errors. Effective wiring – significant time savings

As part of an extensive new construction project for a fully automated potato sorting plant, Schaltanlagenbau Gormanns GmbH wired the 250 drives for conveyor belts, pumps, fans and machines using the SmartWire-DT technology. With conventional point-to-point wiring, an estimated 32 km of cable would need to be laid for the entire plant, with at least another 1 km of cable for traditional cross-wiring within the switch cabinets.

Today, the control system, variable frequency drives and touch panels communicate via a conventional fieldbus. Motor starter combinations networked with SmartWire-DT take over the switching and protection of all drives. These combinations are connected to the control system via one gateway per cabinet and comprise

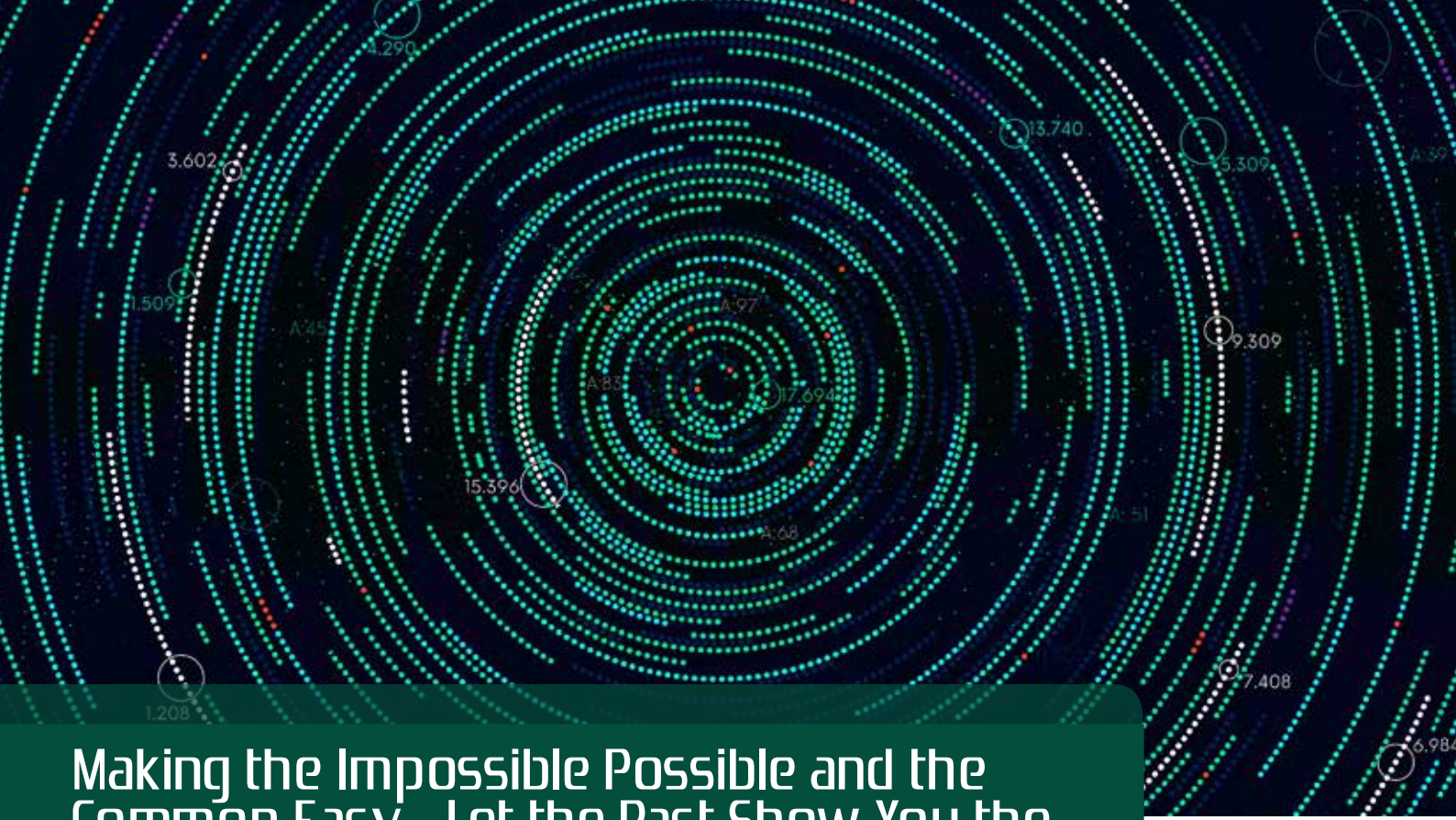
PKZ manual motor starters, DIL contactors and electrical connectors from Eaton's standard range of products. The communication system is not only used in the switch cabinet, but also with peripheral devices: over 50 command points on the machines are connected via I/O assemblies with a high degree of protection (IP65).

The wiring workload was reduced to one-eighth thanks to the intelligent wiring system. Cross-wiring dropped from a good kilometer to just 50 meters and the wiring workload for the command devices on the machines was reduced by approximately 40%. Troubleshooting during commissioning also significantly decreased, as errors were quickly found using the data supplied by the connected devices. Instead of two weeks for commissioning a sorting plant of a similar age, Gormanns needed just 1.5 days for the new plant. The entire complex project was completed in just four months.

### Summary

An intelligent wiring system at device level makes it possible to equip each connected component of a machine with communication capabilities and decentralized intelligence in an effective and cost-efficient manner. As a result, even data from simple automation components can be sent to the superordinate control system or even directly to the local or supra-regional control level. The provision of comprehensive data from the machine leads to a high degree of data transparency, which can be used to optimize productivity and availability. Flexibility, preparation for the future and 'IoT readiness' are additional arguments for using intelligent wiring systems when designing or modernizing machines and systems.





# Making the Impossible Possible and the Common Easy - Let the Past Show You the Way to the Future

## > Jeffrey Phillips, NI

The rapid pace of technological advancement should be celebrated and embraced. It fuels amazing new technologies and scientific achievements that make us more connected and safer. It also pushes the limits of what we previously thought possible. The impact of these achievements is no longer isolated to a narrow market vertical. It permeates every industry and exposes the established market incumbents to an unusual combination of disruption and growth potential. But the pressure and the challenge to drive business impact are daunting in this climate. How do you stimulate growth while making large investments in future technologies without dramatically changing your

business model? Companies are watching their operational costs balloon as they dip their toes into numerous areas of investment that require significant and often disparate expertise. Meanwhile, small startups with incredible focus and no prior obligations can leverage new technologies in ways that established competitors struggle to answer. So how do you protect yourself from disruption? How do you innovate without radically increasing the cost of doing business? It all boils down to one simple question: Do you feel secure in the tools you're using? That's the magic question, whether it's your personal finances, career, or the engineering systems of the future. For instance, the Industrial

Internet of Things ushers in a new era of both networked potential and significant risk. To best understand which software prepares you to most securely engineer future systems, you should turn to the recent past. In 2005, the previous three technological decades were defined by one simple observation made by the cofounder of Intel, Gordon Moore. Moore's law was the prediction, based on the recent past, that the number of transistors per square inch on an integrated circuit would continue to double every 18 months. Seemingly linear growth was just the start of exponential growth. Before we knew it, CEOs from every semiconductor manufacturer talked about the number of parallel processing cores

over the next few years. Intel CEO Paul Otellini promised 80 core chips in the following five years.

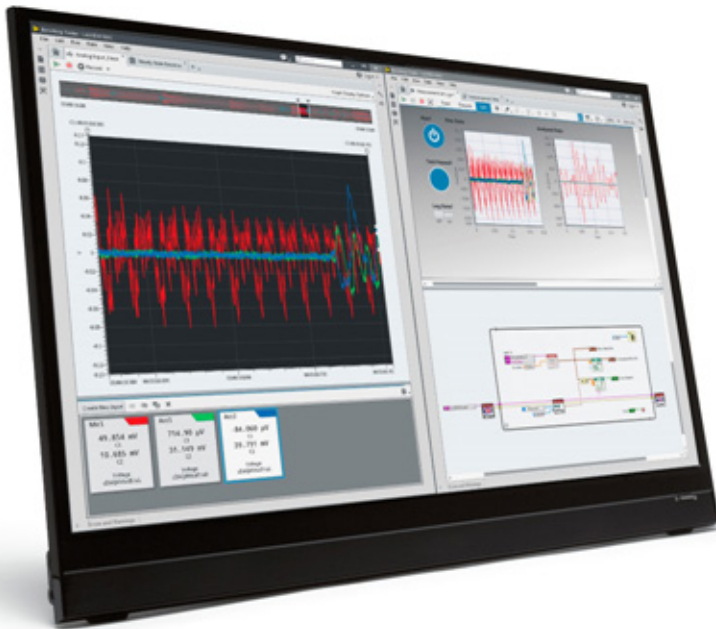
The demand for more processing power with lower latency marched on. Alternative processing fabric

emerged. First, the FPGA stormed into popularity with its software-defined timing and massively complex low-level programming languages. Next, heterogeneous processing was born when the traditional processor and the FPGA were combined onto a single chip.

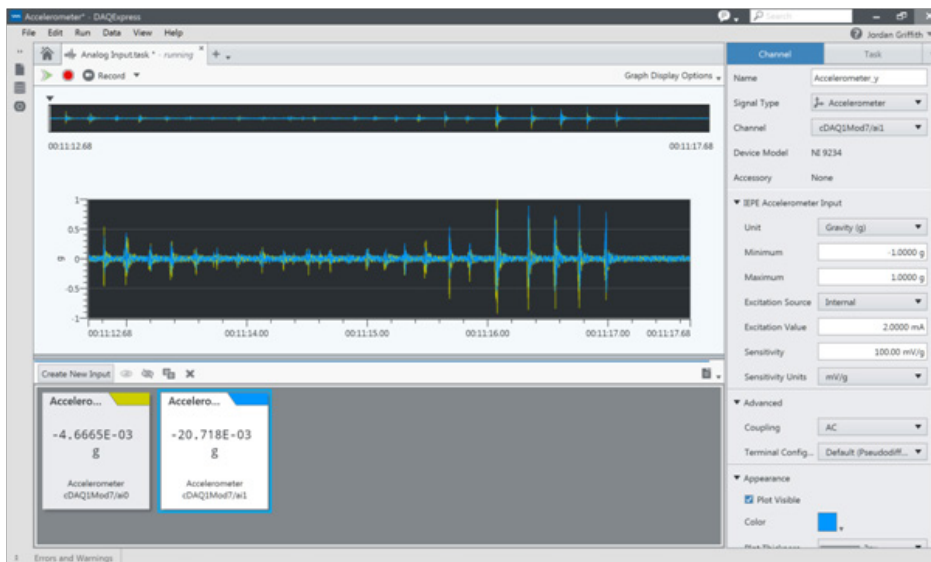
Along with this explosion of processor architectures came a flood of new programming environments, programming languages, and open-source fads bidding their time until the inevitable decline into oblivion. And, of course, the whole burden of figuring out how to efficiently program the processors fell on you.

But now, we look to the future. The explosion of processing capabilities is leading us forward into a world of hyperconnectivity. And this world becomes more connected as engineering systems become more distributed. Trends like 5G and the Industrial Internet of Things promise to connect infrastructure, transportation, and the consumer network to enrich the lives of people the world over. It's inarguable that software will be the defining aspect of any engineering system, if it's not already. And it won't be long before hardware becomes completely commoditized and the only distinguishing component of a system will be the IP that defines the logic.

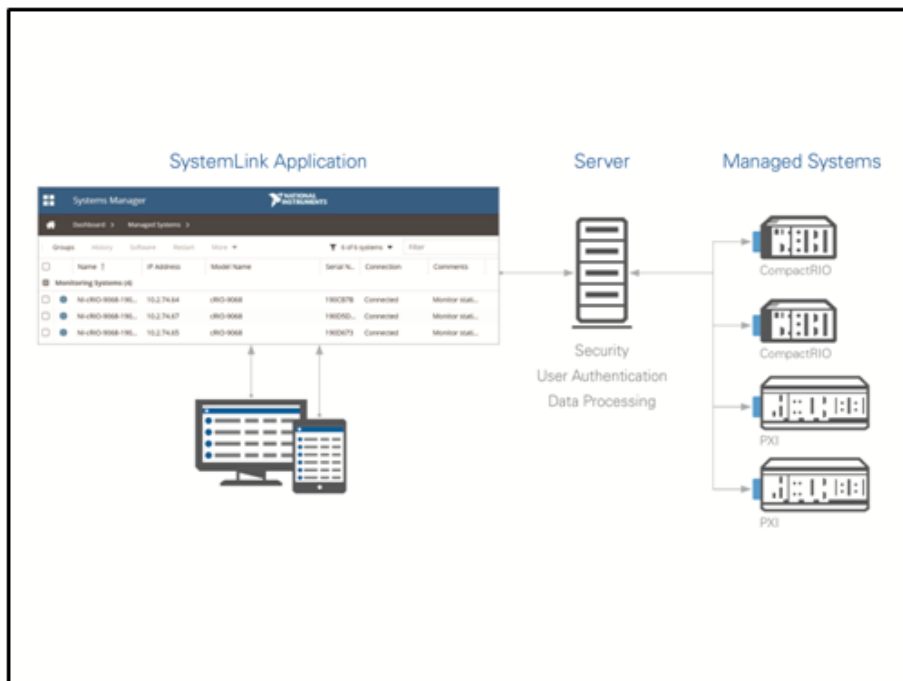
Most test and measurement vendors have been slow to respond to the inevitable rise of software and are just now hitting the market with software environments that help the engineering community. But even those can only get you so far. As the industry continues to evolve, the tools engineers use to design these connected systems must meet four



**Figure 1 – New workflows in LabVIEW NXG mean users can acquire, analyze, and export measurement data without programming.**



**Figure 2 – The interoperability between products in NI's software portfolio simplifies the sharing of IP and transfer of code for more complex development.**



**Figure 3 – SystemLink introduces a web-based interface to manage distributed hardware systems.**

key challenges: productivity through abstraction, software interoperability, comprehensive data analytics, and the efficient management of distributed systems.

### Productivity Through Abstraction

Abstraction is one of those words that is so overused it's in danger of losing its meaning. Simply put, it is making the complex common. In the world of designing engineering systems, complexity often comes from programming. The custom logic that adds the smart to smart systems typically requires a level of coding that's often so complex, it's what separates the pros from the amateurs. The complex must become common, though. To solve this challenge, engineers need a "programming optional" workflow

that enables them to discover and configure measurement hardware, acquire real-world data, and then perform data analytics to turn that raw data into real insight. NI is introducing a new configuration-based workflow in the form of LabVIEW NXG. It is complemented by the graphical dataflow programming paradigm native to LabVIEW and known for accelerating developer productivity in complex system design for nearly 30 years. With this configuration-based interaction style, you can progress from sensor connections all the way to the resulting action without the need for programming and still construct the code modules behind the scenes. That last step is a critical feature that streamlines the transition from one-off insights into repeatable and automated measurements.

### Software Interoperability

With the growing complexity of today's solutions, the need to combine multiple software languages, environments, and approaches is quickly becoming ubiquitous. However, the cost of integrating these software components is considerable and continues to increase. Languages for specialized hardware platforms must be integrated with other languages as these compute platforms are being combined into single devices. The solution to this is typically the design team assuming the burden of integration. However, this is essentially just treating the symptoms and not addressing the root cause. The software vendors must fix the root cause.

By design, NI's software-centric platform places this software interoperability at the forefront of the development process. Though LabVIEW has been at the center of this software-centric approach, many complementary software products from other companies are individually laser-focused on specific tasks, such as test sequencing, hardware-in-the-loop prototyping, server-based data analytics, circuit simulation for teaching engineers, and online asset monitoring. These products are purposefully limited to the common workflows of the engineers and technicians performing those tasks. This characteristic is shared with other software in the industry tailored to the same purpose. However, for NI software, LabVIEW provides ultimate extensibility capabilities through an engineering-focused programming language that defies the limitations of tailored software. For example, consider DAQExpress™.



DAQExpress is new companion software for USB and low-cost plug-in NI data acquisition hardware that drastically simplifies the discovery and configuration of hardware and provides access to live data in two clicks. All the configuration “tasks” within this product are fully transferrable to LabVIEW NXG, which simplifies the transition from hardware configuration to measurement automation.

In addition to interoperating within the NI platform, products like LabVIEW 2017 feature enhanced interoperability with IP and standard communications protocols. For embedded systems that need to interoperate with industrial automation devices, LabVIEW 2017 includes native support for IEC 61131-3, OPC-UA, and the secure DDS messaging standard. It also offers new interactive machine learning algorithms and native integration with Amazon Web Services.

Beyond the individual innovation within each of these products, the collection represents the fruition of NI’s commitment to its ongoing investment in software. This unique combination of software products and their inherent interoperability separates NI’s platform from the rest. Other vendors are just now figuring out that software is the key, but NI’s investment in software has steadily increased over the last 30 years.

## **Comprehensive Data Analytics**

Perhaps the most prolific benefit of the mass connectedness between the world’s systems is the ability to instantaneously access data and analyze every data point you collect. This process is critical to automating

decision making and eliminating preventable delays in the necessary corrective action when data anomalies happen. To create the future network that can support this need, billions of dollars are being poured into research as algorithm experts from around the globe race to meet the demands of 1 ms latency coupled with 10 Gbps throughput. This direction introduces new demands on software. The first is to ensure that the processing elements can be easily deployed across a wide variety of processing architectures and then redeployed on a different processor with minimal (hopefully zero) rework. The second is to be open enough to now interface with data from an infinite number of nodes and via an infinite number of data formats.

NI has invested in server products that allow you to intelligently and easily standardize, analyze, and report on large amounts of data across your entire test organization. A key component is providing algorithms to preprocess files and automatically standardize items such as metadata, units, and file types in addition to performing basic analysis and data quality checks. Based on that data’s contents, the software can then intelligently choose which script gets run. This type of interface is critical to eliminating the complexity of real-time data analytics so you can focus on what matters: the data.

## **Distributed Systems Management**

The mass deployment and connectedness of these systems have renewed the need to efficiently manage all the distributed hardware from a centralized-and often remote-location. Today, this typically requires

replicating single-point deployments across hundreds, and even thousands, of systems. Centralizing the management then leads to the ability to see a real-time dashboard of the hardware from the remote depot instead of physically accessing the system.

SystemLink is innovative new software from NI that helps you centralize the coordination of a system’s device configuration, software deployment, and data management. This reduces the administrative burden and logistical costs associated with systems management functions. The software also improves test and embedded system uptime by promoting awareness of operational state and health criteria. It simplifies managing distributed systems and provides APIs from LabVIEW and other software languages such as C++.

## **Ask Yourself Again**

Beyond the individual innovation within each of these product releases, the collection represents the culmination of the ongoing investment in software that NI has proven committed to year after year. The unique combination of software products and their inherent interoperability separates NI’s platform from the rest. From discovering the Higgs boson particle to decreasing test times by 100X for Qualcomm to being Nokia’s and Samsung’s solution of choice for their 5G research, NI’s software-centric platform is the building block that engineers use to solve the most complex challenges in the world.

**Ask yourself again: How secure do you feel in the tools you’re using?**



## How Wearable Health Technology is Changing the Face of Healthcare

### › Mark Patrick, Mouser Electronics

The miniaturization of biomedical sensors, the proliferation of smartphones and the rise of power efficient wireless protocols has started a generation of wearable medical devices which stand to change the face of healthcare.

These medical wearables go way beyond fitness trackers. They're not just counting steps or tracking heart rates, but monitoring glucose levels and blood pressure, managing chronic pain, or even delivering medication.

At the heart of this revolution in healthcare are wireless technologies which have arisen with the proliferation of the smartphone. Bluetooth and NFC are the wireless protocols driving this new generation

of wearable medical devices.

### **The Wearable Revolution**

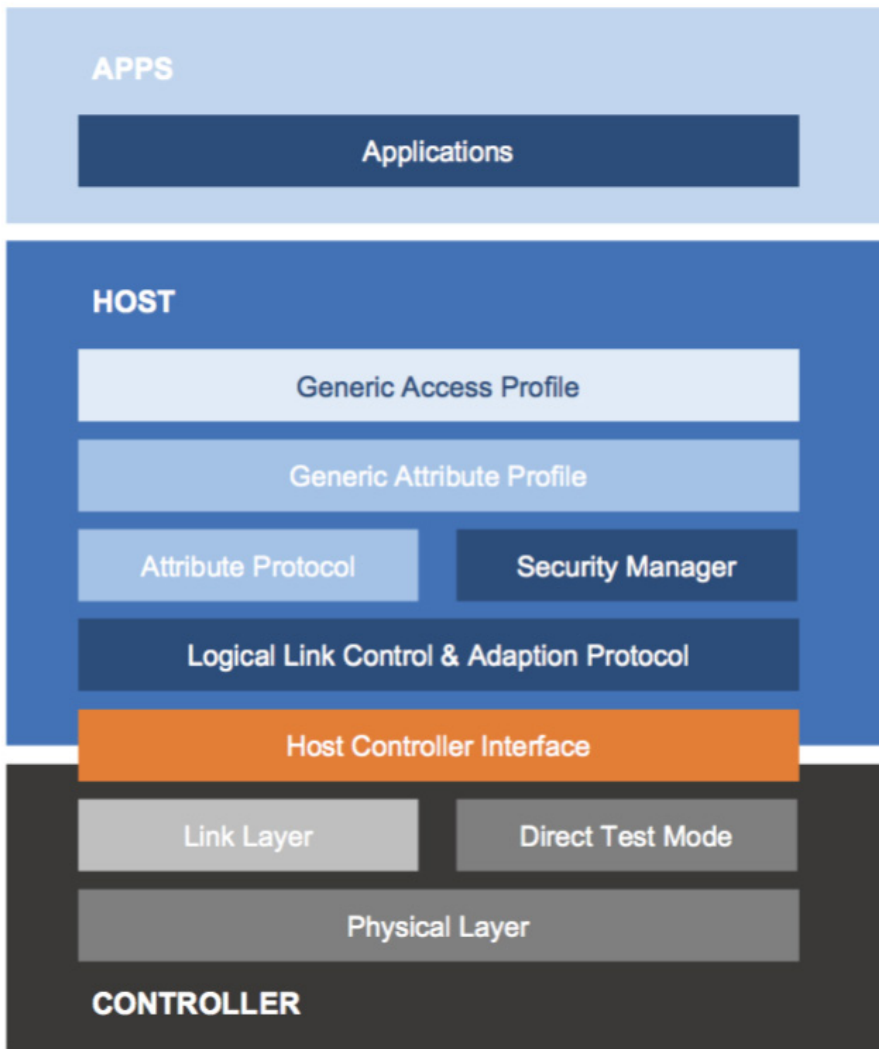
Healthcare has traditionally been practiced in hospitals and private clinics, requiring patients to travel significant distances and delaying treatment. Wearable health technology promises to flip that on its head by enabling "telemedicine" - the administration of healthcare beyond clinical settings, to reach patients whether they're at home, at work, or on the go.

Telemedicine enabled by wearable medical technology has the potential improve both inpatient and outpatient care. For instance, wearables have the potential to

allow hospitals to focus resources on urgent care, as less serious ailments can be diagnosed, and in some cases even treated, remotely with the help of wearable medical devices.

Wearable health monitors can also let patients with more serious ailments shorten their hospital stays and go home earlier while staying monitored around the clock, thus freeing up beds and staff for other patients.

Wearable medical devices can help chronic disease sufferers manage and monitor their condition, and easily share their health information with their physician. Wearable medical devices can also provide convenient and economic



**Contact geometry, orientation, and placement in the insulator can improve signal integrity performance and life cycle**

access to healthcare services to poor, underserved communities, the disabled, and the mobility challenged.

Beyond improving the lives of those with diagnosed diseases, wearables can be used for preventative medicine. The next generation of fitness and health trackers may not just monitor your physical activity, but signs of impending illness to help you fend off serious health issues before they occur.

**Smarter Healthcare with Bluetooth Low Energy**

The most important wireless protocol for medical wearables to have today is indisputably Bluetooth Smart, also known as Bluetooth Low Energy.

Despite its name, Bluetooth Smart is quite different from regular Bluetooth. Whereas Bluetooth classic was designed to stream data to and from peripherals such as headphones, microphones

or keyboards, Bluetooth Smart was designed to be an extremely power-efficient protocol for transmitting short bursts of data from battery powered devices used in metering, monitoring, and sensing applications. That makes it the perfect wireless protocol for wearable medical devices.

Bluetooth Smart uses a different physical and link layer than Bluetooth Classic, but as part of the Bluetooth standard, all smartphones compatible with Bluetooth 4.0 and up are also compatible with Bluetooth Smart.

Bluetooth Smart also allows medical wearables to take advantage of the cellular connectivity, GPS location awareness, and powerful processing capabilities of a smartphone to supplement the device's own capabilities.

A wearable health monitor can, for instance, share sensor data with a smartphone over Bluetooth Smart. The user can then open up the device's healthcare app and view his vital signs. The user's raw health data could also be cross checked against an online database to alert them of signs they are at risk of preventable diseases. That same data could be easily shared with caregivers or loved ones.

As a wireless protocol, Bluetooth Smart has been designed to be optimized for the short, bursty messages characteristic of IoT and wearable devices. Connections can be opened and closed extremely quickly, and message transmission times are short. While Bluetooth Classic connections take hundreds of milliseconds or more, Bluetooth Smart devices can establish a



connection, transmit a message, and close the connection in tens of milliseconds. This fast messaging doesn't just make for responsive devices, but also helps Bluetooth Smart minimize power consumption by maximizing the time the radio is turned off. Combined with a peak transmit power of about 15mA, this allows extremely efficient power usage, and there are Bluetooth Smart devices which can last months or even years off coin cell batteries.

Security is essential for medical applications and Bluetooth Smart doesn't disappoint. It uses robust, 128-bit AES-CCM encryption, and Elliptic curve Diffie-Hellman key generation for protection against eavesdropping.

Implementing Bluetooth Smart can be done using network processors, HCI modules, or SoC chips. Network processors, also known as connectivity ICs, are Bluetooth radio modules with low power MCUs which implement the Bluetooth stack, minimizing the load on the host processor. This makes them appropriate for devices with a low power MCU.

HCI modules are bare-bones Bluetooth radio modules which implement physical and link layer, and rely on the host system to implement the upper layers of the Bluetooth stack. HCI modules are appropriate for devices which have a powerful host processor with the resources to run the Bluetooth stack in addition to application logic.

SoC chips combine Bluetooth radios with relatively powerful MCUs which can run the entire Bluetooth stack along with application logic all on the same chip. These can range in their

processing capability. For instance, the Nordic nRF51822 uses an ultra-low-power consumption ARM Cortex M0 core for maximum power efficiency, while the nRF52832 has a Cortex M4 to support a broader variety of applications. For a majority of wearable applications, an SoC design will provide the best power efficiency, ease of integration and development cost. As a single chip design, SoC devices also lend themselves to small form factor, thin and light wearables.

With its ultra-low power consumption, widespread compatibility, and ease of implementation using SoC modules, it's no wonder Bluetooth Smart is the number one wireless protocol for wearable devices today.

## NFC

While Bluetooth Smart is undeniably important for wearables, it's not the only game in town. Near-Field Communication(NFC) plays an important role as another, often complementary wireless communication protocol.

Unlike Bluetooth which allows devices up to 30 feet away to connect, NFC requires devices to be within 10cm or even less - practically touching. On the surface, NFC's limited range seems like a drawback, but in fact it's key to its success.

By requiring devices to be in extremely close proximity, NFC inherently makes sure that the right devices are connected. Whereas Bluetooth has a complicated pairing process involving selecting the right device and entering passcodes, NFC connections are "tap and go". Users simply tap the devices together

and a connection is automatically established, messages transmitted, and the connection closed.

The quick and intuitive usage of NFC makes it particularly attractive for elderly populations as well as hospital staff, as it means equipment can be deployed with minimal training.

The quick tap and go connections used by NFC are also well suited for clinical settings where multiple devices might need to be read by a centralized smartphone or other NFC reader. With Bluetooth, a connection would have to be manually setup for each separate device sequentially, but with NFC, each device is simply tapped as it needs to be read, without having to wade through a list of possibly dozens of devices in the vicinity.

NFC's other main draw is its extremely attractive power consumption characteristics. NFC devices can often be passively powered - meaning the NFC device is powered by the RF field generated by the NFC reader. The amount of power generated is small, with a typical figure of 4mA at 3.3V, but it's enough to power simple sensor readings.

Without the need for a battery, incredibly small and thin form factors can be made, making NFC an ideal technology for skin patch sensors, implantables, or clothing. Because of its need for close proximity between devices, NFC provides a basic yet effective form of physical security and authentication, and greatly reduces the possibility of Man-in-the-Middle attacks. Like Bluetooth Smart, NFC also supports AES encryption, and Diffie-Hellman key exchange if an additional level

of security is required. NFC is a powerful technology when used on its own, but also works well in conjunction with other wireless technologies. Multiradio modules with both Bluetooth and NFC, for instance, can take advantage of Bluetooth Out of Band pairing where the device uses NFC to establish a secure Bluetooth connection using physical proximity. Users get the best of both worlds - the tap-to-connect security and convenience of NFC, with the range and continuous connectivity of Bluetooth.

### Wearable Medicine

The potential of wearable medical devices is only just being realized. These devices have the power to move the centre of healthcare

from the hospital to the home, potentially improving the lives of the elderly, chronically ill, and underserved populations such as the poor or disabled. Wearables also have the potential to improve the efficiency of hospitals, as well as help diagnose preventable diseases early on, before they transform into serious illnesses.

At the centre of the medical wearable revolution are two key technologies - Bluetooth Smart, and NFC. Bluetooth Smart provides an extremely low power consumption technology with widespread smartphone compatibility, while NFC is an extremely user-friendly technology that enables incredibly thin and light form factors and batteryless designs. Each of these

wireless technologies has its own advantages for the current and coming wave of medical wearables.



**Mark joined Mouser Electronics in July 2014 having previously held senior marketing roles at RS Components. Prior to RS, Mark spent 8 years at Texas Instruments in Applications Support and Technical Sales roles and holds a first class Honours Degree in Electronic Engineering from Coventry University.**

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## SMART HEALTH - DIAGNOSTICS

Photonics-on-chip allows doctors to dream of ultra-small spectrometers, cytometers and microscopes

### > IMEC

**If you can produce small structures on a chip that can handle light, then suddenly all sorts of things become possible. For instance, a whole range of devices are used in medicine that examine cells, molecules and fibers with the help of fluorescent light. And now, thanks to photonics-on-chip, mini-versions of those same large devices can also be produced.**

#### What is biophotonics-on-chip?

Chances are, you use photonics every day without even realizing it: glass fibers enable you to use

a computer or watch television without any problems. With the help of light, these glass fibers send data much more quickly and power efficient than with traditional digital cables.

You can also do the same thing on a chip. Using ultra-small 'fibers' and structures, you can direct light on to a chip and carry out a whole range of tasks. Those tasks can involve processing or sending data, but biological tasks are also possible. In fact, light is the most frequently used medium in medical diagnostics – just think of microscopes and spectrometers. Light enables you to count or visualize cells, measure the properties of materials and tissue,

define a DNA sequence, etc.

Biophotonics-on-chip is a fairly recent area of research that is becoming very important in the medical sector for diagnosis, treatment and follow-up. Doctors will soon be able to use the technology to analyze a blood sample without bulky (fluorescence) microscopes, as well as examine a tissue sample without large spectrometers.

It is quite a challenge to make photonic structures very small and then combine them into a photonic circuit capable of carrying out a specific task with great efficiency and reliability. If you produce structures using silicon, such as computer chips, or based on silicon-



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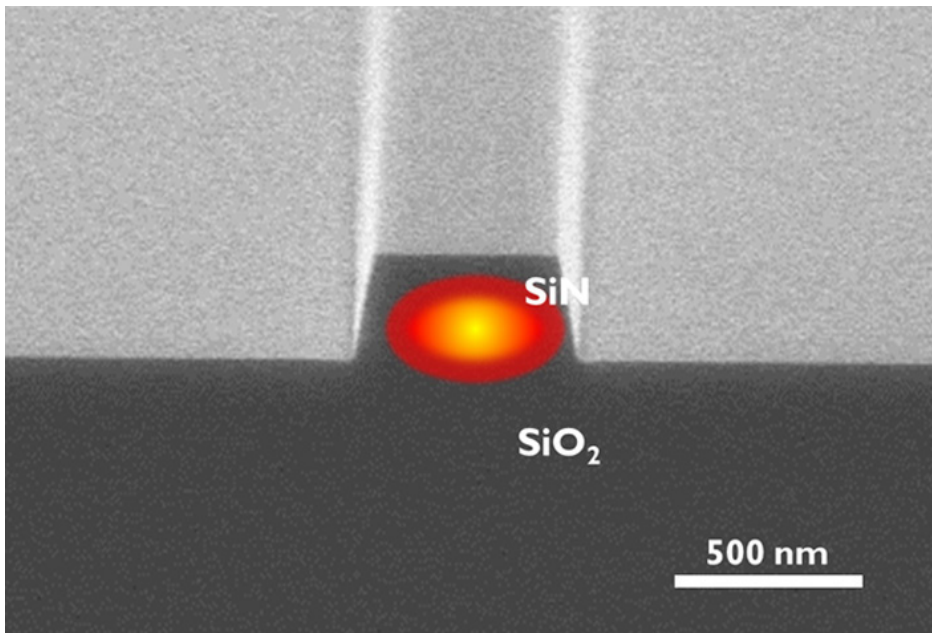
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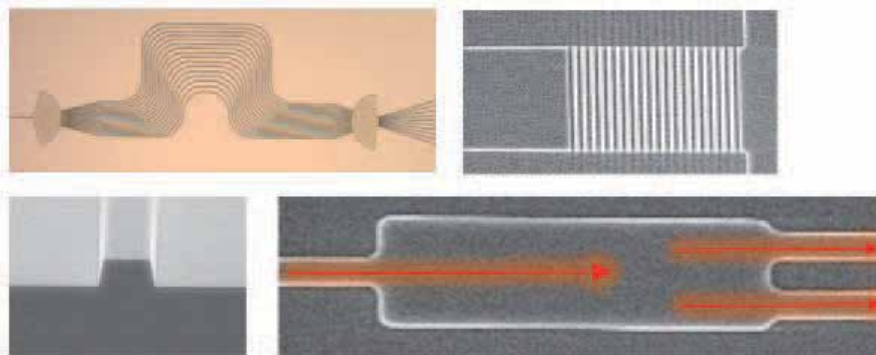


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**Figure 1: Small 'fibers' of silicon nitride (SiN) are produced on top of a silicon chip. These waveguides direct the light along a well-defined path over the chip and along detection sites**



**Figure 2: Some of the photonic components made by imec: spectrometer, fiber waveguide, waveguide and multi-mode interferometer**

compatible materials (SiN), you can incorporate electronic and photonic functions, creating a smart and compact system. And if you can do that, you can easily make hundreds and thousands of systems function alongside each other at the same

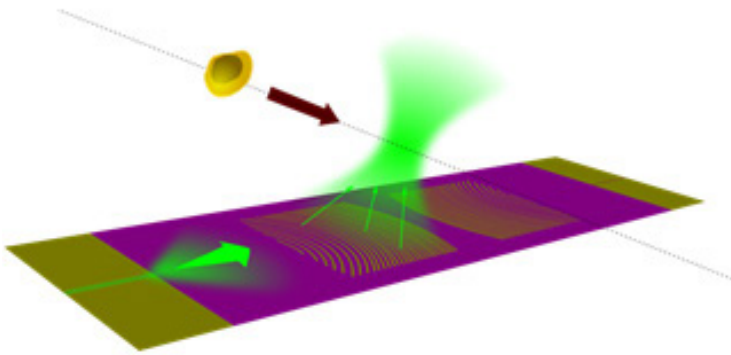
time, which means you'll also get the result much faster than with a single system on its own. Thanks to biophotonics-on-chip we will soon have small, cheap test chips that will assist doctors in their decisions.

## Counting and viewing cells

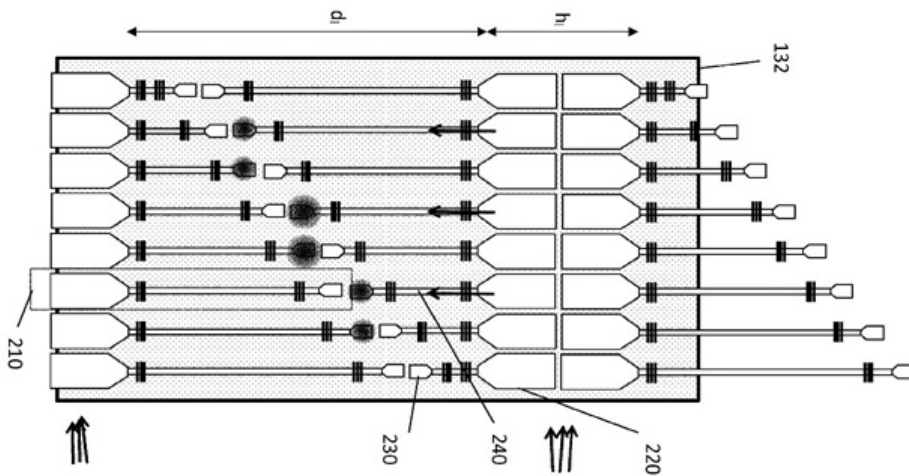
Fluorescent labels are often used to analyze a blood sample in the traditional way. These labels are in fact molecules that bind specifically with, for example, (parts of) a bacterium, gene, cancer cell, etc. Using a cytometer, the blood sample and hence also the labels are illuminated, making them radiate fluorescent light that can be detected. This enables the number of bacteria and cancer cells to be counted or the presence of a specific gene or DNA sample to be determined.

Usually, cytometers are very large and expensive devices that are used in medical laboratories. Imec is developing more compact solutions: cytometers on a chip. In these chips, the cells flow in a microfluidic channel and there are structures above and/or below this channel for identifying and counting specific cells – for example cells with a fluorescent label.

A recent development in this area is a photonic structure called a 'focus-ing grating coupler'. A grating coupler is usually used to couple the light coming from a laser (which shines on the chip) in the waveguide paths on the chip and to shine the light coming out of the waveguides back from the chip (e.g. to a detector that is not integrated on a chip). In the new development, the focusing grating coupler allows light, moving in a waveguide, to shine outward from the surface, to create an upward beam of light on top of the chip. The microfluidic channel that the cells flow along runs through this light beam. In this way, the cells with fluo-rescent



**Figure 3: Focusing grating couplers can send the light in waveguides outward from the surface, enabling them to efficiently illuminate the cells in the microfluidic channel located above**



**Figure 4: Design of the Raman spectrometer on chip**

labels are illuminated, after which they emit fluorescent light. This fluorescent light is captured by the 'diffraction gratings', which sort the light by wavelength. As a result, various fluorescent labels can be detected at the same time. This is a very good example of how compact photonic chips can be used to count cells, even different types of cells (with different fluorescent labels) at the same time. The big advantage

of this approach is not so much that the cell can be optically detected, but that hundreds of these structures can work in parallel, having a huge impact on the throughput of these measurements. Not only is it of value for counting cells, but it is also good for looking at the morphology of the cells. Here again imec has developed an inte-grated solution: the lens-free microscope.

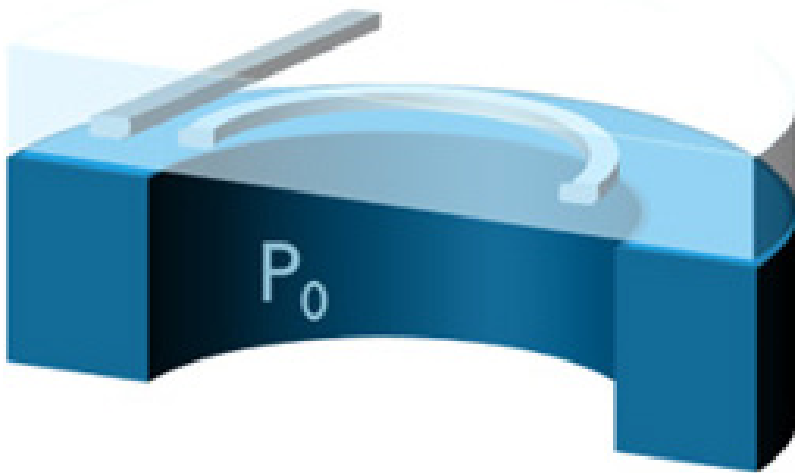
### Spectroscopy in miniature

Spectroscopy is used in medicine to detect certain substances in tissue, skin or areas of the brain, such as cholesterol, lactic acid and ethanol. Melamine in milk, phthalate in toys, contamination in meat or the authenticity of medical drugs can also be detected with spectroscopy. The substances are detected by their specific interaction with wavelengths of light.

There are many forms of spectroscopy, including absorption, reflection, fluorescence and Raman spectroscopy. Imec is aiming to develop a mini-version of the Raman spectrometer on a chip. This would enable a compact little device to be produced for measuring specific substances in a blood sample regularly and non-invasively. This is not possible with existing desktop Raman spectrometers.

The major challenge in developing a Raman spectrometer is balancing the very small usable signal against the large background signal. That's why the detector has to be very





**Figure 5: For its photoacoustic sensor-on-chip, imec uses a membrane with integrated waveguide. When the membrane is moved by a sound wave, the waveguide is stretched and this movement can be recorded**



**Figure 6: Once it becomes possible to miniaturize spectrometers and photoacoustic sensors, the chip may be integrated in a pen like the one in the drawing. The doctor can then use the pen to scan the patient's skin looking for disorders**

sensitive. One of the best-known spectrometer designs is the Michelson interferometer. A beam of light is divided into two beams that take different paths before coming together and interfering. This enables tiny differences in the wavelength to be measured. The disadvantage of this design – particularly if you want to miniaturize it – is that two mirrors are used, one of which moves. Unless the moving mirror is in absolutely the correct position, the measurement is incorrect.

Imec has developed a (patented) solution with no moving parts in which hundreds of structures – interferometers – are used next to each other. Light is shone on the tissue and the scattered light is collected by a collimator. This divides the light – with the help of a beam-shaper – across the various interferometers. Each interferometer is a little smaller than the previous one so that tiny differences in wavelengths can also be measured, as is the case with the Michelson interferometer.

### **A hypersensitive sensor based on light & sound**

Photoacoustics is a fast, relative cheap and harmless way of producing images of the human body. It can be used, for example, in research into skin and breast cancer.

The photoacoustic effect was discovered in 1880 by Alexander Graham Bell, the inventor of the telephone. He illuminated a block of selenium, which created a weak sound (hence photo = light and acoustics = sound). In fact, light and





## INTERCONNECT DESIGN CONSIDERATIONS FOR INDUSTRIAL APPLICATIONS

› **Danny Boesing, Samtec**

Designers in the telecommunications, high-performance computing, and medical industries face ever-changing electrical and mechanical interconnect requirements. These industries are driven by increasing data rates, denser systems, and shrinking product footprints.

Fortunately for designers in other sectors, like industrial, motion control, and some military applications, interconnect requirements do not change as quickly. Reasons for this include longer product life cycles, lighter bandwidth requirements, and designers do not face constant pressure to reduce product size, among other reasons.

Designers in industrial markets are generally not too concerned with high-speed interconnects. Ethernet is usually the maximum bandwidth

requirement.

Many industrial OEM designers use the word “rugged” to describe their board-level interconnect needs. While “rugged” can mean different things to different people, it usually includes the ability to withstand high shock and vibration applications, maintain mechanical and electrical integrity after exposure to harsh environments and after high mating cycles, and provide EMI shielding attributes, to name a few.

Several design elements contribute to a connector being called “rugged,” including the contact design, plating, and insulator design.

### INSULATOR DESIGN

Examples of plastic insulator design features that are popular with industrial product designers include:

- Board locks on connectors that mechanically lock two PCBs together.
- Positive latching systems on discrete wire and IDC cable systems. Manually activated latches can increase unmating force by up to 200%.
- Screw downs which secure the connector mechanically to the board.
- Weld tabs, which significantly increase shear resistance of the connector to the PCB.
- Dust and water protection are often a concern; IP ratings such as IP67 and 68 are frequently required. Space does not allow us to discuss the innumerable insulator design permutations such as insulator material, heat deflection temperature, maximum processing temp, RoHS compliance, or dielectric



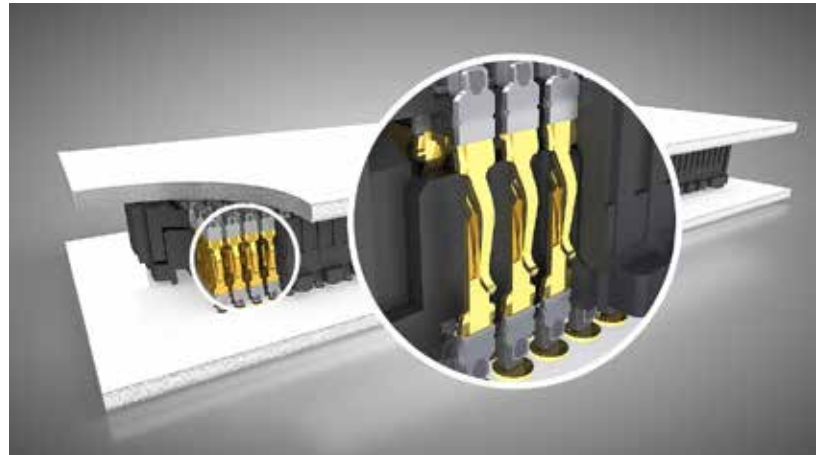
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**Rugged design features can make micro pitch interconnects rugged by incorporating BeCu contacts, weld tabs, latches, and locks**



**Contact geometry, orientation, and placement in the insulator can improve signal integrity performance and life cycle**

strength, among countless other considerations.

### CONTACT DESIGN

We will limit our brief discussion to contact base materials and design for rugged applications. Common base metals include brass, phosphor bronze, and beryllium copper.

■ Brass is the least expensive of the three metals and has excellent electrical properties. Having said that, Samtec recommends not using brass in contacts (receptacles) in a working beam because it could fail due to low yield strengths.

■ Phosphor bronze is stronger than brass and has better spring properties. It is excellent for contacts that have relatively few mating cycles and low contact flexure.

■ Beryllium copper (BeCu), while more expensive than most contact materials, provides the best combination of mechanical and electrical properties. Once formed and hardened, BeCu will retain its shape under a wide variety of conditions.

At Samtec, two contact systems are most popular for industrial

applications. First is a multi-finger, heat-treated BeCu system contact. This is commonly used in 1.27 and 2.00 mm pitch systems. Although these are micro interconnects systems, the contact is designed for rugged environments. For example, a slot in the tail allows more surface area for solder adhesion. Also, connectors with micro tail slots tend to adhere to the wet solder paste prior to reflow better than flat leads. All of this increases the mechanical strength of the connector to the PCB. Also notice the slot in the transition area between the gull-wing tail and the contact. This slot, while seldom needed, is designed to prevent solder wicking. While wicking is rare in SMT applications because of the limited amount of solder, if it should occur, the slot disrupts the capillary action so the solder does not migrate into the contact area.

Second is a dual wipe, phosphor bronze tuning fork design. This design is popular in rugged applications because of the contact geometry. Specifically, the length of the two mating beams (fingers) allows firm, consistent normal forces, and is less

likely to take a permanent set after exposure to numerous cycles.

### BANDWIDTH

While system speed is not a concern for most industrial OEM designers, for some it may become a concern in the future. Industrial Ethernet is usually the maximum bandwidth requirement.

Contact systems can be designed to meet both rugged and higher bandwidth requirements. One popular design incorporates BeCu to maximize spring properties, while the contact geometry and orientation in the insulator optimizes signal integrity. Specifically, the surface of the contact is milled, creating a smooth mating surface area instead of a stamped contact that mates on a cut edge. This smooth mating surface reduces the wear tracks on the contact increasing the durability and cycle life of the contact system. It also lowers insertion and withdrawal forces allowing the connectors to be zippered when unmating.

The contacts are positioned in the plastic insulator so the narrow edges of the pins are parallel to each other.



**Multi-finger,  
heat treated  
BeCu contact  
for high cycle,  
high reliability  
applications**



**Phosphor  
Bronze,  
long-beam  
contact for  
shock and  
vibration  
applications**

This minimizes the parallel surface area reducing broadside coupling and crosstalk.

### PLATING

Designers frequently ask what plating finish we recommend. The best plating finish is whatever material meets your requirements at the lowest cost. Gold is generally specified for high cycle and high reliability applications, or in low voltage or low current applications. Even in very hostile environments, it will remain free of oxides which could cause an increase in contact resistance.

Tin is a lower cost alternative and has excellent solderability. It is used in connector systems where fewer cycles are expected. Tin is also used in high normal force contacts which

cause sufficient wiping action during lead insertion to help break the tin oxide surface film.

Selective gold-tin plating is Samtec's most popular plating option because it provides designers with the best of both worlds. The critical contact area has the reliability of gold, and the tail has the lower cost and solderability of tin.

In conclusion, interconnect systems do not meet industrial performance requirements by chance. The connector insulator, contact system, and rugged features must allow it to withstand high mating cycles, high reliability, and harsh environment applications. Also, rugged contacts and insulators, often on a smaller centerline, are designed to meet higher bandwidth requirements.

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## Copper vs. Fiber: Which Cable Do You Need?

› Brian Shuman, Belden, Inc.

Engineers strive for maximum productivity with minimal downtime, but this goal is only attainable with the right network infrastructure. No matter the industry, if a team doesn't have the right cabling system in place, network reliability and performance can be compromised, leading to very costly production downtime.

This is why investing in high-quality, rugged cabling is crucial – it can reduce both the direct and indirect costs of network failure and give you peace-of-mind that the system is working properly. There are a variety of cabling options out there, so how do teams know they have the right one to support their specific infrastructure and network requirements? Deciphering whether you need fiber or copper cabling is a great place to start.

### **Copper cables: The classic cabling mix**

Copper cabling is the traditional option in industrial installations and is best suited for the majority of industrial data transmission needs. Copper cables come in a variety of forms, including Cat 5e, Cat 6 and Cat 6a twisted pair cables using any number of conductor types, insulations, shielding and jackets. Armoring is also available for extremely harsh environments.

Cat 5e cables are the most widely used copper cables today, but new installations favor the use of Cat 6 cables to meet required Gigabit speeds and increased headroom. Cat 6a cables are also an option for extreme future-proofing, minimizing the lack of bandwidth and headroom.

Teams must be careful when using copper cabling as it can stimulate potential failure points due to ingress from electrical noise, as also known

as, electro-magnetic or radio frequency interference. In light of this risk, these cables can also limit bandwidth capacity and signal transmission at extended distances.

### **Fiber optic cables: The ultimate for future-proofing**

Fiber optic cabling is ideal for industrial environments where high-speed, high-bandwidth data solutions are needed. Because fiber optic cables are typically superior in bandwidth, low attenuation and complete electrical noise immunity, more information can be carried across the network without interruption. They are also smaller and lighter than copper cables, extremely durable and intrinsically safe, with no risk of spark hazards.

Fiber optic Ethernet cables are available for both indoor and outdoor use, including situations where cables need to be buried underground. For example,

fiber optic cabling is great for campus and in-building data backbones because they can anchor to an operation's Ethernet, and also for point-to-point digital signal transmission.

Other important considerations for fiber optic cables include:

■ Typical designs for fiber optic cables consist of multimode fibers in a loose tube configuration, commonly available in two to 72 fiber constructions.

■ To handle gigabit Ethernet light sources and any expanded bandwidth requirements, some cables use a laser-optimized fiber.

■ A basic commercial off-the-shelf (COTS) fiber optic cable will likely not withstand industrial conditions given it is intended for enterprise applications. A fiber optic cable that is designed with ruggedized features to operate in industrial settings is needed.

■ In particularly harsh environments, a chlorinated polyethylene (CPE) outer jacket will provide additional protection against chemicals or abrasion. An armor tape or aluminum/steel interlocked armoring may also be appropriate for extreme environments.

■ For moisture protection, a water-blocking agent should be included in the cable construction.

■ Look for fiber optic cabling with key industry ratings, including IEEE 1202-2006 for flame test and Underwriters Laboratories (UL) ratings for optical fiber, non-conductive riser (OFNR).

### The four questions to ask for copper cables

Once teams understand whether they need copper or fiber cabling, it's important to consider several physical components and surroundings of the cabling system. There are four questions engineers need to ask themselves when faced with a purchasing decision:

1. Should my cable be shielded or unshielded? Unshielded products can be used in most environments, while

shielded products are recommended for environments with high noise. A foil is typically used to protect the integrity of the signal and screen out any undesirable interference or noise. To provide extra durability and protection against noise, a foil/braid combination should be used.

2. Should my conductors be solid or stranded? Solid conductors are appropriate for most installations, while stranded conductors provide extra flexibility for handling smaller spaces, such as robotic or continuous flex applications.

3. Should I go with bonded or non-bonded cables? Bonded-pair cables provide resistance to the rigors of installation by utilizing a manufacturing technique that affixes the insulation of the cable pairs along their longitudinal axes so that no gaps can develop between the conductor pairs. A non-bonded pair cable construction can be susceptible to pair-gapping during installation, which results in impedance mismatches.

4. What insulation material should my cable employ? It depends on the application scenario. Most industrial-grade Ethernet cables utilize a polyolefin insulation. For extreme temperatures, a fluorinated ethylene propylene (FEP) insulation and jacket are recommended for extended operating temperatures of -70° C to +150° C.

■ For oil- and sunlight-resistant cables, polyvinyl chloride (PVC) jackets are typically used. If the cables are exposed to moisture, a water-blocking agent should be part of the cable's construction, as well as inner and outer polyethylene (PE) jackets if the cable is buried.

■ Gas resistance cables call for FEP jackets, while low-smoke zero-halogen (LSZH) jackets are available for environments where acidic smoke and flames are a key risk. This helps avoid smoke toxicity.

■ For continuous flexing or robotic applications, cables with thermoplastic elastomer (TPE) inner and outer jackets are recommended due to the risks and complications involved with caterpillar track (c-track) installation.

Knowing whether you need copper or fiber optic cables and understanding the physical cabling components critical to the success of your application are the first steps in ensuring optimal performance in the face of demanding environments.

During the product selection process, it is very important to take the time to evaluate the marketplace and select top-quality, end-to-end cabling that can withstand tough environmental conditions and also fit with your specific application needs.

Taking this kind of total system approach will result in a more integrated system with all products seamlessly matched to deliver tremendous interoperability and consistently reliable performance every day.

For more on comparing copper vs. fiber cabling, download this free white paper "The Case for Specifying Industrial Ethernet Cable for Harsh Environments."

**Brian Shuman is a senior product development engineering project manager at the Belden Engineer Center in Richmond, Indiana. He has responsibilities in the design, development, testing and technical customer support for copper cables. He is the vice-chair of the ODVA EtherNet/IP Physical Layer Special Interest Group. Additionally, he represents Belden in the TIA TR-42.9 Industrial Telecommunications Infrastructure subcommittee. He is a Registered Communication Distribution Designer through BICSI and a member of IEEE. Shuman earned a B.S.E.E. from Purdue University.**





## Vision C5 DSP for Standalone Neural Network Processing

> Paul McLellan, Cadence

I pointed out recently that although *La La Land* is a romance, the movie opens with cars. The semiconductor industry is like that, too—no matter which way you turn it is automotive. It may not show yet in manufacturing volume and revenue, since it is about 10% of the market. However, the newer parts of automotive, those associated with autonomous driving, have ~30% growth rates (which is close to doubling every two years, by the rule of 70). There are several really big changes, such as automotive Ethernet or security, which I won't discuss today. But probably the biggest change is the need for vision processing.

There are two separate reasons that this is such a big change. Firstly, vision processing has to be done on-vehicle. The amounts of data are insanely large, too large to

upload to the cloud for processing. But more fundamentally, a vehicle cannot require network connectivity to decide whether a light is green or red, or whether that thing ahead is a pedestrian or a mailbox. This is a level of computation that cars have never required before, so is a challenge for the automotive semiconductor ecosystem. The traditional suppliers don't understand high-performance processors and leading-edge processes. The mobile semiconductor ecosystem does, but it doesn't understand automotive reliability and only recently heard the magic number 26262.

(For more on ISO 26262, see my recent post "The Safest Train Is One That Never Leaves the Station". For an introduction to convolutional neural nets (CNN), see *Why is Google So Good at Recognizing Cats?*. Also,

last year Cadence ran a seminar in Vegas that I wrote up in a full week of posts here, starting on Monday with *Power Efficient Recognition Systems for Embedded Applications*.)

The second change is with vision processing itself. If you go back only a few years, vision processing was algorithmic, with the focus of research on edge-detection algorithms, building 3D models from 2D data, and so on. Now the whole field has switched to convolutional neural nets (CNN). But it is not just vision processing that has gone neural, a lot of the decision processing has, too. Arguably, vision processing has advanced more in the last two to three years than since...cue dramatic music...the dawn of time.

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## The standard for the Internet of Manufacturing (IoM) has arrived!



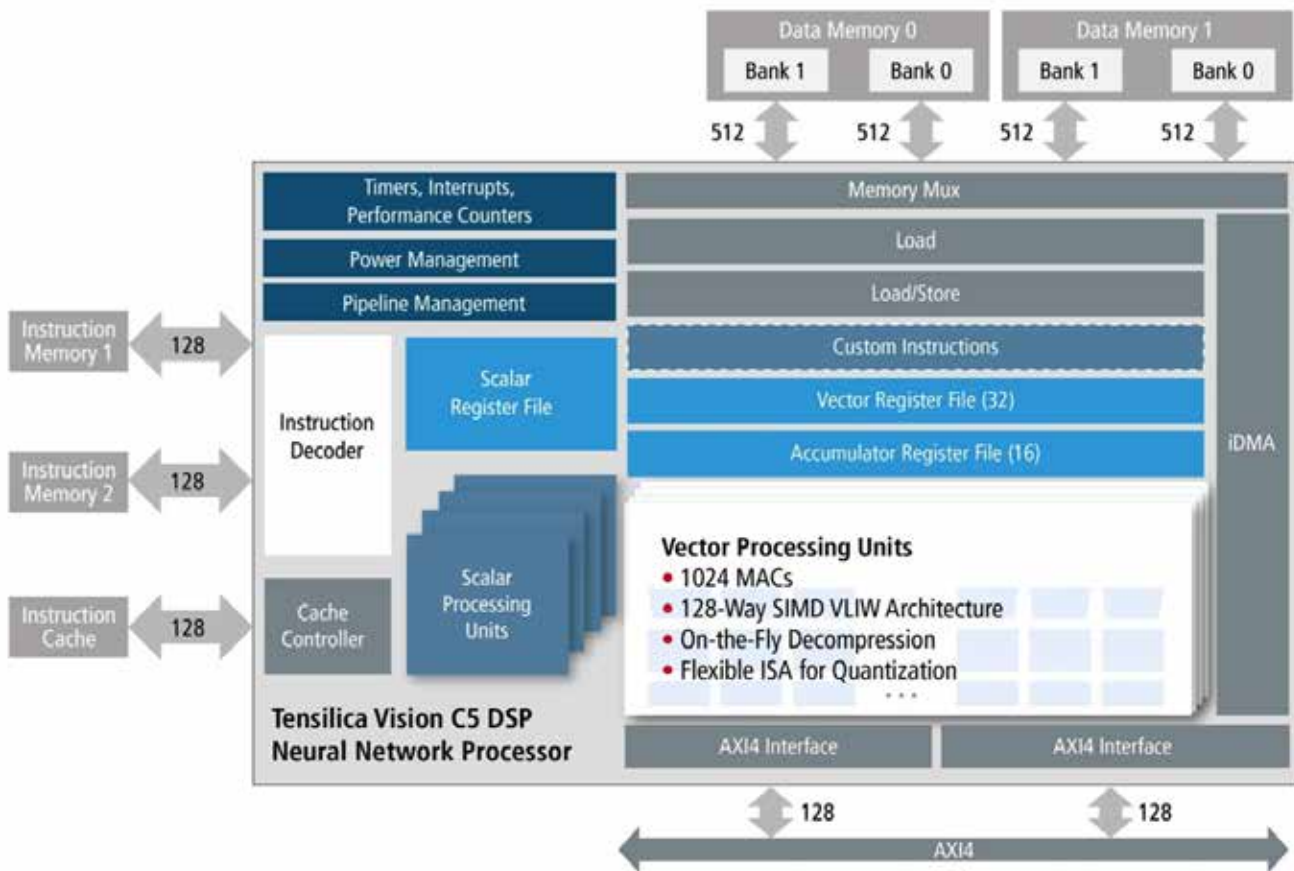
The Open Manufacturing Language (OML) is a real-time communication standard for PCBA manufacturing that defines the interconnectivity of assembly production processes and enterprise IT systems.

For the first time, IT teams, solution providers, and equipment providers can easily integrate shop-floor data to create manufacturing execution solutions based on a single, normalized, vendor-neutral communication interface.

## Take part in shaping the future!

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is the start of this year's Embedded Vision Summit, and will run at the Santa Clara Convention Center until May 3. For details, click on the logo to the right. If you are going, I will see you there.

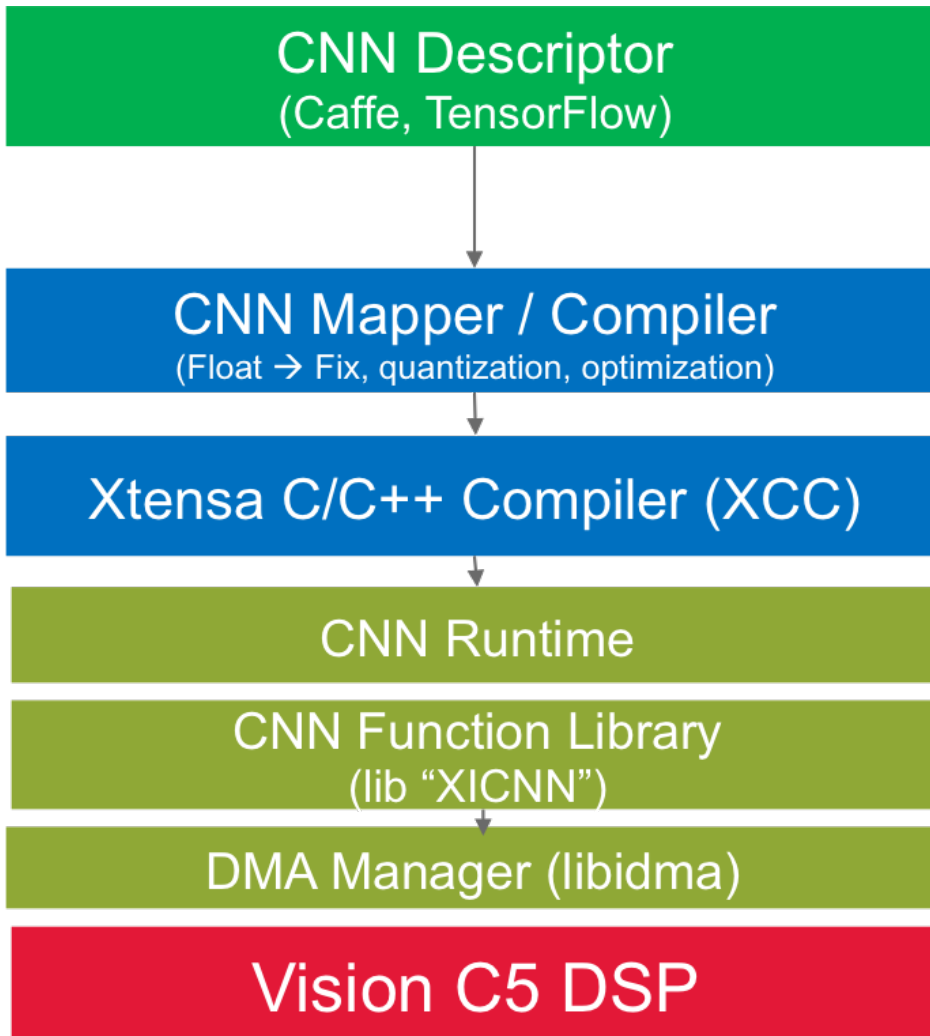
Over the past five years, the summit has grown from a small meet-up to a must-attend industry event with 80 speakers, 50 exhibitors, and over 1,000 attendees. Those numbers are an indication of the growing interest and importance of vision. Their tagline says why. It is "the event for innovators who want to bring visual intelligence into products." These technologies will revolutionize transportation, but also lead to things like security cameras that can tell the difference between your kids fighting and a thief, or drones that can follow you skiing through the trees.

### Tensilica Vision C5 DSP for Neural Network Processing

It has been said that the only predictable thing about the British weather is its unpredictability. Well, the only predictable things about neural networks is that they will change. Obviously the highest performance per watt comes from designing with RTL (or perhaps even gates). But this is also the least amenable to change. The easiest to change is pure software, just run neural network code on the main CPU. But that has no chance of achieving either the performance or the power budget. A specialized programmable neural network processor is the Goldilocks level, neither too not nor too cold, programmable but high performance per watt.

To give you an idea of just how fast things are changing, in 2012 AlexNet was the best recognition system requiring 724M MACS/image. Today, RESNET-152 requires over 11B (and, of course, gets better results from all that work). But that highlights a big challenge for people designing products today: how to pick an inference platform in 2017 for a product shipping in 2019 and perhaps for several years afterwards. It has to have all three of high performance, low power, and programmability. Picking any two of the three is easy, but they all work against each other, so hitting the sweet spot requires a core designed to do all three.

Today, Cadence is announcing just that, the newest member of the Tensilica family, the Vision C5, which is a neural network DSP. It



is targeted at vision, lidar, voice, and radar applications in the mobile, surveillance, automotive, drone, and wearable markets. It has a computational capacity of 1TeraMAC/s (trillion multiply-accumulate operations per second). It is not an accelerator, it is a standalone self-contained neural network DSP. This is important since accelerators only handle part of the problem, requiring a lot of processing power on whatever other processor is in use to do the rest. For example, they may only handle the convolutional (first) step of a CNN, which in addition to only partially offloading the computation, means that a lot of bandwidth is going to be

used shifting data back and forth. The Vision C5 DSP completely offloads all the processing and minimizes the data movement, where much of the power is actually consumed. Typically, neural network applications are divided into two phases, training and inference. The training is normally done in the cloud and requires processing large sets of data requiring 1016 to 1022 MACs per dataset. Inference usually runs closer to the edge of the network, in the drone or car for example. Each image requires 108 to 1012 MACs. The biggest issue, though, is power. It is this inference phase of using neural networks where the Vision C5 DSP is focused.

vision c5 dsp block diagram  
The Vision C5 DSP neural network processor is:

A complete, standalone DSP that runs all layers of CNN (convolution, fully connected, normalization, pooling...)

A DSP for the fast-changing neural network field: programmable and future-proof

Performance of 1 TMAC/s (trillion multiply-accumulates per second)

1024 8-bit MACs or 512 16-bit MACs for exceptional performance at both resolutions

128-way, 8-bit SIMD or 64-way, 16-bit SIMD VLIW architecture

Not a hardware accelerator to pair with a vision DSP, rather a dedicated neural network optimized processor

Architected for multi-processor design—scales to multi-TMAC/s solutions

Same proven software tool set as the Vision P5 and P6 DSPs

<1mm<sup>2</sup> in 16nm

vision c5 software flow  
Wonderful hardware is not a lot of use if it is too difficult to program. There are standard open-source CNN frameworks such as Caffe and TensorFlow that are the most common way to develop in the space. These flow cleanly into the CNN mapper and then all the way down to the Vision C5 DSP.

### Summary

The Vision C5 is targeted at high-performance CNN applications that require TMAC/s operation. For lower performance, such as the neural nets that are occasionally required in mobile, the Vision P6 DSP is more appropriate, with a performance of up to 200 GMAC/s. For the most demanding applications, multicore versions of the Vision C5 DSP fit the bill.



## Going batteryless: How to create the next generation of industrial and IoT devices

### > Scott Soong, Pervasive Displays

Embedded vision summit badgeToday Given that many Internet of Things (IoT) implementations seek to remotely deploy large numbers of devices, one of the biggest challenges is power. With mains often unavailable, the IoT devices must run off batteries and use as little power as possible. But even this is imperfect: batteries eventually run out and must be replaced or recharged. There's also the complexity of needing to monitor charge levels, to avoid downtime caused by dead batteries.

What if it was possible to eliminate these challenges, and create a way of perpetually powering IoT devices? It may sound like the stuff of sci-fi, but there are now ways of harvesting energy that are sufficient to power a useful IoT device. Toppan Printing Co. Ltd., for example, recently

announced its batteryless e-paper display (EPD) with a built-in RFID tag – all powered using harvested RF energy.

By designing the device correctly and using the right energy-harvesting method, it's perfectly feasible to create batteryless devices that can run near-enough forever. For those buying and deploying these devices, the overheads associated with maintaining a large fleet of battery-powered devices are eliminated.

Let's look at the IoT power challenge – and how to solve it – in more detail.

#### **The problem with battery-powered devices in the IoT age**

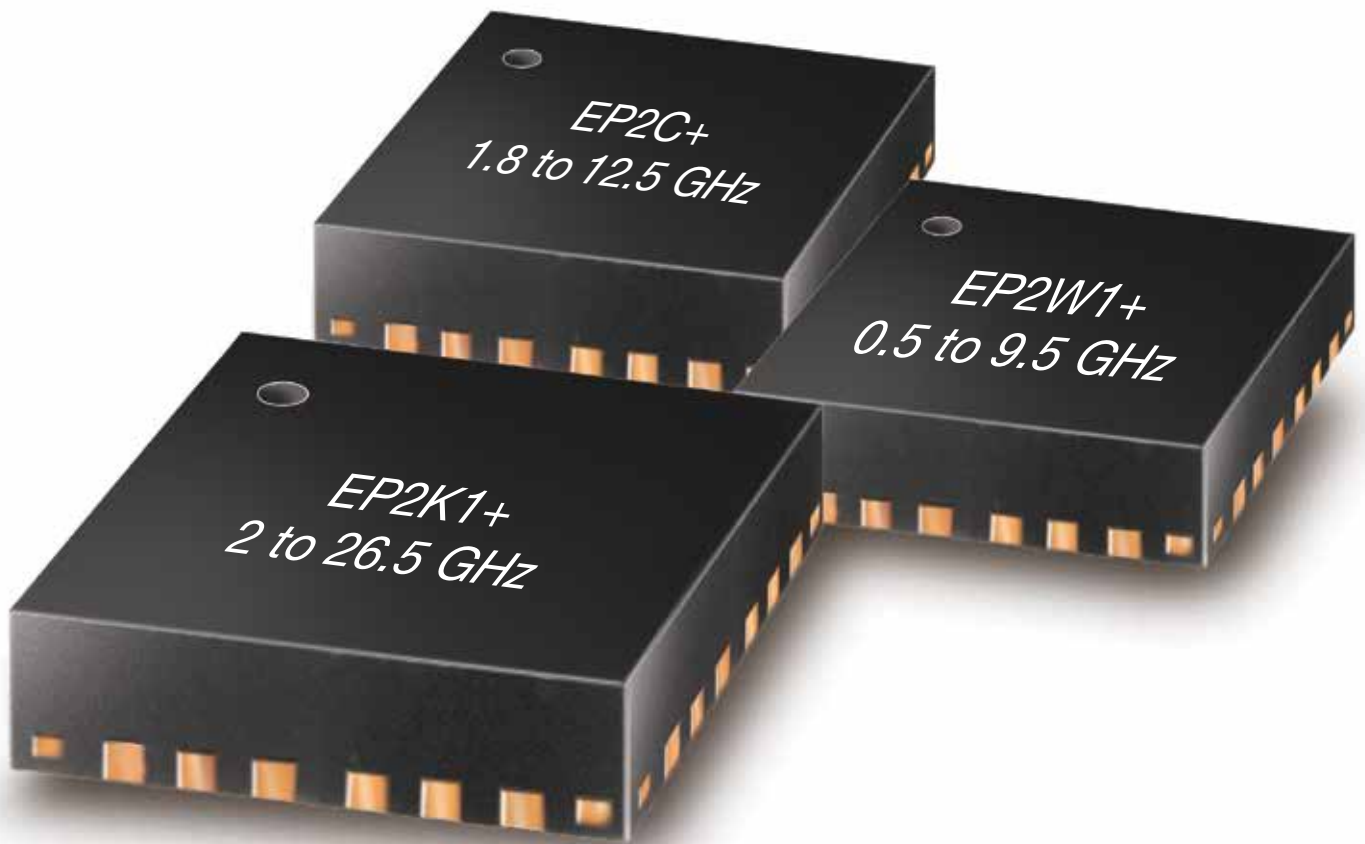
Batteries are key to our modern, wireless ways of living and working.

Everything from our laptops to our smartphones and wearables runs off batteries. Plugging these devices in overnight has become part of our routines – a small price to pay for the advantages of cord-free use.

In the same way consumer electronics have gone wireless, so have industrial devices, thereby paving the way for the IoT. We can now roll out large numbers of sensors and other kit in remote locations, without worrying about power or network cabling.

But this creates a new challenge. Keeping our consumer device batteries charged is workable because there are usually only a few pieces of kit, and they're not usually critical to our existence (if you can't check your personal social media accounts for a few hours, it's not the end of the world).

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## **THE WIDEST BANDWIDTH IN THE INDUSTRY IN A SINGLE MODEL!**

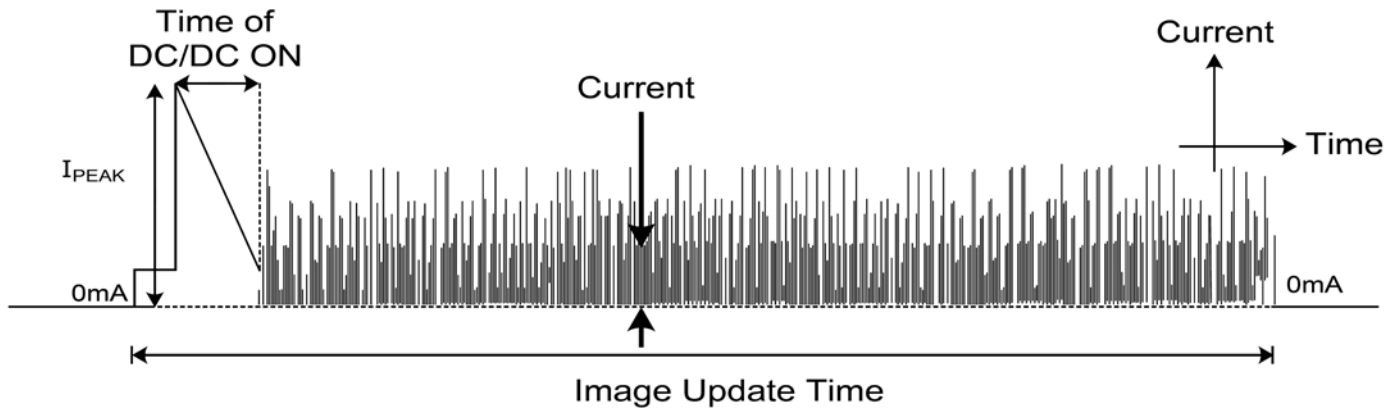
Our new EP-series ultra-wideband MMIC splitter/combiners are perfect for wide-band systems like defense, instrumentation, and all cellular bands through LTE and WiFi. These models deliver consistent performance across the whole range, so you can reduce component counts on your bill of materials by using one part instead of many! They utilize GaAs IPD technology to achieve industry-leading performance, high power handling capability and efficient heat dissipation in a tiny device size, giving you a new level of capability and the flexibility to use them almost anywhere on your PCB! They're available off the shelf, so place your order on [minicircuits.com](http://minicircuits.com) today, and have them in hand as soon as tomorrow!

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■ EP2K-Series, 4x4x1mm

■ EP2W-Series, 5x5x1mm





**Figure 1: This graph shows the current used during an update to an e-paper display (Source: Pervasive Displays)**

It's a different story when you look at industrial applications and the IoT. Firstly, device downtime may have more serious consequences. Operators of battery-powered networks therefore need to monitor charge levels and periodically recharge or replace batteries to ensure uptime.

Secondly, industrial and IoT deployments typically include tens or hundreds of devices. Maintaining this number of batteries represents a major overhead.

**Energy-harvesting:** Ideal for the IoT Energy-harvesting is an ideal way for IoT kit to reduce or even eliminate its reliance on batteries. And by blending this approach with a low-power design, it's possible to create kit that can run almost perpetually. To achieve this goal, the first step is to select the most appropriate means of harvesting energy for the use case. Solar or thermal may seem obvious choices, but can be inconsistent in their delivery of power. The source of energy needs to be available when the device is

being used.

At the same time, the device needs a low-power design – and this goes beyond simply using low-power components. Ultimately, it must be able to operate within a limited power budget.

An example of good batteryless device design is the RF-based contactless smartcard. Inside, they contain a memory chip and antenna, which performs the dual purpose of communicating and harvesting energy. Most of the time, the card is 'off', and uses no power. But when it comes within the RF field of a reader or writer device, the card is energized, enabling the reader/writer to communicate with it wirelessly.

Because the card only needs power to perform read or write operations, RF-based energy harvesting is ideal: there will always be an RF reader/writer as a source of power. And if designers keep to standards, including NFC or RFID, they know what power budget their card must work within, which simplifies the

design process.

Smartcards for authentication or contactless payments represent one of the biggest and most high-profile uses of RF energy-harvesting, but the technique could be used in many other scenarios. Sensors, thermometers or even displays can be powered using RF-harvested energy.

### **E-paper: the display technology that doesn't require a battery**

Made famous by the Kindle ebook reader, e-paper is a particularly interesting technology for manufacturers of batteryless industrial or IoT devices, because it enables them to incorporate displays into their designs.

E-paper uses very little power: where traditional active-matrix LCDs need a power-hungry backlight to make the image visible, e-paper uses electrophoretically charged physical ink particles to create an image, off which ambient light can reflect. Consequently, the content of an





**Figure 2: Toppan’s batteryless EPD with built-in RFID tag (Source: Toppan Printing)**

e-paper display is readable without a backlight. Moreover, where LCDs require a constant current to display even a static image (due to their continual need to refresh), e-paper is bistable, meaning once an image is in place, it consumes no energy. Power is only required to change what’s shown on an EPD. Better still, the current required to update modern e-paper displays, such as those from Pervasive Displays, can be as little as 2 mA.

Because e-paper doesn’t require a lot of energy, and what’s on the display remains visible even in the absence of a power source, it’s perfect for use in industrial and IoT scenarios. It also means it’s ideal for RF, thermal or solar energy-harvesting.

### The Toppan batteryless EPD with RFID tag

While energy-harvesting can’t be used in every situation, it’s

sufficient to drive some surprisingly sophisticated devices. Take Toppan Printing Co. Ltd.’s new batteryless EPD with a built-in RFID tag. This gives the dual benefit of being readable by machines and humans. The device works using RF energy harvested from the NFC reader or writer. It’s available with displays between 1.44 and 2.7 inches, and is under 7 mm thick. It has sufficient memory to store three images, which can be shown on its EPD, as well as 884 bytes of RFID data.

Toppan’s batteryless EPD is aimed at the logistics and warehousing markets, where it can take the place of paper labels in manufacturing and to manage assets or inventories. Thanks to the built-in RFID facility, the tag is also machine-readable, thereby enabling easier and automated tracking. Crucially, because it doesn’t require a battery, the device can be used for large-scale deployments

without incurring unsustainable maintenance overheads.

### The exciting opportunity for IoT device designers

Batteries are an effective way of powering many consumer electronics devices, but in IoT and industrial scenarios, they’re not necessarily suitable. With the need to deploy at scale and with mains power typically unavailable, the overhead of periodically recharging or replacing batteries would quickly become unsustainable.

But by using modern RF, solar or thermal energy-harvesting with low-power components in low-power designs, manufacturers can now create batteryless devices. And by incorporating e-paper displays into their kit, designers can add whole new ways for humans to interact with industrial and IoT gear, free of the challenges that come with battery-reliant devices.

**Scott is CEO of Pervasive Displays and has over a decade of experience in software in addition to 12 years working in displays businesses. During his career, Scott has been a founding partner at four start-up companies, including Pervasive Displays. Scott sits on the board of several other technology businesses as a consulting partner. He was a board member of One Laptop Per Child (OLPC), which looks to provide children in developing countries with a rugged, low-cost, low-power, connected laptop. Scott has an MBA from the Haas School of Business at the University of California, Berkeley as well as a BA from the University of Michigan at Ann Arbor, US.**

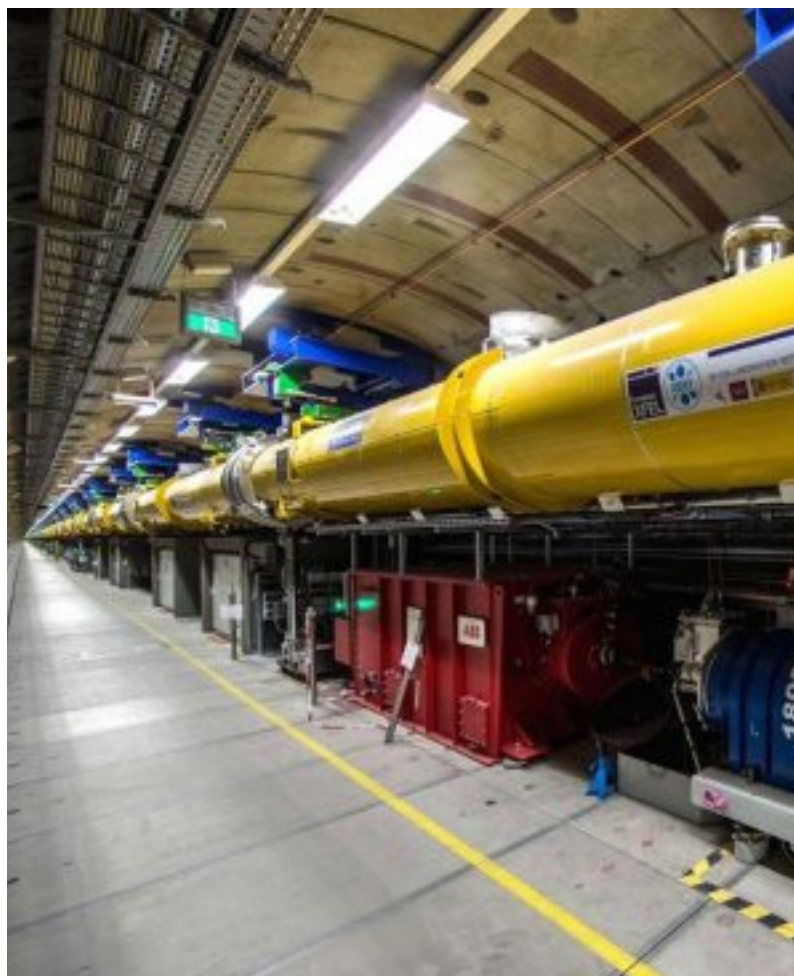
## Biggest X-ray laser in the world generates its first laser light

With its first lasing, the European XFEL reaches the last big milestone before the official opening

In the metropolitan region of Hamburg, the European XFEL, the biggest X-ray laser in the world, has reached the last major milestone before the official opening in September. The 3.4 km long facility, most of which is located in underground tunnels, has generated its first X-ray laser light. The X-ray light has a wavelength of 0.8 nm—about 500 times shorter than that of visible light. At first lasing, the laser had a repetition rate of one pulse per second, which will later increase to 27 000 per second.

European XFEL Managing Director Prof. Robert Feidenhans'l said: "This is an important moment that our partners and we have worked towards for many years. The European XFEL has generated its first X-ray laser light. The facility, to which many countries around the world contributed know-how and components, has passed its first big test with flying colours. The colleagues involved at European XFEL, DESY, and our international partners have accomplished outstanding work. This is also a great success for scientific collaboration in Europe and across the world. We can now begin to direct the X-ray flashes with special mirrors through the last tunnel section into the experiment hall, and then step by step start the commissioning of the experiment stations. I very much look forward to the start of international user operation, which is planned for September."

Helmut Dosch, Chairman of the DESY Directorate, said: "The European X-ray laser has been brought to life! The first laser light produced today with the most advanced and most powerful linear accelerator in the world marks the beginning a new era of research in Europe. This



worldwide unique high-tech facility was built in record time and within budget. This is an amazing success of science. I congratulate all those involved in the research, development, and construction of this facility with passion and commitment: the employees of DESY, European XFEL, and international partners. They have achieved outstanding results and demonstrated impressively what is possible in international cooperation. The European XFEL will provide us with the most detailed images of the molecular structure of new materials and drugs and novel



# Out Of the box



live recordings of biochemical reactions.”

The X-ray laser light of the European XFEL is extremely intense and a billion times brighter than that of conventional synchrotron light sources. The achievable laser light wavelength corresponds to the size of an atom, meaning that the X-rays can be used to make pictures and films of the nanocosmos at atomic resolution—such as of biomolecules, from which better understandings of the basis of illnesses or the development of new therapies could be developed. Other opportunities include research

into chemical processes and catalytic techniques, with the goal of improving their efficiency or making them more environmentally friendly; materials research; or the investigation of conditions similar to the interior of planets. The X-ray laser light of the European XFEL was generated from an electron beam from a superconducting linear accelerator, the key component of the X-ray laser. The German research centre DESY, the largest shareholder of the European XFEL, put the accelerator into operation at the end of April.

In a 2.1 km long accelerator tunnel, the electron pulses were strongly accelerated and prepared for the later generation of X-ray laser light. At near-light speed and very high energies, the intense electron pulses entered a photon tunnel containing a 210 m long stretch of X-ray generating devices. Here, 17 290 permanent magnets with alternating poles interacted with the electron pulses from above and below. The magnetic structures, known as undulators, bring the electrons into a “slalom” course, and with every turn they release extremely short-wavelength X-ray radiation, which intensify across the length of the undulator stretch. For the first lasing, the X-ray light was absorbed and measured shortly before arriving in the underground experiment hall.

The 3.4 km long European XFEL is the largest and most powerful of the five X-ray lasers worldwide, with the ability to generate the short pulses of hard X-ray light. With more than 27 000 light flashes per second instead of the previous maximum of 120 per second, an extremely high luminosity, and the parallel operation of several experiment stations, it will be possible for scientists investigate more limited samples and perform their experiments more quickly. Therefore, the facility will increase the amount of “beamtime” available, as the capacity at other X-ray lasers worldwide has been eclipsed by demand, and facilities have been overall overbooked.

At the start of September, the X-ray laser should officially open. At that point, external users can perform experiments at the first two of the eventual six scientific instruments.



## Cypress Streamlines the Design of Next-Generation USB-C Power Adapters and Chargers with New, Highly-Integrated Controller

Cypress Semiconductor Corp. (NASDAQ: CY), the market leader in USB-C, today announced availability of a new USB-C controller with Power Delivery (PD) that streamlines the design of power adapters, mobile chargers, car chargers and power banks. The EZ-PD™ CCG3PA controller supports the PD 3.0 standard with programmable power supply (PPS) and Qualcomm's Quick Charge (QC) 4.0 protocol, which enable new power source product designs to provide an improved fast charging user experience. As these standards and the USB Type-C standard continue to evolve, compliance and interoperability pose an ongoing challenge, but the programmable CCG3PA controller enables firmware upgradeability to keep up with changes and overcome interoperability issues. The controller offers a high level of integration that minimizes bill-of-material costs and simplifies designs, replacing multiple discrete components with a single-chip solution. More information on the EZ-PD CCG3PA controller is available at <http://www.cypress.com/ccg3pa>.

“As USB-C proliferates this year, the demand for USB-C power sources will increase, putting more pressure on our customers to bring their power adapters, mobile chargers, car chargers and power banks to market quickly, while keeping up with rapidly evolving USB standards,” said Ajay Srikrishna, vice president of Cypress' Wired Connectivity Business Unit. “Our highly-integrated EZ-PD CCG3PA controller is optimized to simplify the design of USB-C power source products, with support for the required charging standards, and the ability to upgrade firmware to keep pace with changes in standards.”

The EZ-PD CCG3PA controller is a one-chip solution that minimizes bill-of-material costs for USB-C power source products by integrating error amplifiers for constant voltage, constant current and PPS applications, a 30 V regulator that allows direct operation from VBUS, VBUS short protection on configuration channel (CC) pins, gate drivers for high-voltage power FETs, a low side current sense amplifier, and dedicated hardware for legacy charger detection protocols plus system level electrostatic discharge (ESD) protection. Programmable overvoltage and overcurrent circuitry protects systems

against power overloads and other faulty operating conditions. The controller also integrates an ARM® Cortex®-M0 and 64KB Flash with read-while-write function for firmware upgradeability. The product enables design of efficient USB-C power adapters for a wide range of applications including mobile phones and PCs.

### Product Availability

The EZ-PD CCG3PA controller is now sampling in 24-pin QFN (16 mm<sup>2</sup>) and 16-pin SOIC (60 mm<sup>2</sup>) packages. The controller will be in production in the third quarter of 2017. Designers can get started with the CY4532 CCG3PA evaluation kit, which is now available for \$149. Cypress provides CCG3PA solution reference designs for a 45-Watt notebook PC power adapter, a 27-Watt mobile phone charger, a 60-Watt car charger and a power bank. More info on Cypress' USB Type-C and PD solutions is available at [www.cypress.com/Type-C](http://www.cypress.com/Type-C).



## NXP Turns up the Volume with Industry's First 12-Volt Smart Amplifier to Deliver Rich, Elevated Sound in Mobile and Portable Devices

NXP Semiconductors N.V. (NASDAQ:NXPI) today introduced the industry's first 12-volt smart audio amplifier, TFA9892. This powerful, but tiny, audio amplifier makes it possible to enjoy higher sound quality in a variety of electronic devices such as smartphones, netbooks and sound bars by combining higher output power, higher efficiency and better drum restitution for deeper and richer bass.

The TFA9892 is the industry's first power amplifier capable of delivering a 12-volt boosted output, reaching above seven watts of output power from a single cell battery, or up to 15 watts from a 12-volt supply. With best-in-class



(1) Supports the new USB PD Rev 3.0 standard and the USB Type-C Authentication Rev 1.0 standards for device-to-device authentication

The R9J02G012 provides support for USB PD 3.0 and USB Type-C Authentication to identify genuine or counterfeit devices. Leveraging more than 30 years of experience in supplying secure microcontrollers (MCUs), Renesas has incorporated highly tamper-resistant technology and information management technology to prevent security attack attempts on MCUs. Renesas has adopted these technologies for the R9J02G012.

(2) Implements the USB PD 3.0 and USB Type-C authentication standards on a compact, single package, reducing the mounting area on the board to less than 50 percent of that from the existing Renesas device

The R9J02G012 integrates support for the USB PD 3.0 and USB Type-C Authentication standards in a single package, where previously each required a separate chip. It is available in an easy-to-mount QFN package as well as the more compact BGA package, reducing the mounting area in cables or electronic devices. The board mounting area is less than 50 percent the area required when using the existing Renesas R9A02G011.

(3) Supports PD firmware update (PDFU) in USB PD Rev 3.0 specification

The R9J02G012 also supports the Power Delivery Firmware Update (PDFU) Specification, Revision 1.0. This optional PD feature is an open standard enabling firmware updates of the device via a USB Type-C cable.

#### Pricing and Availability

Samples of the R9A02G012 are available from June 2017 priced at US\$10.00 per unit. Mass production is scheduled to begin in the beginning of January 2018 and is expected to reach a volume of 1,000,000 units per month in January 2019. (Pricing and availability are subject to change without notice.)

Renesas plans to expand its range of reference designs for applications such as USB Type-C power banks and mobile batteries by combining the R9J02G012 with power products from Renesas and Intersil Corporation, which was acquired by Renesas in February 2017. With the introduction of the R9J02G012, system manufacturers can easily construct a trusted power charging ecosystem of USB PD products based on the USB PD and USB Type-C Authentication standards.

Renesas will exhibit the new R9J02G012 and other USB solutions at the USB-IF booth (hall 1, booth number N0608) during Computex Taipei 2017, which will be held in Taipei,

Taiwan from May 30 to June 2, 2017.



#### Microchip introduces the industry's first MCU with integrated 2D GPU and DDR2 memory for groundbreaking graphics capabilities

Microchip announces the 32-bit PIC32MZ DA microcontroller (MCU) family which is the industry's first MCU with an integrated 2D Graphics Processing Unit (GPU) and up to 32 MB of integrated DDR2 memory. This combination gives customers the ability to increase their application's colour resolution and display size, up to 12 inches with easy-to-use microcontroller (MCU) based resources and tools including the MPLAB® Integrated Development Environment (IDE) and MPLAB Harmony Software Framework.

The PIC32MZ DA family bridges the graphics performance gap between MCUs and microprocessor units (MPUs) for customers who want to stay in the familiar design environment of an MCU. The devices provide MPU-like graphics capabilities with the seamless integration and programming model of Microchip's PIC32 and MPLAB IDE and Harmony software framework. These tools provide a visual graphics design environment, custom display driver creation, graphics libraries and an asset converter that can take a custom graphic and optimise it for their chosen display size.

Features of the new devices include:

- Three-layer graphics controller capable of driving 24-bit color Super eXtended Graphics Array (SXGA) displays
- High-performance 2D Graphics Processing Unit (GPU)
- 32 MB integrated SDRAM or 128 MB externally addressable SDRAM option
- providing expansive storage
- Ample on-chip Flash, SRAM and connectivity option



The addition of DDR2 memory, a first for MCUs throughout the industry, enables 2x faster throughput and large graphics buffers and/or storage for increasingly complex communications protocol stacks and algorithms. The result is smooth, striking interfaces and fewer product variants in a crowded communications control market.

The PIC32MZ DA family is supported by Microchip's MPLAB Harmony Integrated Software Framework, MPLAB X Integrated Development Environment (IDE), MPLAB XC32 Compiler for PIC32, MPLAB ICD 3 In-Circuit Debugger and MPLAB REAL ICE™ In-Circuit Emulation System.

Several additional tools are available including:

PIC32MZ Embedded Graphics with Stacked DRAM (DA) Starter Kit (DM320010) at \$130

PIC32MZ Embedded Graphics with Stacked DRAM (DA) Starter Kit (Crypto) (DM320010-C) at \$130

PIC32MZ Embedded Graphics with External DRAM (DA) Starter Kit (DM320008) at \$140

PIC32MZ Embedded Graphics with External DRAM (DA) Starter Kit (Crypto) (DM320008-C) at \$140

Devices in the PIC32MZ DA family are offered in a variety of package options including a 169-ball BGA, a 176-pin LQFP and a 288-ball BGA for external DDR2 applications. Devices in the family are available today in volume production.

For more information, visit Microchip's Web site at: [www.microchip.com/PIC32MZDA\\_Main681](http://www.microchip.com/PIC32MZDA_Main681)



## Analog Devices' Small Isolated Gate Drivers Deliver Solutions for Next Generation Power Switch Technology

Analog Devices, Inc. (ADI) announced small form factor isolated gate drivers designed for the higher switching

speeds and system size constraints required by power switch technologies such as SiC (Silicon Carbide) and GaN (Gallium Nitride), while still providing reliable control over switching characteristics for IGBT (insulated gate bipolar transistor) and MOSFET (metal oxide semiconductor field effect transistor) configurations. The ADuM4120 and ADuM4121 series leverages ADI's proven iCoupler® isolation technology combined with high speed CMOS and monolithic transformer technology to enable ultra-low propagation delay without sacrificing common mode transient immunity (CMTI) performance.

While legacy alternatives such as optocouplers or pulse transformers struggle to deliver shorter delay and maintain CMTI performance, the robust ADuM4120 and ADuM4121 are purposely designed to enable the higher switching speeds of the new inverter architectures. In systems requiring multiple power switches, these small SOIC packaged isolated gate drivers minimize PCB layout space subsequently reducing cooling requirements. Additionally, their small size allows the gate drivers to be located close to the power switches to reduce the parasitic inductance between the driver and the switch. Operating over a high temperature range and high working voltages, the ADuM4120 and ADuM4121 are ideal for improving the energy efficiency and timing performance stability of solar inverters, motor controllers, and industrial inverter applications.

All four devices in the new series are 2 A output, single-channel gate drivers that provide 5 kV rms isolation with low propagation delay and CMTI performance of >150 kV/μs. Operating with an input supply ranging from 2.5 V to 6.5 V, these isolated gate drivers provide compatibility with lower voltage systems with the benefit of true galvanic isolation between the input and the output. The ADuM4120 and ADuM4120-1 provide thermal shutdown for over temperature protection. The ADuM4120 with input glitch filter reduces system noise on the input pin that could trigger a false output, while the ADuM4120-1 without glitch filter supports low 33ns typical propagation delay. The ADuM4121 and ADuM4121-1 are available with an internal Miller clamp for added protection. The ADuM4121 device is also available with the thermal shutdown. By offering gate

drivers in a small package and retaining key performance specifications, ADI provides designers with the flexibility needed to successfully architect next generation power conversion systems.



### **TI introduces the industry's smallest gate driver and power MOSFET solution for motor control**

TI introduces the industry's smallest gate driver and power MOSFET solution for motor control – May 23, 2017

Texas Instruments (TI) (NASDAQ:TXN) today introduced two new device families that help reduce size and weight in motor drive applications. When used together, DRV832x brushless DC (BLDC) gate drivers and CSD88584/99 NexFET™ Power Blocks require as little as 511 mm<sup>2</sup>, half the board space of competing solutions.

TI introduces the industry's smallest gate driver and power MOSFET solution for motor control – May 23, 2017

The DRV832x BLDC gate drivers feature a smart gate-drive architecture that eliminates up to 24 components traditionally used to set the gate drive current while enabling designers to easily adjust field-effect transistor (FET) switching to optimize power loss and electromagnetic compliance. The CSD88584Q5DC and CSD88599Q5DC power blocks leverage two FETs in a unique stacked-die configuration, which doubles power density and minimizes the FET resistance and parasitic inductances typically found in side-by-side FET configurations.

An 18-volt compact BLDC motor reference design demonstrates how the DRV8323 gate driver and CSD88584Q5DC power block can drive 11 W/cm<sup>3</sup>

power and enable engineers to jump-start their designs for smaller, lighter-weight power tools, integrated motor modules, drones and more. For more information, visit [www.ti.com/smallmotordesign-pr](http://www.ti.com/smallmotordesign-pr).

Benefits of using a CSD88584/99 and DRV832x device together

**Maximum power density:** The combined solution delivers 700 W of motor power without a heat sink, providing 50 percent higher current than conventional solutions without increasing the footprint.

**High peak current:** As demonstrated by the 18-volt BLDC reference design, the smart gate driver and power block are capable of driving a peak current of up to 160 A for more than 1 second.

**Optimal system protection:** The combination enables shorter trace lengths and actively prevents unintended FET turn-on, while also providing undervoltage, overcurrent and thermal protection.

**Superior thermal performance:** The CSD88584Q5DC and CSD88599Q5DC power blocks come in TI's DualCool™ thermally enhanced package, which enables designers to apply a heat sink to the top of the device to decrease thermal impedance and increase the amount of power dissipated to maintain safe operating temperatures for the board and end application.

**Clean switching:** The power blocks' switch-node clip helps eliminate parasitic inductance between high- and low-side FETs. Additionally, the DRV832x gate driver's passive component integration minimizes board traces. Tools and support to jump-start design

In addition to the 18-volt BLDC motor reference design, engineers can search for other motor reference designs that use the power blocks and gate drivers to help solve their system design challenges. The three-phase smart gate-driver evaluation module (EVM) allows designers to drive a 15-A, three-phase BLDC motor using the DRV8323R gate driver, CSD88599Q5DC power block and MSP430F5529 microcontroller LaunchPad™ development kit. The EVM is available from the TI store for US\$99.00.

**Package, availability and pricing**

The new DRV832x BLDC smart gate drivers offer peripheral and interface options for engineers to select the best device for their design: with or without an integrated buck regulator or three integrated current-shunt amplifiers. Each device option is available in a hardware or serial interface and comes in quad flat no-lead (QFN) packaging. The CSD88584/99

power blocks come in DualCool small outline no-lead (SON) packaging, with 40- or 60-V breakdown voltage (BVDSS) choices. All devices are available now, priced and packaged as listed in the table below.



### XP Power delivers wide input 6W and 8W DC-DC Converters in an ultra-compact DIP-16 package

XP Power today announced two new series of fully isolated DC-DC converters in an ultra-compact DIP-16 package, offering a very high power density of up to 50W/in<sup>3</sup>. With two ultra-wide input voltage ranges, they are ideal for any application that requires through-hole mount DC-DC converters compliant with global Information Technology Equipment (ITE) safety approvals IEC60950-1 and UL/cUL60950-1.

Using the latest design techniques, the JWE06 (6W total output power) and JWE08 (8W total output power) DC-DC converters offer 1500 VDC isolation with single or dual output voltages. Both ranges offer devices with either 3.3, 5, 12, 15 or 24VDC single, and  $\pm 12V$  or  $\pm 15VDC$  dual outputs. Each series is able to operate from two ultra-wide input voltage ranges; 9V to 36V and 18V to 75V, with up to 87% efficiency. All models feature undervoltage lockout.

All devices in both series meet EN55032 Level A EMI standards, meaning no additional external filtering is required. This can save both PCB space and BoM cost. They also feature an extended operating temperature range of  $-40^{\circ}\text{C}$  to  $+105^{\circ}\text{C}$ , with no derating or forced air cooling required up to  $+70^{\circ}\text{C}$ . The JWE06 and JWE08 series have zero minimum load requirements and achieve a typical line regulation of  $\pm 0.2\%$  and load regulation of  $\pm 0.5\%$ . For dual output models, cross

regulation is a maximum of  $\pm 5.0\%$  for load variation on one output of between 25% and 100% while the other output is fixed at 100%.

The industry-standard DIP-16 metal cased package measures just 23.8mm by 13.7mm by 8.0mm. This level of integration offers developers the opportunity to reduce overall PCB area or add additional features into existing product profiles.

These class-leading features coupled with their small outline, excellent isolation and industry standard safety compliance make the JWE06 and JWE08 DC-DC converters ideal for a wide range of applications including Automation & Process Control, Broadcast, Fixed and Mobile Telecommunications, Networking & Data-communications, as well as Instrumentation and Specialist Equipment.

The series are available from Digi-Key, element14, Farnell, RS Components, approved regional distributors, or direct from XP Power and come with a 3-year warranty.



### Littelfuse Introduces Surface Mount PPTC Devices to Prevent Charging Cables from Overheating

Littelfuse, Inc., the global leader in circuit protection, today introduced the PolySwitch<sup>®</sup> LoRho Series SMD PPTC that provides protection for charging cables and connectors from heat generated due to faults within the cable connector or port. As connector sizes get smaller, so does pin-to-pin spacing, which increases the chance that dirt, dust, water and other debris will collect between the pins, and cause an electrical fault. Such faults can generate high levels of heat, which can damage charging cables and the devices being charged, as well as injure users. However, when a LoRho Series PPTC is placed on the connector's Vbus line, the device will sense the



temperature rise and stop the charging process until the contamination is removed. Once the fault is corrected, the device automatically resets.

Typical applications for the LoRho Series SMD PPTCs include protecting charging cables and connectors with a small pin pitch (pin-to-pin dimensions), such as microUSB and USB-C. This is especially important in fast-charging applications that use higher voltages and currents, such as smartphones, tablets and laptop computers, TVs and set-top boxes, cameras, and video game consoles.

“The LoRho Series SMD PPTC offers an advantage over devices that offer only overcurrent protection because not all faults result in a higher current. Having both overcurrent and overtemperature protection is critically important to safeguarding users of charging cables,” said Vincent Wu, global product manager at Littelfuse. “Never before has this low resistance, compact size, voltage level, overcurrent and overtemperature protection, and resetability been combined in a single device.”

LoRho Series SMD PPTCs offer these key benefits:

Surface mount design is compatible with reflow soldering processes, which allows for reduced assembly time and cost vs. leaded and strapped devices.

Compact 1206- and 1210-size packages save printed circuit board space at the USB-C connector and ensure the USB-C plug meets USB-IF dimension specifications. Well-suited for use in fast-charging applications up to 12Vdc and 4.5A Ihold.



## 1200V SiC Schottky Diodes from Littelfuse Are First Products from New Platform, Offer Lower Switching Losses, Higher Efficiency

the global leader in circuit protection, today introduced the

first GEN2 Series of 1200V Silicon Carbide (SiC) Schottky Diodes, in conjunction with the start of the Power Conversion and Intelligent Motion (PCIM) Europe 2017 Exhibition. These SiC diodes are the first in a series of products based on the technology platform created through a partnership with Monolith Semiconductor. Additional silicon carbide products based on the technology platform, including 1200V SiC MOSFETs, are already in the pipeline and are scheduled for introduction in the near future.

GEN2 SiC Schottky Diodes are available in ratings of 1200V at currents from 5 A to 10 A in either TO-220-2L or TO-252-2L packages. Compared to standard silicon bipolar power diodes, they allow circuit designers to dramatically reduce switching losses and enable substantial increases in the efficiency and robustness of power electronics systems. They can accommodate large surge currents without thermal runaway, and operate at higher junction temperatures than their silicon counterparts. They also offer best-in-class stored capacitive charge and forward voltage drop.

Typical applications for GEN2 Series SiC Schottky Diodes include power factor correction (PFC), buck/boost stages in DC-DC converters, free-wheeling diodes in inverter stages (switch-mode power supplies, solar, UPS, industrial drives) and high-frequency output rectification—wherever improvements in efficiency, reliability, and thermal management are desired. Designers and manufacturers of industrial power supplies, solar inverters, industrial drives, welding and plasma cutting equipment and EV/HEV charging stations will find them particularly useful.

“The merged p-n Schottky (MPS) device architecture of these new silicon carbide Schottky diodes offers circuit designers enhanced surge capability and extremely low leakage,” said Michael Ketterer, product marketing manager, Power Semiconductors at Littelfuse. “Compared to conventional silicon power diodes, these silicon carbide Schottky diodes boost converter efficiency and power density while helping to reduce system-level costs.”

GEN2 Series SiC Schottky Diodes from Littelfuse offer these key benefits:

Best-in-class capacitive stored charge and negligible reverse recovery make them well-suited for high-frequency power switching. They also ensure negligible switching losses and reduced stress on the opposing switch.

Best-in-class forward voltage drop ensures low conduction losses.

A maximum junction temperature of 175°C provides for a larger design margin and relaxed thermal management requirements.

#### Availability

GEN2 Series SiC Schottky Diodes are available in available in either TO-220-2L (packed in tubes in quantities of 1,000) or TO-252-2L (DPAK) packages (in tape and reel packaging in quantities of 2,500). Sample requests may be placed through authorized Littelfuse distributors worldwide. For a listing of Littelfuse distributors, please visit [Littelfuse.com](http://Littelfuse.com).



### Intel Shows 1.59x Performance Improvement in Upcoming Intel Xeon Processor Scalable Family

Intel unveiled significant performance advances in its upcoming Intel® Xeon® Processor Scalable family. At the SAP Sapphire NOW conference, Intel showed up to 1.59x higher Intel Xeon processor performance running in-memory SAP HANA workloads over the generation it replaces, demonstrating what the new products will deliver to help meet the increasingly complex demands of big-data, in-memory workloads in the modern data center.

Diane Bryant, group president of the Data Center Group at Intel, outlined how the Intel Xeon Processor Scalable family — available in mid-2017 — will provide enhanced performance to in-memory applications like SAP HANA. This will provide customers faster time-to-insight and allow organizations to rapidly respond to change.

Bryant also announced that SAP has certified HANA to support up to 6x greater system memory on the new Intel platform for 4- or 8-socket configurations over the representative installed base of systems available four years ago. More information about the immediate-term benefits of running SAP HANA workloads on the Intel Xeon Processor Scalable family is available at Intel's IT Peer

Network site.

Additionally, exhibiting Intel's commitment to re-architecting the data center to support the future needs of a data-intensive world driven by the growth of artificial intelligence, 5G, autonomous driving and virtual reality, Intel demonstrated live for the first time its future persistent memory solution in a DIMM form factor. Based on 3D XPoint™ media, Intel persistent memory is a transformational technology that will deliver to the mainstream memory that is higher capacity, affordable and persistent.

With Intel persistent memory, Intel is revolutionizing the storage hierarchy to bring large amounts of data closer to the Intel Xeon processor, which will enable many new usage models and make in-memory applications like SAP HANA even more powerful. Intel persistent memory will be available in 2018 as part of an Intel Xeon Processor Scalable family refresh (codename: Cascade Lake).

During a live demonstration of Intel persistent memory at SAP Sapphire, Lisa Davis, vice president of IT Transformation for Enterprise and Government in the data Data Center Group at Intel, noted that with Intel persistent memory, in-memory databases like SAP HANA will be able to deliver even faster transactions, perform real-time analytics and accelerate business decision-making.

In preparation for next year's availability, software developers can accelerate their readiness for Intel persistent memory today with the libraries and tools at [www.pmem.io](http://www.pmem.io). Further product details will be unveiled at a later date.

1 Intel estimate, Intel Xeon processor Scalable family series as compared to a representative Intel® Xeon® processor E7 v4 system. Results are based on internal testing and are provided for informational purposes. Any differences in your system hardware, software or configuration may affect your actual performance.

2 SAP certifies SAP HANA 2 platform for OLAP (Online Analytical Processing) workloads to support up to 3TB of memory per system for the upcoming Intel® Xeon® processor Scalable family for a 4 socket configuration (or 6 TB for an 8 socket configuration). Representative systems available four years ago (Intel® Xeon E7 Processor) were certified to support up to .5 TB (or up to 1 TB in 8 Socket configuration), respectively. Up to 6x greater system memory supported on SAP HANA software vs. available solutions from 4 years ago (representing Data Center installed based).

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software

or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at [www.intel.com](http://www.intel.com).

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products.

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### Ultra-Wideband 3GHz to 20GHz Mixer with Integrated LO Buffer Offers 23.9dBm IIP3 in a Tiny 3mm x 2mm Package

Analog Devices, Inc., which recently acquired Linear Technology Corporation, announces the LTC5553, a double balanced mixer providing best-in-class matched bandwidth capability from 3GHz to 20GHz. The mixer can be used either as an up- or downconverter. In addition, the LTC5553 delivers outstanding linearity of 23.9dBm IIP3 at 14GHz, and 21.5dBm at 17GHz. The device integrates an LO buffer requiring only 0dBm input drive, effectively eliminating an external high power LO amplifier circuit. Moreover, the LTC5553 integrates wideband balun transformers on chip. So all ports operate single-ended, 50Ω matched over their respective specified frequency range. In addition, the mixer has excellent port-to-port isolation, offering -32dBm LO to RF leakage at 17GHz, thus easing external filtering requirements. All of these

features result in minimum external components, simplified design and a very small solution size.

The LTC5553's extremely wide bandwidth and performance is ideal for a wide range of applications including 5G microwave backhaul, broadband wireless services, satellite broadband radios, radar systems, active antenna arrays, X and Ku band transceivers, test equipment, spectrum analysis and satellite communications.

The LTC5553 is offered in a tiny 12-lead, 3mm x 2mm plastic QFN package. The device is rated for operation from -40°C to 105°C case temperature to support extended environmental operating temperature. The mixer is powered from a single 3.3V supply, drawing a quiescent supply current of 132mA. Additionally, the LTC5553 can be shut down via an enable pin. When deactivated, the device draws only 100μA maximum standby current. The enable pin can be driven directly to turn the device on and off rapidly in less than 0.2μs, supporting time-division duplex (TDD) or burst mode type transmitters and receivers. The LTC5553 is priced starting at \$22.00 each in 1,000-piece quantities. Samples and production quantities are available immediately. For more information, visit [www.linear.com/product/LTC5553](http://www.linear.com/product/LTC5553).

Photo Caption: An Ultra-Wideband 3GHz to 20GHz, High Linearity Mixer Integrates LO Buffer



### ON Semiconductor's Advanced Synchronous Rectifier Controller Brings Best-In-Class Simplicity, Reliability and Efficiency to LLC-based Power Supply Designs

ON Semiconductor (Nasdaq: ON), driving energy efficient innovations, has introduced an advanced synchronous rectifier (SR) controller optimized for LLC resonant converter topologies. The FAN6248 requires minimal additional components, delivers high efficiency, eases thermal management, improves overall system reliability,



and simplifies the design of LLC power supplies.

The FAN6248 is an ideal solution for modern, high-performance, power supply units (PSU) where high levels of reliability and efficiency are required in a small space. Typical applications include server and desktop computing, gaming, large screen LCD TV and OLED TV, networking, telecom and LED lighting applications.

The device incorporates an advanced, mixed, SR control methodology combining instantaneous drain voltage detection with previous switching cycle information. The separate 100 V rated sense inputs accurately sense the drain and source voltages across the two SR MOSFETs, allowing for any asymmetries or poor coupling in the secondary winding. With this advanced control approach, the FAN6248 prevents current inversion and avoids SR mis-triggering due to capacitive current spikes, giving highly reliable operation. The anti-shoot-through control within the controller enhances the reliability of the PSU and prevents potentially destructive simultaneous turn on of the two SR MOSFETs.

The FAN6248 and just two external resistors and MOSFETs delivers a simple LLC converters supporting up to 800 W. In particularly noisy environments, adding two capacitors further enhances system stability. The FAN6248 operates reliably and efficiently across a wide range of power levels. Above resonance operation is achieved without the introduction of voltage spikes. At no load, the FAN6248 enters green mode and disables itself. During light load conditions, the controller pulses within green mode giving very efficient power delivery as required by efficiency standards such as 80 PLUS®, DoE VI, and CoC Tier 2.

Inbuilt adaptive parasitic inductance compensation also minimizes body diode conduction in the SR MOSFETs due to its package's stray inductance, thereby increasing PSU efficiency. There are four devices within the series; power supply designers are able to select the most appropriate for their application based upon switching frequency (either 25 kHz-70 kHz or 60 kHz-700 kHz) and the level of stray inductance associated with the MOSFET. The range is suitable for use with MOSFETs in TO-220, D2PAK, DPAK or PQFN package styles. Furthermore, the 10.5 V high gate drive output from the FAN6248 ensures the ability to drive these very wide range of MOSFETs.

“The FAN6248 comprehensively addresses the needs of modern LLC PSU designers. Innovations such as the mixed control methodology and adaptive parasitic inductance compensation ensure reliable and highly efficient operation.” said Shane Chilton, General Manager of the Power Conversion Solutions at ON Semiconductor. “With only two resistors and MOSFETs required to realize an advanced state-of-the-art LLC converter the controller will prove popular with all engineers that are designing for applications that require high levels of performance.” Design support is available from ON Semiconductor, including a 240 W evaluation board incorporating a complete LLC design. A daughter board is also available to incorporate the FAN6248 into existing designs. Please contact your ON Semiconductor sales representative to request evaluation boards.



### Sensors from TT Electronics offer accuracy and longevity for critical applications

TT Electronics, a global provider of engineered electronics for performance critical applications, today launched the PHS family of rotary position sensors that provide precision sensing in harsh environments and in critical applications where repair costs would be high in the case of a failure. The hollow shaft single turn position sensors have been designed and built to embrace three main design points; precision, robustness and reliability. The rotary sensors comprise three separate series named PHS04, PHS07 and PHS11. They convert angular mechanical position or the motion of a shaft or axle to an analogue or digital electrical signal and are designed for applications that require adjustments to control variable outputs such as position, speed or volume.

Characteristics shared by the three series are their dust proof construction and stable output characteristics in harsh environments. A rotational angle of 360 degrees is provided and wide operating temperature ranges of up to -40 to +120°C are tolerated in the case of the PHS11. All of the TT Electronics PHS rotational sensors can be hand or wave soldered and feature long life characteristics of greater than a million cycles, or at least 300,000 in the case of the PHS04 with a 500,000 cycles option available. They are small sized, the PHS11 boasts an ultra thin height of 2.2mm and the PHS04 measures just 4 x 5mm in length and width.

Exhibiting a commitment to and an ability to respond to customers' specific needs and applications, TT Electronics is able to customise the sensors' shaft hole diameters for the PH07 and PHS11 ranges. Rotor types can also be customised from D to H type, as well as electrical output angles and linearity tolerances for super-accurate sensing applications.

Applications for the PHS series are to be found across industrial, medical and transportation markets, and specific ones include robot joint angle control, game controllers, motor drive units, 3D printers, intelligent surveillance camera positioning, rotary angle sensors, electric motor-driven bicycles, HAVC sensors, patient monitoring systems, medical diagnostic devices, dental chair positions, car audio and shift-by-wire gearshift systems.

TT Electronics' PHS04 and PHS07 are supplied in trays or boxes and the ultra slim PHS11 sensors are supplied in tape and reel form. For further information on the PHS family and product selector visit: [www.ttelectronics.com/sensors/rotary-position-sensors-potentiometric/hollow-shaft-potentiometers](http://www.ttelectronics.com/sensors/rotary-position-sensors-potentiometric/hollow-shaft-potentiometers).



## Intersil Introduces Smallest Footprint and Highest Efficiency PMIC for Application Processors, GPUs, FPGAs and System Power

Intersil, a subsidiary of Renesas Electronics Corporation (TSE: 6723), today introduced a highly integrated programmable power management IC (PMIC) that delivers 91% efficiency at 1.1V output voltage for application processors, GPUs, FPGAs and high-performance system power. The new PMIC's low RDS(on) MOSFETs and programmable PWM frequency allows designers to use fewer low-profile external components, enabling a 50mm<sup>2</sup> power-supply that is 40% smaller than competing solutions. The ISL91211 triple/quad output PMIC is ideal for smartphones, tablet computers, solid-state drives, networking and wireless Internet of Things (IoT) devices powered by single-cell Lithium-ion (Li-ion) batteries, or 2.5V – 5.5V power supplies.

The ISL91211 leverages Intersil's latest R5™ modulation technology to provide the industry's fastest single-cycle transient response and highest switching frequency (4MHz) during load transients. Quiescent current is only 62µA while the ISL91211 is regulating the output voltage. The PMIC's superior light load efficiency, regulation accuracy and fast dynamic response prolong battery life.

The ISL91211 PMIC includes highly efficient synchronous buck converters capable of multiphase and single-phase operation while delivering up to 5A per phase of continuous output current. The PMIC's four integrated buck controllers dynamically reconfigure their power stages to address a wide range of applications with high efficiency and high output power. Precise current sensing allows the ISL91211 to automatically and smoothly add or drop phases to optimize power efficiency, and provide overcurrent protection without requiring DCR or resistor sensing circuits at the inductor.

"The latest generation of application processors requires a new PMIC modulation architecture that can dramatically shrink solution size and increase efficiency," said Andrew Cowell, senior vice president of Mobile Power Products at Intersil. "The ISL91211 employs Intersil's new R5 modulator to deliver blazingly fast transient performance and everything designers

need to simplify board layout and dynamically scale power supply performance to meet the requirements of today's multi-core processors."

Key Features and Specifications of ISL91211

Available in two factory configurable options:

ISL91211A: four-phase, three output rails configured as 2+1+1 phase

ISL91211B: four-phase, four output rails configured as 1+1+1+1 phase

5A maximum current per phase up to 20A with four phases

R5 modulator architecture balances current loads with smooth phase adding and dropping for power efficiency optimization

Automatic diode emulation mode for 91% efficiency at 1.1V output voltage

Less than 0.1uA quiescent current ( $I_q$ ) when EN=0V, and 17uA when EN=3.7V

Independent dynamic voltage scaling for each output

Input voltage range of 2.5V to 5.5V

$\pm 0.7\%$  system accuracy; Output voltage remote sensing for accurate voltage regulation at the point-of-load

I2C and SPI programmable output from 0.3V to 2V

Soft-start and full protection against undervoltage, overvoltage, overcurrent, and overtemperature

The ISL91211A triple-output PMIC and ISL91211B quad-output PMIC can be combined with Intersil ISL91127 high efficiency buck-boost regulators to provide application processor and subsystem peripheral rails for battery-operated products.



## Vicor Expands High Voltage Bus Converter Family with New K=1/16, 384VDC – 24VDC in a ChiP Package

Summary: The new BCM6123TD1E2663Txx is a high-

density, high-efficiency, fixed ratio DC-DC converter module in a ChiP package, which operates from a 384VDC nominal input and delivers an isolated and Safety Extra Low Voltage (SELV) 24V secondary output. The new BCM 6123 ChiP is offered in a through-hole form factor measuring 61mm x 23mm x 7.26mm.

Targeting industrial, telecom, and lighting applications, Vicor's family of high voltage bus converters give system designers a simple and cost effective means to create common bus voltages of 12V, 24V, and 48V directly from 384VDC.

Based on the patented Sine-Amplitude Converter topology, high voltage BCM ChiPs are able to reach peak efficiencies of 98% and achieve power densities up to 2400W/in<sup>3</sup>. These flexible modules can be easily paralleled into high power arrays and outputs can be put in series to achieve higher VOUT. In addition, the high voltage BCMs are offered with either analog or digital signal interface and all have an operating temperature range of -40° to 100°C.

Since all Vicor BCMs are bi-directional, designers have the opportunity to incorporate this unique feature in new designs to enhance system functionality.

Lastly, high voltage BCMs allow designers to reduce the amount of bulk capacitance needed at the load by utilizing the Sine-Amplitude Converter's low AC impedance relative to the down-stream regulator, effectively 'reflecting' the capacitance across the module.

With the new K=1/16 model, 500  $\mu$ F of 24V point-of-load capacitance can be effectively provided by 2  $\mu$ F on the module's primary side.





## Allegro MicroSystems, LLC Announces New High Current Integrated DC Motor Driver IC

Allegro MicroSystems, LLC announces a new motor driver IC designed for pulse-width-modulated (PWM) control of DC motors. Allegro's A5950 is capable of peak output currents up to  $\pm 3$  A and operating voltages up to 40 V. This new device is targeted at the automotive market with end applications to include heads-up-display, shift drive, door closure and engine thermal management applications. It is also targeted at the commercial market to drive brush DC motors for ATM cash dispensers, robotic vacuums, printers, copiers and ticketing and vending applications.

Input terminals are provided for use in controlling the speed, direction and torque of a DC motor with externally applied PWM control signals. Internal synchronous rectification control circuitry is provided to lower power dissipation during PWM operation and low current standby mode is included to improve efficiency. Internal circuit protection includes overcurrent protection, motor lead short to ground or supply, thermal shutdown with hysteresis, undervoltage monitoring of VBB, and crossover-current protection. Diagnostic features include an analog output that can be used to monitor the current through the external sense resistor and an open drain FAULTn output.

The A5950 is supplied in a low-profile 4 mm  $\times$  4 mm, 16-contact QFN (suffix "EU") package with wettable flank option (suffix "-J"), or a 16-lead eTSSOP (suffix "LP"), both with exposed power tab for enhanced thermal performance. Allegro MicroSystems, LLC is a leader in developing, manufacturing and marketing high-performance semiconductors. Allegro's innovative solutions serve high-growth applications within the automotive market, with additional focus on office automation, industrial, and consumer/communications solutions. Allegro is headquartered in Worcester, Massachusetts (USA) with design, applications, and sales support centers located worldwide. Further information about Allegro can be found at [www.allegromicro.com](http://www.allegromicro.com).



## CUI Further Expands Thermal Management Portfolio with New Line of Heat Sinks

CUI's Thermal Management Group today announced an expansion to its existing portfolio of Peltier devices and dc fans with the addition of a heat sink product line. The new line of aluminum heat sinks, available in both extruded and stamped versions, are compatible with TO-218, TO-220, TO-252, and TO-263 transistor packages. Designed to improve the heat dissipation of low and high power board level applications, these stampings and extrusions are conveniently measured under four conditions for thermal resistance, making it easier to select the optimal heat sink for natural convection or forced air cooled systems.

The extruded and stamped heat sinks offer tin plated or black anodized material finishes and are available with or without solder pins in vertical or horizontal orientations. Thermal resistances measured at 75°C  $\Delta T$  in natural convection environments are as low as 4.49°C/W, while power dissipation ratings measure up to 16.7 W at 75°C  $\Delta T$  in natural convection.

Along with their standard form factors and sizes, CUI also offers a range of custom heat sink capabilities. With alternate production methods such as forging and die casting as well as extrusions and stampings, CUI can create virtually any shape or profile to fit specific design needs. A variety of additional materials and finishes are available, including clear and color anodization, chromate powder coating, and nickel or zinc plating. Hole punching for custom mounting patterns is also an option. In addition, CUI's standard or custom heat sinks can be integrated with any of its current Peltier and dc fan offerings to achieve more complex thermal solutions.

"At CUI, we see the development and expansion of our thermal management product line as a natural complement to our industry leading portfolio of power products," stated Kraig Kawada, CUI's VP of Product Management. "As the heat in applications continues to rise due to increasing power densities, we believe that the introduction of these heat sinks, along with our current Peltier devices and dc fans will assist our customers in meeting their growing thermal management challenges."

The entire product line of extruded and stamped aluminum heat sinks is available immediately with prices starting at \$0.17 per unit at 1000 pieces through distribution. Please contact CUI for OEM pricing or custom solutions.



### Harwin extends 1.25mm micro signal high-reliability connector range

Following strong customer uptake of its initial release of the high-reliability Gecko Screw-Lok 1.25mm pitch connector, Harwin has now doubled the range, with four new pin count sizes complementing the existing product options. The company, who specializes in manufacturing interconnect solutions capable of meeting the most challenging of application demands, has announced the addition of 20, 26, 34 and 50-contact connectors. These sizes are available in all the existing connector designs:

Vertical PCB throughboard and SMT in both male and female

Horizontal PCB throughboard in male

Cable housings in both male and female  
Metal (aluminium) backshells for both male and female cable housings

Connector options doubled

The total number of new options added to the range is 36. This broadens the options available to customers dramatically, thereby enabling their specific application requirements to be fully addressed without compromises being made. As with the existing Gecko Screw-Lok products, the new additions feature ruggedized 'mate

before lock' stainless steel screw fixings for increased security with inbuilt corrosion resistance against salt spray and humidity. Pivotal to the success of the Gecko product family are Harwin's patented single piece 4-finger beryllium copper female contacts. These can withstand up to 1,000 repeated mating cycles without any loss of performance. The connector design is also optimized to withstand high vibration, shock and extremes of temperature, thereby ensuring optimum electrical performance and durability when placed under the harshest of operational conditions, even in these larger size envelopes.

Hi-Rel, Small Size

The Gecko-SL family continues to provide the industry with a package that is up to 45% smaller than conventional Micro-D connectors and up to 75% lighter. It delivers the combination of robustness, compact footprint and increased flexibility that engineers need for modern space constrained, high reliability designs. Other specifications maintained throughout the range are:

Contacts rated to 2.8A individually, 2.0A for all contacts simultaneously

Operating temperatures of -65°C to +150°C

20g vibration, Z axis 100g 6m/s shock, with no discontinuity greater than 1µs

Manufactured from environmentally-friendly materials; lead, phosphate and halogen free

Image: Addition of further sizes to Gecko Screw-Lok offering results in higher pin counts for increased design flexibility









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