

New-Tech

Magazine

Europe

August
2016

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Making cities
smarter

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accuracy in a
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Switching
hundreds of volts
and amps without
loss





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0603



0805



1206



1612



1812

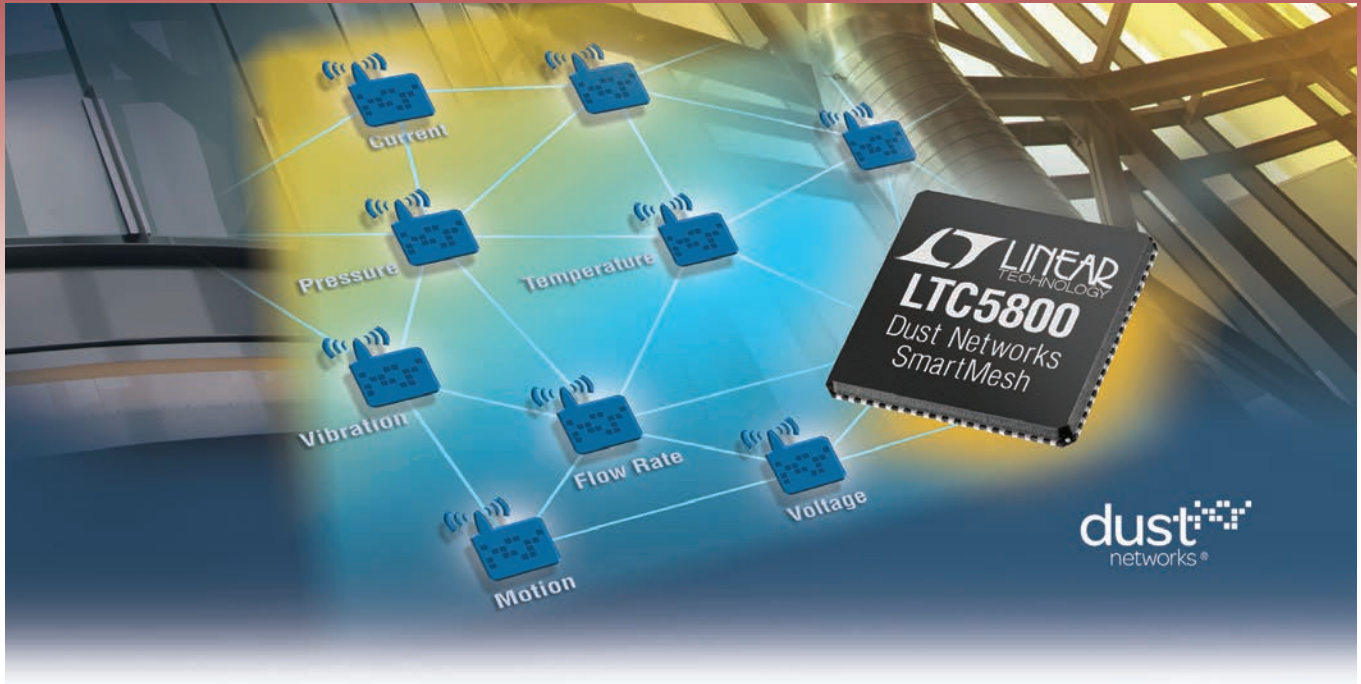


2220



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Wireless Mesh Network. Wired Reliability.



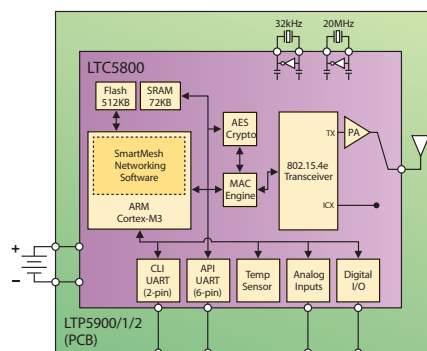
Every Node Can Run on Batteries for >10 Years at >99.999% Reliability

The Dust Networks LTC[®] 5800 and LTP[®] 5900 product families from Linear Technology are embedded wireless sensor networks (WSN) that deliver unmatched ultralow power operation and superior reliability. This ensures flexibility in placing sensors exactly where needed, with low cost “peel and stick” installations. The highly integrated SmartMesh[®] LTC5800 (system-on-chip) and LTP5900 (PCB module) families are the industry’s lowest power IEEE 802.15.4e compliant wireless sensor networking products.

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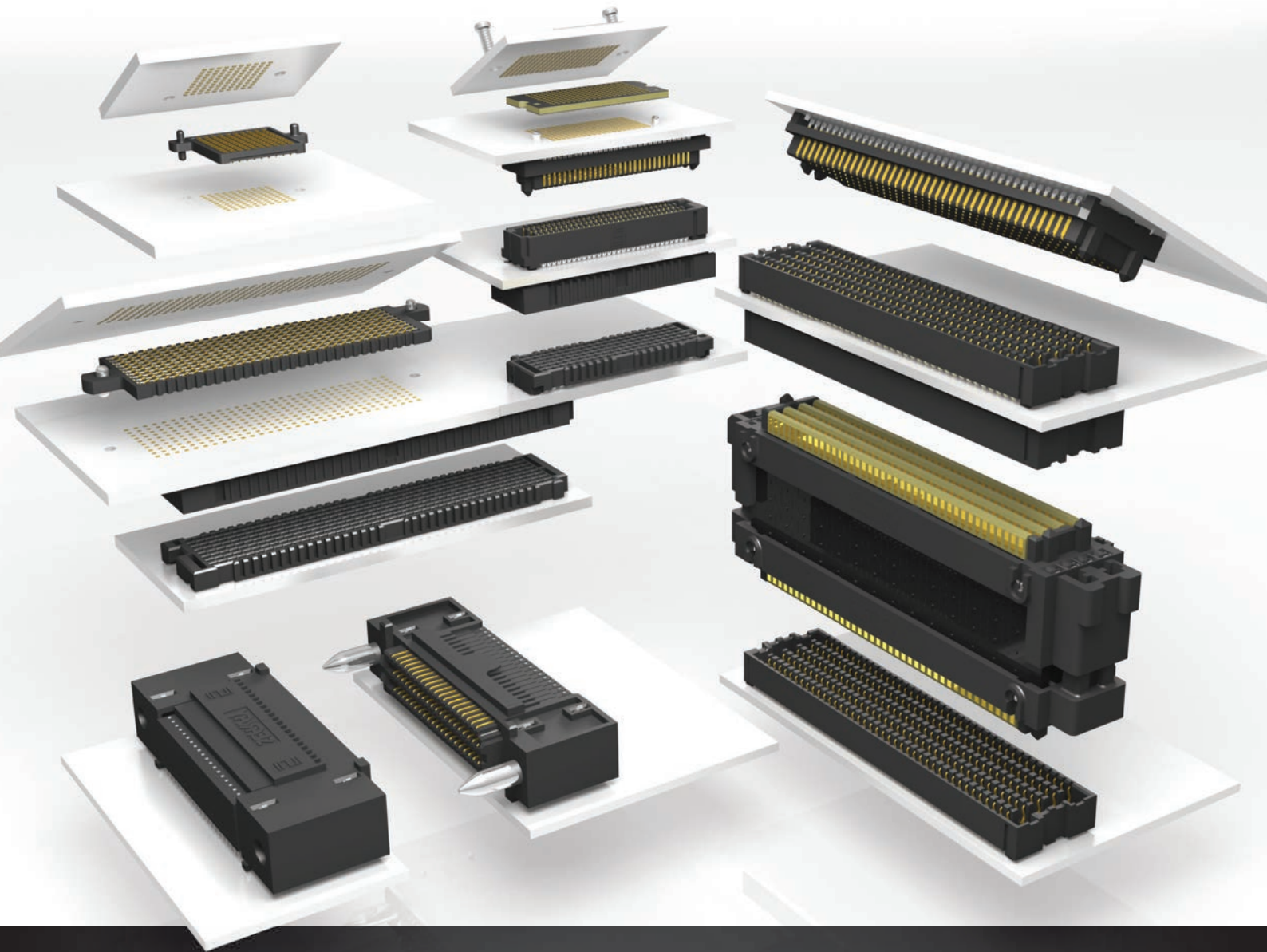
Our new EP-series ultra-wideband MMIC splitter/combiners are perfect for wide-band systems like defense, instrumentation, and all cellular bands through LTE and WiFi. These models deliver consistent performance across the whole range, so you can reduce component counts on your bill of materials by using 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 today, and have them in hand as soon as tomorrow!

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August 2016

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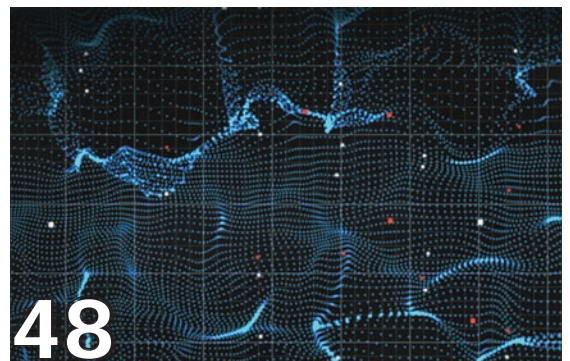
Our specialized target audiences prefer **New-Tech Europe** because they know that our publications are a reliable source of the latest information in their respective fields. Our multidimensional editorials, news items, interviews and feature articles provide them with a full, well-rounded picture of 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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Nokia expands virtual reality leadership globally with OZO launch in China

Nokia has extended its leadership position in the global virtual reality (VR) production marketplace with a China launch for OZO, the world's first VR camera for professional content creators. OZO and its robust software suite, which dramatically reduces the time, complexity, and costs associated with capturing and editing VR content, will be commercially available in China in Q3, having launched previously in the U.S. and Europe.



"We see tremendous potential for OZO in China, an exciting market with immense growth opportunities for VR and OZO. There's a genuine hunger among consumers for more immersive, high quality and professionally produced entertainment," said Ramzi Haidamus, president of Nokia Technologies. "As a single-body camera giving content professionals a simple way to produce compelling content for their audiences, OZO is tailor made to fill a very important gap."

In conjunction with the China launch, Nokia also announced a partnership with LeVR – the VR division of LeEco, one of the largest online video companies in China – to distribute OZO content. LeVR intends to deploy OZO VR solutions on their platform.

Nokia has also established an aggressive new global price that

reflects the company's continued commitment to lead and foster the nascent VR industry by providing world-class solutions for the production and distribution of professional VR content. As such, effective today OZO is priced at \$45,000 in the United States and €40,000 in the EU, with equivalent pricing anticipated in China. OZO will be available to order through Nokia reseller partners in China in September, with shipments expected in October.

Announced in July 2015, OZO is the first purpose-built, professional-grade virtual reality camera designed to dramatically reduce the time, complexity and costs associated with VR production.

The OZO portfolio continues to expand with the forthcoming OZO Live and OZO Player SDK commercial releases, creating the only market solution that can simultaneously capture 3D 360 video and spatial audio – two must-have features to deliver a truly immersive end-user VR experience.

Announced at NAB 2016, OZO Live has been used by select partners during the summer to successfully stream live 3D 360 degree VR at top-tier entertainment, sports and news events, including World Youth Day, and a P!nk concert at the Hollywood premiere of Disney's Alice Through the Looking Glass.

Dot-drawing with drones

You may have heard of plans to use drones for delivering packages, monitoring wildlife, or tracking storms. But painting murals? That's the idea behind a project in Paul Kry's laboratory at McGill University's School of Computer Science. (MRO/Multimedia) flying robots could someday help artists create outdoor murals



You may have heard of plans to use drones for delivering packages, monitoring wildlife, or tracking storms. But painting murals?

That's the idea behind a project in Paul Kry's laboratory at McGill University's School of Computer Science. Prof. Kry and a few of his students have teamed up to program tiny drones

to create dot drawings – an artistic technique known as stippling.

It's no simple feat. Programming the aerial robots to apply each payload of ink accurately and efficiently requires complex algorithms to plan flight paths and adjust for positioning errors. Even very slight air currents can toss the featherweight drones off course.

The drones, which are small enough to fit in the palm of a hand, are outfitted with a miniature arm that holds a bit of ink-soaked sponge. As they hover near the surface to be painted, internal sensors and a motion capture system help position them to dab the ink in just the right places.





Latest News

➔ So far, the flying robots have rendered – on paper – portraits of Alan Turing, Grace Kelly, and Che Guevara, among others. Each drawing is composed of a few hundred to a few thousand black dots of varying sizes.

Night flights

Kry came up with the idea a few years ago, as a way to do something about the blank hallways and stairwells in the building that houses his lab. "I thought it would be great to have drones paint portraits of famous computer scientists on them," he recalls. He bought a few of the tiny quadcopters online and had a student start on the task as a summer project in 2014, under a Canadian government award for undergraduate research.

Later, master's students Brendan Galea and Ehsan Kia took the project's helm, often working at night and into the wee hours of the morning so the drones' artistic efforts wouldn't be disturbed by air turbulence from other students coming in and out of the lab.

An article on the project by Kry and the three students won

a "best paper" prize in May at an international symposium in Lisbon on computational aesthetics in graphics and imaging.

Aiming high

And the work goes on. Eventually, larger drones could be deployed to paint murals on hard-to-reach outdoor surfaces, including curved or irregular facades, Kry says.

"There's this wonderful mural festival in Montreal, and we have giant surfaces in the city that end up getting amazing artwork on them," he notes. "If we had a particularly calm day, it would be wonderful to try to do something on a larger scale like that."

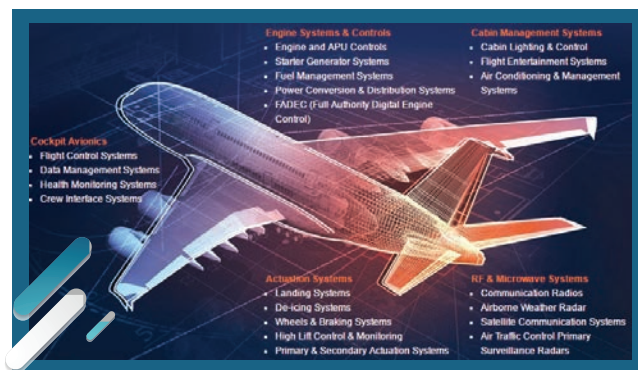
The work was supported by funding from the Natural Sciences and Engineering Research Council of Canada, the Fonds de recherche du Québec - Nature et technologies, and the Canada Foundation for Innovation.

"Stippling with Aerial Robots" Galea, Brendan; Kia, Ehsan; Aird, Nicholas; Kry, Paul G.; Eurographics Association May 2016 Expressive symposium.

Microsemi Wins Jet Propulsion Laboratory's Prestigious 'Supplier Trust and Recognition Award'

Microsemi Corporation (Nasdaq: MSCC), a leading provider of semiconductor solutions differentiated by power, security, reliability and performance, today announced it is the recipient of the Jet Propulsion Laboratory (JPL) 'Supplier Trust and Recognition Award' for the company's outstanding Electro Static Discharge (ESD) and Foreign Object Debris (FOD) quality control programs, underscoring Microsemi's commitment to maintaining the highest quality standards across all its product lines. As the representative for all NASA sites, U.S. government agencies, and their key suppliers and customers, Joint Audit Planning Committee (JAPC) in collaboration with JPL's Procurement Quality Assurance department presented the award to Microsemi during a ceremony at the company's San Jose, California facility.

"We are truly humbled by this honor from JPL, as this



validates Microsemi's legacy of quality assurance and our team's commitment to providing exceptional processes for our product development, manufacturing and delivery," said Lisa Konigsberg, director of corporate quality for Microsemi. "This award also demonstrates the importance of listening to our customers, taking a holistic approach to quality assurance

and continually reaching out for feedback to ensure we consistently exceed our customers' expectations - ultimately developing a high level of trust resulting in continued business growth."

Microsemi has a long history of providing the highest quality aerospace and defense solutions, which require high reliability products to be tested and handled in tightly controlled areas. The company extends this differentiation across all its market segments requiring the highest quality standards, ➔



→ including communications, data center and industrial.

Microsemi was recognized by JPL for successfully supporting a JAPC audit by demonstrating excellence in the operations of its testing area and product warehouse, which led to its 'Supplier Trust and Recognition Award.'

For more information about Microsemi's aerospace and defense certifications and recognitions, visit Microsemi's site. With one of the industry's most comprehensive portfolios of space products, Microsemi provides radiation-tolerant field programmable gate arrays (RT FPGAs), radiation-hardened mixed-signal integrated circuits (ICs), radiation-hardened DC-to-DC converters, precision time and frequency solutions, linear and POL hybrids, custom hybrid solutions, and radiation-hardened discretes including the broadest portfolio of JANS

Class diodes and bipolar products. Microsemi is committed to supporting its products throughout the lifetime of its customer programs. The company continues to innovate and expand its portfolio, most recently adding its new LX7730 radiation-tolerant telemetry controller IC providing key functions for sensor monitoring, attitude and payload control, as well as its RTG4™ high-speed signal processing radiation-tolerant FPGA family. The RTG4's reprogrammable flash technology offers complete immunity to radiation-induced configuration upsets in the harshest radiation environments, requiring no configuration scrubbing, unlike SRAM FPGA technology. For more information about Microsemi's space products, visit <http://www.microsemi.com/applications/space>.

Marvell Expands its awarding winning SSD product suite by introducing Advanced BGA SSD controllers for new generations of slim, High Performance computing Device

Marvell a world leader in storage, cloud infrastructure, Internet of Things (IoT), connectivity and multimedia semiconductor solutions, today announced the expansion of its solid-state drive (SSD) portfolio to include the 88NV1160 Non-Volatile Memory (NVM) Express DRAM-less SSD controller. Marvell's 88NV1160 DRAM-less SSD controller provides the industry's leading performance per Watt and up to 1600MB/s read speeds. The 88NV1160 can be used in a single ball grid array (BGA) package SSD, as well as in a standalone controller in a tiny 9x10mm package which makes it compatible with M.2230 and M.2242 form factors. These features make the 88NV1160 optimized for a new generation of slim computing devices such as productivity tablets and ultrabooks. The new controller is currently available for sampling to key customers globally.

"As the world's leading storage controller provider, Marvell has a long track record of bringing to market world-class innovations, including the pioneering integration of Host Memory Buffer technology into DRAM-less products. Working closely with other ecosystem leaders, Marvell has continued to advance the industry and drive a new generation of low power, small form factor mobile computing systems," said Dr. David Chen, Vice President of SSD Business at Marvell Semiconductor, Inc. "The 88NV1160 controller is optimally engineered for high performance tablets and ultrabooks, providing unparalleled performance per Watt and the largest

NAND compatibility on the market."

The 88NV1160 is the latest solution in Marvell's award-winning line of DRAM-less SSD controllers which includes its 88NV1120 SATA and 88NV1140 PCIe Gen3x1 NVMe products. Marvell's 88NV1160 enables Peripheral Component Interconnect Express (PCIe) Gen3x2 Non-Volatile Memory Express (NVMe) BGA SSD, and provides full support for 2D and 3D NAND, ONFI and Toggle, MLC, TLC and QLC. The 88NV1160 facilitates BGA SSD support for both 16x20mm and 11.5x13mm form factors.

Key features of Marvell's 88NV1160 include:

- NVMe support over PCIe Gen3x2
 - Fully hardware automated NVMe 1.3 support with Host Memory Buffer support
 - Low power management (L1.2) design
 - Powerful dual core ARM® Cortex®-R5 CPUs
 - Embedded SRAM with hardware accelerators to optimize IOPS performance
 - ONFI3 and Toggle2 NAND support
 - NANDEdge™ LDPC error-correction technology boosts SSD endurance and reliability and supports 15nm 2D TLC and 3D TLC/QLC
 - Full turnkey firmware and manufacturing support compatible with mainstream NAND
 - 28nm low power CMOS process
- for more information visit Marvell's site.



Novatek Licenses CEVA-XM4 Imaging and Vision DSP for Embedded Visual Intelligence

CEVA, Inc. (NASDAQ: CEVA), the leading licensor of signal processing IP for smarter, connected devices, today announced that Novatek Microelectronics, Taiwan's 2nd largest fabless IC design house, has licensed and deployed the CEVA-XM4 intelligent vision DSP for its next-generation vision-enabled System-on-Chips (SoCs) targeting a range of end markets requiring advanced visual intelligence capabilities. Novatek's current camera SoC lineup for car DVR and surveillance systems integrates the 3rd generation CEVA-MM3101 imaging & vision DSP and is shipping in volume.

By integrating CEVA-XM4 as a dedicated vision processor in their next-generation SoC designs, Novatek and its customers can rapidly deploy highly-sophisticated vision algorithms to enable advanced applications such as surveillance systems with face detection and authentication, drone anti-collision systems and advanced driver assistance systems (ADAS). These types of applications are built utilizing CEVA's Deep Neural Network (CDNN2), a proprietary software framework that enables deep



learning tasks to run on the CEVA-XM4 and outperform any GPU or CPU-based system in terms of speed, power consumption and memory bandwidth requirements.

CEVA's imaging and vision DSPs address the extreme processing requirements of the most sophisticated computational photography and computer vision applications such as video analytics, augmented reality and advanced driver assistance systems (ADAS). By

offloading these performance-intensive tasks from the CPUs and GPUs, the highly-efficient DSP dramatically reduces the power consumption of the overall system, while providing complete flexibility. The platform includes a vector processor developed specifically to deal with the complexities of such applications and an extensive Application Development Kit (ADK) to enable easy development environment. The CEVA ADK includes CEVA-Link, which streamlines software development and integration effort, a set of advanced software development tools and a range of software products and libraries optimized for the DSP.

Würth Elektronik eiSos acquires AMBER wireless GmbH

Unified for Pioneering Wireless Solutions
AMBER wireless GmbH, manufacturer of wireless connectivity solutions, is part of Würth Elektronik eiSos GmbH & Co. KG now. With the merger the owner-run wireless specialist founded in 1998 lays the foundation for its further growth and the globalization of its activities. Through the acquisition, Würth Elektronik eiSos considerably expands its range in growth fields, such as Internet of Things, Industry 4.0 and Smart Metering.



At the formal signing of the acquisition agreement: (from l. to r.) Christian Brych (Fellow partner AMBER Wireless GmbH), Heinz Brych (Managing Director AMBER Wireless GmbH), Oliver Opitz (Division Manager Strategic Product Development, Würth Elektronik eiSos GmbH & Co. KG) and Tanja Hochschild (Post Merger Integration Manager, Würth Elektronik eiSos GmbH & Co. KG)
Image source: Würth Elektronik eiSos

AMBER wireless is one of the leading manufacturers of low power ISM/SRD solutions in Europe and offers highly efficient wireless products in the 169 MHz, 433 MHz, 868 MHz, 915 MHz and 2.4 GHz frequency bands. These wireless solutions are considered to be important components for growth-intensive application areas, such as sensor networks, Internet of Things, telemetry, logistics, asset tracking, Smart Metering, medical technology, security systems, as well as Smart Home, industry and building automation.

"Integration of AMBER



➔ wireless is our good fortune. The expertise and the products, which the new colleagues contribute, support Würth Elektronik eiSos in a strategically crucial segment. The leading-edge technology for industrial wireless networks boosts our range for growth markets like Industry 4.0, IoT or Smart Metering. Planned investments in this field will support our global activities”, according to Oliver Konz and Thomas Schrott, CEOs of Würth Elektronik eiSos Group.

Heinz Brych, founder and Managing Director of AMBER wireless GmbH, says: “I know we are in good hands with Würth Elektronik eiSos. Here we will receive the necessary support to expand our global presence. Strong relationships with semiconductor manufacturers across the world, a global sales network and outstanding direct selling – these are things where Würth Elektronik has the edge over us and from which we are set to profit greatly. I'm glad to be able to secure the future of AMBER wireless in this way.”

congatec introduces highly flexible IoT gateway system

congatec, a leading technology company for embedded computer modules, single board computers and embedded design and manufacturing services, introduces its flexible IoT gateway solution. This new, highly flexible IoT gateway system is application ready and easily customizable for rapid field deployment. The congatec IoT gateway offers extreme levels of flexibility in terms of processing performance and software integration, able to host up to 8 wireless antennas that can be connected to 3 mini PCI Express slots and 6 internal USB based slots for wireless and wired connectivity modules. Customized system designs are also available upon request.

OEMs utilizing the conga IoT gateway system benefit from a pre-configured, pre-certified IoT gateway that can easily connect a wide range of heterogeneous sensors and systems to cloud-based services. Target uses include Industrial Internet of Things (IIoT) applications such as smart cities, smart agriculture, connected homes and vehicles, digital signage systems and other IoT applications.

congatec's CEO Jason Carlson explains its application-ready-system strategy for IoT gateways: “The large and fast growing IoT market is well served by congatec's traditional embedded computer boards and module products, but OEMs are increasingly demanding IoT gateways that are complete, application-ready systems. To meet this growing need, congatec has designed a highly flexible and configurable gateway system that can be optimized to meet a wide variety of specific application demands. Together with our embedded design and manufacturing services, we can now meet any specific IoT gateway requirement.” As well as the engineering and production of optimized IoT solutions, congatec's embedded design and manufacturing service also includes certification services, an increasingly essential element of deploying wireless technologies and edge devices that connect to carrier grade infrastructures.

The wireless connectivity of the congatec IoT gateway system is extremely scalable: 6 internal USB ports and 3 miniPCIe

slots are available and able to support LTE 3GPP modems, 2x WI-FI, 2x LAN with PoE and PROFINET features, low power Bluetooth (BTLE) and 6LoWPAN. Other low power wide area networks including LORA, 3GPP, LTE-MTC, Sigfox or UNB can be supported upon customer request. This allows for maximum flexibility in supporting all major IoT connectivity requirements. The housing is equipped to mount up to 8 antennas supporting multiple wireless standards in parallel, while enhancing signal quality by utilizing antenna diversity. The small size (200x230x40mm³) metal housing is certified to IP53 protection class for outdoor applications.

In order to deliver optimal and rapid IoT gateway designs, congatec developed the system to support scalable computing performance utilizing Qseven modules, which range from the NXP single-core i.MX6 processor up to a quad core Intel Pentium CPU. The gateway also supports the upcoming next generation of Intel Atom processors (Intel code name “Apollo Lake”) for deployment in emerging IoT gateway and edge computing application scenarios, up to and including high availability fog computing systems.

The congatec embedded board support packages cover all major operating systems – including Windows 10 IoT – to enable easier software integration. The congatec IoT gateway system also supports all the features of congatec's embedded board controller, which are a must for reliable IoT applications. Amongst other functions, the congatec feature set enables secure boot, management of Multi-Master I²C Bus, Multi Stage Watchdog, non-volatile User Data Storage, Manufacturing and Board Information, Board Statistics, as well as Power Loss Control.

Talk to your congatec sales representative today to discover how your IoT applications can be implemented using the congatec IoT gateway system.



Intel CEO Introduces Vision for Merged Reality at 2016 Intel Developer Forum

The 2016 Intel Developer Forum (IDF) kicked off today in San Francisco with an opening keynote by Intel CEO Brian Krzanich. Krzanich articulated the company's vision for the future of technology spanning virtual reality, autonomous driving, the industrial Internet, and the important role developers play in bringing this future to life. On stage, and in an editorial on Medium, Krzanich explained his vision for merged reality - a new way of experiencing physical and virtual interactions and environments through a suite of next-generation sensing and digitizing technologies.

According to Krzanich, "Merged reality delivers virtual world experiences more dynamically and naturally than ever before – and makes experiences impossible in the real world now possible."

A replay of today's keynote will be available here in the Intel newsroom. Below is a summary of the IDF Day 1 news. Please check back for 2016 IDF news and updates.

IDF Day One News Highlights:

Unveiled Intel Project Alloy, an all-in-one virtual reality solution that features the compute and sensors integrated directly into the headset and leverages Intel® RealSense™ technology. Project Alloy will be offered as an open hardware platform in 2017. More information at "Intel Unveils Project Alloy."

Announced a collaboration with Microsoft to bring virtual reality to mainstream PCs. This new high-end compute platform is capable of delivering human-like senses to a new generation



Intel CEO Brian Krzanich welcomes thousands of developers to the 2016 Intel Developer Forum in San Francisco on Tuesday, Aug. 16, 2016, with an opening keynote presentation. His presentation offered perspective on the unique role Intel will play as the boundaries of computing continue to expand. (Credit: Intel Corporation)

of smart devices and is now available. More information at "Make Amazing Things Happen in IoT and Entrepreneurship with Intel Joule."

Announced the availability of the Yuneec Typhoon H drone with Intel RealSense technology, the Intel Aero Platform Compute Board and the Intel Aero Platform Ready-to-Fly Drone. More information at

"New Opportunities and Tech for Drone Developers and Enthusiasts."

Announced the Intel® Euclid™ Developer Kit for researchers, makers and robotics developers. This device integrates sense, compute, and connect capabilities in an all-in-one

candy bar size form-factor that gives developers the ability to quickly and easily create applications with Intel RealSense technology. More information at "Intel Announces Tools for RealSense Technology Development."

Intel Custom Foundry announced its 10 nm design platform will now offer access to ARM Artisan® physical IP to enable foundry customers to achieve best-in-class PPA (power, performance, area) for power-efficient, high-performance implementations of their designs for mobile, IoT and other consumer applications. Zane Ball, co-general manager of Intel Custom Foundry, explained the news in a blog post and also welcomed LG Electronics as an Intel Custom Foundry customer on 10 nm. More information at "Accelerating Foundry Innovation for a Smart and Connected World."

Tektronix Begins Delivery of the IsoVu™ Optically Isolated Measurement System

Tektronix, a leading worldwide provider of measurement solutions, today announced that the IsoVu™ Measurement System previewed earlier this year at the APEC 2016 show is now shipping and available for worldwide delivery to customers. Pricing for the optically isolated measurement system starts at \$12,000. For full details, visit the Tektronix site.

IsoVu Technology Combines 1 GHz Bandwidth, Wide Common

Mode Range, with Superior Common Mode Rejection to Make Previously Hidden Signals Visible

The IsoVu™ platform uses an electro-optic sensor to convert input signals to optical modulation, electrically isolating the device-under-test from a Tektronix oscilloscope. The system incorporates four separate lasers, an optical sensor, five optical fibers, and sophisticated feedback and control [➔](#)



→ techniques. The sensor head, which connects to the test point, has complete electrical isolation and is powered over one of the optical fibers. Ten patent applications have been filed for this ground breaking technology. A critical advantage this technology offers for designers, such as those working on power devices involving GaN and SiC technologies, is superior common mode rejection that makes signals previously buried in common mode noise visible for the first time. IsoVu offers 1 Million:1 (120 dB) common mode rejection (CMRR) up to 100 MHz and 10,000:1 (80 dB) CMRR at 1 GHz. By comparison, competitive solutions at 100 MHz offer approximately 20 dB CMRR at 100 MHz, making IsoVu 100,000 times better. “The feedback we received from designers at APEC was overwhelmingly positive, with many of them facing a critical need for the design insights IsoVu now makes possible,” said Chris Witt, general manager, Time Domain Business Unit, Tektronix. “Currently there is no measurement system on the market with IsoVu’s combination of high bandwidth,



2000V common mode voltage range and breakthrough common mode rejection ratio.”

Using IsoVu, engineers can accurately measure small differential signals (5 mV – 50 V) in the presence of large common mode voltages from DC to 1 GHz. IsoVu is the first signal acquisition product where the common mode voltage capability does not de-rate over bandwidth. IsoVu technology is available in 6 models of the TIVM Series Isolated Measurement Systems with 200 MHz, 500 MHz and 1

GHz bandwidth configurations with either 3-meter or 10-meter fiber optic cable lengths. The 10-meter cable option offers the same performance specifications as the 3-meter option and allows users to move their test system away from the interference and radiated emissions of the device under test. With this option, IsoVu is well-suited for such applications as remote testing and EMI validation.

Doubling battery power of consumer electronics

New lithium metal batteries could make smartphones, drones, and electric cars last twice as long.

An MIT spinout is preparing to commercialize a novel rechargeable lithium metal battery that offers double the energy capacity of the lithium ion batteries that power many of today’s consumer electronics.

Founded in 2012 by MIT alumnus and former postdoc Qichao Hu ’07, SolidEnergy Systems has developed an “anode-free” lithium metal battery with several material advances that make it twice as energy-dense, yet just as safe and long-lasting as the lithium ion batteries used in smartphones, electric cars, wearables, drones, and other devices.

“With two-times the energy density, we can make a battery half the size, but that still lasts the same amount of time, as a lithium ion battery. Or we can make a battery the same size as a lithium ion battery, but now it will last twice as long,” says Hu, who co-invented the battery at MIT and is now CEO of SolidEnergy. The battery essentially swaps out a common battery anode

material, graphite, for very thin, high-energy lithium-metal foil, which can hold more ions - and, therefore, provide more energy capacity. Chemical modifications to the electrolyte also make the typically short-lived and volatile lithium metal batteries rechargeable and safer to use. Moreover, the batteries are made using existing lithium ion manufacturing equipment, which makes them scalable.

In October 2015, SolidEnergy demonstrated the first-ever working prototype of a rechargeable lithium metal smartphone battery with double energy density, which earned them more than \$12 million from investors. At half the size of the lithium ion battery used in an iPhone 6, it offers 2.0 amp hours, compared with the lithium ion battery’s 1.8 amp hours.

SolidEnergy plans to bring the batteries to smartphones and wearables in early 2017, and to electric cars in 2018. But the first application will be drones, coming this November. “Several customers are using drones and balloons to provide free Internet to the developing world, and to survey for disaster relief,” →



Latest News

→ Hu says. Putting these new batteries in electric vehicles as well could represent “a huge societal impact,” Hu says.

Lithium metal, for one, reacts poorly with the battery’s electrolyte - a liquid that conducts ions between the cathode (positive electrode) and the anode (negative electrode) - and forms compounds that increase resistance in the battery and reduce cycle life. This reaction also creates mossy lithium metal bumps, called dendrites, on the anode, which lead to short circuits, generating high heat that ignites the flammable electrolyte, and making the batteries generally nonrechargeable.

Measures taken to make the batteries safer come at the cost of the battery’s energy performance, such as switching out the liquid electrolyte with a poorly conductive solid polymer electrolyte that must be heated at high temperatures to work, or with an inorganic electrolyte that is difficult to scale up.

While working as a postdoc in the group of MIT professor Donald Sadoway, a well-known battery researcher who has developed several molten salt and liquid metal batteries, Hu



helped make several key design and material advancements in lithium metal batteries, which became the foundation of SolidEnergy’s technology.

One innovation was using an ultrathin lithium metal foil for the anode, which is about one-fifth the thickness of a traditional lithium metal anode, and several times thinner and lighter than traditional graphite, carbon, or silicon

anodes. That shrunk the battery size by half.

But there was still a major setback: The battery only worked at 80 degrees Celsius or higher.

So Hu developed a solid and liquid hybrid electrolyte solution. He coated the lithium metal foil with a thin solid electrolyte that doesn’t need to be heated to function. He also created a novel quasi-ionic liquid electrolyte that isn’t flammable, and has additional chemical modifications to the separator and cell design to stop it from negatively reacting with the lithium metal. The end result was a battery with energy-capacity perks of lithium metal batteries, but with the safety and longevity features of lithium ion batteries that can operate at room temperature.

FORD TARGETS FULLY AUTONOMOUS VEHICLE FOR RIDE SHARING IN 2021: INVESTS IN NEW TECH COMPANIES, DOUBLES SILICON VALLEY TEAM

Ford announces its intent to have a high-volume, fully autonomous SAE level 4-capable vehicle in commercial operation in 2021 in a ride-hailing or ride-sharing service.

To get there, the company is investing in or collaborating with four startups to enhance its autonomous vehicle development, doubling its Silicon Valley team and more than doubling its Palo Alto campus.

“The next decade will be defined by automation of the automobile, and we see autonomous vehicles as having as significant an impact on society as Ford’s moving assembly line did 100 years ago,” said Mark Fields, Ford president and CEO. Autonomous vehicles in 2021 are part of Ford Smart Mobility, the company’s plan to be a leader in autonomous vehicles, as well as in connectivity, mobility, the customer experience, and data and analytics.

Building on more than a decade of autonomous vehicle research and development, Ford’s first fully autonomous vehicle will be a Society of Automotive Engineers-rated level 4-capable vehicle

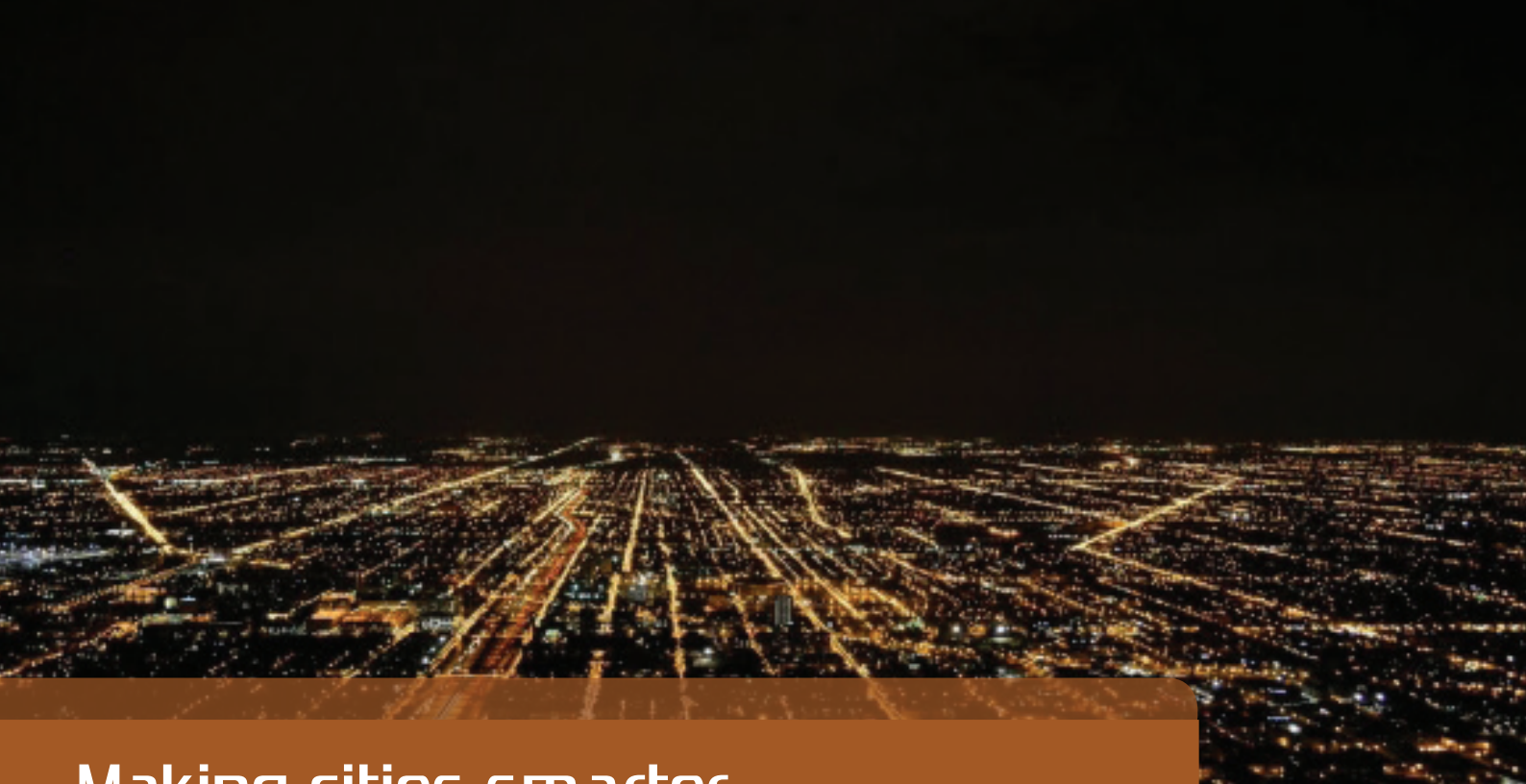


without a steering wheel or gas and brake pedals. It is being specifically designed for commercial mobility services, such as ride sharing and ride hailing, and will be available in high volumes.

“Ford has been developing and testing autonomous vehicles for more than 10 years,” said Raj Nair, Ford executive vice president, Global Product Development, and chief technical officer.

This year, Ford will triple its autonomous vehicle test fleet to be the largest test fleet of any automaker – bringing the number to about 30 self-driving Fusion Hybrid sedans on the roads in California, Arizona and Michigan, with plans to triple it again next year.

Ford was the first automaker to begin testing its vehicles at Mcity, University of Michigan’s simulated urban environment, the first automaker to publicly demonstrate autonomous vehicle operation in the snow and the first automaker to test its autonomous research vehicles at night, in complete darkness, as part of LiDAR sensor development.



Making cities smarter

> Jennifer Formichelli, Institute for Data, Systems, and Society

MIT researchers are creating tools that synthesize and collect data so that urban planners can vastly improve the quality of urban life.

Imagine your city as it might be in the not-so-distant future

Transportation in this city is various, pleasant, and low-impact. There are safe and efficient bike lanes, and anyone can order a cheap ride from an autonomous, minimal-emissions vehicle. Because fewer people drive, and almost no one idles in traffic, air quality is high. There are plenty of parks and open spaces because cars are less prevalent. Life in your city is happy, healthy, and sustainable. Your city is, above all, a smart city.

The smart city, like the smart home, is built on and around the "Internet of things," in which networked products gather, store, and share user data while communicating with one another

in order to create improved and highly-efficient living environments. In a smart city, the Internet of things expands outward from the home into a plethora of automated and interconnected urban devices. The communication between and among these devices allows for vast amounts of municipal data to be gathered and eventually analyzed. A smart city leverages its collection of massive data to learn about its residents, showcasing the ways in which smart cities are beginning to transcend the Internet of things, by gathering massive data sets that are gradually helping researchers understand vast and complex networks.

However differently smart cities may be defined or described, underlying them all is an array of interconnected social networks and systems, an understanding of which allows for data-driven urban planning that stands to vastly improve the quality of urban life. Sarah Williams, an Institute for Data,

Systems, and Society (IDSS) affiliate and assistant professor of urban design who directs MIT's Civic Data Design Lab - an urban studies center that uses both data visualization and data collection to identify and understand various urban phenomena - is an example of an urban planner using this data to communicate the complexities of urban life in order to drive decisions. "When data is made comprehensible to a large number of people," Williams remarks, "it is well-positioned to drive social change. Creating tools that synthesize and collect data transforms how we see the world, at one time showing us the effects of policies while also providing essential information to develop new urban strategies."

William's research shows the kind of impact IDSS researchers are having by developing and communicating an understanding of vast and complex urban social networks. At the same time, other IDSS researchers are

New-Tech Europe

Read To Lead



helping to develop smart technologies that will power future cities, such as autonomous vehicles and smart energy meters, using a systems approach to build effective solutions for the improvement of urban life and the solution of societal problems.

Transportation systems in smart cities

Transportation is one of the greatest of those problems, and one of the most essential areas for innovation within the smart city - particularly the promise of autonomous vehicles. Emilio Frazzoli, an IDSS faculty affiliate based in the Department of Aeronautics and Astronautics, has made significant inroads in the area of autonomous vehicle innovation. Frazzoli joined project leader and senior paper author Daniela Rus, the Andrew and Erna Viterbi Professor in Electrical Engineering and Computer Science - as well as other colleagues - in testing an autonomous vehicle pilot scheme last fall in Singapore, where the Singapore-MIT Alliance for Research and Technology (SMART) is based. Over six days, autonomous golf carts were made available to visitors in a large, public garden in Singapore, where passengers could summon them through an online booking station and book rides to and from predetermined points. The small carts, a minimalist version of an autonomous vehicle with a maximum speed of 15 miles per hour, adroitly navigated paths in the garden, making sure to avoid pedestrians and cyclists.

Frazzoli is now working to create street-ready autonomous vehicle technology that could transform urban travel in the near future. "If deployed more broadly," Frazzoli remarks, "autonomous cars have the potential to change how we think of personal mobility, especially in urban settings. Cars that are able to drive autonomously to pick up customers,

take them to their destination, and then park themselves (or serve the next customer) can provide a mobility service that is almost as convenient as privately owned cars, with the sustainability of public transportation." Another contribution from Frazzoli to autonomous vehicle technology is a mathematical model he developed with Carlo Ratti, a professor of the practice and director of the SENSEable City Lab in MIT's Department of Urban Studies and Planning. The model plans for an autonomous, or "slot-based," intersection" (SI). These intersections remove the need for traffic lights by allowing autonomous vehicles, acting in concert as part of the Internet of things, to communicate with one another to ensure that each arrives at an intersection precisely when a "slot" required to pass through safely becomes available. This process speeds up traffic flow by eliminating unnecessary stoppage, decreasing emissions and increasing efficiency. Frazzoli's model demonstrates that it is possible to create a city without traffic lights, though such an achievement would require new innovation in other areas, for instance in developing ways for pedestrians and cyclists to move safely along with vehicles through SI intersections.

Smart incentives

The smartest of smart cities go even further than mechanical and systematic improvements, however, by helping their residents learn how to best conserve resources, including their own money. The large amounts of data gathered on transportation patterns in cities is helping researchers understand and develop incentives that encourage people to adapt their behaviors to a more efficient model, and to make more optimal choices, such as traveling during off peak hours.

MIT assistant professor and IDSS faculty member Jessika Trancik, in

collaboration with Moshe Ben-Akiva, professor of civil and environmental engineering, is leading a large project that explores possibilities for helping people adapt their transportation behavior. The pair, along with several other MIT departments and a team at the University of Massachusetts at Amherst, are developing the Mobility Electronic Market for Optimized Travel, or MeMOT, a system in which consumers are rewarded — as they are in other areas of the marketplace — for optimal behavior. As Trancik remarks, "People make transportation choices based on their preferences and the information that they have. There is no question that access to information ... affects personal transportation choices on a daily basis."

By being given accurate, real-time information and feedback, consumers and residents are encouraged to exchange less efficient patterns of behavior for more efficient ones. In a smart city, where behaviors can be measured, data revealing actual behaviors and choices can also be more readily gathered, allowing for urban architects and engineers to learn which individual choices could be changed to improve overall quality of life and efficiency. Trancik remarks that's "why models are important. Through modeling we can combine the most useful pieces of information in diverse data sets to provide a picture of the daily choices available to consumers of vehicles, drivers and travelers more generally."

This sort of rapid responsiveness to readily available data, applied to individual choices about transport, energy, and other resources, could, in fact, be the very thing that finally closes the "open loop" of the energy markets, creating more efficient, reliable grids, something particularly necessary in the present and future age of "mega-cities."

Smart energy systems

Energy is one of the markets in which it is simultaneously difficult and crucial for consumers to make good, informed choices. This is because typical energy markets are "closed," as demand doesn't vary according to price (although price fluctuates with demand). Energy market prices fluctuate with extreme frequency, and, since most customers have no access to this data in real-time, they are unprepared and unable to respond to these sorts of pricing markets. Customers instead tend to base energy choices on convenience rather than price, creating an open loop that allows energy companies to set price according to demand, but which doesn't allow customers to respond to price. The normal feedback loop in these markets, however, is complicated by rapid price fluctuations.

When customers are given real-time pricing information in energy markets, as with "smart meters," the consequences of good responses can, surprisingly, be devastating, according to research conducted by IDSS Director Munther Dahleh and others. If demand changes according to price fluctuation, which is the goal of most "smart technologies" that provide consumers with real-time data, rapid and erratic fluctuations in demand could result. Such fluctuations could cause a particularly dangerous situation in energy markets, which have "ramp constraints," meaning that supply cannot easily keep up with rapidly fluctuating demand.

Dahleh and his collaborators, MIT research scientist Mardavij Roozbehani and Professor Sanjoy Mitter, are exploring just this nexus by using control theory (a branch of engineering and mathematics that studies how dynamic systems can be modified by feedback) to create a feedback loop for energy pricing that would allow for consumer pricing response, while mitigating excessive fluctuations in demand. Solving this problem could

make for significantly better energy policy, contributing to more efficient and smarter cities that create less systemic risk to the grid, and make the grid considerably smarter. Dahleh remarks that "the smart grid, through smart metering, will enable real-time demand shifting to cope with the uncertainty of renewable generation and to reduce the stress on the power grid. To realize this value, we are developing models and strategies to design incentive mechanisms, through pricing or availability of information, that will shape the consumer's behavior in a fair and efficient manner."

Future promises

The smart cities of the not-too-distant future will themselves be feedback loops and smart grids comprised of interconnected, networked technologies that help people make informed choices based on efficiency, quality of life, and convenience. A sophisticated understanding of the data behind these complex networks will allow researchers to create continually improved systems that help people lead better, more efficient lives.

Although the prospect, and the reality, of smart cities does raise serious questions about cybersecurity, trust, and digital privacy, smart cities promise a great deal of improvement in the quality of life for their residents. The advances made by IDSS researchers, working across disciplines and domains, may even mean that tomorrow's "mega cities" — which once threatened to drain natural resources, and cause massive congestion across systems — will instead be "mega smart cities," fitted with highly-efficient interconnected systems that work together to offer residents a good, sustainable quality of life, and far more promising futures.

This article is part of a series highlighting major areas of research and innovation at MIT's new Institute for Data, Systems, and Society.

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Ferrite Beads Demystified

› Jefferson Eco and Aldrick Limjoco, Analog Devices

Introduction

An effective method for filtering high frequency power supply noise and cleanly sharing similar voltage supply rails (that is, analog and digital rails for mixed-signal ICs) while preserving high frequency isolation between the shared rails is the use of ferrite beads. A ferrite bead is a passive device that filters high frequency noise energy over a broad frequency range. It becomes resistive over its intended frequency range and dissipates the noise energy in the form of heat. The ferrite bead is connected in series with the power supply rail and is often combined with capacitors to ground on either side of the bead. This forms a low-pass filter network, further reducing the high frequency power supply noise.

However, improper use of ferrite beads in system design can lead to some detrimental issues. Some examples are unwanted resonance due to combining the bead with a decoupling capacitor for low-pass filtering and the effect of dc bias current dependency that degrades the EMI suppression capability of the bead. With proper understanding and consideration of the ferrite bead's behavior, these issues can be avoided.

This article discusses the important considerations that system designers need to be aware of when using ferrite beads in power supply systems such as impedance vs. frequency characteristics with varying dc bias current and unwanted LC resonance effects. Ultimately, to address the issue on the unwanted resonance, damping techniques will be introduced

and a comparison of the effectiveness of each damping method will be presented.

The device used to demonstrate the effects of ferrite beads as an output filter is a 2 A/1.2 A dc-to-dc switching regulator with independent positive and negative outputs (ADP5071).

The ferrite beads used in the article are mainly chip type surface-mount packages.

Ferrite Bead Simplified Model and Simulation

A ferrite bead can be modeled as a simplified circuit consisting of resistors, an inductor, and a capacitor, as shown in Figure 1a. RDC corresponds to the dc resistance of the bead.

C_{PAR} , L_{BEAD} , and R_{AC} are (respectively) the parasitic capacitance, the bead inductance, and the ac resistance (ac

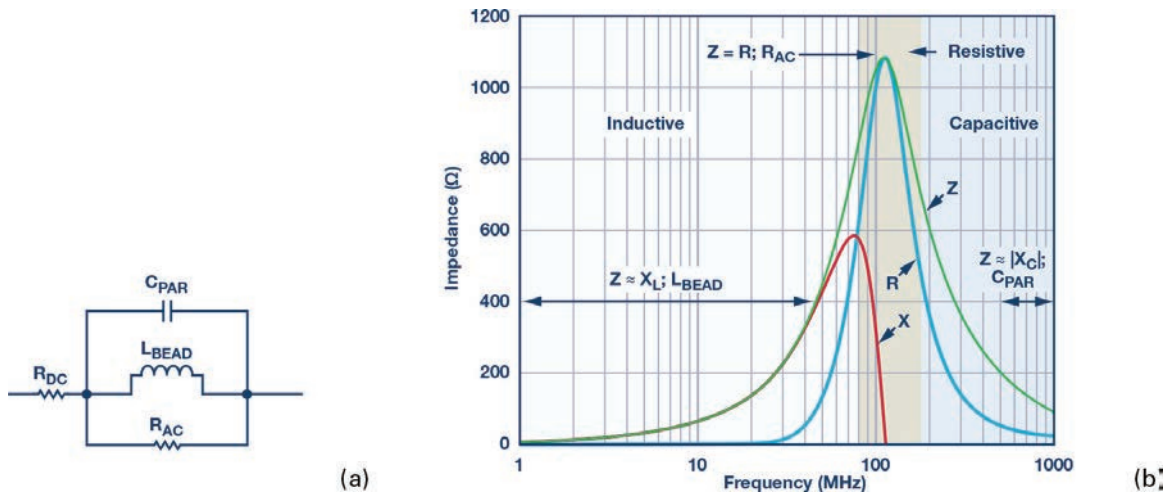


Figure 1. (a) Simplified circuit model and (b) Tyco Electronics BMB2A1000LN2 measured ZRX plot.

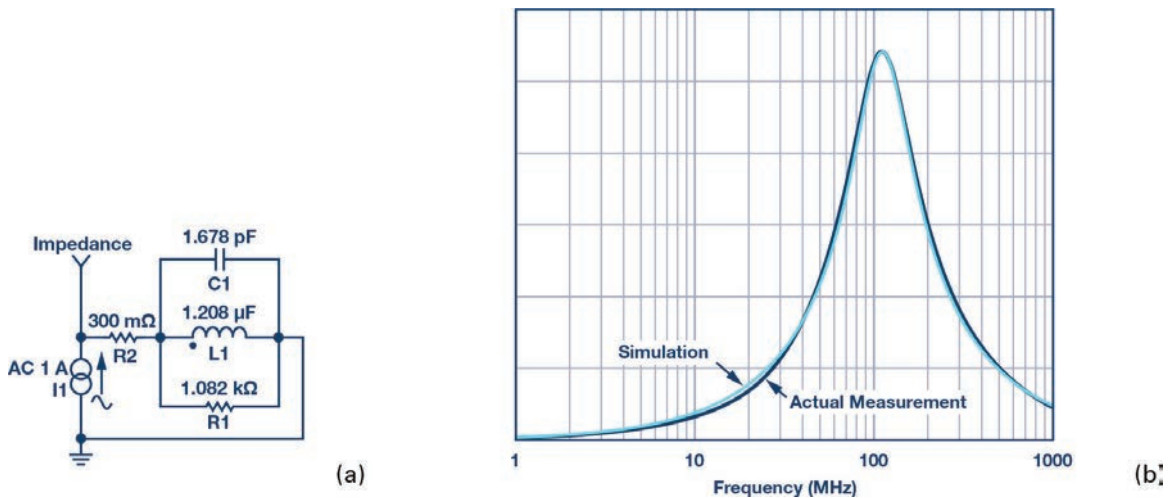


Figure 2. (a) Circuit simulation model and (b) Actual measurement vs. simulation.

core losses) associated with the bead. Ferrite beads are categorized by three response regions: inductive, resistive, and capacitive. These regions can be determined by looking at a ZRX plot (shown in Figure 1b), where Z is the impedance, R is the resistance, and X is the reactance of the bead. To reduce high frequency noise, the bead must be in the resistive region; this is especially desirable for electromagnetic interference (EMI)

filtering applications. The component acts like a resistor, which impedes the high frequency noise and dissipates it as heat. The resistive region occurs after the bead crossover frequency ($X = R$) and up to the point where the bead becomes capacitive. This capacitive point occurs at the frequency where the absolute value of capacitive reactance ($-X$) is equivalent to R . In some cases, the simplified circuit model can be used to approximate the

ferrite bead impedance characteristic up to the sub-GHz range. The Tyco Electronics BMB2A1000LN2 multilayer ferrite bead is used as an example. Figure 1b shows the measured ZRX response of the BMB2A1000LN2 for a zero dc bias current using an impedance analyzer. For the region on the measured ZRX plot where the bead appears most inductive ($Z \approx X_L; L_{BEAD}$), the bead inductance is calculated by the

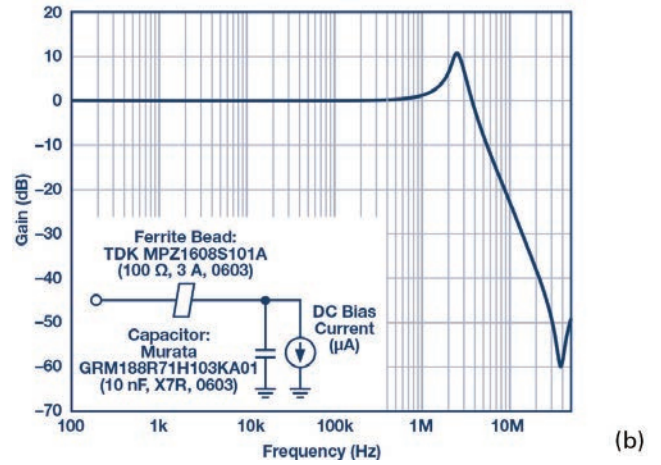
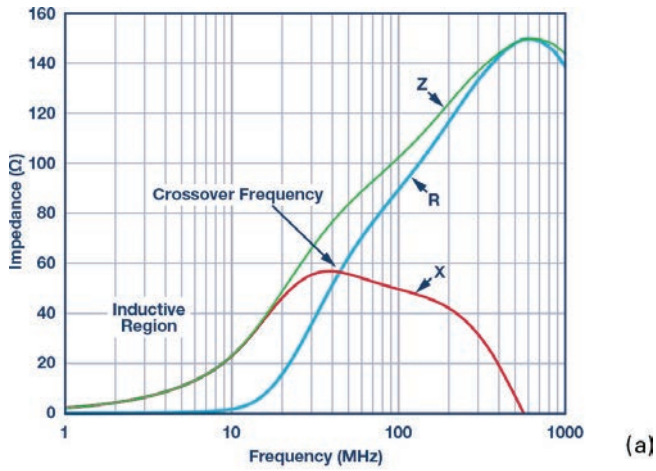


Figure 4. (a) A TDK MPZ1608S101A ZRX plot and (b) a S21 response for a ferrite bead and capacitor low-pass filter

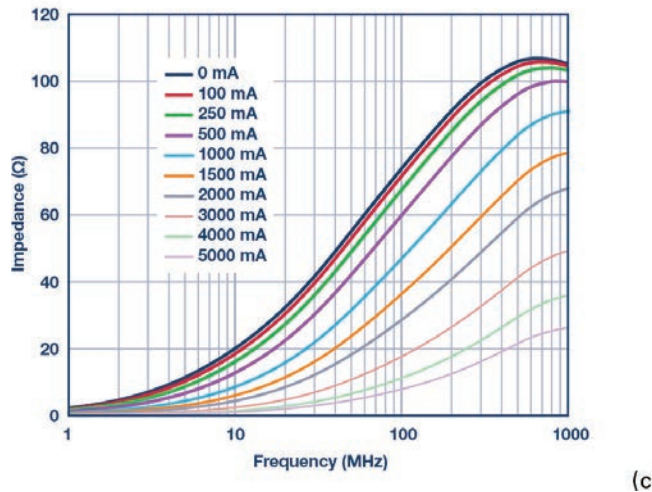
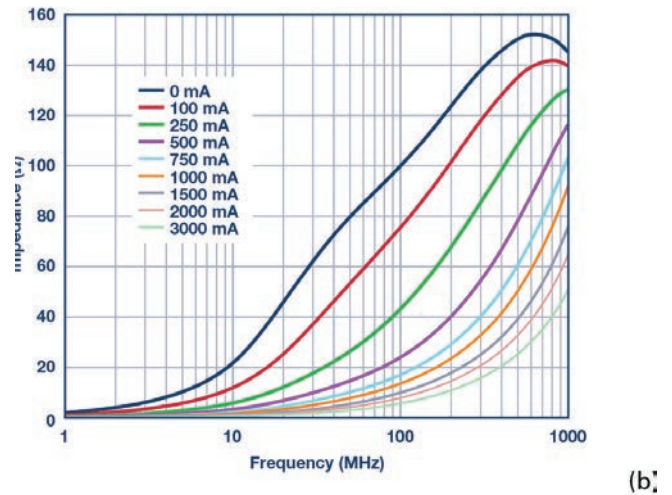
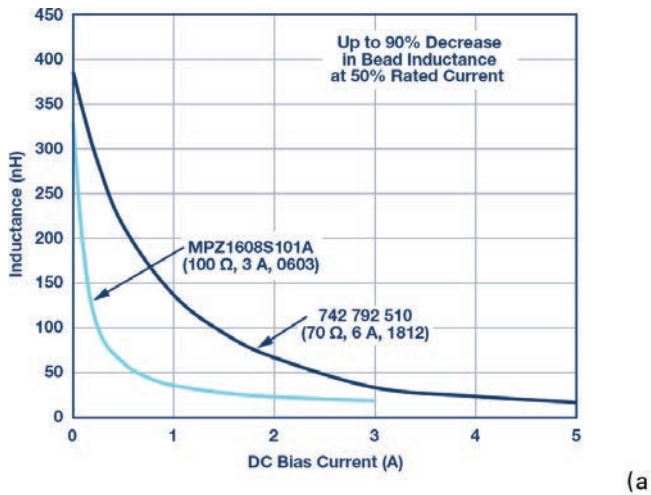


Figure 3. (a) The effect of dc bias current on bead inductance and impedance curves with respect to dc bias current for: (b) a TDK MPZ1608S101A bead, and (c) a Würth Elektronik 742 792 510 bead

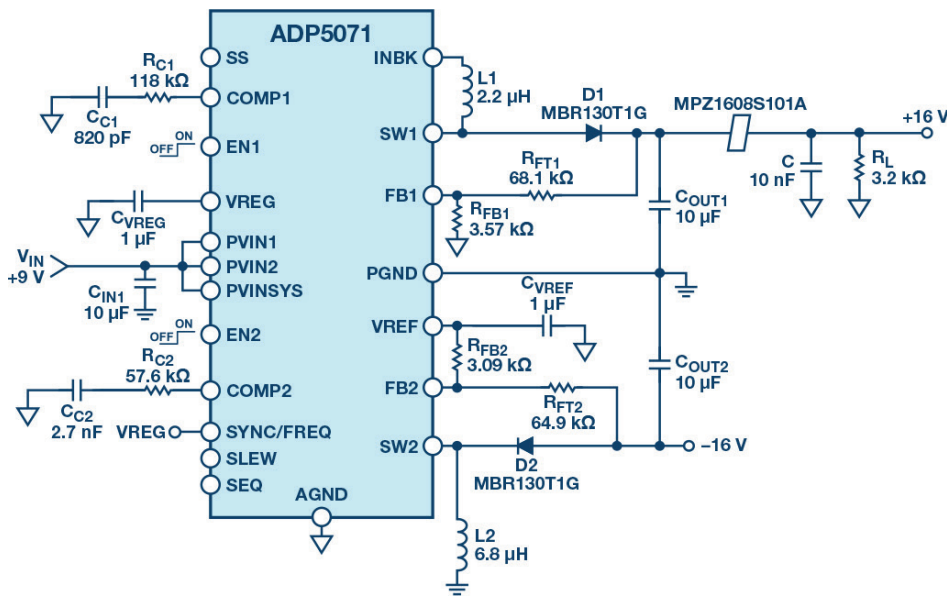


Figure 5. ADP5071 application circuit with a bead and capacitor lowpass filter implementation on positive output

following equation:

$$L_{BEAD} = \frac{X_L}{2 \times \pi \times f}$$

where:

f is the frequency point anywhere in the region the bead appears inductive. In this example, $f = 30.7$ MHz. X_L is the reactance at 30.7 MHz, which is 233 Ω .

Equation 1 yields an inductance value (L_{BEAD}) of 1.208 μ H.

For the region where the bead appears most capacitive ($Z \approx |X_C|$; C_{PAR}), the parasitic capacitance is calculated by the following equation:

$$C_{PAR} = \frac{1}{2 \times \pi \times f \times |X_C|}$$

where:

f is the frequency point anywhere in the region the bead appears capacitive. In

this example, $f = 803$ MHz $|X_C|$ is the reactance at 803 MHz, which is 118.1 Ω .

Equation 2 yields a parasitic capacitance value (C_{PAR}) of 1.678 pF.

The dc resistance (R_{DC}), which is 300 m Ω , is acquired from the manufacturer's data sheet. The ac resistance (R_{AC}) is the peak impedance where the bead appears to be purely resistive.

Calculate R_{AC} by subtracting R_{DC} from Z . Because R_{DC} is very small compared to the peak impedance, it can be neglected.

Therefore, in this case R_{AC} is 1.082k Ω . The ADIsimPE circuit simulator tool powered by SIMetrix/SIMPLIS was used to generate the impedance vs. the frequency response. Figure 2a shows the circuit simulation model with

the calculated values and Figure 2b shows both the actual measurement and simulated result. In this example, the impedance curve from the circuit simulation model closely matches the measured one.

The ferrite bead model can be useful in noise filtering circuit design and analysis. For example, approximating the inductance of the bead can be helpful in determining the resonant frequency cutoff when combined with a decoupling capacitor in a low-pass filter network. However, the circuit model specified in this article is an approximation with a zero dc bias current. This model may change with respect to dc bias current, and in other cases, a more complex model is required.

DC Bias Current Considerations

Selecting the right ferrite bead for power applications requires careful consideration not only of the filter bandwidth, but also of the impedance characteristics of the bead with respect to dc bias current. In most cases, manufacturers only specify the impedance of the bead at 100MHz and publish data sheets with frequency response curves at zero dc bias current. However, when using ferrite beads for power supply filtering, the load current going through the ferrite bead is never zero, and as dc bias current increases from zero, all of these parameters change significantly.

As the dc bias current increases, the core material begins to saturate, which significantly reduces the inductance of the ferrite bead. The degree of inductance saturation differs depending on the material used for

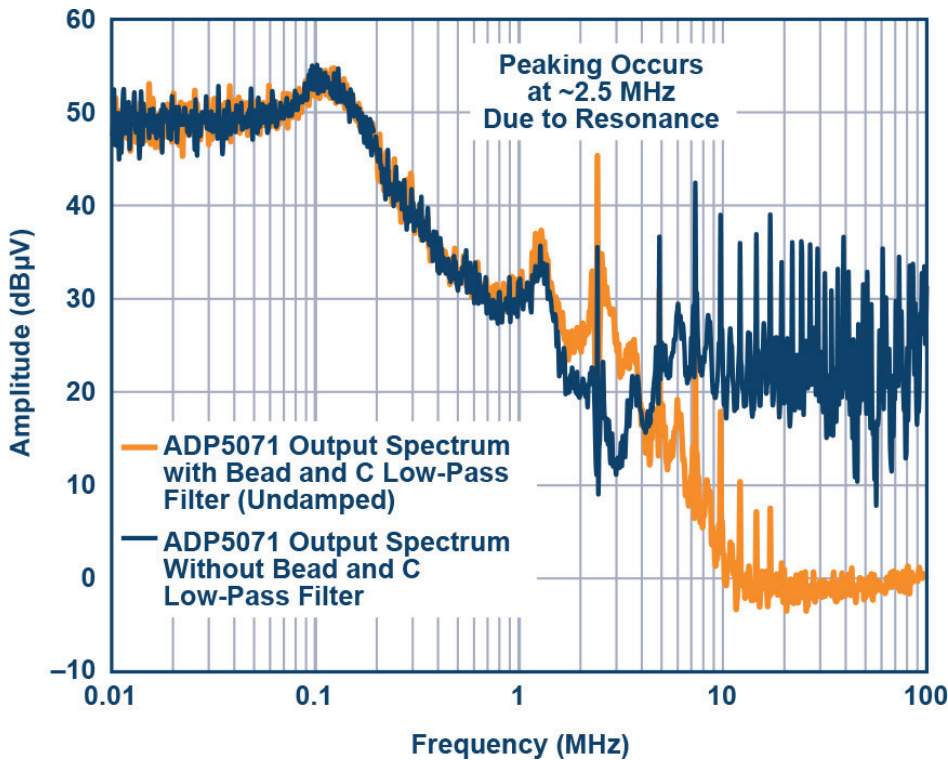


Figure 6. ADP5071 spectral output at 5 mA load

the core of the component. Figure 3a shows the typical dc bias dependency of the inductance for two ferrite beads. With 50% of the rated currents, the inductance decreases by up to 90%. For effective power supply noise filtering, a design guideline is to use ferrite beads at about 20% of their rated dc current. As shown in these two examples, the inductance at 20% of the rated current drops to about 30% for the 6 A bead and to about 15% for the 3 A bead. The current rating of ferrite beads is an indication of the maximum current the device can take for a specified temperature rise and it is not a real operating point for filtering purposes.

In addition, the effect of dc bias current can be observed in the reduction of impedance values over

frequency, which in turn reduces the effectiveness of the ferrite bead and its ability to remove EMI. Figure 3b and Figure 3c show how the impedance of the ferrite bead varies with dc bias current. By applying just 50% of the rated current, the effective impedance at 100MHz dramatically drops from 100Ω to 10Ω for the TDK MPZ1608S101A (100Ω, 3A, 0603) and from 70Ω to 15Ω for the Würth Elektronik 742 792 510 (70Ω, 6A, 1812). System designers must be fully aware of the effect of dc bias current on bead inductance and effective impedance, as this can be critical in applications that demand high supply current.

LC Resonance Effect

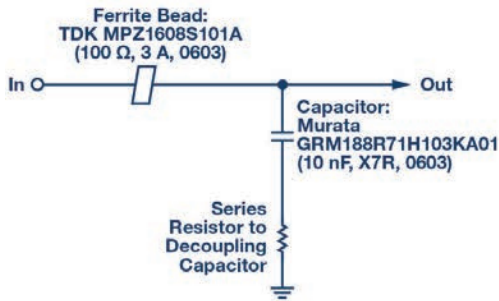
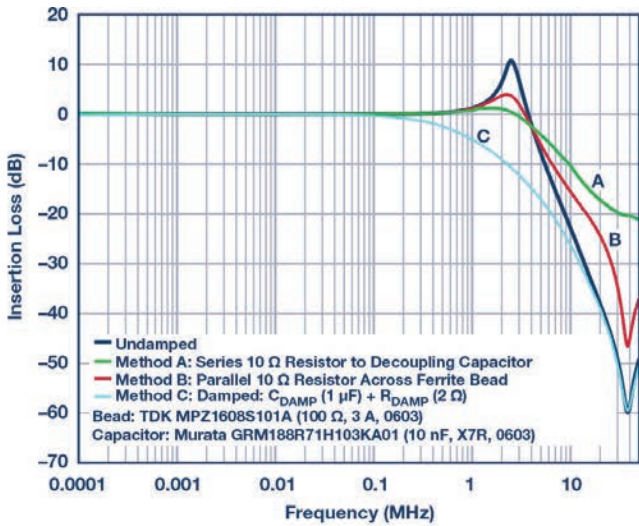
Resonance peaking is possible when

implementing a ferrite bead together with a decoupling capacitor. This commonly overlooked effect can be detrimental because it may amplify ripple and noise in a given system instead of attenuating it. In many cases, this peaking occurs around the popular switching frequencies of dc-to-dc converters.

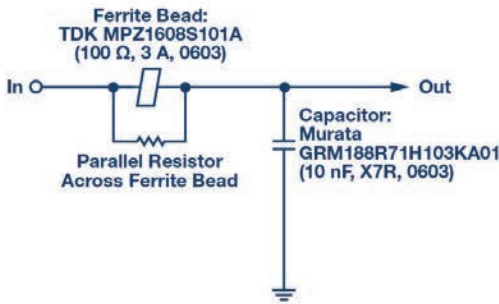
Peaking occurs when the resonant frequency of a low-pass filter network, formed by the ferrite bead inductance and the high Q decoupling capacitance, is below the crossover frequency of the bead. The resulting filter is underdamped. Figure 4a shows the measured impedance vs. frequency plot of the TDK MPZ1608S101A. The resistive component, which is depended upon to dissipate unwanted energy, does not become significant until reaching about the 20MHz to 30MHz range. Below this frequency, the ferrite bead still has a very high Q and acts like an ideal inductor. LC resonant frequencies for typical bead filters are generally in the 0.1MHz to 10MHz range. For typical switching frequencies in the 300kHz to 5MHz range, additional damping is required to reduce the filter Q.

As an example of this effect, Figure 4b shows the S21 frequency response of the bead and capacitor low-pass filter, which displays a peaking effect. The ferrite bead used is a TDK MPZ1608S101A (100Ω, 3A, 0603) and the decoupling capacitor used is a Murata GRM188R71H103KA01 low ESR ceramic capacitor (10 nF, X7R, 0603). Load current is in the microampere range.

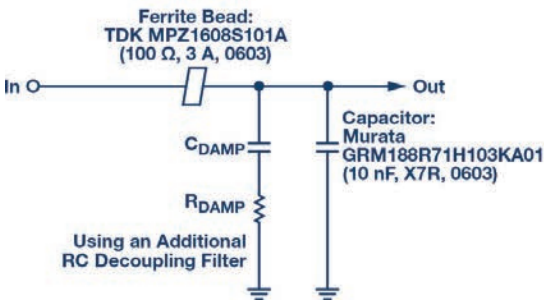
An undamped ferrite bead filter can exhibit peaks from approximately 10dB



Method A

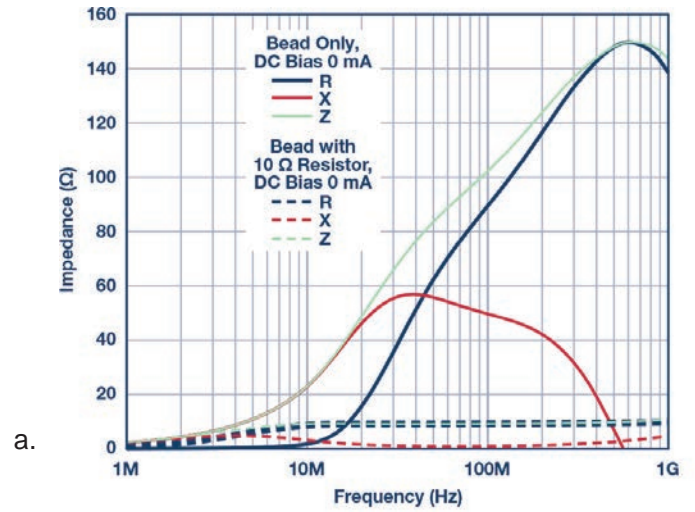


Method B

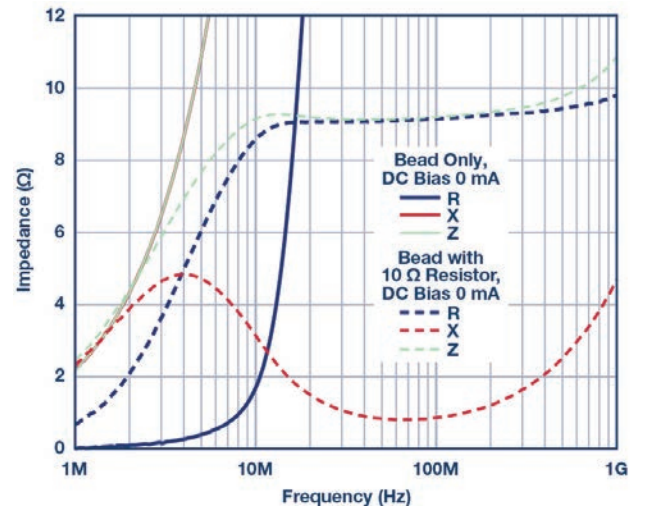


Method C

Figure 7. Actual frequency response for various damping methods



a.



b.

Figure 8. (a) MPZ1608S101A ZRX plot and (b) MPZ1608S101A ZRX plot, zoom view.

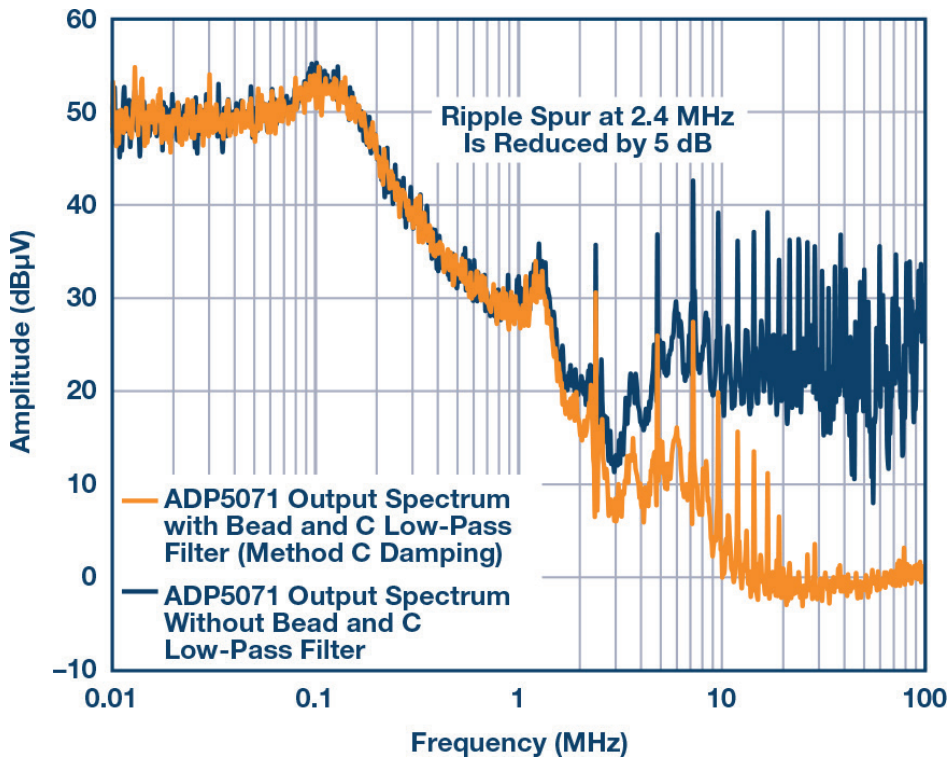


Figure 9. ADP5071's spectral output plus a bead and capacitor lowpass filter with Method C damping.

to approximately 15dB depending on the Q of the filter circuit. In Figure 4b, peaking occurs at around 2.5MHz with as much as 10dB gain.

In addition, signal gain can be seen from 1MHz to 3.5MHz. This peaking is problematic if it occurs in the frequency band in which the switching regulator operates. This amplifies the unwanted switching artifacts, which can wreak havoc on the performance of sensitive loads such as the phase-lock loop (PLL), voltage-controlled oscillators (VCOs), and high resolution analog-to-digital converters (ADCs). The result shown in Figure 4b has been taken with a very light load (in the microampere range), but this is a realistic application in sections of circuits that need just a few

microamperes to 1 mA of load current or sections that are turned off to save power in some operating modes. This potential peaking creates additional noise in the system that can create unwanted crosstalk.

As an example, Figure 5 shows an ADP5071 application circuit with an implemented bead filter and Figure 6 shows the spectral plot at the positive output. The switching frequency is set at 2.4MHz, the input voltage is 9V, the output voltage is set at 16V, and the load current of 5mA. Resonant peaking occurs at around 2.5MHz due to the inductance of the bead and the 10nF ceramic capacitor. Instead of attenuating the fundamental ripple frequency at 2.4MHz, a gain of 10dB occurs. Other factors that

have an effect on the resonant peaks are the series and load impedances of the ferrite bead filter. Peaking is significantly reduced and damped for higher source resistance. However, the load regulation degrades with this approach, making it unrealistic in practice. The output voltage droops with load current due to the drop from the series resistance. Load impedance also affects the peaking response. Peaking is worse for light load conditions.

Damping Methods

This section describes three damping methods that a system engineer can use to reduce the level of resonant peaking significantly (see Figure 7).

Method A consists of adding a series resistor to the decoupling capacitor path that dampens the resonance of the system but degrades the bypass effectiveness at high frequencies. Method B consists of adding a small parallel resistor across the ferrite bead that also dampens the resonance of the system. However, the attenuation characteristic of the filter is reduced at high frequencies. Figure 8 show the impedance vs. frequency curve of the MPZ1608S101A with and without a 10Ω parallel resistor. The light green dashed curve is the overall impedance of the bead with a 10Ω resistor in parallel. The impedance of the bead and resistor combination is significantly reduced and is dominated by the 10Ω resistor. However, the 3.8MHz crossover frequency for the bead with the 10Ω parallel resistor is much lower than the crossover frequency of the bead on its own at 40.3MHz. The bead appears resistive at a much lower frequency range,

lowering the Q for improved damped performance.

Method C consists of adding a large capacitor (CDAMP) with a series damping resistor (RDAMP), which is often an optimal solution.

Adding the capacitor and resistor damps the resonance of the system and does not degrade the bypass effectiveness at high frequencies. Implementing this method avoids excessive power dissipation on the resistor due to a large dc blocking capacitor.

The capacitor must be much larger than the sum of all decoupling capacitors, which reduces the required damping resistor value. The capacitor impedance must be sufficiently smaller than the damping resistance at the resonant frequency to reduce the peaking.

Figure 9 shows the ADP5071 positive output spectral plot with Method C damping implemented on the application circuit shown in Figure 5. The CDAMP and RDAMP used are a 1 μ F ceramic capacitor and a 2 Ω SMD resistor, respectively. The fundamental ripple at 2.4MHz is reduced by 5dB as opposed to the 10dB gain shown in Figure 9.

Generally, Method C is the most elegant and is implemented by adding a resistor in series with a ceramic capacitor rather than buying an expensive dedicated damping capacitor. The safest designs always include a resistor that can be tweaked during prototyping and that can be eliminated if not necessary.

The only drawbacks are the additional component cost and greater required board space.

Conclusion

This article shows key considerations that must be taken into account when using ferrite beads. It also details a simple circuit model representing the bead. The simulation results show good correlation with the actual measured impedance vs. the frequency response at zero dc bias current.

This article also discusses the effect of the dc bias current on the ferrite bead characteristics. It shows that a dc bias current greater than 20% of the rated current can cause a significant drop in the bead inductance. Such a current can also reduce the effective impedance of the bead and degrade its EMI filtering capability. When using ferrite beads in supply rail with dc bias current, ensure that the current does not cause saturation of the ferrite material and produce significant change of inductance.

Because the ferrite bead is inductive, do not use it with high Q decoupling capacitors without careful attention. Doing so can do more harm than good by producing unwanted resonance in a circuit. However, the damping methods proposed in this article offer an easy solution by using a large decoupling capacitor in series with a damping resistor across the load, thus avoiding unwanted resonance. Applying ferrite beads correctly can be an effective and inexpensive way to reduce high frequency noise and switching transients.

References

AN-583 Application Note, [Designing Power Isolation Filters with Ferrite Beads for Altera FPGAs](#). Altera Corporation.

[Application Manual for Power Supply Noise Suppression and Decoupling for Digital ICs](#). Murata Manufacturing Co., Ltd.

Burket, Chris. ["All Ferrite Beads Are Not Created Equal - Understanding the Importance of Ferrite Bead Material Behavior."](#) TDK Corporation.

Eco, Jefferson and Aldrick Limjoco. AN-1368 Application Note, [Ferrite Bead Demystified](#). Analog Devices, Inc.

Fancher, David B. ["ILB, ILBB Ferrite Beads: Electromagnetic Interference and Electromagnetic Compatibility \(EMI/EMC\)."](#) Vishay Dale.

Hill, Lee and Rick Meadors. ["Steward EMI Suppression."](#) Steward.

Kundert, Ken. ["Power Supply Noise Reduction."](#) Designer's Guide Consulting, Inc.

Weir, Steve. ["PDN Application of Ferrite Beads."](#) IPBLOX, LLC.

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Changes in Wireless Demand a New Test Approach

> David Hall, National Instruments

Many of you likely remember receiving your first text message or downloading your first web page on a mobile phone. Today, a mobile phone can download high-resolution video in seconds and provide higher data throughput than your first laptop. However, the goal of tomorrow's wireless is much bigger than giving you faster download speeds.

Within a decade, the number of connected devices will outnumber connected people 10 to 1. As a result, future wireless standards are evolving to address new use cases for connecting things instead of merely people. These things will not only use new wireless technologies but also require new instrumentation and carry a lower price tag. Because future devices demand a different approach to wireless test, we at NI are continuing to evolve our PXI platform to address tomorrow's wireless test challenges.

Future of Wireless

The International Telecommunication Union's (ITU's) vision for International Mobile Telecommunications in 2020 (IMT-2020) outlines one of the clearest requirements for the range of use cases in future wireless standards. This vision, designed as a framework to communicate the technical requirements of 5G, outlines three distinct use cases. Although these use cases specifically define the requirements of future mobile communication standards, they reflect the changing requirements for technologies like 802.11ad, 802.11ax, Bluetooth 5.0, NFC, and more.

The first wireless use case, Enhanced Mobile Broadband (eMBB), defines the evolution in network capacity and peak data rates expected from a future wireless technology – and is designed to deliver up to 10 Gbps of downlink throughput, which is 100X that of single-carrier LTE. The second

use case, Massive Machine-Type Communication (mMTC), is designed to deliver wireless access to more devices in more locations at a lower cost. The third and final use case is Ultra-reliable Machine-Type Communication (uMTC) – and established new requirements for improved are latency and packet error rates.

The requirements of tomorrow's wireless technology are not only driving new wireless standards like NB-IoT, 5G, and 802.11ax but also changing the way engineers design and test mobile devices. For example, wider bandwidths in future standards like 5G require wider bandwidth RF instruments. In addition, multi-antenna technologies like MIMO and beamforming produce a need for modular and flexible instrumentation that can scale from testing single-antenna devices to 8x8 MIMO devices and beyond. Finally, lower cost radios also require lower cost approaches to wireless test. In a scenario where

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Figure 1. Three Use Cases for 5G

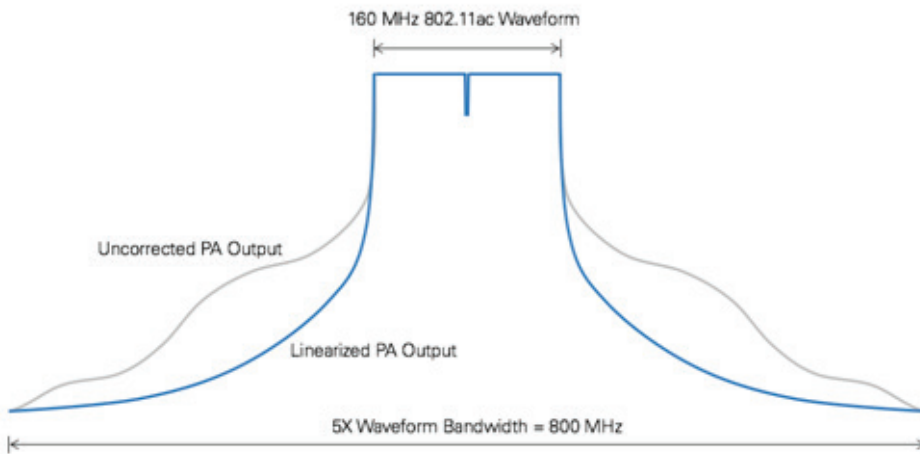


Figure 2. DPD Algorithm Using 5x Signal Bandwidth

wireless radios cost 20 percent of today's prices, next-generation test equipment must be capable of faster and more parallel test approaches.

Evolution of the NI Vector Signal Transceiver

In 2012, NI announced the revolutionary

new PXI Vector Signal Transceiver (VST). The VST was unique in that it combined a 6 GHz RF signal generator, 6 GHz RF signal analyzer, and a user-programmable FPGA into a single PXI module. Not only did the instrument's excellent RF performance allow it to serve applications

from R&D to manufacturing test, but its user-programmable FPGA enabled applications ranging from measurement acceleration to channel emulation. However, the evolution of wireless technology demands a new approach to RF design and test. As a result, NI has introduced a second-generation VST that offers wider bandwidth, extended frequency range, and a larger FPGA in an even smaller form factor.

Bandwidth

Over the past decade, wireless standards have evolved to use significantly wider bandwidth channels to achieve higher peak data rates. For example, since 2003, Wi-Fi has evolved from 20 to 40 to 160 MHz in today's 802.11ax. Mobile communication channels have evolved from 200 kHz in GSM to 100 MHz in today's LTE-Advanced technology. In the future, technologies like LTE-Advanced Pro and 5G will drive this trend even further.

Especially when testing semiconductor devices, the bandwidth requirements of the instrument often exceed the bandwidth of the signal. For example, when testing RF power amplifiers (PAs) under digital predistortion (DPD) conditions, the test equipment itself must extract a PA model, correct for nonlinear behavior, and then generate a corrected waveform. Advanced DPD algorithms often require 3X to 5X the RF signal bandwidth. As a result, instrument bandwidth requirements can be up to 500 MHz for LTE-Advanced (100 MHz signal) and 800 MHz for 802.11ac/ax (160 MHz signal). One of the most significant enhancements of the second-generation VST is its wider instantaneous bandwidth: 1 GHz. Because of this wider bandwidth, engineers can use the second-generation VST to solve application challenges that currently can't be met



Figure 4. Typical 8x8 MIMO System with 8 VSTs

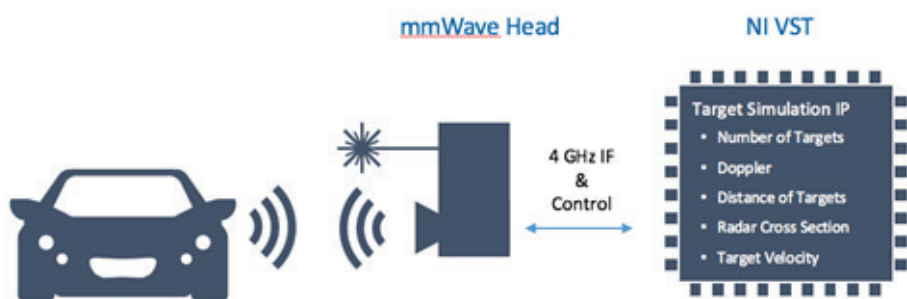


Figure 5. Radar System Block Diagram with Custom mmWave Head

using existing instrumentation.

Modular and Easily Synchronized

Modern communications standards ranging from Wi-Fi to mobile use sophisticated multiantenna technology. In these systems, MIMO configurations provide a combination of either higher data rates through more spatial streams or more robust communications through beamforming. Because of these MIMO benefits, next-generation wireless technologies like 802.11ax, LTE-Advanced Pro, and 5G will use more complex MIMO schemes with up to 128 antennas on a single device.

Not surprisingly, MIMO adds a lot of design and test complexity. It not only increases the number of ports on a device but also introduces multichannel

synchronization requirements. To test a MIMO device, RF test equipment must be capable of synchronizing multiple RF signal generators and analyzers. In these configurations, the instrument's form factor and the synchronization mechanism are critical.

Fortunately, the second-generation VST is small enough that engineers can synchronize up to eight VSTs in a single 18-slot PXI chassis with one slot dedicated to a PXI controller.

Designed by Software

A final requirement of next-generation wireless test systems is that engineers can design them with software. Advanced wireless test applications increasingly require engineers to tailor the behavior of the instrument's firmware. In these applications, engineers can experience

significant improvements in instrument performance simply by moving closed-loop control, measurement acceleration, real-time signal processing, or synchronous device under test control on the instrument itself.

One application that software-designed instrumentation can uniquely solve is radar prototyping. In this application, customers can use the FPGA as a complete target simulator. In radar applications, a radar system detects a "target," such as an automobile, airplane, or other object, by sending a stimulus signal and then waiting for the response. Attributes of the stimulus' reflection off the target, such as the delay and frequency shift, indicate both the distance and velocity of the target. The combination of the VST's wide bandwidth and user-programmable FPGA makes it ideal for target emulation. In addition, engineers can easily customize the FPGA to modify the types of targets they need to simulate.

Part of a Platform

One of the most important features of the VST is that it is part of a complete hardware and software platform. In the current era of smart, connected devices and ICs, modern test instrumentation has transitioned from discrete instruments to highly integrated test systems. As a result, meeting the latest measurement challenges like envelope tracking PA test and radar prototyping requires a platform of instruments that can be synchronized, customized, and easily controlled with software.

Although the next wave of wireless technologies, from 5G to 802.11ax, will introduce significant design and test challenges, NI's second-generation VST was created explicitly to address them. With wider bandwidth, a smaller form factor, excellent RF performance, and software customizability, the VST is scalable to meet the most difficult test challenges today and tomorrow.



Satellite-based bird tracking system relies on high-rel interconnect technology

> Scott Flower, Harwin

An ambitious project to track the global migration pattern and behaviour of birds from space using a small satellite is well underway. The size and extreme conditions that such a satellite - termed 'Cubesat' - will experience during the mission puts huge pressures on the electronic systems employed. This means that WUSAT - the Warwick University Satellite Team which is developing satellites for this project - must be very innovative in design, and must select components that are capable of performing reliably under such harsh environments.

Billions of birds, bats and large insects migrate long distances annually, sometimes between continents. So far, scientists have been unable to follow such small creatures individually

during their journeys. However, knowledge of individual movement patterns is essential for an ecological and evolutionary understanding of dispersal. ICARUS, an acronym for 'International Cooperation for Animal Research Using Space', is a global collaboration of animal scientists which plans to establish a satellite-based infrastructure to observe not only migratory birds and bats, but also sea turtles.

ICARUS (<http://icarusinitiative.org/science-projects>) will help solve two major enigmas in biology: we need to understand the ontogeny of behavioural and movement traits of animals in the wild; and the selection acting on individuals in the wild (i.e. where, why and when do individuals die). It is envisaged that the ICARUS small animal tracking system will enable researchers to address some major concerns, such as:

- Spread of infectious diseases (via

birds, bats, rodents or insects)

- Relationship between biological diversity and ecosystem functioning
- Follow and predict bird presence, to enhance aviation safety
- Migration routes and patterns

WUSAT's latest CubeSat satellite - designed to be launched from the International Space Station (ISS) - aims to work in collaboration with the ICARUS system. GPS, 3D acceleration and other data collected in black-box-loggers on individual animals is transmitted in small data packages to these Low Earth Orbit (LEO) satellites where it is decoded and downlinked to a ground station.

WUSAT, working in conjunction with world-renowned electronics engineering consultancy, Roke Manor Research, is one of the partners developing the LEO Cubesat. Warwick University's WUSAT team has been established for ten years and since 2012 it has been developing its own



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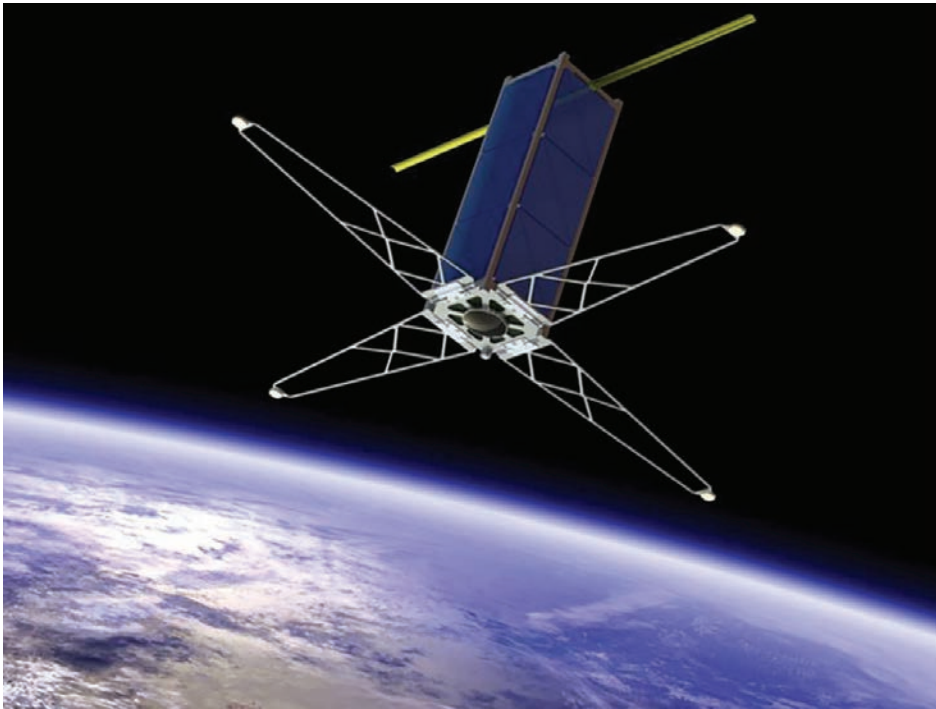


Figure 1: The WUSAT 3 ICARUS project showing three CubeSats stacked on top of each other with a deployable antenna array

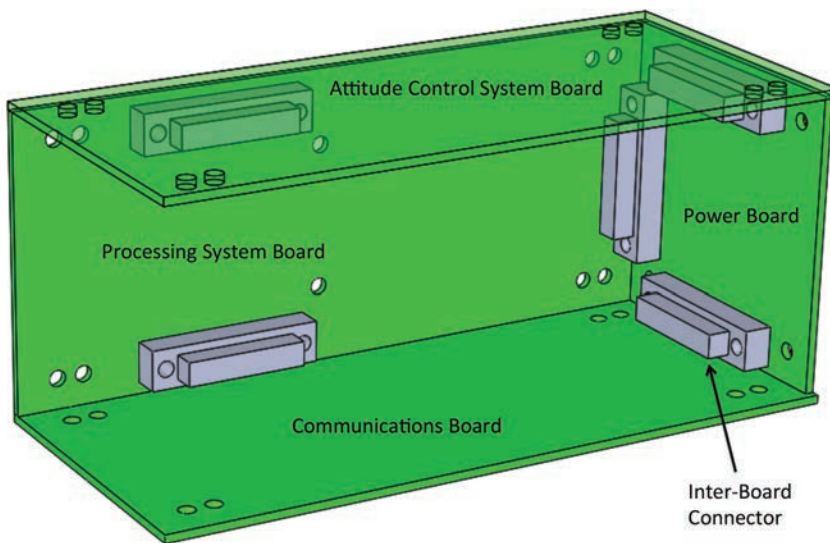


Figure 2. (a) Circuit simulation model and (b) Actual measurement vs. simulation.

Cubesat satellite, a nanosatellite, typically a cube 0.1m wide, with a mass

of less than 1.33kg. In April 2013, its first Cubesat (WUSAT1) was launched

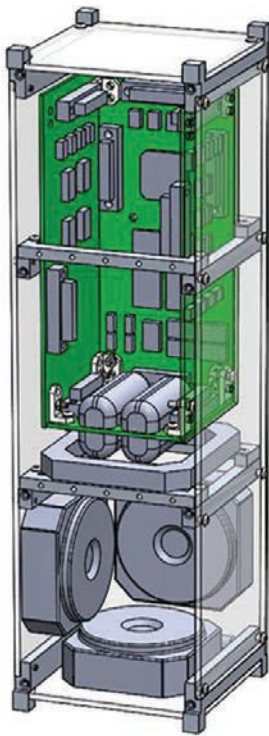
via a high-altitude weather balloon to an altitude of 30km in order to test its systems in a harsh environment where the ambient temperature dropped to lower than -50°C , prior to future rocket launches. WUSAT2 launched in 2015 carrying a spectroscopy payload to an altitude of 90km as part of the prestigious DLR/SNSB project REXUS (Rocket Experiment for University Students).

For WUSAT 3, the ICARUS project, designed for deployment from the ISS in 2018, the team has opted for a three-unit design, effectively three CubeSats stacked on top of each other. At the top end of the device is a deployable antenna array, which will be the receiver for the ICARUS signals. (See figure 1)

As mentioned at the top of this article, the small size and challenging operating conditions experienced in space applications require the electronic systems used to be extremely rugged. At launch, systems can be subject to several G shock forces, and when in orbit, temperatures can vary from very cold to extremely hot, depending on the position of the satellite relative to the sun. Electronic interconnection systems are especially vulnerable, since they must not only guarantee the integrity of the electrical signal, they also have a physical role to play.

Size and weight are always determining issues in any space application: the smaller and lighter the components the greater the payload can be...and in a tiny nanosatellite, this becomes even more important. Then there is also the economic consideration. In space terms, Cubesats are relatively inexpensive. But they still cost thousands of pounds to develop and launch, and there is no opportunity to fix any problem once launched. Simply, the connectors must not fail.

Since its inception WUSAT has chosen to use high reliability connectors from Harwin. The company uses a



Diagrammatic depiction of the WUSAT 3 design

4-fingered beryllium copper female contact which delivers excellent electrical and mechanical performance. Products such as the 2mm pitch Datamate and Mix-tek families, the Gecko 1.25mm pitch family and high power M300 connectors are rated to withstand extremes of shock, vibration and temperature and have been used in many satellite applications as well as other aerospace, oil and gas exploration, robotics, UAVs, motor sport, military vehicles and other mission-critical projects.

For the latest WUSAT 3 mission, the team is still in the development phase. But one of the most intriguing possibilities the team is considering uses four Datamate connectors, not only to provide electrical connection but also to deliver the structural integrity of a four PCB box section design where the boards become self-supporting (see figure 2). Typically, PCBs used in Cubesat designs are

stacked one on top of another, separated by pillar spacers. The new proposed arrangement would not only increase available space, it would also save a lot of wire to board between stacked PCBs. Just as importantly, it would also allow best design practice to be employed when designing the signal processing circuitry - a major part of this project.

The box cube structure proposed uses Harwin's Datamate J-Tek connectors, which feature locking jackscrews for additional mating security - essential if the structural integrity of the design is to rely on the ruggedness of the connector. In fact, not only space applications, but several other industries such as aviation, defence, robotics and motor sport now prefer to specify jackscrews rather than latches or other fixing mechanisms, which can wear and fail due to excessive vibration.

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Three Steps for Reducing Total Cost of Ownership in Pumping Systems

› Lionel Gaudrel and Arnaud Savreux, Schneider Electric

Electricity usage costs have become an increasing fraction of the total cost of ownership (TCO) for industrial pumping systems. In fact, energy cost represents 40% of the TCO of a typical pump. It is possible to reduce the electrical consumption by at least 30% through appropriate energy management practices while reducing the maintenance cost. This paper explains how to reduce TCO with a limited investment.

Introduction

Wherever pumping systems are present—in environments such as buildings and water/wastewater and oil and gas facilities—energy consumption exerts a major influence on cost. Despite the fact that electrical energy cost represents 40%

of the total cost of ownership (see Figure 1) of pumping systems, many organizations fail to introduce the proper steps to leverage cost reduction through efficiency improvements. To solve this dilemma, the following major barriers need to be recognized and addressed:

- **Lack of proper metrics** – Energy efficiency has traditionally not been used in assessing performance. In most organizations, the responsibilities of energy procurement and efficient operations are separate and consistent / standardized metrics are not utilized.
- **Knowledge gap** – A lack of awareness in energy efficiency opportunities is prevalent and, as a result, potential savings and other benefits are missed.
- **Fear of investment** – Operations personnel often struggle to present attractive large or even

small investments to their finance organizations (fig 1).

This paper demonstrates how deployment of an energy management plan, with limited investment, can provide reductions in pumping systems TCO while maintaining sustainability objectives. Any sound energy plan should take into account the following three steps:

1. Energy efficiency management
2. Asset management
3. Energy cost management

For the purposes of this paper, the scope of a pumping system will be defined as encompassing all related elements starting from the point of the electrical utility connection down to the point of end use. This paper will illustrate how energy management best practices can result in a 20% reduction in TCO and a return of investment (ROI) within 24 months.

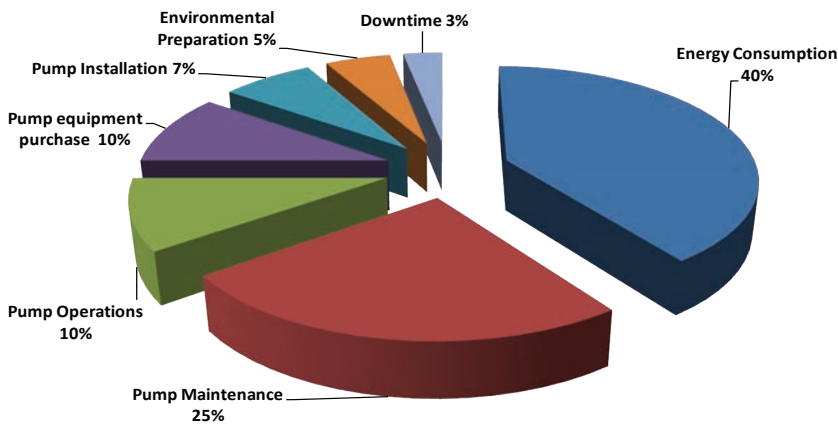


Figure 1: Typical pump life-cycle cost profile (Courtesy of Hydraulic Institute and Pump Systems Matter)

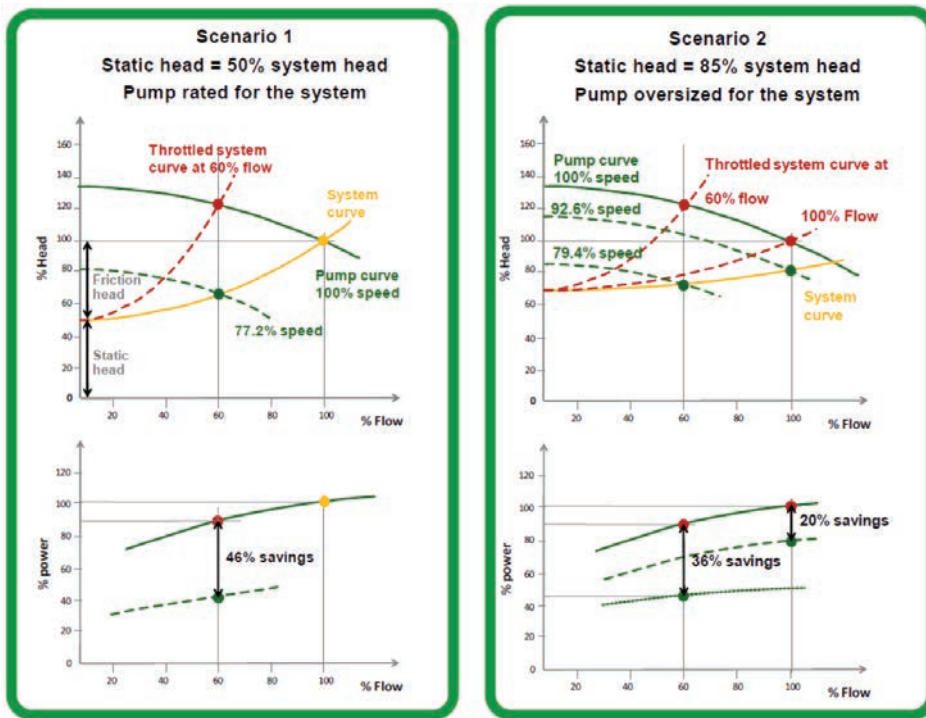


Figure 2: Energy saved with variable vs. fixed speed drives at 100% and 60% flow, according to the static head and pump sizing. The operating point is represented as the intersection of the pump curve with the system curve

Step 1: Energy efficiency management

Energy efficiency is now a global high priority for both industrialized and emerging countries. The Rio conference and Earth Summit of 1992

and the Kyoto Protocol of 1997 resulted in the signing of a global treaty that sets binding targets for reduction of greenhouse gas emissions. The International Energy Agency (IEA) and various governments and non-governmental organizations

(NGOs) agree that the reduction of CO2 emissions and the resulting energy savings can be achieved through the deployment of energy efficient products and systems.

The challenge, however, is that the nature of production in industrial environments is in a constant state of flux. Production cycles, for example, are influenced by variables such as market demand, weather, and local regulations. As a result, factory and building operators need to understand how and when energy is used in order to minimize consumption and related costs.

The pump system energy management approach discussed in this paper will review the nature of efficiency loss not only for individual components within the system, but also for the system as a whole, integrated entity.

In pumping systems, most inefficiency comes from:

- A mismatch between the pump deployed and the actual system requirement (i.e., undersized or oversized)
- The improper use of throttling valves and damper technologies to control the flow of liquids

These two elements imply that the way pumping systems are controlled plays a major role regarding how efficiency can be improved. Control systems themselves are composed of both hardware and software components. On the hardware side, variable speed drives are a primary enabler of high efficiency performance.

The example in Figure 2 on page 3 compares two installations (one with a variable speed drive one with a fixed drive throttled system) in which static heads (height difference between the source and the end use) are different.

- At fixed speed (the throttled system

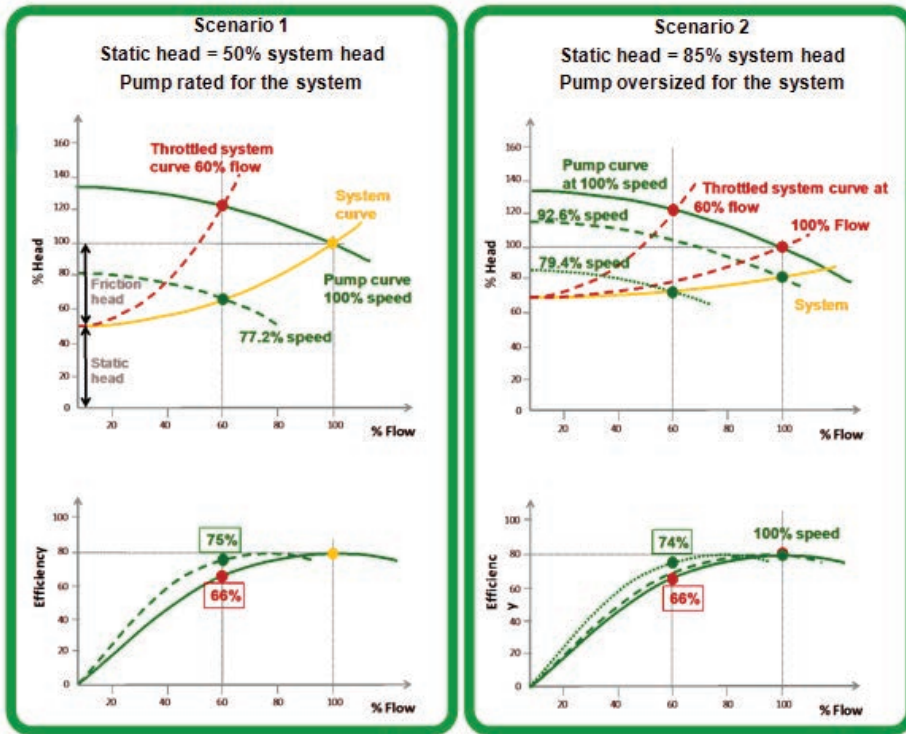


Figure 3: Comparison of two efficiency scenarios at different flow rates: 8 to 9% more efficient with variable speed drives at 60% flow

example), it is necessary to add a throttle valve in the hydraulic circuit. This adjusts the flow by increasing or decreasing the flow resistance. This will modify the system curve. However, the speed remains the same so the pump curve does not change. The flow rate is matched but the head is much higher than required resulting in poor energy savings.

- If a variable speed drive is deployed, the system curve does not change. The pump curve is modified according to flow speed and affinity laws (rules of hydraulics that express the relationship between variables involved in pump performance such as head, volumetric flow rate, shaft speed, and power). Adjusting the speed matches the process requirement and results in significant

energy savings.

Energy savings depends on the static head: the lower is the static head, the bigger the energy savings (and speed variation range). In order for a pumping action to occur, it is necessary to generate enough power to overcome the static head. The friction head is the amount of head required to push the liquid through the pipe and fittings. It depends on flow rate, pipe size, pipe length, and viscosity.

- Scenario 1 (Figure 2): the static head represents 50% of the system head, and the pump is rated for the head and flow of the system. At 100% flow, the power consumed by the pump is the same at both fixed speed and with a variable speed drive. At 60% flow, the energy savings resulting in the

variable speed drive use is 46%.

- Scenario 2 (Figure 2): the static head represents 85% of the system head, and the pump is oversized by 20%. In real world scenarios, 75% of pumps are oversized (by 10% to 30%) in order to meet anticipated lifetime peak production, to anticipate future needs, or to rationalize spare parts inventory. Therefore, a variable speed drive saves 20% of energy at 100% flow and saves 36% energy at 60% flow.

Changing the operating point on the pump curve also changes the efficiency of the pump itself. The pump performs at maximum efficiency at its full capacity. This corresponds to what is referred to as the Best Efficiency Point (BEP). In terms of installation design and operation, the objective is to work as closely as possible to the BEP. By varying the speed, the pump efficiency remains roughly the same but is applied to a new flow rate. At fixed speed, reducing the flow rate quickly deteriorates the pump efficiency (because it works far from the BEP) while adjusting the speed keeps the efficiency close to the BEP (see Figure 3).

Determining pump efficiency is only a first step in identifying system performance levels. Monitoring efficiencies via software can detect operating points that are not suitable for the pump. Access to such data can help to improve both system energy efficiency and reliability.

Summary of pump energy efficiency management best practices

The energy efficiency of a pumping system can be improved by implementing the following simple

Motor efficiency class	Global	USA	EU (old)	EU (new)	China	Australia
Premium	IE3	NEMA premium	-	IE3	-	-
High	IE2	EPAct	Eff 1	IE2	Grade 1	AU2006 MEPS
Standard	IE1	-	Eff 2	IE1	Grade 2	AU2002 MEPS
Below standard	IE0	-	Eff 3	-	Grade 3	-

Table 1: Alignment of motor efficiency categorization levels from the various geographical regions

actions:

- Replace fixed drives with variable speed drives to boost the efficiency. Connected to a pump, a variable speed drive can control speed, pressure, and flow in conjunction with dynamic process and production requirements.
- Monitor production data and energy consumption data via software dashboards. Continuous tracking of the deviation between production output and energy consumed allows for rapid and cost effective decision-making. Intelligent Electronic Devices (IEDs) such as variable speed drives that are tied into the monitoring system, play a major role in reporting data related to operation, production, and energy in real time. Monitoring points should be close to the load because that is where most of the power is consumed. The closer the monitoring is to the load, the more insights can be acquired relative to cost savings.
- Monitor the operating point of the pump and its efficiency on a continual

basis in order to visualize trends. Observance of the trends can then lead to sensible actions that improve efficiency, and verify the impact of improvements to the system.

- Use proper metrics to identify an increase or decrease in efficiency on particular systems and to compare efficiency performances of different pumps in multiple sites. A recommended key performance indicator (KPI) metric is the specific energy consumption metric (in kWh/m³).

Efficiency standards: Motors

In the realm of efficiency improvement, motors play an important role as part of the overall pumping system. In 2008, the International Electrotechnical Commission introduced the IEC60034-30 and IEC60034-31 standards as an efficiency classification system for motors. Countries have published laws and regulations based on these standards and require the usage

of more efficient motors in order to reduce CO₂ emissions. Table 1 aligns the various levels of standards across different geographical regions.

Over the next several years, government regulations will require higher efficiency motors. European Union countries that require IE2 motors today will require either IE3 motors or IE2 motors with variable speed drives in 2016. An IE3 motor will increase efficiency by 2% for 4kW / 5HP motor power when compared to an IE2 motor, and by 1% for a 90kW / 125HP motor. Although these gains are significant, if variable speed drives are deployed, the potential for further efficiency gain is greater.

Efficiency standards: Pumps

As with motors, new standards and regulations have been adopted in the domain of pumps. The European Commission (EC), for example, has adopted regulation n°547/2012 under

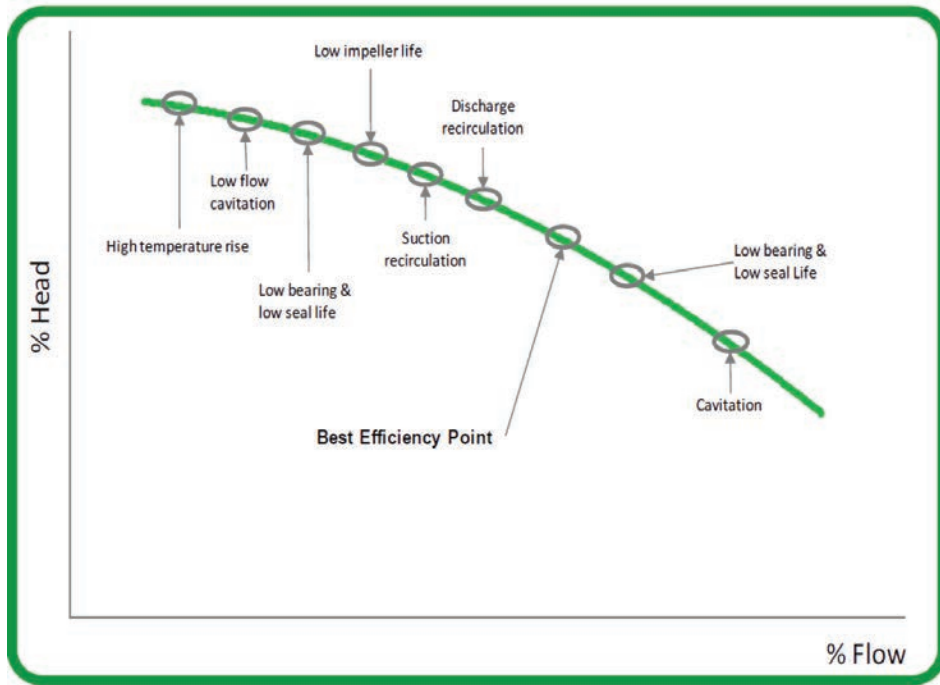


Figure 4: Maintenance related issues that impact pump performance (Courtesy of Barringer & Associates- “Pump practices & life”)

Directive 2009/125/EC in regard to eco-design requirements for water pumps. The EC regulation is intended to suppress the availability of low efficiency water pumps. It is applicable in the European Union to rotodynamic water pumps for pumping clean water.

The EC regulation defines a Minimum Efficiency Index (MEI) for affected pumps. The MEI is a criterion based on evaluation of European pump manufacturer statistical data, on technological aspects, on fluid dynamic laws, and on operating points included between 75 and 110% of the BEP flow rate.

According to regulation n°547/2012, as of January 1st 2013, pumps must attain an MEI of higher than 0.1. This affects the manufacturers of pumps because 10% of their configurations have been rendered obsolete. As

of January 1st 2015, new pumps being sold to end users must attain an MEI of 0.4 or higher. That means that 40% of manufacturers' current inventory will be rendered obsolete. The efficiency increase between MEI 0.4 and 0.1 is around 5%.

In order to further expand efficiency gains, the European Union has requested a new directive which defines a broader view of the pumping system. Moving forward for efficiency measurement purposes, a pumping system will include the pump, the motor, the load profile and the variable speed drives. This will result in a potential savings of 30% compared to 3.6% with the current “pump only” approach.

The IEC regulation n°547/2012 does not yet include fire fighting pumps, self priming pumps, displacement pumps, pumps for private and public

wastewater and for fluids with a high solids content, pumps for swimming pools, pumps for fountains, and clean water pumps larger than 150 kW. (In many of these areas preparatory studies are underway for the future development of new efficiency standards).

Other regions in the world have defined their own minimum energy performance for pumps. The calculation method in Brazil is similar to the EU approach. In China, the regulation GB19762-2007 is applicable for clean water pumps. That regulation defines 3 grades where grade 1 is used for very high efficiency pumps. Grade 3 is the minimum efficiency authorized. The method of calculation used to define the grade is different from the method used by EU regulation. The US Department of Energy (DOE) has begun work evaluating new energy standards for pumps. The DOE has published a rulemaking framework and has shared documents regarding commercial and industrial pumps with manufacturers, consumer groups, federal agencies, and states in order to gather feedback.

Step 2: Asset management

Physical assets such as pumps need to be maintained on an ongoing basis. Maintenance costs represent 25% of TCO (see Figure 1) and therefore maintenance practices warrant examination in terms of contribution to energy-influenced savings. Maintenance costs are unavoidable due to the wear of components during system operation, and because the cost of downtime attributed to loss of production would threaten the solvency of the business. In pumping

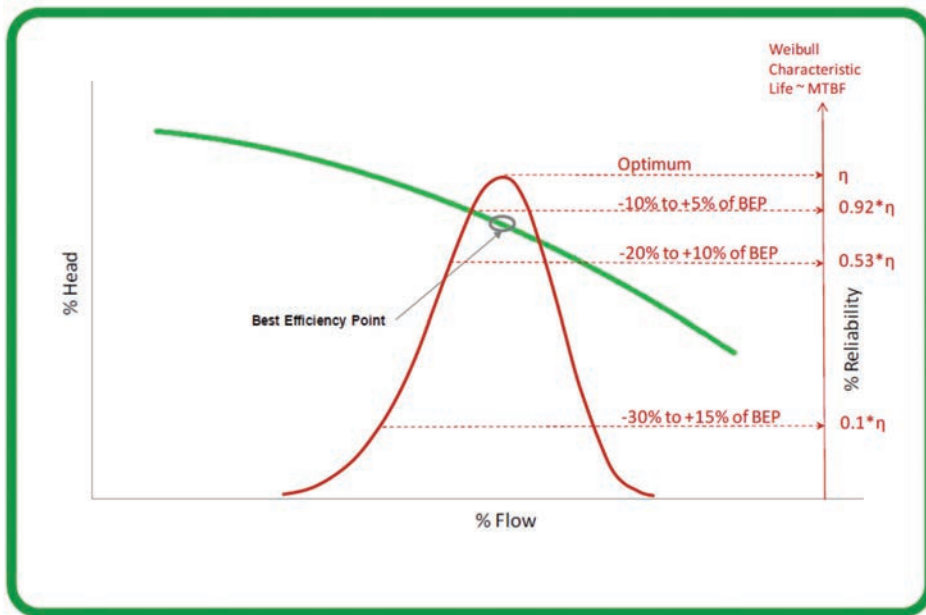


Figure 5: Effect of the distance from the BEP on reliability (Courtesy of Barringer & Associates - "Pump practices & life")

installations, many moving parts mean that proper maintenance of motors, drives, pumps, and associated pipes is crucial. Numerous steps can be taken to assure that maintenance costs are kept at a minimum while integrity of the systems is kept stable. All pumps should be operated within the parameters of a given pump's specifications (often stated in the pump supplier's instruction manual / data sheet). As discussed, pump efficiency varies according to operational parameters. The pump is designed for optimal operation at the best efficiency point (BEP) but 75% of the pumping systems are oversized by around 30%. Figure 4 (previous page) illustrates how pumps begin to waste significant efficiency when appropriate maintenance practices are neglected. For example, discharge recirculation can occur if the pump operates at 65% of the BEP flow rate, causing damage to the impeller, and a damaged impeller will be less efficient.

Variable speed drives can help to keep the operating point close to the BEP and also protect the pump against destructive forces generated by inefficiencies. Extreme situations such as dry running, low flow operation, or cavitation (due to low net positive suction head) which can cause instantaneous damage are avoided. Monitoring the operating point of the pump and its efficiency provides diagnostics that can help predict when potential system problems will occur.

Figure 5 illustrates how operating away from the BEP not only decreases the efficiency but speeds up the wear and tear on the pump thereby reducing reliability. For example, operations run at 60% of BEP result in:

- 50% lifetime reduction of seals
- 20% lifetime reduction of bearings
- 25% lifetime reduction of casing and impeller
- Approximately 100% increase of maintenance cost

Wear is unavoidable due to mechanical parts that are moving and to the action of the fluid being pumped. Erosion is generated by the speed of fluid, and it could be increased by slurries (sand or bigger particles). Corrosion is due to chemical or electrochemical reaction that attacks the pump materials. Even treated drinking water causes corrosion in cast iron casings as a result of the catalytic effect of bacteria. Erosion and corrosion mostly impact the pipes, the impeller, and the case (which are key operating components).

Efficiency drops by 10 to 15% for an unmaintained pump (see Figure 6). Moreover, the major loss in efficiency occurs in the first few years of the pump's life. Regular maintenance avoids losses in efficiency and capacity which can occur before the pump fails.

Some of the factors that debilitate a pump are visible. Others are not. For example, a worn seal is apparent. However, hydraulic wear is not. A problem that is not visible occurs before it is identified. This creates a situation of urgent corrective maintenance, and the defects may have affected other parts of the pump.

Maintenance practices

A number of approaches are available that can help to address the issue of maintenance in a cost effective manner. Preventive maintenance implies the systematic inspection and detection of potential failures before they occur. Condition-based maintenance is a type of preventive maintenance, which estimates and projects equipment condition over time, utilizing probability formulas to assess downtime risks. Corrective

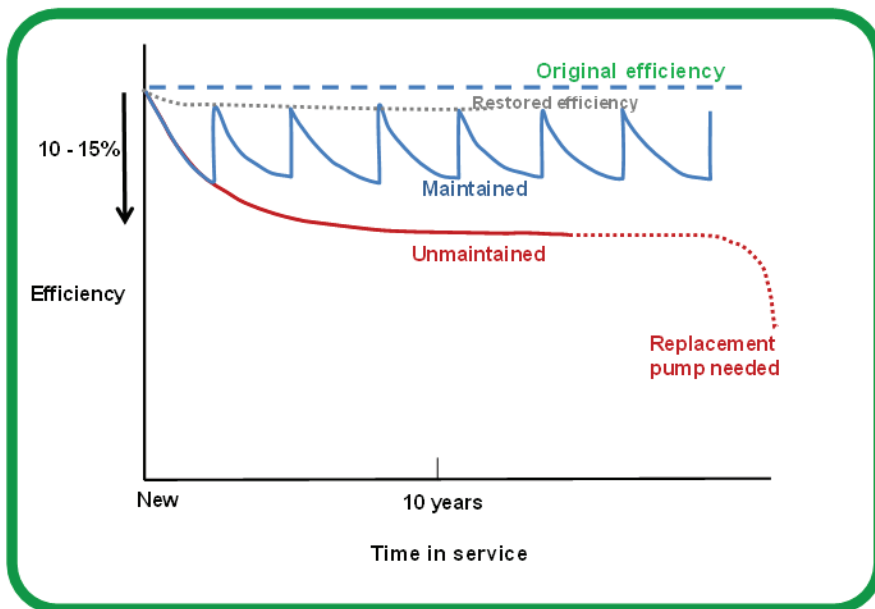


Figure 6: Average wear trends for maintained and unmaintained pumps (Courtesy of ETSU - Energy Savings in Industrial Water Pumping Systems)

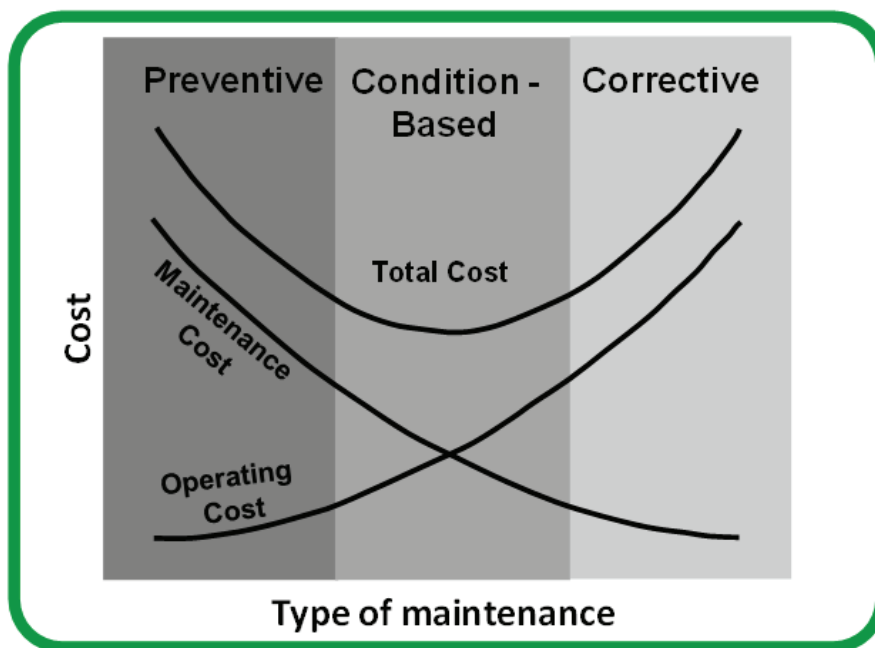


Figure 7: Cost curves of the different maintenance approaches (Courtesy of Penn State University / Applied Research Laboratory - "Open systems architecture for condition-based maintenance")

maintenance is a response to an unanticipated problem or emergency. Figure 7 illustrates the cost curves of these three types of maintenance. Condition-based maintenance is the most cost effective of the three approaches.

Condition-based-maintenance monitors system data on an ongoing basis and provides an accurate assessment of the health, or status of components, devices, and / or the complete system.

As it relates to pumps, variables such as suction pressure, discharge pressure, pump speed, power, flow, and temperatures are monitored to detect a loss of efficiency. Identification of the potential problems is possible by combining the efficiency trends and process variables.

Variable speed drives have the capability of measuring process variables, temperature and power with high accuracy and to assess the pump efficiency. If connected to the automation system, they continuously monitor the health of the system and can indicate in a precise manner when proper maintenance is needed. Figure 8 illustrates how a worn part can impact the pump efficiency curve.

Pipes

As part of the overall pumping system, pipes are also subject to issues such as overpressure, leakage, or pipe burst. An overpressure situation can be caused by poor pump control. A situation called "water hammer" can also occur. Water hammer is caused by a pressure or shock wave that travels through the pipes, generated by a sudden stop in the velocity of the water. This sudden acceleration and deceleration on the motor can be avoided with the help of a variable

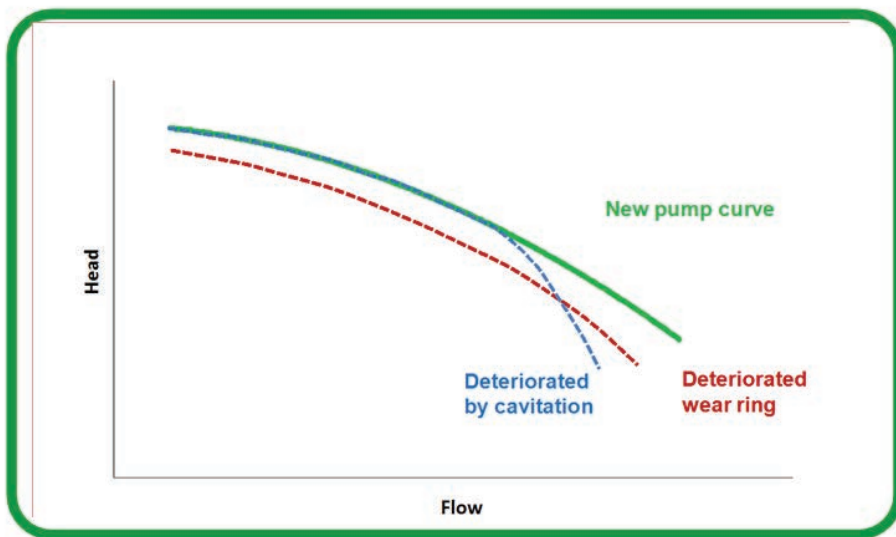


Figure 9
Fundamental elements of a typical industrial electrical bill

speed drive (sudden variation in flows is avoided). Leakage can also be reduced by automatic adjustments to pressure when appropriate.

Motors

Protection against mains voltage and frequency fluctuations can help maintain the integrity and extend the lifetime of motors. In cases where motors are equipped with variable speed drives, those electrical disturbances are not transmitted to the motor.

Protection against high temperature conditions can also extend the life of the motor assets. Devices such as thermal relays, PTC or PT100 thermal sensors can help and are manageable through the variable speed drive.

In cases where long motor cables are used in conjunction with motors and variable speed drive, it is recommended that filters be installed in order to avoid the dv / dt and

motor voltage surge effects (see the Schneider Electric white paper "An Improved Approach for Connecting VSD and Electric Motors" for more details on this subject). Note: For submersible bore hole pumps, it is recommended to verify the peak to peak voltage and the dv / dt at the motor terminals with the motor-pump supplier.

Step 3: Energy cost management

Building owners, water / wastewater and oil and gas facilities operators are presented with utility bills that have multiple components. These can include power demand charges, energy demand charges, time-of-use charges, ratchet clauses, cost-of-fuel adjustments, power factor penalties, customer service charges and national, regional, and local taxes. A misinterpretation of utility rate structures can lead

to poor management of electrical consumption and to higher costs. Most energy bills cover similar basic elements (see Figure 9). Familiarity with the terms can help to understand where the opportunities for cost reductions exist.

Below are some definitions for common terms used:

Customer charge - This is a fixed charge that depends upon the size of the connection that links the industrial installation in question to the electrical utility network. The customer charge is calculated according to an anticipated power consumption range, and the price of the actual power that is consumed. Both of these elements are influenced by the type of contract that has been signed between the corporation and the utility.

Actual energy charge - This charge corresponds to the consumed active energy, which is the cumulative energy consumed over a given period of time. The kilowatt hours (kWh) rate depends upon the time period the energy was consumed, and whether that consumption occurred during "peak" and / or "off peak" hours.

Demand charge - This charge represents the highest average power consumed within any 15 minute time period over the span of a month's time is tracked by the utility. This number is then multiplied by the demand charge rate in order to produce the demand charge that appears on the electrical bill. That means consumers are charged for a peak demand even if it only happened once during the month.

Power factor penalty - The power factor is the ratio between the active power (that generates work)

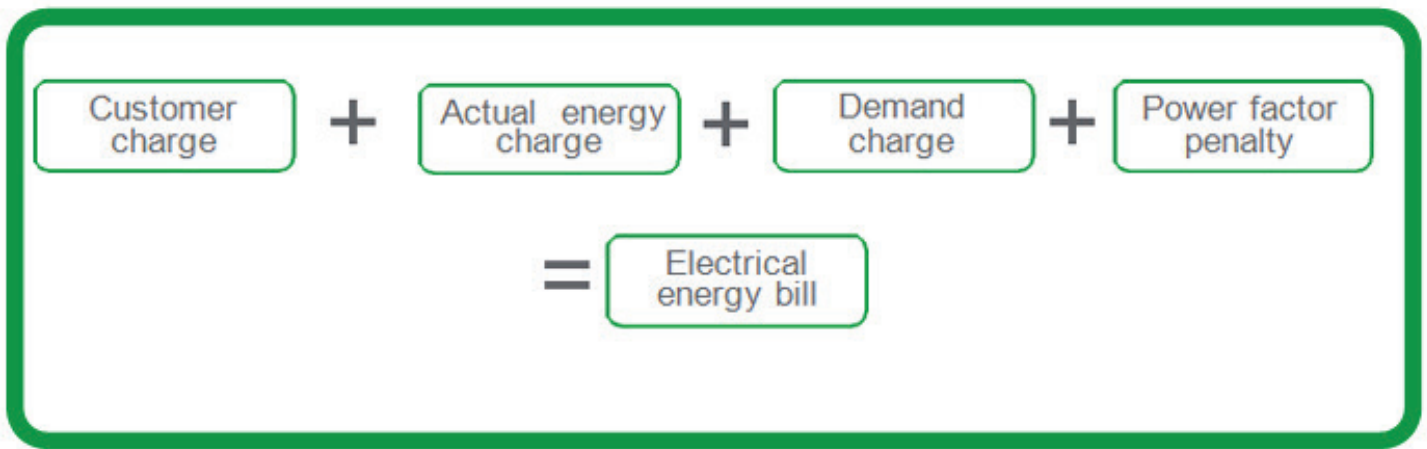


Figure 8: Worn pump curve vs. new pump curve

and the apparent power (that could potentially be used to generate work). That means that a certain portion of the power that is delivered by the electrical utility to the industrial site is not billed (because it did not generate work). If the power factor is less than the given value mentioned in the contract (say around 0.9), the consumer is invoiced for the power factor (reactive power). A lot of equipment or devices have power factor lower than 1: motors, induction furnaces, transformers, variable speed drives, computers, fluorescent lighting.

Best practices for energy cost reduction through bill management

The electrical energy bill for the site can be reduced by implementing the following series of simple actions:

- Locate and review the utility contract itself to better understand the charges associated with the bill and how they can be controlled. Up to 10% savings without any capital investment could be achieved with the support of a company specialist in energy management.

- Adjust the timing of energy usage from the peak rate period to the off peak period as much as is possible (e.g. by controlling differently reservoir and pumping operations).

- Reduce the monthly peak demand number in order to reduce the demand charge. In most cases, 75% of the applications are oversized. Variable speed drives, which can reduce power demand by 20%, are a technology that helps organizations to size according to process requirements.

- Power factor penalties that are due to motor and that mitigate harmonics at 48% of THDi for 80% load, can be canceled out by deploying variable speed drives to pumps.

- Reduce the amount of energy that is consumed that is not linked with revenue generation. An active control of the leakage will significantly reduce the operational cost.

Conclusion

By pursuing best practices in energy efficiency management, asset management, and energy cost management, total cost of ownership of pumping system networks can be

reduced by up to 20%. One simple technology, the variable speed drive with embedded energy management functionality, has the capability of being a major contributor to achieving achieve the TCO target.

The variable speed drive is fully integrated in the numerous steps that can be taken in order to implement an effective energy management plan. These include adopting energy efficient technologies, implementing condition-based maintenance practices, and optimizing cost control of the electrical bill. The linking of pumping processes to energy systems helps to improve business performance through better energy management.

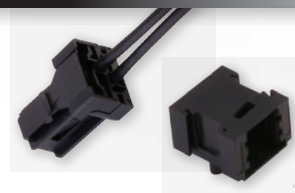
Organizations that are ill equipped to jumpstart an energy efficiency program should seek the assistance of mission-critical subject matter experts. The alternative invites unnecessary delay, risk, and expense. To achieve operational sustainability, organizations must act quickly to assess their current programs and begin building an operational methodology that emphasizes improvement in energy efficiency.

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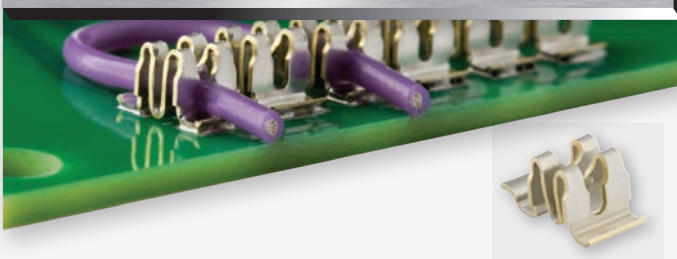
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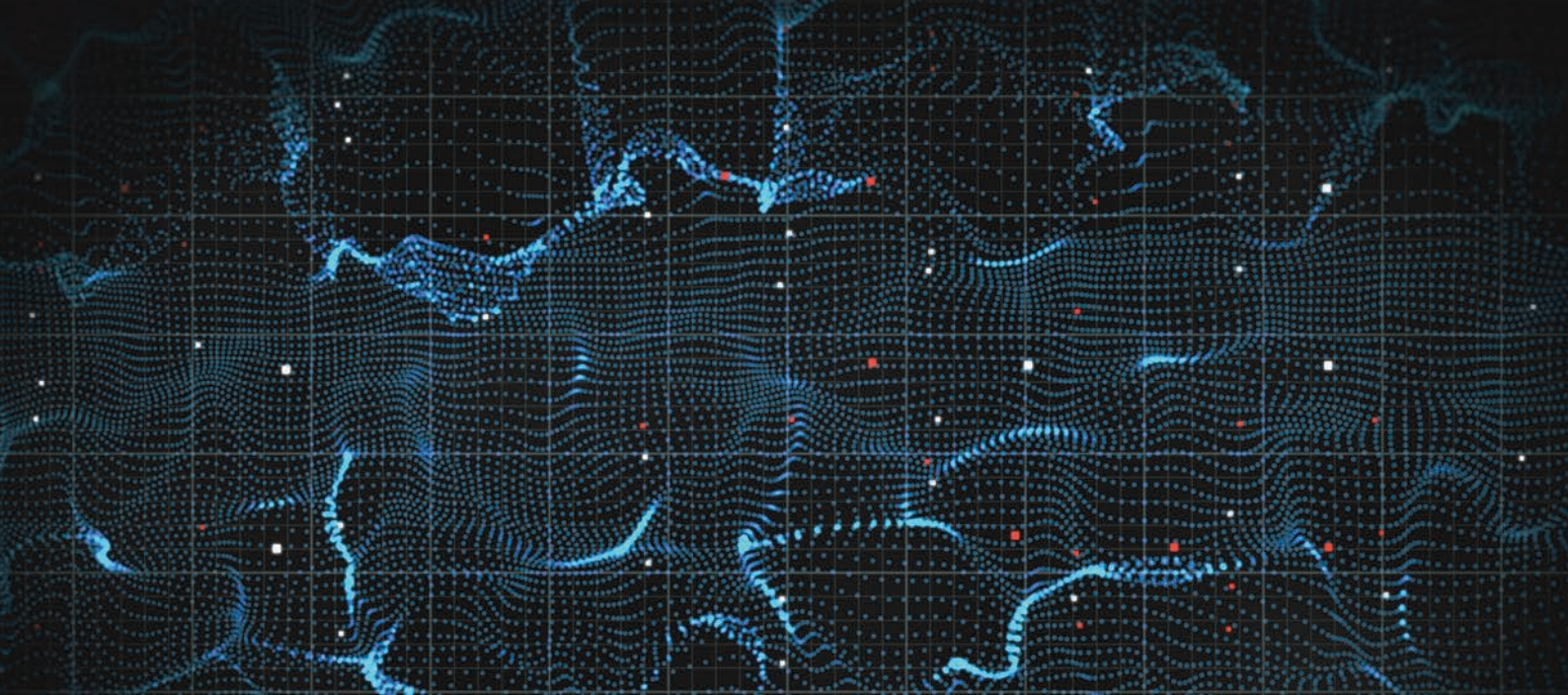


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Speed meets accuracy in a new EM scanning technique

> Ruska Patton, EMSCAN

For designers of electronics such as integrated circuits and circuit boards, electromagnetic emissions are a critical concern. Designers need to ensure the final products comply with international standards for controlling radiated emissions. They must also take care that a product does not cause self-interference or interference with other devices when working as part of a larger system.

If electromagnetic interference (EMI) and compatibility (EMC) problems are not detected and fixed early in the design process, consequences can include production delays, missed time-to-market goals and higher costs. To correct problems early, they must be identified before compliance testing, and with details that standard far-field compliance testing cannot provide. Far-field measurements indicate whether a device has passed or failed, but do

not add much value for discovering the root causes of an emissions issue.

For this reason, very-near-field tools capable of pinpointing problems are essential to designers and verification engineers - and the faster and more accurate the tools, the better.

Limitations of today's methods

However, most available tools emphasize either high speed or high precision, not both. Traditional very-near-field measurement with a handheld probe is useful for finding sources of emissions. By moving the probe to various points on a circuit board, the user can find hotspots related to any emissions problem. But this method doesn't provide an overall picture of the board, so it can miss some potential sources of emissions. Robotic positioners can individually scan all

the various features where emissions might occur with high precision, but they can take hours.

A much faster method is to use a scanning array that applies multiple probes at once, enabling the user to measure a whole board or section of a board in less than a second. It is not only faster, but ultimately repeatable. On the other hand, the fixed distance between the probes in the array means this method may not be effective for obtaining very fine detail and isolating the precise source of an emission.

Combining the best of both worlds

Now, a new scanning technique is available that delivers both speed and accuracy, with the ability to precisely pinpoint emissions even from inside an integrated circuit or microchip in just minutes. The EMxpert™

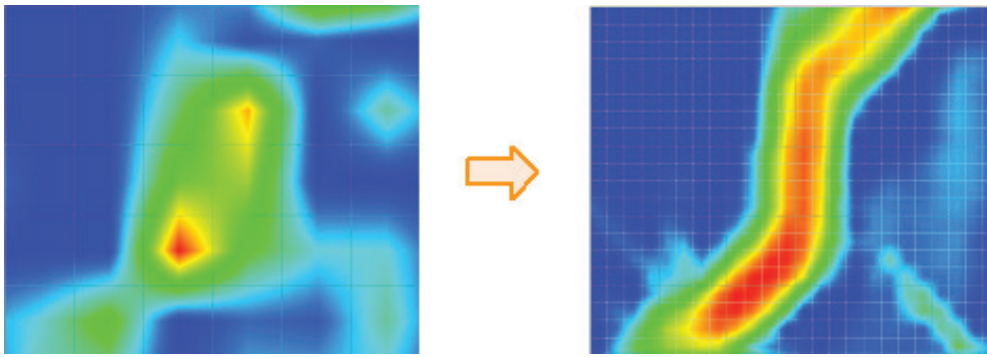


Figure 1. EMSCAN EMxpert ERX+ spatial scans at level 1 (left) and level 3 (right)

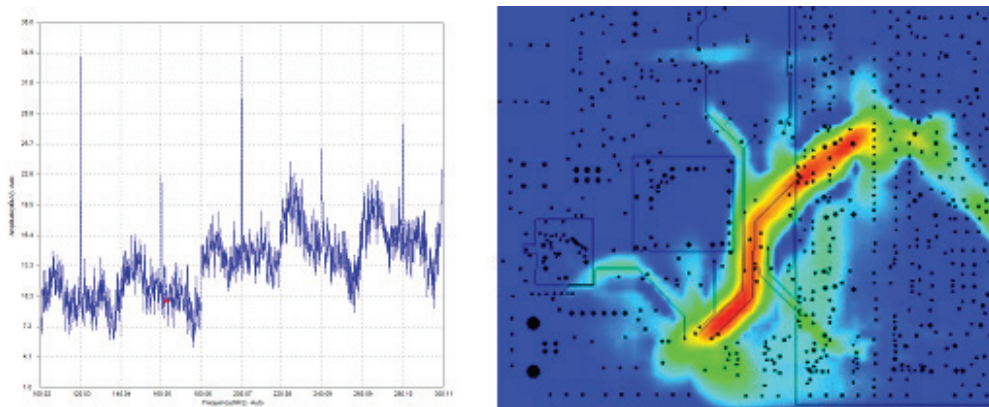


Figure 2. Spectral and spatial views of a scan

ERX+ product from EMSCAN™ effectively provides higher resolution by combining a 1,218-probe array with a small amount of mechanical motion. A robotic positioner moves the entire array methodically to fill in the distance between probes. This technique increases the density of points measured, up to 4,000 times the number of points, by dividing the scanned area into tighter and tighter grids according to user settings (Figure 1).

The ability to increase density makes a significant difference in the resolution of the spatial image provided by the scan. For example, changing from a level 1 scan to a level 7 scan, the highest density setting, reduces the effective

space between measurement points from 7.5mm to just 0.1mm. Details of small features become available, even inside components.

Analyzing a PCB with the EMxpert ERX+

The EMxpert ERX+ scanner enables a designer or engineer to very quickly sample the magnetic field distribution of a product and visually display the results. The solution uses an embedded spectrum analyzer and intuitive visual imaging to provide both a spectral view to identify the frequencies of emission and a spatial view to visualize where the emissions are coming from (Figure 2).

The scans are so quick that it is possible

to capture intermittent or changing events and measure emissions as different system functions take place, such as reading or writing data.

A quick scan typically identifies many emissions. The designer can use the EMxpert ERX+ software, which is highly interactive, to jump around the board, zoom in and isolate emissions by location or frequency. Overlaying a design file, like a Gerber file, of the board onto the spatial view makes it easy to correlate energy shown in the display to specific circuit board features such as ICs, power planes and control lines (Figure 3). For multilayer boards, the user can display added layers to follow emissions coming from a trace that starts on one layer and continues

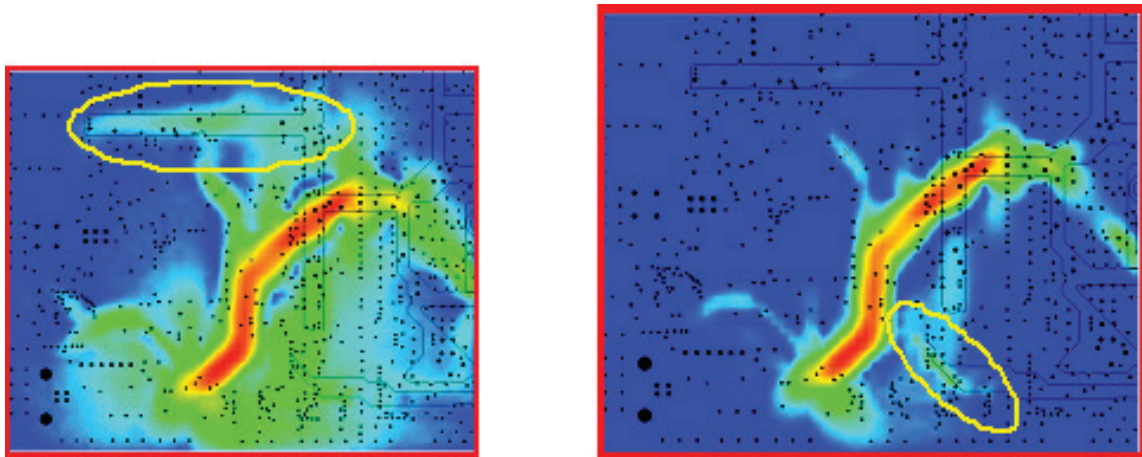


Figure 3. Energy coupled onto power plane (left) and control line (right)

deeper.

If currents move onto an internal layer that is shielded, there will be no fields in the external environment for the EMxpert ERX+ to measure. In this case, the currents are not relevant to a radiated emissions problem. If the shielded feature is the root cause of emissions leaking out of holes in the shield or at the board edge, the scanner will be able to measure it.

Viewing emissions from inside an IC

The extremely high resolution of the EMxpert ERX+ scanner enables it to peer inside an IC and isolate the radiation from individual pins and wire bonds at different frequencies. The system software can also import images when

design files are not available. Spectral and spatial views can be combined to provide a three-dimensional image of emissions. Looking inside an IC, it is possible to see the sources of radiation - whether it is coming from the die region itself, from some of the pins on the IC, or spilling onto the IC from a different portion of the board (Figure 4). By using this information along with knowledge of the IC design, the user can come up with solutions to emissions problems.

Helping to improve software simulations

With the EMxpert ERX+, organizations can also overcome one of the most difficult problems for software simulation today. They can use

simulation to model a system and predict the radiated emissions. But in some cases, the complexity of the design makes this approach impractical due to setup and computational constraints. Or, because of intellectual property concerns, detailed design files may not be available. In these cases, it can be useful to measure the emissions from the most complex part or the hidden portion of the system using the EMxpert ERX+ and import these measured fields into the simulation as a "black box." These imported fields can then be simulated along with larger but less complex features to estimate the radiated emission from the entire system.

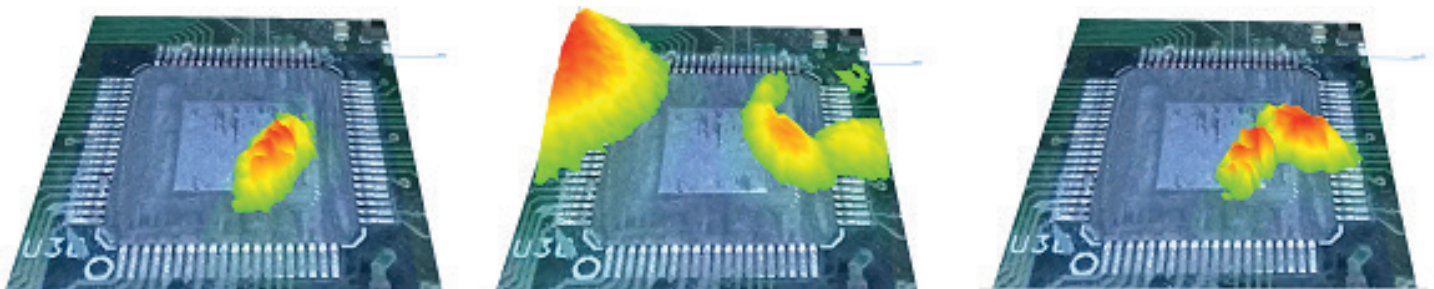


Figure 4. Views of IC emissions at various frequencies

Predicting EMC compliance

Very-near-field measuring with the EMxpert ERX+ is an excellent PCB diagnostic, but not for product compliance. The product will still need to pass standard far-field compliance tests in a testing chamber. However, organizations can use the EMxpert ERX+ results to predict whether a device will pass the chamber tests or not. This far-field prediction capability estimates the results that would be obtained from a given board if it was tested in a compliance setup, and the predicted results have been shown to track closely with the actual results. If a device is predicted to fail, changes made in the lab can then be validated using far-field prediction before going to the chamber.

Conclusion

Together, the capabilities provided by

EMxpert ERX+ add up to faster time to market, reduced project costs and increased productivity for electronics companies. EMxpert ERX+ presents real-time scans in seconds to identify spurious and continuous EM emissions. The instrument provides spatial and spectral scans that allow design teams to cut one to two design cycles out of their product development process. It also reduces their EMI testing time by up to two orders of magnitude.

Design teams can conduct scans on the EMxpert ERX+ system in their offices and obtain results in a matter of minutes. To test a new design in a third-party chamber could require that an engineer travel to an offsite test facility for the better part of a day - after potentially waiting days or weeks for a chamber to become available. The spatial and spectral scans provided by

the system also improve the ability to document new features and can be key elements in product marketing, giving customers graphic proof of a product's EMI characteristics.

The EMxpert ERX+ represents a new step forward in plug-and-play, high-resolution EMC and EMI testing, enabling designers to rapidly diagnose and solve emission problems in a single design cycle from the convenience of their own environment.

Ruska Patton is responsible for the evolution of EMSCAN's real-time near-field measurement solutions. Having started with EMSCAN as Design Engineer and then Manager of the Design Group, he now leads the development of new EMSCAN solutions from concept through successful products in market.



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Functional Safety and what it means for System IP

> hopkins, ARM Processors

Functional safety for Silicon IP used to be a niche activity, limited to an elite circle of chip and system developers in automotive, industrial, aerospace and similar markets. However over the last few years that's changed significantly. There's now a more tangible vision towards self-driving cars with increasingly adventurous Advanced Driver Assistance Systems (ADAS) to capture people's interest along with media-rich in-vehicle infotainment. Moreover the emergence of drones in all shapes and sizes and the growing ubiquity of industrial Internet of Things are also proliferating the requirement for functional safety, all of which are relevant to ARM®.

Much like any technology market surrounded in 'buzz' these burgeoning applications require semiconductors to make them happen and the fast-pace of product innovation has attracted

huge interest from ARM's partners. In the IP community ARM leads the way with a broad portfolio of IP from ARM Cortex®-M0+ to the mighty Cortex-A72 and beyond. With a heritage in secure compute platforms and functional safety ARM is well placed to enable the success of its silicon partners.

What's functional safety all about?

In a nut-shell, functional safety is what the name says, it's about ensuring that products operate safely and continue to do so even when they go wrong. ISO 26262 the standard for automotive electronics defines functional safety as:

ISO 26262 "the absence of unreasonable risk due to hazards caused by malfunctioning behaviour of electrical / electronics systems".

Standards for other markets such as

IEC 61508 for electrical and electronic systems and DO-254 for airborne electronic hardware have their own definitions, although more importantly they also set their own expectations for engineering developments. Hence it's important to identify the target markets before starting development and ensure suitable processes are followed – attempts to 'retrofit' development processes can be costly and ineffective so best avoided. Figure 1 illustrates a variety of standards applicable to Silicon IP.

In practice, functionally safe means a system that is demonstrably safe to a skilled third-party assessor, behaving predictably in the event of a fault.

It must fail safe which could be with full functionality or graceful degradation such as reduced functionality or a clean shutdown followed by a reset and restart. It's important to realize

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“Functional safety is the *absence of unreasonable risk* due to *hazards caused by malfunctioning behaviour of electrical / electronics systems*” [ISO 26262]

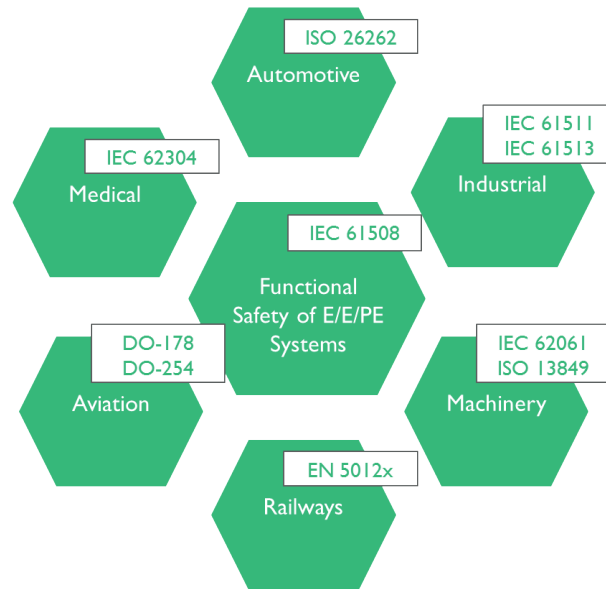


Figure 1. Standards for functional safety of silicon IP

that not all faults will lead to hazardous events immediately. For example a fault in a car's power steering might lead to incorrect sudden steering action. However, since the electronic and mechanical designs will have natural timing delays, faults can often be tolerated for a specific amount of time. In the ISO 26262 this time is known as the fault tolerant time interval, and depends on the potential hazardous event and the system design.

What's at fault?

Failures can be systematic, such as due to human error in specifications and design, or due to the tools used. One way to reduce these errors is to have rigorous quality processes that include a range of plans, reviews and measured assessments. Being able to manage and track requirements is also important as is good planning and qualification of the tools to be

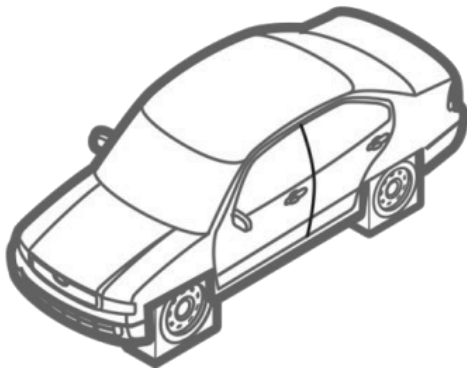
used. ARM provides ARM Compiler 5 certified by TÜV SÜD to enable safety-related development without further compiler qualification. Another class of failure is random hardware faults; they could be permanent faults such as a short or broken via as illustrated by Figure 2. Alternatively they could be soft errors caused by exposure to natural radiation. Such faults can be detected by counter measures designed into the hardware and software, system-level approaches are also important. For example Logic Built-In-Self-Test can be applied at startup or shutdown in order to distinguish between soft and permanent faults. Error logging and reporting is also an essential part of any functionally safe system, although it's important to remember that faults can occur in the safety infrastructure too. Selection of counter measures is part of the process I enjoy the most, it

relates strongly to my background as a platform and system architect, and often starts with a concept-level Failure Modes and Effects Analysis (FMEA). Available counter measures include diverse checkers, selective hardware and software redundancy, as well as full lock-step replication available for Cortex-R5 and the 'old chestnut' of error correcting codes which we use to protect the memories of many ARM products.

Get the measure of functional safety

Faults that build up over time without effect are called latent faults and ISO 26262 proposes that a system designated ASIL D, its highest Automotive Safety Integrity Level, should be able to detect at least 90% of all latent faults. As identified by Table 2, it also proposes a target of 99% diagnostic coverage of all single point failures and a probabilistic metric

Systematic fault



Permanent fault



Soft error

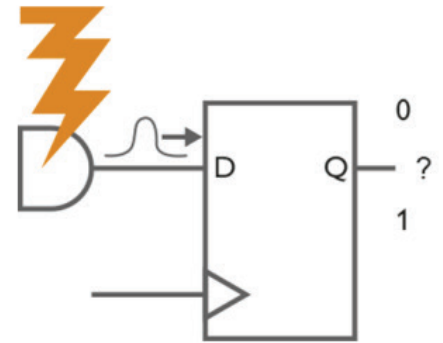


Figure 2. Classes of fault

Proposed Target	ASIL B	ASIL D
Single point fault	≥90%	≥99%
Latent faults	≥60%	≥90%
PMHF	<10 ⁻⁷ / h	<10 ⁻⁸ / h

Table 1. ISO 26262 proposed metrics

for random hardware failures of $\leq 10^{-8}$ per hour.

These metrics are often seen as a normative requirement, although in practice they are a proposal, and developers can justify their own target metrics because the objective is to enable safe products, not add bullet points to a product datasheet.

A question I often ask myself in respect of semi-autonomous driving is whether it's safer to meet the standard's proposed metrics for ASIL D with 10,000 DMIPS of processing or have 100,000 DMIPS with reduced diagnostic coverage and enable

'smarter' algorithms with better judgement? The answer is application specific, although in many cases a more capable performant system could save more lives than a more resilient system with basic functionality, so long as its failure modes are not wildly non-deterministic.

Irrespective of the diagnostic coverage achieved, it's essential to follow suitable processes when targeting functionally safe applications – and this is where the standards really help. Even if you're not targeting safety, more rigorous processes can improve overall quality.

Get it delivered

When developing for functional safety, an essential part of the product is the supporting documentation which needs to include a safety manual to outline the product's safety case, covering aspects such as the assumptions of use, explanation of its fault detection and control capabilities and the development process followed. Safety cases are hierarchical in use, the case for an IP is needed by chip developers to form part of their safety case which then enables their customer and so forth. Most licensable silicon IP will be developed as a Safety Element out of Context (SEoC), where its designers will have little no idea how it will subsequently be utilised. Hence the safety manual must also capture insight from the IP developers about their expectations in order to avoid inappropriate use.

At ARM we support users of targeted IP with safety documentation packages, which always includes a safety manual.

So in summary when planning for functional safety think PDS:

Process

Development

Safety documentation package



Switching hundreds of volts and amps without loss

› Reinhard Zimmermann, RECOM Power GmbH

Efficient use of electrical power is a goal shared in every area of electrical engineering and electronics. Wind and solar have come to provide a significant part of our daily energy needs, placing the focus on power electronics components able to switch hundreds of volts and amps at a high degree of efficiency before this green power can be fed into the grid. We refer to state-of-the-art power switches, IGBTs and SiC-FETs, and how to supply the respective gate drivers with voltage in the most effective possible way.

These semiconductor technologies are to be found today not only in wind and solar power inverters, but

across the board in power electronics, ranging from motor control to welding equipment, induction furnaces and vacuum generators to e-mobility and more.

Developers only had bipolar power transistors available to them in the early stages of the power electronics; these were suitable for reverse voltages of up to 500V and could switch currents of 100 amps and more; this might be a perfectly respectable level of performance, but it comes at the cost of very high control currents - usually ten to twenty percent of collector current - to keep switching losses from relatively sharp edges in limits.

The first power MOSFETs (metal oxide field effect transistors) to be developed solved this problem. A MOSFET gate is insulated by design, only requiring negligibly small currents to charge

and discharge the gate capacitor. This development significantly reduced power losses from gate control.

Obviously, there were still two sources of loss as known from bipolar semiconductors:

1. Switching losses from limited edge steepness during switching cycles
2. ON losses while the semiconductor is in its ON state

ON losses are intrinsic to the technical specification of MOSFETs and are therefore largely fixed; switching losses on the other hand depend on control quality, which may be improved in the development phase by suitable circuit designs.

IGBTs combine the advantages of MOSFETs and bipolar transistors

The disadvantage of higher ON losses on the drain-source path



Fig. 1 Highly insulated DC/DC converters optimise power supply to IGBT and SiC-FET drivers in power electronics

was eliminated by the development of IGBTs or insulated date bipolar transistors. As the name suggests, this is a combination of MOSFET at the input and bipolar transistor at the output, providing the best of both worlds. Like MOSFETs, IGBTs operate almost without control current, and have low voltage drops on the collector and emitter paths in their ON state as is typical of bipolar transistors allowing them to switch high voltages and currents while keeping losses very low.

SiC-FETs are ideal for higher power and higher frequencies

IGBTs use monocrystalline silicon as a semiconductor material compared to silicon carbide in SiC-FETs. Silicon carbide has a higher melting point and allows much thinner insulation

layers at the gate, which improves thermal conductivity and allows higher power density. The switching losses in SiC-FETs are lower than IGBTs by a factor of at least four (Fig. 2) – an advantage that especially pays off in higher performance ranges and higher switching frequencies. SiC-FETs will still only dominate in the high-performance range due to cost, and will not be able to drive IGBTs out of the mass market.

Insulated DC/DC converters ensure optimised power supply

As mentioned above, control quality is the main determinant in switching losses, so gate drivers and their power supply deserve special attention. Input signal and power supply to driver ICs need very effective insulation as they are directly coupled to the high

potential in the IGBTs or SiC-FETs; insulated DC/DC converters provide an especially convenient solution in the latter.

Commercially available driver modules are asymmetrically controlled by positive and negative voltage. However, IGBT and SiC-FET drivers differ in the voltage levels required.

Data sheets quote threshold voltages of +3V for For IGBTs. In practice, however, quick, clean switching requires +15V, even requiring a negative bias voltage on the gate to switch off securely and prevent an undesired restoration of power due to the high dV/dt load. In practice, -9V has proven to be a safe bias voltage. Converters with voltages from +15V and -9V are therefore required for supplying IGBT drivers (Fig. 3, left).

SiC-FETs raise a somewhat different situation as their switching thresholds are between +1V and +2V. A gate-source voltage of +20V makes sense to keep conductive losses (RDSON) to a minimum – settling for a conventional +15V value for IGBTs would increase RDSON losses by up to 30%. A negative voltage of -5V has established itself as ideal for them to switch off reliably (Fig. 3, right). A more negative voltage would result in a change in gate-source parameters, leading to impaired stability.

High dV/dt places a strain on the insulation barrier

A DC/DC converter's insulation can be visualised as a dam dimensioned for a certain maximum level – a dam that is high enough will withstand the waves in a storm surge, but flooding even at places will cause a breach.

A DC/DC converter behaves the same way. High switching frequencies –

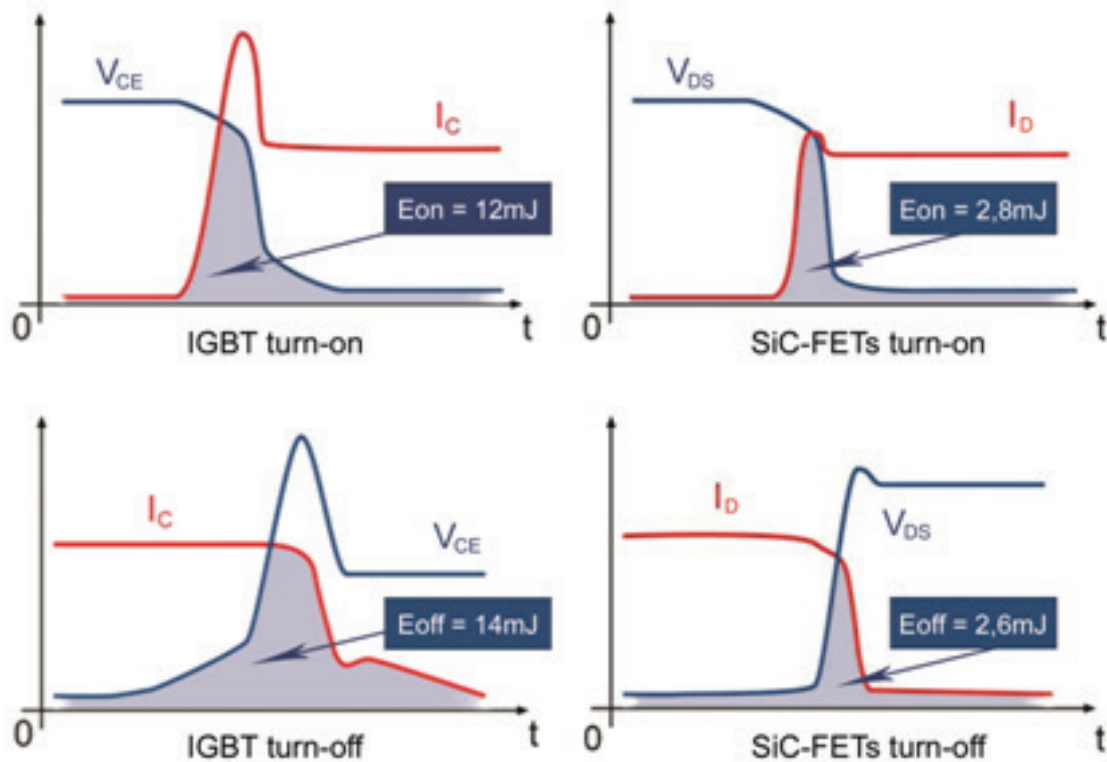


Fig. 2: Current/voltage AUC while switching on (diagrams above) and off (below) is a measure of switching losses. SiC-FETs (top and bottom right) are more efficient than IGBTs by approximately a factor of four due to the steeper switching edges – at 25°C ambient temperature and taking the losses from one body diode into account

usually 10kHz to 50kHz for IGBTs and somewhat more than 50kHz in SiC-FETs – and steep edges put constant stress on insulation components in the system. Voltage peaks can cause surges that strain the insulation in a transducer to its limits, especially in combination with “hidden” parasitic capacitances and inductances in the circuit. There is no magic formula to calculate voltage peak levels and therefore life expectancy of the system to any degree of accuracy.

Measuring equipment can only help to a very limited extent, as even the relatively small capacitance in a high-voltage oscilloscope probe will taint

the result. An voltage spike measured at 2kV, for example, could well be double that without exposure to the probe. There is no final guarantee, and relying on measurement with a converter on insulation that is already tightly dimensioned risks the long-term reliability of the product. Developers therefore tend to allow sufficient safety reserves and use converters with the best possible insulation in dimensioning fast power switches.

High-quality DC/DC converters for IGBT and FET SiC applications

The RECOM DC/DC converters

range includes a complete range of converters designed specifically for supplying IGBT and SiC-FET drivers. The converters have asymmetric outputs at either +15V/-9 V (IGBT) or +20V/-5V (SiC-FET) at input voltages of 5V, 12V, 15V and 24V. The power required also depends on switching frequency – up to 1W is usually sufficient for around 10 kHz, whereas 2W is required for 50kHz and more. These products operate in power-sharing mode where the rated power can be distributed across the two outputs.

Insulation causes additional differences. Products in the RKZ

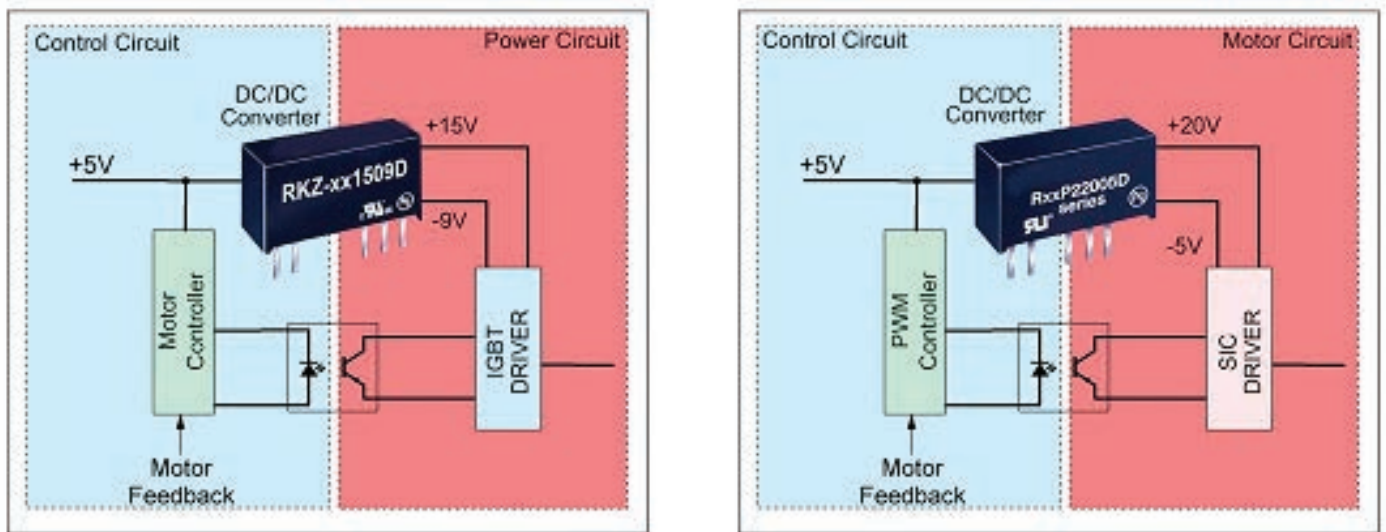


Fig. 3: Highly insulated DC/DC converters with asymmetric outputs of +15V/-9V (such as RECOM RKZ1509) or +20V/-5V (such as RECOM RxxP22002D) provide a convenient method of powering IGBT and SiC-FET drivers.

range are available at isolation voltages of 3kVDC and 4kVDC, with RxxP2xx versions as high as 5.2kVDC. As usual at RECOM, the new product

families have been subjected to hard HALT tests at RECOM's in-house environmental laboratory during development to ensure long service life,

and are guaranteed for three years. The products are manufactured according to the RoHS2 and Reach directive, and certified according to UL 60950-1.

Power Your System with the Smallest DC-DC Converter












8W in DIP-16 Package MDW08 Series

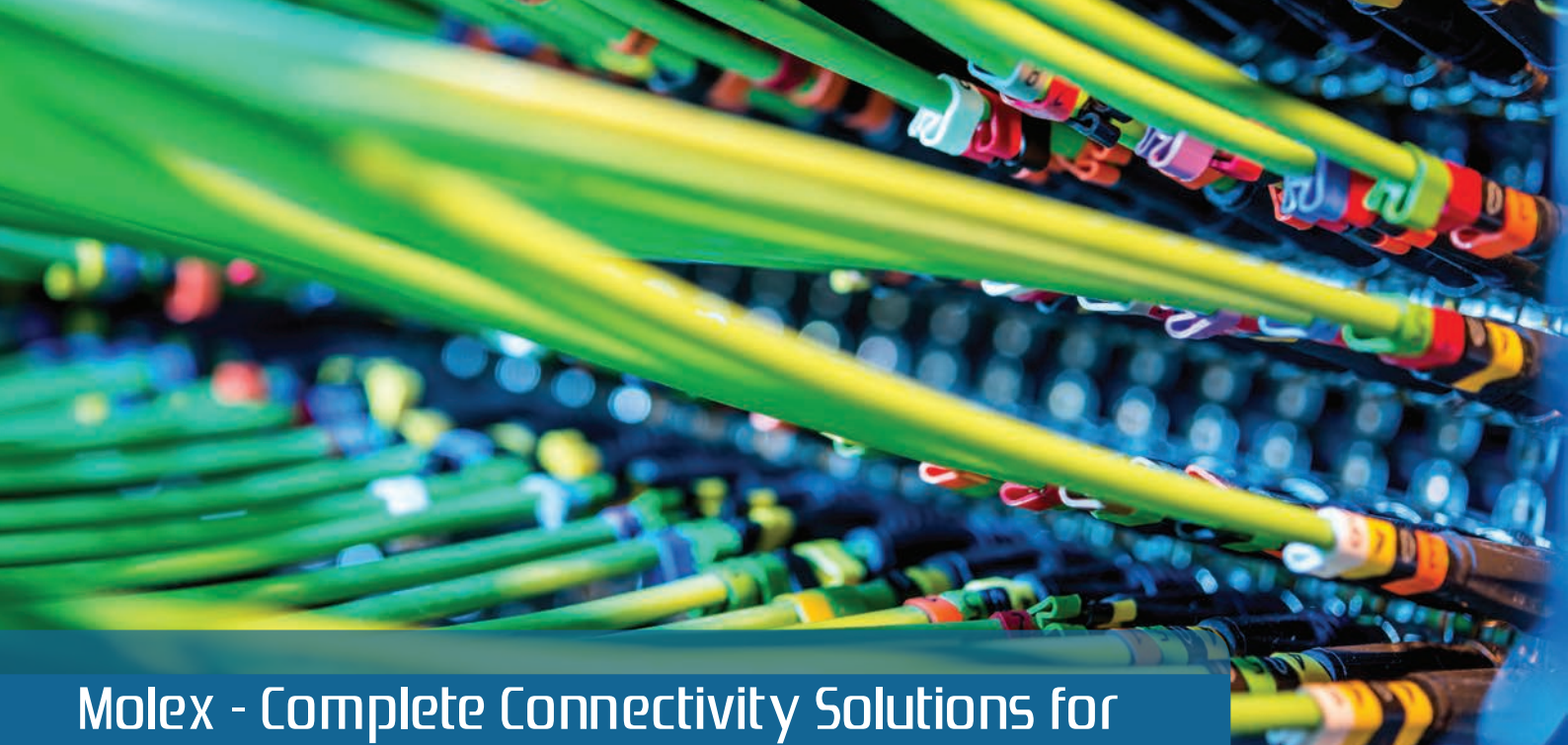




Israel Distributor Wanted
Please kindly contact us at sales@minmax.com.tw



MINMAX TECHNOLOGY CO., LTD.
www.minmax.com.tw



Molex - Complete Connectivity Solutions for Automation Infrastructures

› Hannah-Lena Gehring, Molex

The desire to harness the wealth of information available from smart, networked devices to revolutionise industrial processes is the very essence of Industry 4.0. Machine builders are taking every opportunity to adopt technologies that help realise this concept – one being secure connectivity solutions that perform reliably, even under extremely harsh conditions. In this article, Hannah-Lena Gehring, product manager for the Brad® M16, M23 and M40 product range in the transportation and industrial division at Molex, outlines the connectivity solutions supporting automation infrastructures and presents new additions that complement the offering.

Automobile builders and other high-end manufacturers are already applying Industry 4.0 techniques, creating enterprise-wide Ethernet platforms that link directly from the office to the device. Here, a well-designed infrastructure is required that mitigates security risks while providing

transparency to assess what's happening on the plant floor. This promises clear advantages to OEMs, in terms of cost and risk reductions, performance enhancements and greater flexibility.

Machine builders, line builders and robotic system integrators alike are looking to vendors to provide ready-made and assembled interconnect solutions that include everything from PLC backplane modules to multiport and IO blocks to provide soft-wiring connections to IOs. In addition, they are also looking for interface cards that support communication between the robotics and the rest of the line as well as power connectors to control motors and servo systems.

As industrial automation technologies continue to improve manufacturing quality and efficiency, Molex is committed to remaining ahead of the curve. Reflecting these trends, Molex has widened its offering for the industrial automation infrastructure via strategic acquisitions and new

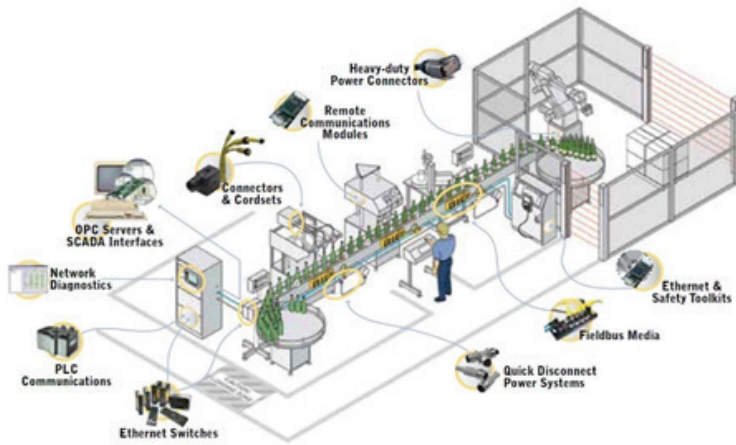
product developments.

Today, Molex technology can provide everything from a single connector to a fully realised solution.

With a broad portfolio of standard Brad products to address all kinds of industrial automation applications, these products can also be modified for customer-specific needs. The circular connectors are offered with IP69K sealing and are UL approved. This product family also includes IEC compliant connectors, such as the Cat 6, Micro-Change CHT (Circular Hybrid Technology) and Industrial Ethernet interconnect solutions.

A comprehensive range of cables for sensors, measurement, controls, robotics, network and drives applications, manufactured and rigorously tested at the Molex Fimar facility in Italy, provide excellent performance, quality and durability for this industrial sector. The standard portfolio addresses a broad range of applications, while customer-specific solutions are also possible.

Complete Solution For Automation Infrastructures In Harsh Environments



Brad M23 - 4+3+PE male connector.



Brad M23 12-pole female cordset.



Brad M23 and M40 cordsets

The culmination of the recent Flamar acquisition and new product development strategies is epitomised by the introduction of the Brad M23 Signal and Power overmoulded cordsets. The cordsets, which integrate Flamar WSOR (weld-slag and oil-resistant) cable with the space-saving M23 form factor, help ensure reliable performance in harsh industrial environments, including welding applications, metalworking and machining processes using cutting oil. They are also particularly well-suited for use in automotive and material handling applications, meeting the stringent power and connectivity specifications machine builders require.

Adhering to the de facto industry standard, the cordsets interface easily with existing M23 infrastructure, while the IP67 sealing ensures the connectors perform reliably. In addition, they complement the existing

Molex M23 offering, which includes field-attachable connectors and panel-mounted receptacles.

Promoting soft-wiring techniques, the low-profile, pre-assembled and overmoulded connector can be fitted in less than one minute, reducing maintenance costs and machine downtime. Also, wiring and assembly errors are mitigated and valuable space is saved.

Available with multiple pin-out options and numerous standard cable lengths, the cordsets deliver clear benefits to the machine builder, in terms of excellent flex and torsion performance, over a wide operating temperature range.

Further developments are on the Molex automation infrastructure roadmap. Within the priority areas, there is a major focus on expanding the Brad portfolio with power connectors; the recent introduction of the M12 power is an excellent example of progress.

In addition, the M40 overmoulded power cordsets with WSOR cable fitted as standard are currently being introduced.

As the industry continues its journey along the road to Industry 4.0, a variety of specific issues may arise that require meticulously designed and complete customised solutions – that's where trusted partners are vital. Regardless of the end application, Molex will provide machine builders with fully-tested cable assemblies and products for a wide range of applications. Customers need only define the overall features; then Molex, based on its fully comprehensive know-how, will propose a solution, guide the customer through the options, and then supply the finished product.

Molex continues to empower the industrial infrastructure with innovative communication, control and connectivity solutions to deliver precisely what is required in terms of reliability and performance – especially in harsh conditions. For machine builders to develop best-in-class automation equipment with global compatibility, which ultimately drives long-term relationships and repeat business with end-user customers, a partner that offers global support and access to leading connectivity solutions is an essential requirement.



Hannah-Lena Gehring, product manager for the M16, M23 and M40 product range in the transportation and industrial division at Molex.

Dinner in 3D

We're all accustomed to having appliances on our kitchen counters, from toasters and blenders to coffee makers and microwaves. If Mechanical Engineering Professor Hod Lipson has his way, we'll soon need to make room for one more - a 3D food printer that could revolutionize the way we think about food and prepare it. Over the past year, Lipson and his students have been developing a 3D food printer that can fabricate edible items through computer-guided software and the actual cooking of edible pastes, gels, powders, and liquid ingredients - all in a prototype that looks like an elegant coffee machine. The printer is the result of a design project devised by Lipson and his students, led by Drim Stokhuijzen, an industrial design graduate student visiting from Delft University of Technology in the Netherlands, and Jerson Mezquita, an undergraduate student visiting from SUNY Maritime who is now a research associate in Lipson's Creative Machines Lab (CML).

"Food printers are not meant to replace conventional cooking - they won't solve all of our nutritional needs, nor cook everything we should eat," says Lipson, a pioneering roboticist who works in the areas of artificial intelligence and digital manufacturing. "But they will produce an infinite variety of customized fresh, nutritional foods on demand, transforming digital recipes and basic ingredients supplied in frozen cartridges into healthy dishes that can supplement our daily intake. I think this is the missing link that will bring the benefits of personalized data-driven health to our kitchen tables - it's the 'killer app' of 3D printing."

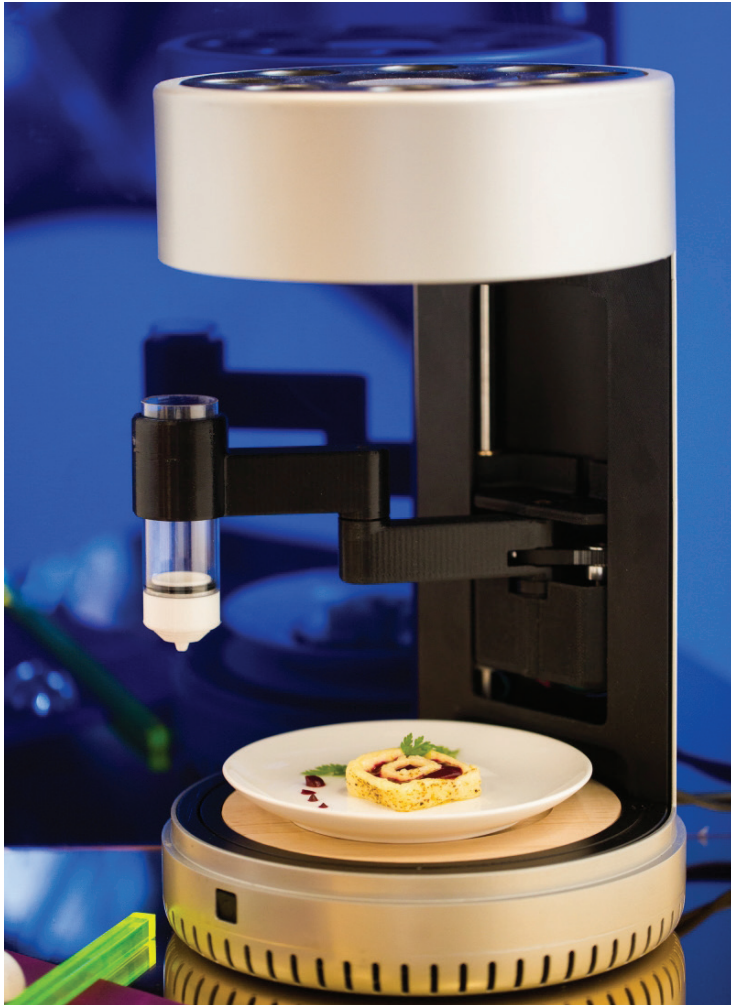
Lipson's 3D printer - Image courtesy of Timothy Lee Photographers

Lipson's team, who also includes PhD student Joni

Mici and undergrad Yadir Lakehal, has been working nonstop to get the prototype up and running - the major challenge is getting the printer to "cook" the food. Lipson notes that, while he is sure they can get the technology to work this summer, "stuffing it all into the new machine, which is much more compact than the printer we've been using, is a big challenge." The printer is fitted out with a robotic arm that holds eight slots for frozen food cartridges; the students are now working on incorporating an infrared heating element into the arm. Lipson, a member of Columbia's Data Science Institute, sees 3D printing as a universal technology that has the potential to revolutionize lives by enabling us to design and manufacture things with unprecedented freedom. Instrumental in advancing 3D printing for more than 20 years, Lipson was one of the first researchers to work on multi-material printing, first printing electromechanical systems and moving on to bioprinting. Printing biomaterials led him to printing food, which he says is an especially exciting area: "It touches on something that's very basic to our lives. We've been cooking forever, but if you think about it, while technology and software have wormed their way into almost every aspect of our lives, cooking is still very, very primitive - we still cook over an open flame, like our ancestors millennia ago. So this is one area where software has not yet permeated. And when software touches something, it takes off."

Taking off to the kitchen, Lipson and his team are collaborating with New York City-based International Culinary Center (ICC), a top culinary school in the U.S. Working closely with Chef Hervé Malivert, ICC's director of food technology and culinary coordinator, Lipson led several workshops to bring together ICC's culinary creativity with the CML's technical knowledge to create new kinds of foods - novel textures, combinations, and spatial arrangements of basic ingredients that chefs cannot currently put together. Malivert hoped to expose his students to the future of food and new food technologies; Lipson's aim was to explore and study the potential of printed food, to create and document the

Out Of the box



Lipson's 3D printer
Image courtesy of Timothy Lee Photographers

student-designed recipes, and unveil what food in 2025 might look like.

While working with the ICC, Lipson also offered a new class this past spring on digital manufacturing at the Engineering School. More than 32 students, mostly undergrads, took the pilot course whose final project focused on food printing. At the end of the semester, they demonstrated unusual printed edible constructs.

Cream cheese was a popular choice as it was easy to extrude from the printer and blended nicely with other ingredients. He plans to offer the class again next year.

Lipson and his team aim to have their prototype printing much faster and more accurately by the end of the year, and, they hope, cooking as it prints, too. Unlike conventional oven cooking, their 3D printer will be able to cook various ingredients at different temperatures and different durations, all controlled by new software being developed by Computer Science Professor Eitan Grinspun. The software is critical, since the 3D printer they have been experimenting with is meant to design and print machine parts, holes, screws, notches, cuts, and bends, not your next meal.

Grinspun, who directs the Columbia Computer Graphics Group, is creating software that can predict what a 3D-printed shape will look like after it has been cooked for a specific time at a set temperature. His team is developing a volumetric material simulator that accounts for thermal transfer and the change of material phase (the food's viscoelastic properties) under heating/cooling conditions, in effect, attempting to replicate oven-cooking food.

3D food printing offers revolutionary new options for convenience and customization, from controlling nutrition to managing dietary needs to saving energy and transport costs to creating new and novel food items. Lipson sees it as the "output device" for data-driven nutrition and personal health, akin to precision medicine, with huge potential for a profound impact.

Lipson is especially excited about working with the ICC chefs and plans to continue the collaboration. "We've already seen that putting our technology into the hands of chefs has enabled them to create all kinds of things that we've never seen before, that we've never tried. This is just a glimpse of the future and what lies ahead."

-by Holly Evarts

ROHM presents most comprehensive range of Automotive Grade LDO Regulators

AEC-Q100-qualified devices provide superior characteristics, high reliability and miniaturization options for a multitude of Automotive applications

ROHM has recently announced the availability of two new LDO regulator families, complementing the existing portfolio of LDOs and bringing the total number of its automotive-grade LDOs up to 184. With its miniaturized package size, ROHM's new BUxxJA2MNVX-C series is the world's smallest Automotive-grade LDO regulator whereas the BD7xxLx series provides unmatched quiescent current features. Customers are now able to choose from multiple voltage and current options as well as packaging solutions to meet the exact requirements of their application, whether in automotive body, power train and infotainment or advanced driver assistance systems (ADAS). Both line-ups are based on ROHM's vertically integrated product system along with its proprietary analog design process and package technologies to achieve high efficiency in a compact form factor while adding to design flexibility and reliability.

In recent years, Automotive power supply ICs continue to increase in sophistication and functionality, accompanied by a greater need for an expanded offering to cover a wide range of characteristics and application requirements – such as package type and output current – instead of simply focusing on an all-in-one-solution. The BD7xxLx series together with the BD4xxMx series is optimized for all applications which are connected to the battery and which require an extreme low quiescent current. Thanks to its wide input voltage range (up to 50V max. voltage) and wide operating temperature range spanning -40° to +125°C, this family is a perfect solution for automotive body, powertrain and infotainment systems. The BD7xxLx line-up is composed by 8 part numbers, with optional output voltage from 3.3V and 5V, output current capability from 200mA up to 500mA and 3 standard package types.

The proliferation of accident prevention measures and automated driving systems are demanding advanced

safety systems that deliver higher performance. While this increases the number of sensors, camera modules and other mounted components, there is also a need to decrease part size to improve design flexibility and reduce vehicle weight. However, so far it has been difficult to design power supply ICs that deliver high reliability in a very small form factor. Until now, for harsh automotive system environments with increased noise, temperature and vibration, the smallest package size that could provide the necessary level of reliability has been 1.5mm². The new AEC-Q100 qualified BUxxJA2MNVX-C series provides automotive grade reliability in an ultra-compact 1mm² package, decreasing the mounting area by 55% over existing products. At the same time, stand-by current consumption (35uA) and load regulation characteristics (65mV load fluctuation) are reduced by half, contributing to smaller, higher performance automotive safety modules. Unlike conventional products requiring an external capacitance of at least 1.0uF to prevent oscillation, the new regulator types support smaller external capacitors as low as 0.22uF for further miniaturization.



New Cypress Automotive LED Driver Delivers Robust Performance and Minimizes the Bill-of-Material for Headlight Systems

Cypress Semiconductor Corp. (NASDAQ: CY) today introduced an automotive LED driver that enables smaller and more cost-effective headlight systems. The new S6BL112A automotive-grade LED driver is the industry's first to feature synchronous control, which helps it provide industry-leading conversion efficiency, enabling stable performance in a lighting system. The

device is able to drive LEDs at a high 2.1-MHz switching frequency, which enables a compact headlight solution that uses small, inexpensive inductors, reducing physical size and bill-of-materials costs. The LED drivers combine with Cypress's Traveo™ microcontrollers (MCUs) and power management ICs (PMICs) to provide a best-in-class automotive front-lighting solution.

Cypress's S6BL112A Automotive LED driver features an input voltage range of 4.5-42 V that encompasses extreme operating conditions such as cold-cranking—when the automobile engine starter draws an excessive amount of current due to starting the engine in cold temperatures - or load dump - a power surge that occurs when an automobile battery is disconnected while the alternator is supplying current during engine operation. The LED driver also facilitates the design of electrical system safeguards by including System Safety Functions such as under current detection, over current and voltage protection, as well as the ability to mask undesired LED OPEN diagnosis during cold cranking. Additionally, its synchronous operation eliminates unstable dimming that can occur when the input voltage is low. More information on Cypress's automotive LED drivers is available at <http://www.cypress.com/automotive-led>.

"With the fast-growing usage of LED lighting systems in cars and other vehicles, automotive suppliers are seeking to minimize the component count and cost in these systems without compromising on reliability or performance," said Kiyoe Nagaya, vice president of the Analog Business Unit at Cypress. "Cypress's automotive LED drivers provide a compact, efficient headlight solution, supported by our complementary automotive MCUs and PMICs, with robust performance even in extreme temperatures or when faced with disruptive electrical noise."

The S6BL112A is a one-channel 2A output Buck LED driver that supports both analog and PWM dimming functions, enabling precise brightness control. Its switching frequency can be set between 205 kHz and 2.1 MHz, with high output current accuracy of +/-2%. The device enables slew rate control without an external filter, limiting Electro Magnetic Interference (EMI) generation that can harm peripherals.

Product Availability

The new S6BL112A LED driver is currently sampling, with production expected in the fourth quarter of 2016. It is available in a 16-pin, thermally-enhanced TSSOP package.

Cypress Enables Leading-Edge Automotive Systems

Cypress works with the world's top automotive companies to bring leading-edge automotive systems typical of luxury models to mainstream vehicles, including Advanced Driver Assistance Systems (ADAS), 3-D graphics displays and full-featured touchscreens. The Cypress-Spansion merger created the industry's No. 3 provider of memories and microcontrollers (MCUs) for the automotive market with a combined portfolio that includes the Traveo™ MCU family, power-management ICs (PMICs), PSoC® programmable system-on-chip solutions, CapSense® capacitive-sensing solutions, TrueTouch® touchscreens, LED drivers, NOR flash, F-RAM™ and SRAM memories, and USB, Wi-Fi and Bluetooth® connectivity solutions. The portfolio is backed by Cypress's commitment to zero defects, world-class service and by our adherence to the most stringent industry standards, such as the ISO/TS 16949 quality management system, the Automotive Electronics Council (AEC) guidelines for ICs and the Production Part Approval Process (PPAP). Learn more at www.cypress.com/automotive.

New automotive actuators from TT Electronics deliver significant improvements to next generation haptic accelerator pedals

TT Electronics, a global provider of engineered electronics for performance critical applications, has introduced new automotive actuators for next-generation of haptic accelerator pedals. The new TT Electronics actuators tackle the weak spots of systems currently available on the market, offering a sub 400 gram total weight, a significant reduction from the total weight of comparable pedals.

The TT Electronics haptic pedal actuators enable power-efficient transmission, consuming less than one watt of energy with an active actuator when it reaches a pedal force increase of at least 10 newtons. The pedal force the

driver feels increases when the drivetrain changes from battery to combustion engine. The additional pedal force can be customised according to OEM specification.

The TT Electronics actuator offers a high degree of reliability without long-term degradation across -40°C to 80°C . Offering a substantial improvement on conventional systems which can frequently fail to function after increased or long duty cycles or across wide temperature ranges.

The simple, lightweight, rugged and compact TT Electronics actuator provides optimum design possibilities for customer-specific applications.

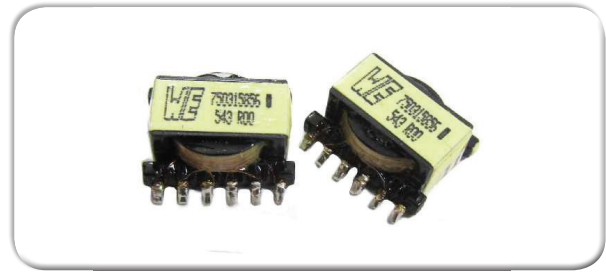
For further information please visit www.abelektronik.com or www.ttelectronics.com.



Wurth Electronics Midcom Announces a New Flyback™ Transformer in Partnership with Texas Instruments

Watertown (USA), 18 August 2016 – In partnership with Texas Instruments, Wurth Electronics Midcom developed a new Flyback™ transformer for TIDA-00550 PLC Analog Input Module. This pick & placeable transformer, 750315856, is built on a low profile ER11.5 package and features outputs of 27V, 5V and -5V, which supplies power to Texas Instruments' TIDA-00550 PLC Analog Input Module. The transformer meets the requirements of functional insulation and offers a wide operating temperature range of -40°C to 125°C with an isolation voltage of 625V at 1 second. Wurth Electronics Midcom's 750315856 transformer is suited for applications including PLC, isolated multi-channel analog input modules, test and measurement, and industrial process control and automation.

To learn more, visit www.we-online.com/midcom



36V Ultralow Noise Precision Op Amp Features 30nVP-P 0.1Hz to 10Hz Noise

Linear Technology introduces the LT6018, a precision op amp featuring 30nVP-P 0.1Hz to 10Hz noise and $50\mu\text{V}$ max input offset voltage. Designed especially for applications sensitive to low frequency noise, the LT6018 has a very low $1/f$ corner frequency of less than 1Hz. The low input offset voltage holds over temperature and input common mode range: TC_{VOS} is $0.5\mu\text{V}/^{\circ}\text{C}$ maximum and CMRR is 124dB minimum. Open loop gain is typically 142dB, enabling the device to achieve less than 1ppm nonlinearity.

The LT6018 has 15MHz gain-bandwidth product and employs slew enhancement circuitry to achieve up to $30\text{V}/\mu\text{s}$ slew rate. The part draws 7.2mA, which can be reduced during periods of non-use to $6.2\mu\text{A}$ using its shutdown pin.

The LT6018 is specified for operation from 8V to 33V supplies, for industrial (-40°C to 85°C) and extended (-40°C to 125°C) temperature ranges. It is available in SO-8E with exposed center pad for enhanced heat dissipation, and space-saving 4mm x 3mm DFN packages.

The LT6018 is priced starting at \$3.25 each in 1,000 piece quantities. For more information, visit www.linear.com/product/LT6018.

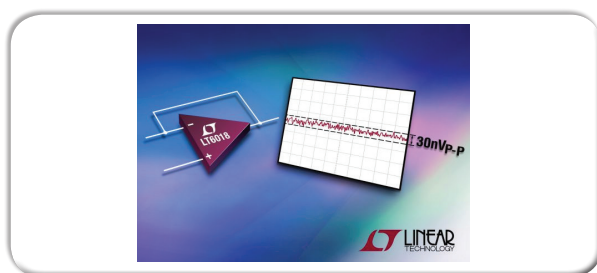
Photo Caption: Precision Op Amp Achieves 30nVP-P $1/f$ Noise

Summary of Features: LT6018

- Ultralow Voltage Noise
 - o 30nVP-P Noise: 0.1Hz to 10Hz
 - o $1.2\text{nV}/\sqrt{\text{Hz}}$ Typical at 1kHz
- Maximum Offset Voltage: $50\mu\text{V}$

- Maximum Offset Voltage Drift: $0.5\mu\text{V}/^\circ\text{C}$
- CMRR: 124dB (Minimum)
- AVOL: 132dB (Minimum)
- Slew Rate: $30\text{V}/\mu\text{s}$
- Gain-Bandwidth Product: 15MHz
- Wide Supply Range: 8V to 33V
- Ultralow THD: -115dB at 1kHz
- Unity Gain Stable
- Low Power Shutdown: $6.2\mu\text{A}$
- SO-8E and $4\text{mm} \times 3\text{mm}$ 12-Lead DFN Packages
- 4.5kV HBM and 2kV CDM Tolerant

Pricing shown is for budgetary use only and may differ due to local duties, taxes, fees and exchange rates.



Synchronous Rail-to-Rail, Single Resistor Step-Down Regulator Sinks/Sources $\pm 5\text{A}$ from 0V to 14.5VOUT

Linear Technology Corporation announces the LTC3623, a $\pm 5\text{A}$ high efficiency, current mode synchronous buck regulator that is adjustable from 14.5V down to 0V output with a single resistor. Proven on Linear Technology's prior linear regulators and switching regulators, this innovative architecture uses a $50\mu\text{A}$ current reference, combined with a single resistor, to set the output voltage. Its unique design enables easy current sharing between multiple regulators, setting the output voltage for all of the regulators with a single external resistor. The LTC3623's bipolar $\pm 5\text{A}$ sink and source capability, wide VIN and VOUT capability, current mode control for tight line and load regulation, high efficiency, low external parts count and parallel capability make it ideal for modern multirail systems, in addition to tracking supplies, ASIC substrate biasing, DDR memory supplies, point-of-load power supplies, portable instruments, distributed power supply systems, battery-powered equipment and thermo electric cooler systems.

The LTC3623's wide 4V to 15V input voltage range is ideal for dual-cell Li-Ion applications, and fixed 5V and 12V intermediate bus systems. Low RDS(ON) integrated N-channel power MOSFETs and synchronous rectification deliver efficiencies as high as 96%. The device's novel design allows dynamic adjustment of output voltage from 0V to $\text{VIN} - 0.5\text{V}$, offering virtually rail-to-rail performance. The LTC3623's ability to sink up to 5A down to 0VOUT enables it to power down individual rails in the system as needed. Its on-chip trimmed reference achieves high accuracy of $\pm 1\%$. Furthermore, output regulation and transient response are independent of output voltage. The user can directly drive the LTC3623's ISET pin with an external voltage supply to program the converter's VOUT. Additionally, output voltage tracking or soft-start is easily programmed via the ISET pin for applications that require power sequencing.

The LTC3623's 400kHz to 4MHz switching capability enables the use of tiny, low cost capacitors and inductors, and combined with its compact QFN package, offers a very compact solution footprint for multirail applications. Additional device features include: programmable wire drop compensation, an input supply voltage regulation loop for extracting power from high impedance sources such as solar panels, an output current monitor, a power good voltage monitor, external synchronization capability and thermal protection.

The LTC3623 is available in a thermally enhanced, 24-lead $3\text{mm} \times 5\text{mm}$ QFN package, with both E and I grades specified for an operating junction temperature of -40°C to 125°C . Devices are in stock, and pricing for the E grade starts at \$3.95 each in 1,000-piece quantities. For more information, visit www.linear.com/product/LTC3623.

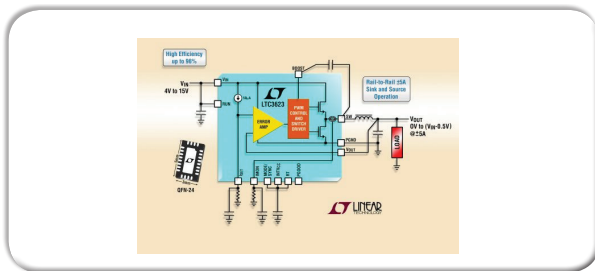
Summary of Features: LTC3623

- Single Resistor Programmable VOUT: 0V to $\text{VIN} - 0.5\text{V}$
- ISET Accuracy: $\pm 1\%$
- Tight VOUT Regulation Across VOUT Range
- Output Current Monitor Accuracy: $\pm 5\%$
- Programmable Wire Drop Compensation
- Easy to Parallel for Higher Current & Heat Spreading
- Input Supply Voltage Regulation Loop
- High Efficiency: Up to 96%
- Output Current: $\pm 5\text{A}$

- Integrated Power N-MOSFETs (60mΩ Top & 30mΩ Bottom)
- Adjustable Switching Frequency: 400kHz to 4MHz
- VIN Range: 4V to 15V
- Current Mode Operation for Excellent Line & Load Transient Response
- Shutdown Mode Draws Less Than 1μA Supply Current
- Thermally Enhanced, 24-Lead 3mm × 5mm QFN Package

Pricing shown is for budgetary use only and may differ due to local duties, taxes, fees and exchange rates.

Photo : 15V, ±5A Monolithic Synchronous Step-Down Regulator Offers Outputs to 0V



Intersil Introduces High Efficiency, High Current Buck-Boost Regulators for Battery-Powered Portables

Up to 96% efficiency and industry's lowest quiescent current makes new ISL91127 and ISL91128 ideal for low-voltage, battery-operated systems

Milpitas, Calif., Aug. 15, 2016 – Intersil Corporation (NASDAQ: ISIL), a leading provider of innovative power management and precision analog solutions, today announced the ISL91127 and ISL91128 high efficiency buck-boost regulators. The latest in Intersil's industry-leading buck-boost family, the new devices feature 4.5A switches, best-in-class efficiency up to 96%, and a compact footprint ideal for providing system power or powering the peripherals in battery-operated devices. They offer the industry's lowest quiescent current of 30μA for superior light load efficiency.

In hand-held device applications where the input voltage may be higher or lower than the output voltage, buck-boost regulators improve efficiency and provide longer battery life compared to a boost regulator plus bypass solution. With increasing demands for smaller and smaller footprints, Intersil's ISL9112x compact QFN and

WLCSP packages enable power designs that maximize efficiency while providing flexibility and ease of design. The ISL91127 and ISL91128 operate in buck, boost or buck-boost mode, depending on the relation between input and output voltages, and provide smooth transitions between modes to prevent noise and glitches. This capability, combined with patented Intersil technology for delivering superior light load efficiency with ultra-low quiescent current, maximizes efficiency under all conditions. This is essential to improve battery life by reducing power drain and heat dissipation in portable and mobile applications.

The new buck-boost regulators' wide input voltage range of 1.8V to 5.5V supports multiple battery topologies, and their wide output voltage range of 1V to 5.2V combined with 3A output current provide the ultimate in design flexibility. The ISL91128 also features I2C programmable dynamic output voltage adjustability, which eliminates feedback resistors and allows the reuse of the same design for multiple output voltage needs.

"Hand-held device designers are constantly challenged to create smaller, more efficient products whether it is the latest wearable, a portable medical device or next-generation smartphone," said Andy Cowell, senior vice president of Mobile Power Products at Intersil. "Intersil specializes in providing the most efficient power delivery with excellent transient response. Our latest buck-boost regulators leverage generations of experience in the most demanding mobile applications to provide customers with extended battery life in a compact, easy-to-use package."

Key Features and Specifications of ISL91127 and ISL91128 • 30uA typical quiescent current: the lowest of any high current buck-boost in the industry

- Up to 96% efficiency (PVIN = 3.6V, Vout = 3.4V~4V, Iout = 200mA)
- Output current up to 3A in boost mode (PVIN = 3V, Vout = 3.3V)
- Input voltage can range from 1.8 to 5.5V, output voltage can be adjustable or fixed at 3.3V • Full protection for under-voltage, short-circuit, and thermal faults to ensure safe operating conditions and reliable system operation
- ISL91128 offers I2C dynamic voltage adjustability for output voltage, and ringing suppression for superior EMI performance

The ISL91127 and ISL91128 can be combined with the ISL9003A, ISL9016, ISL9021A, and ISL9001A LDOs to

support multiple output rails with improved ripple. They also work with the ISL9113 sync boost converter and ISL91133 boost regulator if additional higher voltage rails are required, and lower voltage rails are supported with the ISL9104 and ISL9103 sync buck converters.

Pricing and Availability

The ISL91127IR is available now in a 4mm x 4mm, 20-pin QFN package and is priced at \$1.29 USD in 1k quantities. The ISL91127 is also available in a 20-bump, 2.15mm x 1.74mm WLCSP package priced at \$1.25. The ISL91127IRN-EVZ fixed 3.3V evaluation board and ISL91127IRA-EVZ adjustable voltage evaluation board are available for purchase. For more information, please visit: <http://www.intersil.com/products/isl91127>.

The ISL91128 is available now in a 20-bump, 2.15mm x 1.74mm WLCSP package and is priced at \$1.25 USD in 1k quantities. For more information, please visit: <http://www.intersil.com/products/isl91128>.



Micron Introduces Mobile 3D NAND Solution for Next-Generation Smartphones

New Micron Mobile 32GB 3D NAND memory technology delivers better quality, performance and reliability for next-generation mobile multimedia and streaming experiences

Micron Technology, Inc., (Nasdaq:MU) today introduced the company's first 3D NAND memory technology optimized for mobile devices and its first products based on the Universal Flash Storage (UFS) 2.1 standard. Micron's initial mobile 3D NAND-based 32GB solution is targeted specifically for the high and mid-end smartphone segments which make up approximately 50 percent of worldwide smartphone volume[1]. As mobile devices bypass personal computers as consumers' primary computing device, user behaviors heavily impact the device's mobile memory and storage requirements.

Micron's mobile 3D NAND addresses these concerns, enabling an unparalleled user experience that includes seamless high definition video streaming, higher bandwidth gameplay, faster boot up times, camera performance and file loading.

"Micron continues to advance NAND technology with our introduction of 3D NAND and UFS products for the mobile segment," said Mike Rayfield, vice president of Micron's mobile business unit. "The improved performance, higher capacity and enhanced reliability of 3D NAND will help our customers meet the ever-growing demand for mobile storage and will enable much more exciting end user experiences."

To meet the elevated hardware demands stemming from increased mobile video and multimedia consumption, as well as the anticipated increased storage demands that will result from the introduction of 5G wireless networks, Micron 3D NAND technology stacks layers of data storage cells vertically with extraordinary precision to create storage solutions with three times more capacity than previous generation planar NAND technologies. Because capacity is achieved by stacking cells vertically, Micron is able to pack more storage cells into a much smaller die area, resulting in the delivery of the industry's smallest 3D NAND memory die measuring only 60.217mm². A smaller die enables a tiny memory packaging footprint which can free up space for additional mobile battery size or enable smaller form factor devices.

"3D NAND technology will be vital to the continued development of smartphones and other mobile devices," said Greg Wong, founder and principal analyst at Forward Insights. "With the advent of 5G and mobile's increasing influence in our digital lives, smartphone makers are in need of the most advanced technology to store and manage the ever-increasing volume of data. Micron's 3D NAND for mobile is well suited to address the market's evolving data storage needs by enabling a more seamless user experience for high resolution video, gaming, and photography."

3D NAND: Powering the Changing Mobile Landscape
Micron's first 3D NAND for mobile offers several competitive technical advantages. New features include: Industry's first mobile product built on floating gate technology, a universally utilized design refined through

years of high-volume planar flash manufacturing Micron's first memory devices with UFS 2.1 standard, which enable best-in-class Sequential Read Performance for the mobile market

3D NAND-based multichip packages (MCPs) also include low power LPDDR4X, providing up to 20 percent more energy efficiency than standard LPDDR4 memory Industry's smallest 3D NAND memory die, measuring only 60.217mm², allows tiny memory packaging ideal for ultra-small form factor devices; Micron's 3D NAND die is up to 30% smaller than planar NAND die of the same capacity.

Micron's 3D NAND solutions for mobile are now sampling with mobile customers and partners and will be widely available by the end of 2016.

[1] Source: Micron internal forecast



Highly integrated Hall sensors by Infineon reduce systems costs considerably

The new Hall sensors of Infineon Technologies AG (FSE: IFX / OTCQX: IFNNY) enable automotive, industrial and consumer electronics to meet strict environmental standards. Also, they help fulfil the requirements of very cost-effective and compact designs. The Hall sensors of the new TLx496x family are highly integrated, have precise switching points, a stable operation and a low power consumption. They are available as latch and switch-type sensors.

The TLx496x Hall sensors consume no more than 1.6 mA. That is a power consumption of some 50 percent lower than comparable products. And the 5-V versions only consume 1.4 mA. The high ESD robustness and the precise, stable magnetic switching points are suitable for systems where energy efficiency, robustness and precision matter. TLx496x Hall sensors reduce system

costs. Two to four of the previously needed passive components are now redundant, which also reduces the amount of space they take up on the circuit board.

All of the TLx496x Hall sensors – switches and latches – have an integrated Hall element, a voltage regulator, choppers, an oscillator and an output driver. The voltage regulator powers the Hall element and the active circuits. The chopper ensures that the temperature remains stable and minimizes the effects of process fluctuations, which occur for three reasons: First, each single Hall sensor has a slightly different magnetic switching point as a result of the manufacturing process; second, the permanent magnets in the brushless DC (BLDC) motor lose magnetic field strength as the temperature rises and third, the Hall output voltage is affected by stress and temperature. The TLx496x Hall sensors compensate all of these effects. This is why they switch very precisely over the entire specified temperature range and total lifespan.

Optimized for 5-Volt systems for automotive applications: TLE496x

The TLE496x-xM series is suitable for automotive applications with an operating voltage of 3.0 V to 5.5 V, which generally are not exposed to overcurrent. Target applications are all systems that need a precise Hall switch or Hall latch for an expanded temperature range of -40 °C to 170 °C. The TLE496x-xM is typically used in power windows and sunroofs, trunk locks, windshield wipers, seatbelts, camshafts, shift levers and the many controls used in BLDC motors. The latches' (TLE4963-1M/2M) magnetic behavior and switching points make them particularly suitable for applications with precise index counting (for pole wheels or the recording of the rotor position) and for BLDC motors. The Hall switch (TLE4965-5M) is particularly suitable for the recording of switch and lever positions and the detection of open/close states.

Optimized for 5-Volt systems for industrial applications: TLI496x

The TLI496x-xM series is functionally the same as the TLE496x-xM but is specified for a temperature range of -40 °C to 125 °C and is JESD47 qualified. The TLI496x-xM is typically used in BLDC motors in e-bikes and fans in PCs, in electric drives in building automation (such as blinds and garage doors) as well as the detection of

open/close states in white goods and building security/burglar protection.

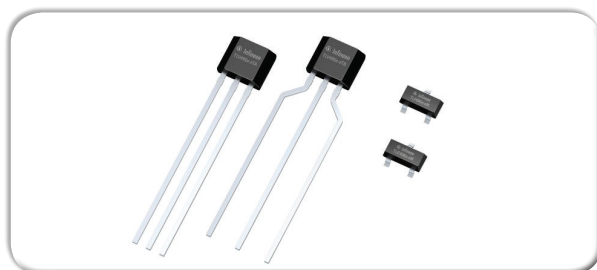
Optimized for cost-sensitive consumer electronics:
TLV496x

The TLV496x-xTA/B series was specifically developed for the cost-effective, contactless positioning. Typical applications are BLDC motors in white goods (such as dishwashers and washing machines), compressors in air-conditioners, fans in PCs as well as blinds, garden tools and building security/burglar protection (e. g. door and window contacts, gates and roller shutters). Despite the pressure to cut costs, these applications need very precise Hall latches or Hall switches (unipolar/bipolar) for temperatures ranging from -40 °C to 125 °C. The TLV496x-xTA/B versions have a power consumption of 1.6 mA and an ESD protection up to 4 kVH HBM (Human Body Model). The output has overcurrent protection and automatically switches off at high temperatures.

Availability and development support

The Hall sensors of all three series are available in high volume. Development support includes online simulation tools and application manuals.

More information about Infineon sensors is available at www.infineon.com/sensors and www.infineon.com/hall-switches.



STMicroelectronics Reveals Ultra-Tiny Low-Dropout Regulator in Breakthrough Bumpless Chip-Scale Package

STMicroelectronics has introduced the LDBL20, a 200mA Low-Dropout (LDO) regulator in a minuscule 0.47mm x 0.47mm x 0.2mm chip-scale package that is ideal for wearable and portable devices and for flexible electronics such as multifunction connected smart cards.

The LDBL20's bumpless STSTAMP™ package breaks through the minimum I/O-area and height limitation imposed by the diameter of traditional flip-chip solder bumps, enabling unprecedentedly small footprints and low mounted heights. The LDBL20 extends ST's family of compact LDOs, which includes devices from 2mm x 2mm DFN to a 0.69mm x 0.69mm CSP with 300mA output.

In addition to its size advantage, the LDBL20 is an outstanding performer. The 200mA output makes it as powerful as larger devices from other manufacturers. The input voltage can range from 1.5V to 5.5V, with 200mV typical dropout. Rejection (PSRR) of 80dB at 100Hz and 50dB at 100kHz simplifies filtering over a wide frequency range to provide a stable rail for low-power circuitry in battery-operated applications. Quiescent current of 20µA no-load, 100µA full-load, and 0.3µA in standby help maximize efficiency under all operating conditions.

A wide range of output voltages is available on request, from 0.8V up to 5.0V in 50mV increments. Designers can also take advantage of built-in features of the LDBL20, which include logic-controlled electronic shutdown, internal soft-start, and support for active output-voltage discharge if required.

An evaluation board for the LDBL20, STEVAL-LSB034V1, is also available, which assists design-in to a wide range of products such as fitness and blood-pressure monitors, glucose meters, hearing aids, wearable sensors, smart headphones, portable audio devices, smart plugs, smart watches, and smartcards.

The LDBL20 is in production now, priced from \$0.25 for orders of 1,000 pieces.

For further information please visit the product information page at www.st.com.

Ultra-small STAMP™ package
New Low-Dropout Regulator



ST

■ New Panasonic HL Series Electric Double Layer Capacitors (ELDC) “Gold Capacitors” offer long life and superior performance over secondary batteries for auxiliary power applications

Low resistance, ultra-fast charge and discharge cycle; suits backup power supplies for servers and solar applications

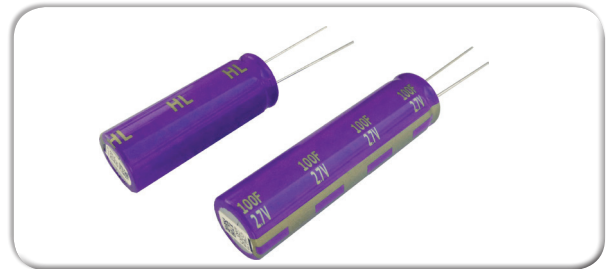
Panasonic Automotive & Industrial Systems Europe announces its new HL Series Electric Double Layer Capacitors (ELDCs), which offer low resistance combined with guaranteed long life over a wide temperature range, down to -40deg.C and extending to +65deg.C. Panasonic HL Series gold capacitors are wound radial lead type devices, which achieve far better capacitance compared to aluminium electrolytic capacitors (up to 1,000 times greater) and superior charge and discharge performance compared with secondary batteries. The further benefit of a rapid charge and discharge cycles, (over 100,000 times) and exceptional ageing characteristics make Panasonic HL Series ELDCs ideal for applications such as backup power supplies for servers and storage devices, auxiliary power supplies for solar-powered products including street lighting, and driver-assist for motors and actuators in a variety of markets.

Maximum operating voltage for the HL Series is 2.7VDC and nominal capacitance ranges from 50 F to 100 F. These ELDCs are also guaranteed to maintain their capacitance and internal resistance without drifting at low temperatures, as opposed to market competition where capacitance and internal resistance may change up to $\pm 30\%$ and ≤ 7 times respectively of initial measured values. Both the 50F device and the 100F device in the HL Series are guaranteed for a life of 2,000 hours at +65deg.C. For power backup applications, ageing characteristics influence the choice of EDLC due to the rise in internal resistance and rapid decline in capacitance. Due to the unique electrolyte used in Panasonic parts, these ageing effects are mitigated besides delivering significant space-saving.

Mustafa Khan, Product Marketing Manager Capacitors at Panasonic comments: “Our new HL Series raises the bar for reliability, endurance and scalable backup

solutions offering opportunities for cost and space-saving. Another reason piquing the market interest for our EDLCs is the use of leakage safe electrolyte material which does not result in release of Hydrogen Cyanide. This market differentiation has won us many environmentally conscientious customers”.

For further information on the HL Series Electric Double Layer Capacitors please visit: <https://eu.industrial.panasonic.com/>.



■ Vishay Intertechnology’s Anti-Surge Thick Film Chip Resistors Combine Superior Pulse and ESD Handling With High Power Rating for Automotive and Industrial Applications

Vishay Intertechnology, Inc. (NYSE: VSH) today released a new series of anti-surge, high-power thick film chip resistors optimized for automotive and industrial applications.

For applications subject to high and repetitive surge pulses, devices in the AEC-Q200-qualified Vishay Draloric RCS e3 series offer superior pulse load performance and ESD surge characteristics when compared to standard chip resistors. In addition, the devices provide higher power ratings up to 0.4 W.

RCS e3 series resistors are available in three compact case sizes to save space on densely packed PCBs — 0402, 0603, and 0805. With its specified power of 0.25 W, the RCS0603 e3 resistor covers the power ratings of standard 0603, 0805, and 1206 resistors, allowing designers to standardize components and take advantage of the lower costs of smaller components.

The devices offer a resistance range from 1 Ω to 10 M Ω

with tolerances of $\pm 0.5\%$, $\pm 1\%$, and $\pm 5\%$; TCR of ± 100 ppm/K and ± 200 ppm/K; and an operating voltage range from 50 V to 150 V. The resistors operate over a temperature range of $-55\text{ }^{\circ}\text{C}$ to $+155\text{ }^{\circ}\text{C}$ and are RoHS-compliant and halogen-free.



Intersil Announces Industry's First Rad Tolerant 36V Instrumentation Amplifier with Integrated Differential ADC Driver

Intersil Corporation (NASDAQ: ISIL), a leading provider of innovative power management and precision analog solutions, today introduced the industry's first radiation tolerant 36V instrumentation amplifier (in-amp) featuring an integrated differential analog-to-digital converter (ADC) driver. The high performance ISL70617SEH differential input, rail-to-rail output in-amp delivers the industry's highest signal processing performance for low-level sensor telemetry data critical to communication satellites. Its high integration and best-in-class performance reduces system size, weight and power (SWAP) costs, and accelerates time to market.

The ISL70617SEH enables higher common-mode rejection ratio (CMRR) and power supply rejection ratio (PSRR) than the competition, at all gain settings. Designers can easily program the in-amp's gain from 0.1 to 10,000 using two external resistors. The device is wafer-by-wafer guaranteed to 75krad (Si) with a low dose rate exposure of 10mrad/sec, which more closely resembles the space environment than the high dose rate testing used with competitive devices. The ISL70617SEH leverages Intersil's proprietary silicon on insulator process to provide single event latch-up (SEL) and single event burnout (SEB) robustness of 60MeV in heavy ion environments. And its single event transient (SET) performance of $<10\mu\text{sec}$ eliminates the need for

extra filtering.

The ISL70517SEH joins the ISL70617SEH, and offers similar features but implements a differential input and rail-to-rail single-ended output. Both in-amps allow designers to power the input/output stages from different supplies using individual power supply pins. Designers are able to take the input signals riding on a high common-mode voltage and level shift them to a low voltage device. For example, Intersil's in-amps can protect downstream ICs from high voltage signals by tying the amplifier's rail-to-rail output to an ADC's low voltage power supply. This also preserves the ADC maximum input dynamic range and eliminates ADC input overdrive.

"The ISL70617SEH is the space industry's first true differential-ended ADC driver," said Philip Chesley, senior vice president of Precision Products at Intersil. "This extends our portfolio of rad hard products exceeding the mission assurance needs of military and commercial communication satellites."

Key Features and Specifications of ISL70617SEH and ISL70517SEH

Low input offset of $30\mu\text{V}$, and low input bias current of 0.2nA

Excellent CMRR and PSRR of 120dB typical for attenuating, gaining and filtering sensor signals to improve signal quality

Wide operating range from $\pm 4\text{V}$ to $\pm 18\text{V}$ covers the majority of analog supply rails

Closed loop -3dB BW 0.3MHz ($\text{AV} = 1\text{k}$) to 5.5MHz ($\text{A} = 0.1$)

Extended operating temperature range of $-55\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$

Electrically screened to DLA SMD# 5962-15246

Acceptance tested to a higher dose level of 75krad(Si), wafer-by-wafer

Industry's lowest dose rate (0.01rad(Si)/s) radiation tolerance of 75krad(Si)

SEB LETTH ($\text{VS} = \pm 18\text{V}$) immune up to $60\text{MeV}\cdot\text{cm}^2/\text{mg}$

The ISL70617SEH and ISL70517SEH can be combined with the ISL71830SEH 16-channel and ISL71831SEH 32-channel 5V multiplexers, ISL71590SEH temperature sensor, ISL71090SEH25 voltage reference, ISL75052SEH 1.5A LDO regulator, ISL75051SEH 3A LDO regulator, and op amps such as the ISL70444SEH,

ISL70244SEH, ISL70417SEH, ISL70218SEH, ISL70227SEH, ISL70419SEH to support a telemetry signal chain with superior radiation tolerant performance. Availability

The ISL70617SEH differential I/O instrumentation amplifier and ISL70517SEH single-ended instrumentation amplifier are available now in 24-lead ceramic flatpack packages. Evaluation boards are available to evaluate device features and performance, and SEE and total dose testing reports are available for both devices. For more information on the ISL70617SEH and ISL70517SEH, please visit: www.intersil.com/products/isl70617seh.



TI announces the only Qi-certified 15-W wireless power transmitter

Industry's most efficient 15-W solution delivers high power and fast-charge wireless charging to industrial applications

Texas Instruments (TI) (NASDAQ: TXN) today introduced the industry's first Wireless Power Consortium (WPC) v1.2 Qi-certified 15-W wireless power transmitter. The bq501210 enables 84 percent system efficiency with significantly less thermal dissipation than traditional wireless power devices. The transmitter supports multiple fast-charging protocols and offers an array of flexible and customizable features such as personal electronics, medical and space-constrained industrial applications. To learn more about the bq501210, visit www.ti.com/bq501210-pr-eu.

Industrial end equipment such as electronic point-of-sale devices and handheld medical equipment reap the benefits of 15-W wireless power. This breakthrough in technology enables connectorless models and reduces overall end-application size by helping eliminate the need for bulky wiring.

Features and benefits of the bq501210

System efficiency at 84 percent: Fixed-frequency operation helps achieve the industry's highest 15-W efficiency as well as reducing electromagnetic interference (EMI).

Fast-charging capability: Fast-charge negotiation with mobile devices enables the transfer of up to 10 W to compatible receivers, including existing fast-charging devices on the market.

Wide-voltage aptitude: The High-Voltage Dedicated Charging Port (HVDCP) protocol negotiates with capable AC/DC wall adapters to adjust the input voltage. The rail control output provides power to deliver a full 15 W with inputs between 15 V and 19 V, and enables lower power operation, such as 5 W, with inputs as low as 5 V.

The new 15-W transmitter joins TI's proven portfolio of scalable wireless power solutions, which also includes 2.5-W, 5-W and 10-W products that provide designers with best-in-class thermal ratings and wide input-voltage and output power ranges, along with customizable sizes and power levels to fit a wide variety of wireless power needs.

Tools and support

Engineers can speed time to market and easily evaluate the new device's features and performance with the bq501210 evaluation module (EVM). The bq501210EVM-756 is available for US\$149.

Availability and pricing

The bq501210 transmitter is shipping in volume production now and is available through the TI store and the company's authorized distribution network. The bq501210 comes in a 9-mm-by-9-mm very thin quad flat no-lead (VQFN) package and is priced at US\$3.75 in 1,000-unit quantities.

Find out more about TI's wireless power solutions

Read the blog post, "What does wireless power mean for industrial applications?"

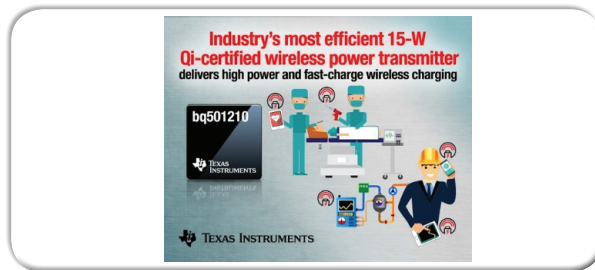
Check out TI's battery-management solutions.

Visit the TI E2E™ Community Battery Management forum to search for solutions, get help, share knowledge, and solve problems with fellow engineers and TI experts.

TI and wireless power

TI's wireless power-management products enable innovative, efficient wireless charging capabilities for mobile phones, tablets and other portable electronics, and wireless power charging transmitters ranging from stand-alone charging pads to those embedded in cars and furniture. The company offers the most extensive

portfolio of power integrated circuits (ICs) that support the WPC's Qi standard and the AirFuel Alliance standard.



Epson Begins Volume Production of S1D13L04 Display Controller for High-Resolution Color TFT Panels

Seiko Epson Corporation (TSE: 6724, "Epson") has begun volume production of S1D13L04 display controllers that support color TFT*1 liquid crystal display panels with up to XGA resolution. Epson plans to produce 20,000 units per month.

Manufacturers are increasingly demanding color TFT liquid crystal display panels for use in industrial equipment and medical instrument control panels because of their good visibility and rendering capability. Moreover, as prices for color TFT LCDs fall, they are adopting larger panel sizes and higher resolutions (e.g., XGA). In addition, low-power devices are increasingly required for mobile devices and environmentally-conscious manufacturing.

In response to these needs, Epson developed the S1D13L04. The latest addition to Epson's simple LCD controller series, the S1D13L04 is a low-cost, low-power solution that provides the essential functions of a display controller.

The S1D13L04, which supports panel resolutions ranging from QVGA to XGA, is ideal for displays used in industrial equipment, medical instruments, measuring equipment, office equipment, home automation systems, and a host of other products.

The S1D13L04 uses external SDRAM as a display frame buffer and addresses up to a maximum of 16 megabytes. It is equipped with 16-bit direct/ indirect and serial interfaces which offer flexible interfacing with a CPU. Display functions include multiple windows, alpha blending*2, transparency, gamma correction*3, pseudo color expansion, mirror, and 180-degree rotation

functions. Images can be displayed in the main window as well as in overlaid picture-in-picture windows (PIP1 and PIP2).

*1 A type of active-matrix liquid crystal display that uses thin-film transistors (TFTs). They are widely used for displays on products such as PCs and LCD TVs.

*2 Alpha-blending: The process of overlaying two images, each with a set transparency, to create a composite image.

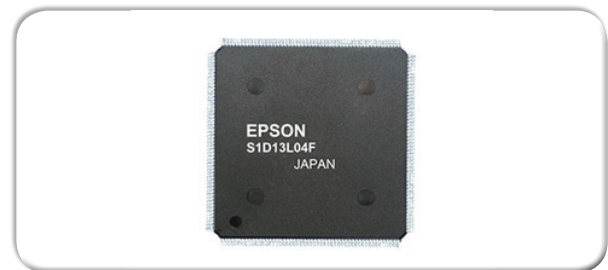
*3 Gamma correction: A process for adjusting the brightness and color of images on a display.

Notes:

See the attachment for the features and specifications. PDF (58KB)

Please see the link below for further details about these products.

http://global.epson.com/products/semicon/products/lcd_controllers/simple_lcd.html.



High-Voltage Converter from STMicroelectronics Enables Ultra-Low-Consumption Power Supplies in Smart Home and Industrial Applications

STMicroelectronics has introduced a high-voltage power converter that allows designers to build an ultra-low-consumption, simple, and cost-effective SMPS (Switched-Mode Power Supply) with a 5V output voltage. Particularly suited for low-power applications in home appliances, building, lighting, and motion control, as well as small industrial and consumer applications, the VIPER01 operates directly from a rectified mains supply and integrates an 800V avalanche-rugged Power MOSFET with PWM (Pulse-Width Modulation) current-mode control and multiple protection circuits.

The converter is tailored to provide the auxiliary supply to microcontrollers in IoT devices that are permanently connected to the Internet or a local network.

The new device belongs to the VIPerPlus™ family of high-voltage converters, now in its second generation, and exploits ST's proprietary BCD (Bipolar-CMOS-DMOS) technology. BCD allows the integration in a single chip of a high-performance PWM controller with a high-voltage logic-level control transistor, protection and diagnostic circuitry, without significantly impacting the robustness and reliability of the power transistor.

The VIPER01 enables designers to meet the most stringent energy-saving standards[1], as it has very low power consumption and switches automatically to pulse frequency modulation under light load conditions. It can be used in fly-back, buck, and buck-boost converter topologies, while the integrated high-voltage start-up, sense-FET, error amplifier, and oscillator with jitter allow a complete application to be designed with the minimum number of external components.

Key features of the VIPER01 include:

800 V avalanche-rugged Power MOSFET allowing ultra-wide VAC input range;

Embedded HV start-up and sense-FET;

Current mode PWM controller;

Drain current limit protection;

Wide supply-voltage range from 4.5V to 30V;

Self-supply option allows auxiliary winding or bias components to be removed;

Jittered switching frequency reduces the EMI filter cost;

Embedded error amplifier with 1.2V reference voltage;

Protections with automatic restart include overload/short-circuit, line or output OVP, maximum duty cycle counter, VCC clamp;

Embedded thermal shutdown;

Built-in soft-start for improved system reliability.

The VIPER01 comes with a set of tools including evaluation kits, application notes, and spice models to jumpstart more robust, safer, and cost-effective SMPS designs.

VIPER01 is available now in volume at a price of US\$ 0.364 for 1,000 units.

For further information please visit www.st.com/viperplus [1] These include the US Energy Star and the European EuP Lot 6 tier 2 from EC Ecodesign Directive.

High-voltage power converter
for Smart Homes and Factories



e2v increases space presence with new QML class V certified space grade data converters

e2v's latest 12-bit space grade digital-to-analog data converter (DAC) has been awarded QML class V certification from the US Defense Logistics Agency (DLA).

e2v's EV12DS130B DAC device family has been awarded the globally recognised space qualification of QML class V by the US DLA, increasing e2v's portfolio of QML qualified data converters. The certification is a great achievement for e2v as it is the highest level of qualification for a space integrated circuit. This qualification dramatically reduces the amount of product testing required, streamlining the process for adoption of e2v's world leading data converters. e2v already has over 3,000 data converter flight models in space and aims to further its space market share as it continues to increase its list of QML class V data converters. The certification of the EV12DS130B follows on just six months after e2v was awarded its first QML class V certification of space grade data converters, demonstrating e2v's commitment to growing its presence in the space market.

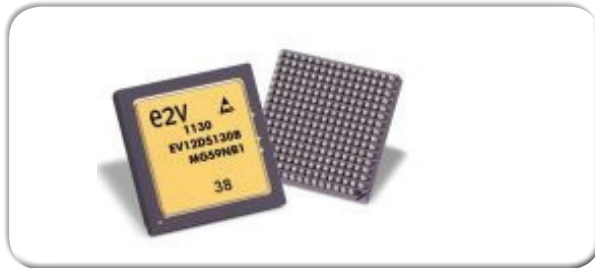
The EV12DS130B operates in the microwave domain, boasting significant benefits for software defined RF systems in space, such as the removal of costly frequency converters. Its unrivalled performance makes it suitable for applications such as satellite communications, synthetic aperture radar imaging, global navigation satellite systems and other forms of scientific space-borne instruments.

Laurent Monge, Vice President of Semiconductors at e2v, commented, "We understand the time and investment our space customers dedicate to each program. Increasing our number of QML class V certified solutions helps to reduce space system design time by lowering the amount

of product pre-testing required.”

The QML class V awarded to these parts, in addition to the QML class V ratings of e2v's manufacturing facilities in France and the United States, reinforces e2v's commitment to the space market.

Visit www.e2v.com/BDC-QMLV to find out more.



Epson Shipping Samples of New 16-bit MCU for Driving LEDs at Up to 56 mA

Analog Devices, Inc. (ADI) today introduced a D/A – Ideal for control panels with displays for factory automation systems and home appliances –

Seiko Epson Corporation (TSE: 6724, “Epson”) has begun shipping samples of the S1C17M13, a new 16-bit microcontrol unit (MCU) with Flash memory integrated on-chip. This MCU is designed to drive light-emitting diodes (LEDs) at up to 56 mA*. Epson plans to produce 200,000 units per month when volume production begins in March 2017.

Epson has long integrated drivers in its MCUs to control LCDs in applications that use them. Recently, however, there has also been a sharp increase in the number of factory automation products and home appliances that use 7-segment LED displays or LED indicators. Epson anticipates ongoing demand for LEDs as a means for displaying simple information, as LEDs are bright, self-emitting, and easily visible even in dark environments.

On the other hand, LEDs have to be driven at a current of about 10 mA to produce a constant level of brightness. This has made it necessary to add dedicated external driving circuits to today's low-voltage, low-power MCUs. Moreover, users have had to develop their own control software and embed it in an MCU to achieve efficient multiple-digit segment displays. LEDs are simple, but they require more external driving components than LCDs. Users have thus had to spend considerable time and money developing LED software-as much if not more than for LCDs. Reducing users' costs and development times has thus been an issue.

The S1C17M13, Epson's first MCU for LED display applications, is ideally engineered to solve this issue. This product operates at voltages ranging from 1.8 V to 5.5 V and readily supports the 5 V needed for most factory automation products. The new MCU has five pins that can output up to 56 mA*. By using these high-output pins as common pins in combination with an additional eight other segment pins, users can drive a segment LED display with up to 8 segments x 5 common pins without the use of external transistors on the common lines.

In addition, the MCU has an integrated hardware controller that supports dynamic lighting control. Customers can use a simple software setting to select any segment (LED) they wish to light up. They can fine-tune the lighting interval and adjust the brightness to any of four levels. These new features will help users reduce the cost of their products as well as their total development times.

Epson also plans to commercialize a derivative product in the series (the S1C17M12) that does not include the 12-bit AD converter. Two types of evaluation boards are also available for the new product.

* Maximum output current per pin at an operating voltage of 5 V. Not capable of multiple simultaneous outputs.

Notes:

See the attachment for the features and specifications. PDF (107KB)

Please see the link below for further details about these products.

http://global.epson.com/products/semicon/products/mcu/16bit_index.html#ac02



Next generation ams light sensors to shrink smart phone apertures up to 50%

TMD2620 proximity sensor and TMD2725 ALS modules reduce LED emitter-to-sensor gap to just 1.0mm while

eliminating the effect of optical cross talk

ams AG (SIX: AMS), a leading provider of high performance sensors and analog ICs, today introduced new proximity sensing and proximity/ambient light sensing modules which enable android smartphone manufacturers to reduce the sensor aperture in the display's cover glass to its smallest diameter.

Use of the TMD2620 proximity sensor or the TMD2725, a combined proximity and ambient light sensor, enables phone manufacturers to reduce the aperture's size by as much as 50%, improving aesthetic appeal, especially in devices with a white or light-colored bezel. The TMD2620 and TMD2725 enable aperture size as small as 1.4 and 2.0mm respectively. The TMD2620 and TMD2725 feature a breakthrough in optical module packaging which allows the emitter – an infra-red (IR) LED – and photodiode to be placed just 1.0mm apart. Lenses on top of the emitter and sensor along with an optical barrier between them help to minimize crosstalk, caused by reflections from the surfaces of the cover glass. Offset adjustment registers eliminate the effect of any residual crosstalk from the module's proximity calculations. Automatic ambient light subtraction further enhances the accuracy of the device's proximity measurements. The ability to measure up to a range of 100mm is comparable to laser-based solutions.

“Until now, inability to overcome the effects of optical crosstalk have prevented android phone manufacturers from reducing proximity sensing apertures below 3.0mm”, said Herbert Truppe, Senior Marketing Manager at ams. “Now the TMD2620 and TMD2725 overcome those challenges and enable a smaller aperture than has previously been possible.”

The TMD2620 and TMD2725 are in volume production now. Unit pricing in order quantities of 1,000 is \$0.36 for the TMD2620, and \$0.43 for the TMD2725.

For sample and evaluation module requests and for more technical information, go to www.ams.com/proximity-detection/TMD2620 or www.ams.com/ambient-light-sensors/TMD2725.

Small Aperture Proximity Detection

- Enables 1.4 mm glass aperture
- Improved proximity results through automatic light subtraction

www.ams.com/TMD2620



Vishay Intertechnology Miniature Minimold Through-Hole IR Receivers Offer Improved Optical Performance and RF Noise Rejection, Wave or Reflow Soldering Options

Vishay Intertechnology, Inc. (NYSE: VSH) today broadened its optoelectronics portfolio with the introduction of two new series of miniature infrared (IR) receiver modules for IR remote control applications in consumer products. Offered in the new Minimold package, Vishay Semiconductors TSOP33xxx and TSOP53xxx series devices deliver the same RF noise rejection as Minicast receivers while surpassing the high optical performance of Mold package devices.

For products such as televisions, set-top boxes, air conditioners, and hi-fi audio systems, the devices released today provide high sensitivity with typical irradiance down to 0.08 mW/m² at 0° for the TSOP33xxx series and 0.12 mW/m² for the TSOP53xxx series. While the 0° sensitivity is the same as for the Mold package, the Minimold package exhibits higher sensitivities than the Mold device at all off-angles up to 45°. The Minimold package also comes with the proven “F” option for an enhanced optical filter against out-of-band optical noise.

To simplify designs, TSOP33xxx and TSOP53xxx series devices feature a photo detector, preamplifier circuit, and IR filter in a single 3-pin epoxy package. The receivers offer a supply voltage from 2.5 V to 5.5 V; very low supply current of 0.35 mA typical for the TSOP33xxx series and 0.7 mA for the TSOP53xxx series; transmission range up to 45 meters; and carrier frequencies from 30 kHz to 56 kHz. The devices provide improved immunity against ambient light and are insensitive to supply voltage variations and ripple noise.

The IR receivers are offered in five automatic gain control (AGC) versions for short and long burst codes. The TSOP331xx, TSOP332xx, TSOP531xx, and TSOP532xx provide legacy compatibility with all common IR control data formats. The TSOP333xx, TSOP334xx, TSOP533xx, and TSOP534xx are ideal for all remote control applications and suppress spurious pulses from energy-saving lamps and Wi-Fi sources, in addition to continuously transmitted data signals.

While devices in Mold and Minicast packages only support wave or hand soldering, Minimold receivers with the “P” option also provide support for IR reflow soldering. TSOP33xxx and TSOP53xxx series receivers are available in two holder and three bend options, including a top-view surface-mount version. The devices are RoHS-compliant, halogen-free, and Vishay Green.

Samples and production quantities of the TSOP33xxx and

TSOP53xxx series are available now, with lead times of four weeks. Pricing for U.S. delivery only is \$1.00 per piece.



Energy Harvesting Power Management Unit Delivers Industry-Leading Efficiency in Energy Scarce IoT Applications

Analog Devices, Inc. announced a power management unit (PMU) designed to enable faster and more efficient energy harvesting in IoT applications where energy is scarce. Due to its unique circuit design, the ADP509x is among the most efficient energy harvesting PMUs on the market, converting harvested power down to the 16 μ W to 100mW range with only sub- μ W operation losses. The ADP509x also delivers the fastest cold-startup time available today. Devices relying on energy harvesting in low energy conditions often have to slowly accumulate enough energy to turn on, resulting in long delays before the device can start sensing, processing, and transmitting. This can result in missed data collection, slow operation, and poor user experience. The ADP509x PMU solves these problems with an innovative multiple-power-path design, which enables faster startups and smoother operation.



IZT Unveils Next Generation of its High Performance Receivers

IZT GmbH expands its powerful RF receiver family introducing the IZT R5000. The next generation of high performance

receivers combines up to 100 MHz instantaneous bandwidth with the proven excellent RF performance of the legacy IZT receivers. The R5000 covers the frequency range between 9 kHz and 18 GHz.

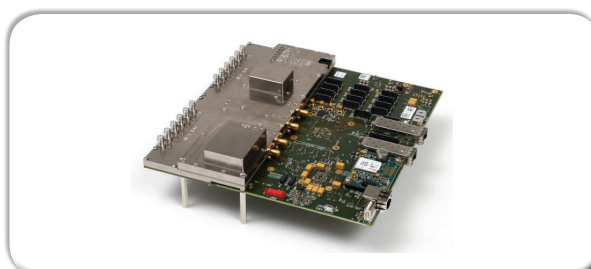
Received signals will be available as high resolution spectrum data in combination with up to four configurable wideband I/Q data channels with user configurable sample rates and independent center frequencies.

The wideband channels provide I/Q data between 5 MHz and 100 MHz bandwidth. Additional 32 channels with up to 4 MHz bandwidth each can be used for narrowband monitoring, demodulation or analysis functionality in software. A dual 10-Gbit optical interface ensures adequate throughput in all operational scenarios.

The IZT R5000 gives system integrators direct access to the control and data interfaces, where the received RF signals will be available both in IQ and PSD format. When combined with the IZT Signal Suite Software, the new RF receiver also supports IZT's patented technique for frequency selective and dynamic recording of active portions of the spectrum. This feature results in a substantial reduction of required storage space.

"This new family of receivers uses latest digital signal processing technologies on a compact and robust hardware platform. This puts IZT in a leading position to address demanding applications, for example airborne direction finders or unattended outdoor nodes for spectrum monitoring or Time-Difference-Of-Arrival location finding" stated Rainer Perthold, CEO of IZT.

The IZT R5000 can be configured for TDOA (Time-Difference-Of-Arrival) and DF (Direction Finding) applications. Like the IZT R3000, the IZT R5000 series will be available in various configurations and mechanical form factors ranging from rack-based, single channel indoor applications to multi-channel direction finding receivers for outdoor or airborne applications.



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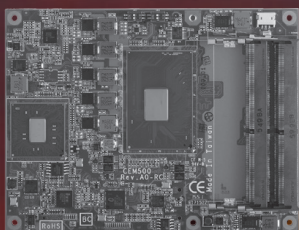
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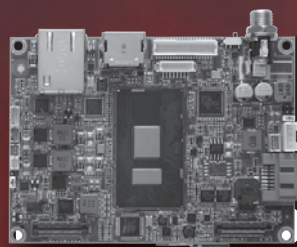
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CEM500

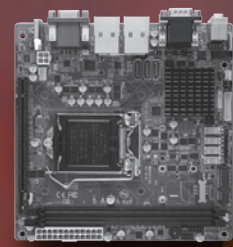
COM Express Type 6 Module with 6th Generation Intel® Core™ i7/i5/i3 & Celeron® Processor, Intel® QM170/HM170, 125x95 mm



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PICO500

Pico-ITX SBC with 6th Generation Intel® Core™ i7/i5/i3 & Celeron® Processors, HDMI/ LVDS, 1 GbE LAN and Audio , 100x72 mm



0°C ~ +60°C

MANO500

Mini-ITX SBC with LGA1151 Socket 6th Generation Intel® Core™ i7/i5/i3, Pentium® & Celeron® Processor, Intel® H110, HDMI/ DP/VGA/LVDS/eDP, Dual LANs and USB 3.0

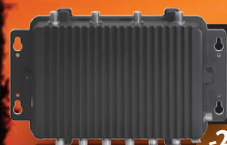
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Full IP67

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Rugged IP67-rated Fanless Embedded System with Intel® Atom™ Processor E3845 1.91 GHz, VGA, 2 GbE LANs, 2 USB 2 COM and 9~36 VDC Power Input



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