

New-Tech

Magazine — *Europe*

December
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Why Voice Over Wi-Fi?





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Precession Test 75Ω (CBL)	DC-3	N, F	2-6	-55/+105
Armored (APC)	DC-18	N	6.0-15	-55/+105
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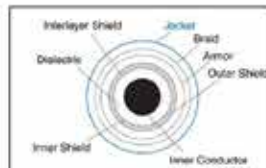
[†] Custom lengths available by special order.

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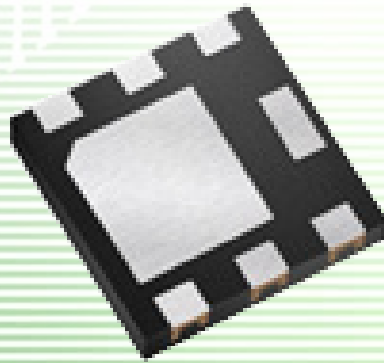
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December 2015

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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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STMicroelectronics Contributes to AIOTI working group on smart living environments

The Alliance for Internet of Things Innovation (AIOTI) publishes the twelve reports containing the "Recommendations for future collaborative work in the context of the Internet of Things Focus Area in Horizon 2020" covering the main focus areas of the Internet of Things (IoT) Work Programme 2016-2017. These documents have been elaborated by eleven working groups (WGs) encompassing industry high level experts, innovators, end-users, law experts and representatives of societal challenges, who have worked intensively together for the last six months.

The report from WG01 built on the work of the IoT Research Cluster (IERC) and is focused on boosting the IoT technological advancements and converging the shaping and development of new dynamic business models and IoT ecosystems. As chair of the AIOTI WG01, Dr. Ovidiu Vermesan, Chief Scientist at SINTEF said: "our report will promote the market emergence of IoT and overcome the fragmentation of 'silos', architectures and applications. IoT technology is the needed enabler for eliminating the 'digital divide' and creating the basis for the implementation of the Digital Single Market".

The AIOTI WG02 focused on how to stimulate the innovation ecosystem for AIOTI. Mr. Kees van der Klauw from Philips, chair of WG02 said: 'our working group developed clear engagement rules for participation in IoT Large Scale Pilots, making sure that we involve the right stakeholders, that we build and link platforms and that we apply the appropriate rating criteria and funding mechanisms. And we are committed to implement them'. The Chair of the WG03 and Senior Research Officer at



the European Telecommunications Standards Institute (ETSI), Mr. Patrick Guillemin, remarked that: "the work of AIOTI working group on "IoT Standardisation" is seen as a reference for the AIOTI Working Groups in order to address the interoperability issues and to recommend the use of standard-based solutions for the deployment of IoT solutions. We have been talking to SDOs and Alliances about collaborations and interworking as a means to reduce fragmentation. What AIOTI brings to all this is a dramatic acceleration of the pace of discussion." The Chair of the WG04 on "Policy Issues" and Head of Enterprise Regulation at Vodafone Group, Mr. Robert MacDougall, put emphasis on the fact that the AIOTI Policy Report makes a number of recommendations, in relation to privacy, security, liability and net neutrality, which should go a long way to creating an effective environment for the successful development of the Internet of Things within Europe. And he stressed: "I believe that this is the right moment to address any possible barriers which may restrict the adoption of IoT as part of the Digital Single Market."

Alcatel-Lucent IP and SDN technology to increase agility to TIM's national backbone network

Integrated IP and optical core network will take advantage of Carrier SDN technology, making the network more agile and allowing TIM to optimize costs while meeting data demands.

Alcatel-Lucent (Euronext Paris and NYSE: ALU) is to

transform and make more agile the national 'backbone' network of TIM in Italy, deploying its portfolio of IP core routing and Carrier software-defined networking technology to optimize the provision of new video and cloud services.

The transformation project with TIM will see Alcatel-Lucent deploying its 7950 Extensible Routing System (XRS) IP Core Router portfolio alongside its previously provided 100G agile optical networking technology. Alcatel-Lucent's 5620 Service Aware Manager (SAM) will enable integrated end-to-end management of [➔](#)



High-performance ARM® Cortex® -M7 core-based MCU family with Ethernet for real-time control applications

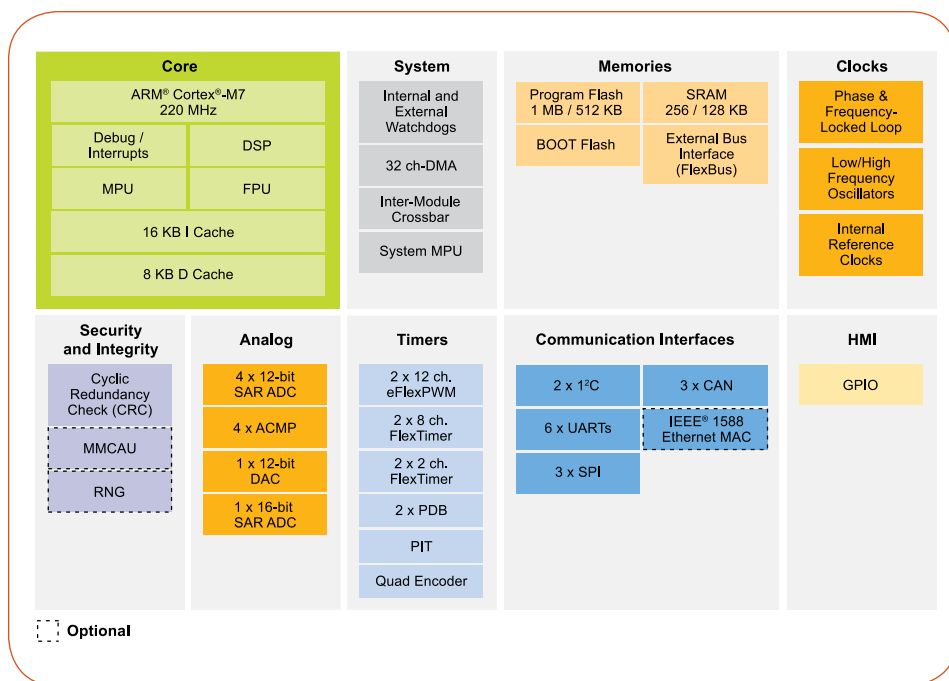
Kinetis KV5x MCU Family

The Kinetis KV5x family of microcontrollers (MCUs) is a high-performance solution offering exceptional precision, sensing and control for some of the most demanding applications in motor control and power conversion.

TARGET APPLICATIONS

- ▶ Connected industrial drives
- ▶ Industrial motor control
 - BLDC motors
 - PMSM motors
 - AC induction motors
- ▶ Industrial automation
- ▶ Multi-motor control
- ▶ Switch mode power supply (SMPS)
- ▶ Photovoltaic systems
- ▶ Uninterruptible power supply (UPS)

KINETIS KV5x MCU FAMILY BLOCK DIAGRAM





IP and optical transport network. The network will be implemented by end of 2016.

TIM will also use Alcatel-Lucent's Carrier SDN-based Network Services Platform which will allow it to cost-efficiently define new services and activate them in real-time. This reduces TIM's costs and improves network operations while offering its subscribers a high-quality, on-demand service experience.

Key Facts

- Under this agreement Alcatel-Lucent will deploy its 7950 XRS nationwide across Italy, with the 5620 SAM providing end-to-end network management across the IP and optical network layers, allowing TIM to meet its customers' demands for high-quality, fast and efficient data services into the future.
- Alcatel-Lucent will also deploy its Network Services

Platform. The NSP is a Carrier SDN technology developed specifically for application in the Carrier Wide Area Network (WAN) that combines network-aware service automation with service-aware network-automation so that service providers can reduce network complexity and gain the insight and control needed to deliver on-demand network services quickly, profitably and at scale.

- Alcatel-Lucent's 7950 XRS portfolio delivers class-leading scale, efficiency and versatility to address a wide range of networking requirements. More than 50 customers have chosen to deploy the 7950 XRS to-date.
- In June, Alcatel-Lucent announced it would deploy its 100G agile optical networking technology using the 1830 Photonic Service Switch in TIM's core and metro networks.

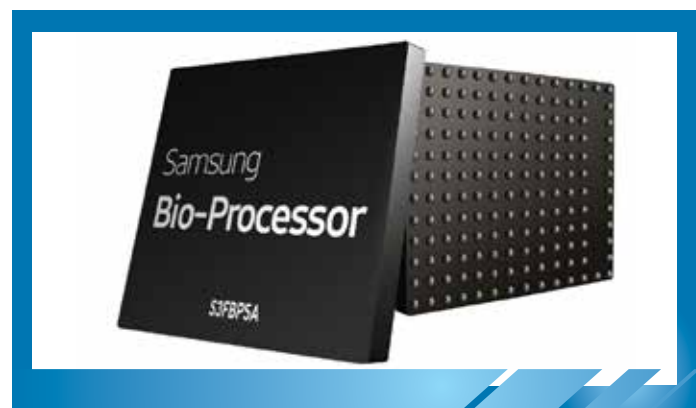
Samsung Addresses a Growing Mobile Health Market with Industry's First Smart Bio-Processor

Samsung addressing the growing trend of quantified health with an all-in-one advanced system logic chip for the health-oriented wearables market, the Bio-Processor Samsung Electronics Co., Ltd., a world leader in advanced semiconductor technology, today announced that it is addressing the growing trend of quantified health with an all-in-one advanced system logic chip for the health-oriented wearables market, the Bio-Processor. The Samsung Bio-Processor, now in mass production, is specifically designed to allow accelerated development of innovative wearable products for consumers who are increasingly monitoring their health and fitness on a daily basis.

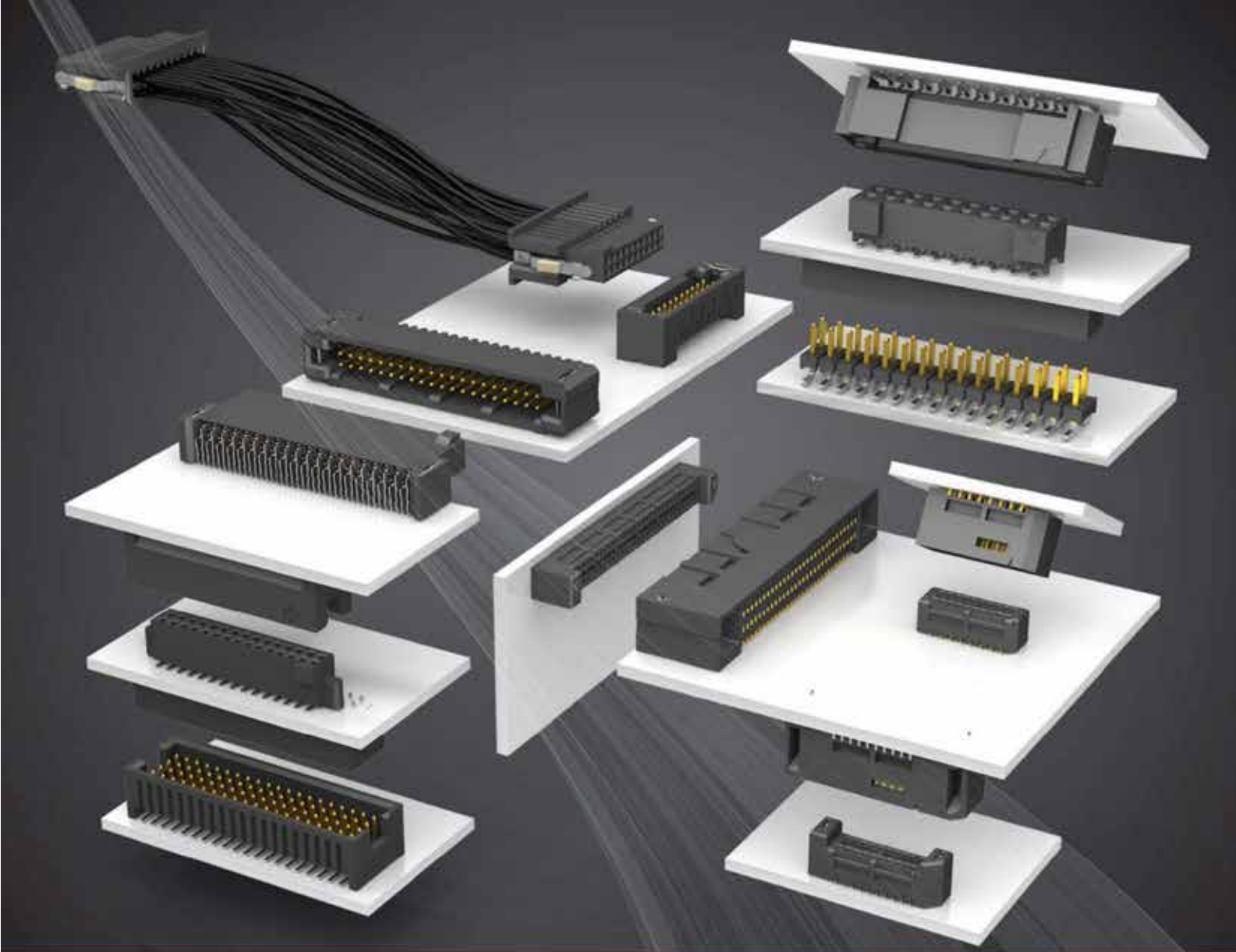
"With improvements in smart, fitness devices and an increase in consumer health consciousness, more and more people are looking for ways to monitor various personal bio-data, or fitness data, to constantly manage their health" said Ben K. Hur, Vice President of marketing, System LSI business at Samsung Electronics.

Samsung Bio-Processor: Small in size; Big on Versatility

Samsung's Bio-Processor is the industry's first all-in-one health solution chip. By integrating not only Analog Front Ends (AFE), but also microcontroller unit (MCU), power management integrated circuit (PMIC), digital signal processor (DSP), and eFlash memory, it is able to process the bio-signals it measures without the need of external processing parts. Even with its integrated design, the Bio-Processor is particularly innovative thanks to its incredibly small size. When compared to the total area of the discrete parts, the Bio-Processor is only about one fourth of the total combined size, which is ideal for small wearable devices, offering a bounty of options when designing new devices.



Samsung's Bio-Processor is the industry's first all-in-one health solution chip



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LG ADVANCES SMART HOME ECOSYSTEM WITH SMARTTHINQ™ HUB AT CES 2016



LG's New SMARTTHINQ™ HUB

LG Electronics (LG) will unveil its newest addition to its IoT ecosystem, SmartThinQ™ Hub, at CES 2016. LG SmartThinQ Hub serves as a gateway to smart sensors and connected appliances in the home but is more than that, with the ability to display reminders from personal calendars and stream music from its built-in speaker. The elegantly designed SmartThinQ Hub includes a 3.5-inch color LCD display and connects to a smartphone app to facilitate two way communication with smart appliances and smart sensors in the home. The SmartThinQ Hub expands LG's SmartThinQ platform to monitor and control home appliances such as washing machines, refrigerators, ovens, robotic vacuum cleaners, air conditioners and a variety of sensors. The SmartThinQ Hub plays a central role in


LG's smart home platform by collecting information from smart appliances as well as conventional devices connected to SmartThinQ sensors via Wi-Fi, Zigbee and Bluetooth. Data is displayed in the form of notifications on the LCD screen or announced through its embedded speaker, acting as the central "hub" of the smart home.

As like all other LG home appliances and consumer products, the LG SmartThinQ Hub is designed to look great in the home. The unit features a metallic body in two attractive color schemes: Champagne Gold and Black. The LCD display is tilted at an angle to be easily readable and the high-quality speaker can stream music from thousands of free stations from iHeartRadio or play whatever is on a smartphone or tablet via Bluetooth.

The SmartThinQ Hub is compatible with a number of devices from other manufacturers and service providers that support the AllJoyn® Alliance open source framework. LG recently formed a partnership with Lowe's, the world's second-largest hardware retail chain, to integrate LG's smart devices with Lowe's Iris smart home services. LG's partnerships with other service providers are a key advantage of LG's smart home system, which prioritizes compatibility across multiple brands. Such partnerships allow LG to offer packaged bundles that enhance safety, energy savings, air care or convenience that might include a SmartThinQ Hub, a SmartThinQ sensor and a variety of smart appliances and devices from other manufacturers such as smart lighting, motion sensors and moisture detecting sensors.

Developing advanced Bluetooth Smart remotes has been made 'checkbox-clicking' easy with Nordic's latest 'nRFready Smart Remote 3' reference design

Nordic Semiconductor announces it has launched its latest 'nRFready Smart Remote 3' reference design that is said to make the development of advanced Bluetooth® Smart remotes as easy as clicking on a list of check box options, and so minimizing time-to-market and unnecessary design risk.

Targeting remote control OEMs/ODMs and smart TV, set-top box, and digital media device manufacturers, the nRFready Smart Remote 3 reference design is designed to deliver a rich, intuitive, and engaging end-user experience. It employs state-of-the-art voice input and speech recognition control, a 6-axis motion 



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Lighting



Data Center



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Cloud



Mobility



Five Years Out



sensing 'Air-mouse', multi-touch trackpad technology, plus 39 developer-programable buttons and legacy IR hardware support (to control IR-only products).

"One area we have worked hard to really further optimize is the voice input control," explains Nordic Semiconductor Product Marketing Manager, John Leonard. "This includes developing an even more robust wireless link for wireless audio data, and 20 percent better current consumption compared to Nordic's previous nRFready Smart Remote 2 solution."

Leonard claims that developing advanced Bluetooth Smart remotes using the nRFready Smart Remote 3 reference design has been made "check-box-clicking" easy thanks to a newly-developed configuration Wizard that works in the Keil development environment.

"The Wizard and underlying software is built in a modular format that has refined the developer element down to a list of check-boxes that allow every parameter of the remote to be configured and fine-tuned," explains Leonard. "This includes large chunk function decisions such as whether to employ a track-pad or motion sensing, down to specifying the number of milliseconds it takes for the remote to wake-up from sleep mode."



In operation, the nRFready Smart Remote 3 reference design employs Nordic's nRF51822 System-on-Chip (SoC) and so is designed to work as an add-on for Nordic's existing nRF51 Development Kit (DK). An nRF51 DK is required to use this reference design but is not included and must be purchased separately. The add-on contains all the external sensor devices that can interface with the nRF51 DK.

NXP Announces Beginning of New Era in NFC Technology

First of Four New NFC Solutions Released to Quicken Design Process and Ensure Robust Operation in Challenging Environments

With the flagship solution, PN5180, NXP Semiconductors N.V. (NASDAQ:NXPI), co-inventor of Near Field Communication (NFC), announced the beginning of a new era in the evolution of NFC to bring intuitive proximity technology everywhere. PN5180 is an advanced, multi-protocol (ISO/IEC 15693, Felica™, MIFARE® and ISO/IEC 14443A/B) NFC frontend that delivers more efficient, robust, and reliable operation, even in harsh environments. Building on the success of the PN512, PN5180 delivers four times more output power and is designed to enable state-of-the-

art readers for contactless payment without the need of an additional booster.

"NFC moves increasingly into new and more demanding applications, now transportation terminals need to support EMV payment schemes and have to interact with new payment or transit form factors like NFC-enabled phones, wearables and even rings. The requirements for performance, reliability and interoperability therefore expand," said Pradip Mistry, vice president of research and development at Cubic Transportation Systems. "NXP succeeds to bring NFC to the next level in technology with the PN5180 and its new features like Dynamic Power Control and Adaptive Wave Shaping which enables us to deliver an unmatched user experience to our end customers."

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ZVE-3W-83+	2000-8000	35	2	3	1295
ZVE-3W-183+	5900-18000	35	2	3	1295
ZHL-4W-422+	500-4200	25	3	4	1150
ZHL-5W-422+	500-4200	25	3	5	1670
ZHL-5W-2G+	800-2000	45	5	5	995
ZHL-10W-2G+	800-2000	43	10	12	1295
ZHL-16W-43+	1800-4000	45	12	16	1595
ZHL-20W-13+	20-1000	50	13	20	1395
ZHL-20W-13SW+	20-1000	50	13	20	1445
LZY-22+	0.1-200	43	16	30	1495
ZHL-30W-262+	2300-2550	50	20	32	1995
ZHL-30W-252+	700-2500	50	25	40	2095
LZY-2+	500-1000	47	32	38	2195
LZY-1+	20-512	42	50	50	1995
ZHL-50W-52+	50-500	50	63	63	1395
ZHL-100W-52+	50-500	50	63	79	1995
ZHL-100W-GAN+	20-500	42	79	100	2395
ZHL-100W-13+	800-1000	50	79	100	2195
ZHL-100W-352+	3000-3500	50	100	100	3595
ZHL-100W-43+	3500-4000	50	100	100	3595

Listed performance data typical, see minicircuits.com for more details.

* Protected under U.S. Patent 7,348,854

* Price Includes Heatsink





BMW i3 and Internet of Things and Smart Home integrations to be showcased at 2016 CES

BMW will return to Las Vegas for the 2016 Consumer Electronics Show at the Las Vegas Convention Center to showcase Internet of Things and Smart ...

BMW will return to Las Vegas for the 2016 Consumer Electronics Show at the Las Vegas Convention Center to showcase Internet of Things and Smart Home integrations, the Interior of the Future, Future Driving Experiences, and BMW ConnectedRide. BMW will have a presence at the South Plaza, located outside the Las Vegas Convention Center's South Hall.

BMW will demonstrate how the all-electric BMW i3 can be further connected to drivers' daily lives with Internet of Things and Smart Home integrations. Through advancements in R&D projects, drivers could precondition their homes and vehicles, remotely park their BMW i3 and schedule a charging program based on their daily agenda.



Interior of the Future advancements, Future Driving Experiences and BMW ConnectedRide will be revealed.

BMW will present Advancements in Mobility Solutions through innovative technologies for urban environments.

BMW will also demonstrate ConnectedDrive innovations currently available in the BMW 7 Series, including remote controlled parking, gesture control and touch command.

A refreshed version of the BMW i8 Spyder Concept is also rumored to be unveiled showcasing some of the latest technologies cooked in the BMW R&D department.

More productivity from a single source: Competency from single components through to control systems.

FESTO

Factory automation

Controls complete machine cells or small machines, for example for the assembly of small workpieces, manual workstations, test and inspection machines, and also upstream functions such as dancer rollers and handling devices. With the automation platform CPX.

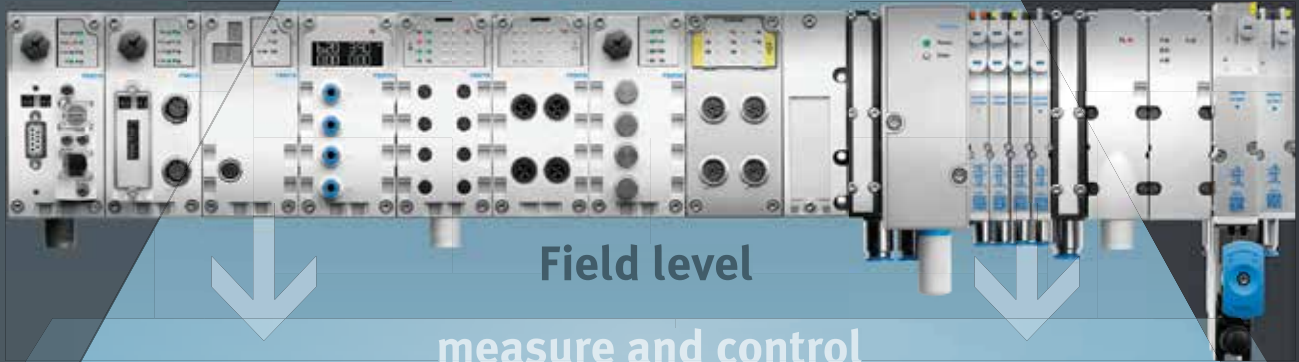
Process automation

Controls fluid and discrete processes with fluid and motion control, for example filtration and osmosis, biotech/pharma and chemical industries, packaging machines and machine tools, dispensing, mixing, cooling, lubricating, washing, cleaning and sterilising. With the automation platform CPX.

Management
level

transfer

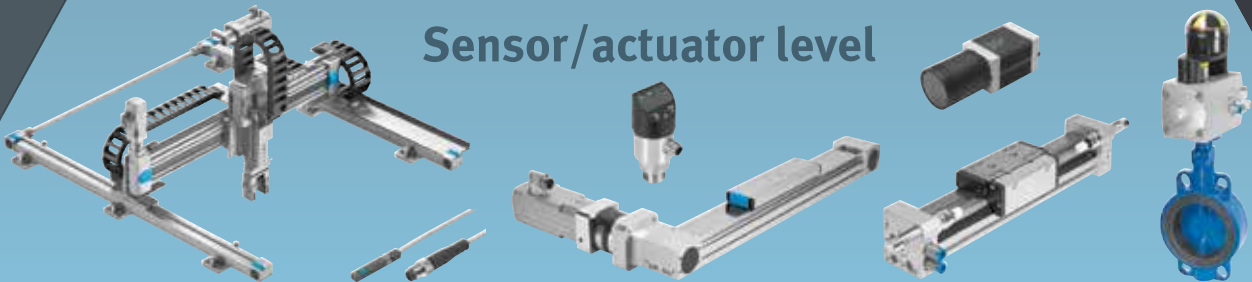
Control level



Field level

measure and control

Sensor/actuator level



Electric vehicle battery manufacturing



Dancer controllers



Small parts assembly



Flow system and motion control



Sand filtration



Reverse osmosis



The New Hardware Hipsters INNOVATE WITH HARDWARE IN TODAY'S SUBSTREAM MARKETS

› Ramses Valvekens, Bart Keppens, Phill Christie, Jeroen Van Ham

Phill Christie from imec IC-link talked to three experts from imec IC-link's IP & Design Partnership Program: Ramses Valvekens from system-on-chip design company Esasics, Jeroen Van Ham from analog and mixed-signal design company ICsense, and Bart Keppens from Sofics, a provider of intellectual property (IP) for electrostatic discharge protection. Together, they take a snapshot of what is needed to innovate with hardware in today's substream markets.

Until recently, building hardware was not cool. With lengthy development cycles and a huge upfront investment for custom ICs, innovators have long turned to software to develop new products. But today a new generation of hardware hipsters has arrived. They build today's smart systems that interact intelligently with their environment. Systems for small innovative markets, which they can

deliver faster, more flexible, and with lower upfront investments.

Is hardware cool again?

For at least the last two decades, custom integrated circuits were implemented in leading edge technologies with development cycles longer than the shelf-lives of the products. It was punishingly expensive if you made a design mistake, and the upfront investments needed for leading edge silicon technology were eye-watering. Developing these custom ICs was therefore almost exclusively the playing field of large multinational semiconductor companies with deep pockets. Innovation in the global markets of consumer, computing, telecom and mobile was necessarily characterized by generation after generation of incrementally better products, based on IP-portfolios that took large teams several years to develop.

But today's new generation of hardware hipsters are pushing the boundaries of what you can do with hardware; with systems that perceive their surroundings and start thinking about their environment with their cloud-based brains. Commenting on this, Joi Ito, director of the MIT Media Lab, said that "hardware is the new software" and that hardware start-ups are looking a lot like the software start-ups of the previous digital age. They are aggressively targeting innovative new Internet Of Things (IoT) markets, such as life sciences and medical diagnosis, automotive, security, vision and imaging, and industrial applications. These are rapidly growing, much more segmented and with a need for specialized lower-volume ASICs. So here the economies of scale which favor larger companies do not play. Progress, change and innovation under these conditions does not

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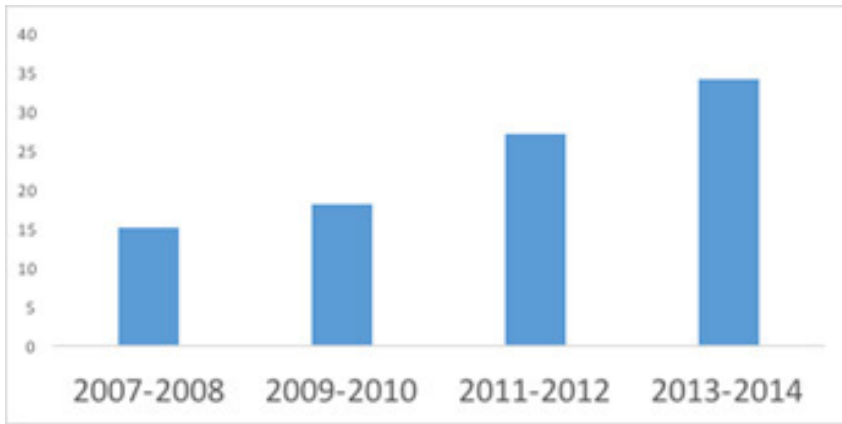


Fig 2: Number of IC-link projects in the areas of security, medical & wearables, radio access, and imaging & vision systems. Between the years 2011 and 2014, the number of projects in these areas approximately doubled

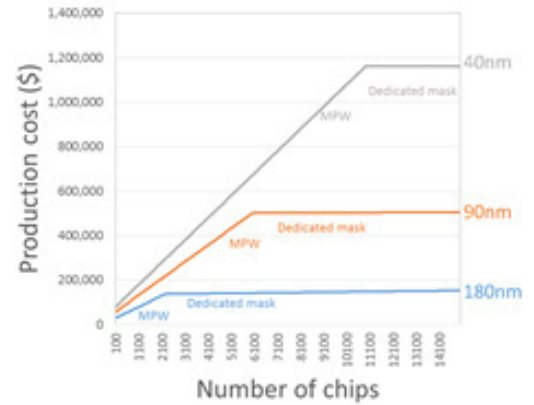


Fig 3: The new hardware hipsters

follow schedules or five-year plans. It occurs through the rapid, dynamic, collective interaction across borders and time zones. The rise of these hardware hipsters, interacting with other startups in the new growth markets is referred to as substream innovation. It is new, definitely cool, and it is changing the way innovation is done in this era of the Internet of Everything.

The anatomy of silicon IoT applications Admittedly, investment and media interest are drawn to the possibilities of huge data collections generated by the new wireless, perceptive systems. But to turn physical data into bits, you need hardware, and you need it to be smart and accurate. Here are a few aspects where the new hardware hipsters make a difference.

“A typical IoT product consists of several digital and analog components that need to be interconnected, packaged and protected from the harsh environments encountered in day to day life,” says Jeroen Van Ham from ICsense. “Unlike the digital

world, in the analog world there is no real advantage in using the latest deep submicron technology nodes. In fact, there is little silicon area to gain because analog circuits usually don’t scale with shrinking transistor sizes. For an analog designer, in most cases it is even harder to design the same low-noise circuit in a smaller node because of the lower power supply voltage, which leads to less dynamic range. As a result, in a typical interface application, the preferred node still is 0.18um (either plain CMOS or a specialty flavor for high-voltage support). There is no use in trying to map a complex analog sensor interface to a state-of-the-art foundry process node; it is a waste of money.”

As for the digital side, the incremental NRE (non-recurring engineering) cost for integrating digital components is often small compared to an analog-only chip. The resulting unit production cost of an integrated digital solution can therefore be significantly lower than that of (multi-chip) alternatives.

“However,” adds Ramses Valvekens, “Few successful chips never get updated. In the new, fast-moving markets, it is key to make digital designs future-proof. With scalable, dynamic designs, it becomes possible to roll-out a real product road map for a chip. At Esasics, we succeed in doing that by parametrizing designs and by generating and assembling them using custom-designed hardware generators and Hardware Description Languages (HDLs). Such designs can be efficiently targeted towards different technologies, scaled and reused, in whole or in parts, in follow-on versions and derived products.”

In many new designs, the traditional analog IP buy-in model doesn’t fit well. Take MEMS (micro electro-mechanical systems) sensors, often an essential component in smart hardware. These sensors are becoming smaller and cheaper, thereby producing more (Brownian) noise and making them less sensitive to physical inputs. But end-customers keep demanding the same resolution and accuracy. As a

result, the challenge is passed on to the circuit level. Initially to the circuit's analog-front-end, and subsequently to digital signal processors. Available analog IPs are generic, maybe programmable to some extent, but not co-designed with the sensor and the reference circuits that are required at system level. As a result, the traditional analog IP buy-in model where a set of IPs is glued together in a chip will result in a sub-optimal system. Instead of working with standard component analog IP, a much better approach is to work with proven topologies (whose functionality is already proven in silicon) and fine-tune them for the application's sweet spot.

A last and equally essential aspect that the new hardware hipsters have covered is electrostatic discharge (ESD), electrical overstress (EOS) and latch-up. Bart Keppens from Sofics says that what he has learned by supporting innovative startups is that many of the applications require non-standard on-chip ESD/EOS protection clamps, which are not always covered in mass-produced designs. "For example, the driving voltage of the implanted chip to restore hearing for (near) deaf people is in the order of 20V, much beyond the typical I/O interfaces provided by the foundry or I/O providers. Similarly, small signals (order of a few mV or mA) captured by sensors for motion detection and touch remain hidden in the noise or are lost due to leakage. Moreover, the probability of ESD stress is much higher as they are operated in harsh environments. For example, the plastic of your smartphone cover rubbing on the cloth of your back-pocket

can generate very high voltages just millimeters away from very sensitive components, such as high-speed USB ports."

Enabling low-cost prototyping and small-volume production

For substream innovators, unlike for larger companies, achieving the lowest possible unit production cost is not the first concern. They can reduce the production unit cost later on, once the product is on the market and customers turn out to buy more products than anticipated. Their game plan centers on producing truly innovative and high-margin products for niche markets, with the potential to grow into larger, more mature markets.

Instead, when a startup or an innovative SME implements an IoT product involving a custom chip design, the go/no-go decision is typically taken by private or venture capital investors and dominated by the required amount of upfront investment (NRE cost), the time-to-market, and the ability to precisely define the chip's requirements.

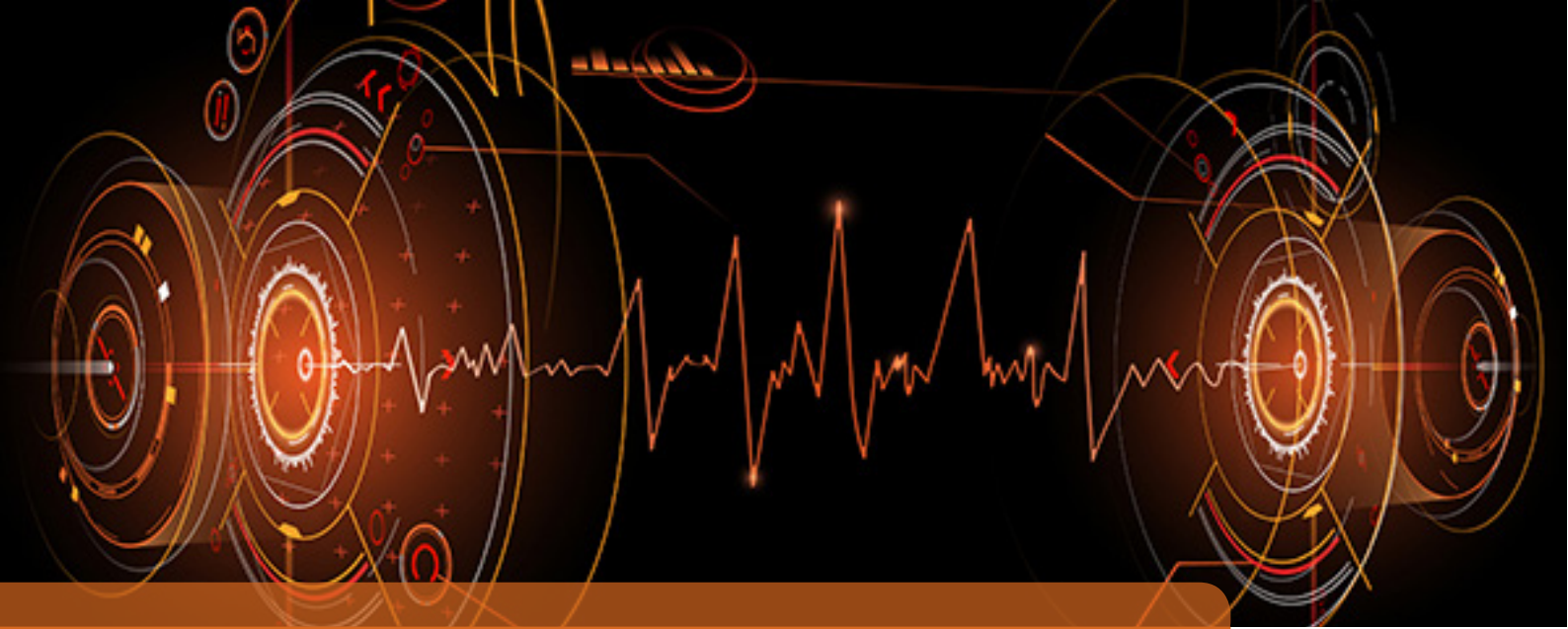
"That is where IC-link and its design partners may help," says Ramses Valvekens. "They can help lower the NRE costs and shorten the time to market through their extensive IP and know-how. In addition, together with the customer, they will help define and focus the chip requirements."

One essential factor included in the NRE is the initial cost of the lithographic mask set needed to process the wafers. These can cost, even for mature technologies, in the range of 100,000s of dollars.

Especially to lower these high NRE cost for SMEs, foundries have introduced multi-project wafers (MPWs) and made these accessible through partners such as imec IC-link. In MPWs, designs of many customers share space on the same mask, but with hard limits imposed on the maximum number of chips per wafer, and the total number of wafers that can be ordered. For very small production runs measured in the thousands, mature MPW technologies offer extremely low initial costs, as low as 10,000s of dollars for a batch of approximately 100 prototypes of 32 mm². Below figure illustrates the impact that MPW processing has on small volume production, as well as the change in the cost model when higher production volumes require a transition to a dedicated mask.

Substream innovation is here to stay

The convergence of high-growth, fragmented, wirelessly connected application domains characterized by manufacturing sweet spots using mature technologies has led to an explosion of activity by SMEs. New product ideas can be generated by small teams of people and taken quickly to small volume production and are no longer only the domain of large international corporations. Imec IC-link and its partners have committed to support this process, by providing infrastructure, design and IP assistance.



New DAC Architectures Address Diverse System Design Challenges

› Estibaliz Sanz Obaldia and Junifer Frenila, Analog Devices

With current market dynamics constantly driving toward shorter design cycles, enhanced system functionality, and more portable end systems, the need for a new methodology to simplify these challenges without adding design complexity is a must. This article will address some key system challenges for control and measurement that are topical across many applications, including data-acquisition systems, industrial automation, programmable-logic controllers, and motor control.

The article will also explore the latest advances in bipolar digital-to-analog converter (DAC) architectures and how these topologies can address end-system challenges, which include adding even more functionality and intelligence within the same or reduced space. On top of that, it will discuss discrete and more functionally complete solutions, as well as outline a number of alternatives to traditional design topology that support higher flexibility in design reuse and system modularity.

It should be noted that the figures provided below are not the actual schematics, but illustrations on how applications could be achieved with

multifunctional DACs and other components. While it doesn't include aspects such as circuits for power supplies, bypassing, and other passive components, these diagrams illustrate how applications can be implemented in general.

Data-Acquisition Systems

Data-acquisition systems (DAQs) are used to measure an electrical or physical singularity, such as voltage, current, or pressure, with a microcontroller or microprocessor for data-processing capability. DAQs consist of sensors, amplifiers, data converters, and a controller with embedded software that controls the acquisition process.

In a process-control application, it's critical that the sensor is sensitive enough to preserve the quality of the signal to be measured. But even if the sensor is sensitive enough, the signal-chain errors such as gain and offset could still interfere with the signal quality. High-performance applications employ DACs in automatic calibration of the conditioning circuits in data-acquisition systems. Figure 1 shows the block diagram of a pressure-sensing system. It illustrates how bipolar DACs

can be used in an automated gain and offset calibration scheme.

The precision bridge transducer receives an excitation signal from a pressure sensor and produces an output voltage. Due to the low amplitude of the transducer's signal, an instrumentation amplifier is typically used as a signal multiplier. This low-amplitude signal is susceptible to errors. Such errors are usually caused by drift due to changes in temperature, parasitic errors across circuit boards, and tolerances of passive components. With the use of a bipolar DAC, gain and offset calibrations can be implemented into the system to dynamically correct the errors as the system operates over time. Depending on the level of adjustment and the polarity required, a complete, high-resolution and multifunctional bipolar DAC can greatly simplify the calibration process. The DAC can be programmed through a high-speed, 4-wire SPI interface with a serial data output (SDO) line available to facilitate daisy-chain and read-back operation.

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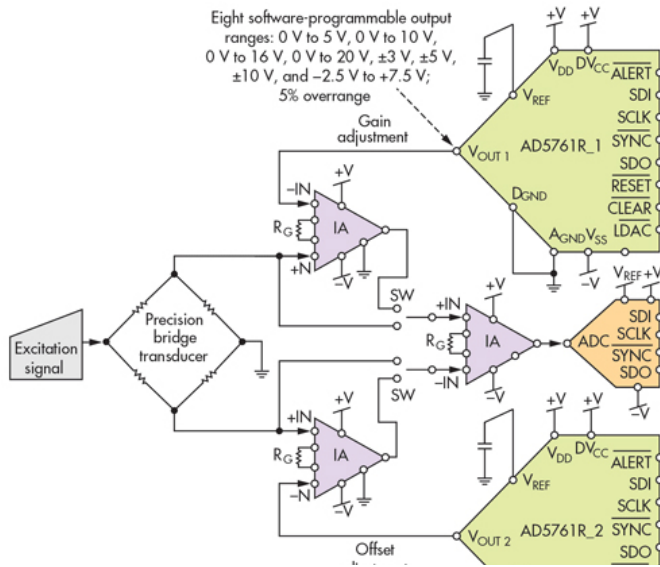
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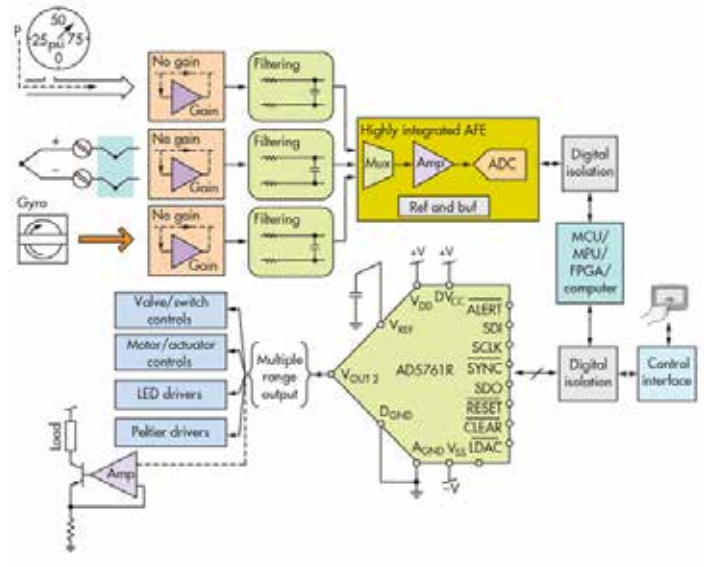
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1. The use of a high-resolution and multifunctional bipolar DAC simplifies calibration in this pressure sensing system.



2. Performance of the signal-acquisition and control units defines the operational efficiency of an industrial automated system.

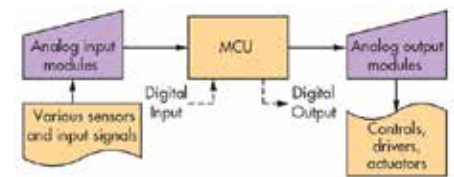
within the industrial-automation space. Regardless the application though, the functionality and performance of such automated systems lies in their signal acquisition and control units. On the acquisition side, the sensitivity of the sensors, adaptability of the conditioning circuits, and the speed of acquiring correct information from low-level signals is very important. On the control side, the flexibility to adapt to the requirement of various actuators and drivers is vital. Figure 2 shows an example of an industrial automated system. A thermocouple with cold-junction compensation is used to measure the temperature of industrial equipment, such as a laser machine or heavy duty motor. The voltage is gained up, filtered, and sent to an integrated analog-front-end (AFE) IC for conversion and the digital data is passed into the processor for analysis. Based on the processed data, the processor sends signal to a control DAC, which is also fully isolated, to drive an industrial fan, activate cooling apparatus such as a Peltier, or open the valve of a water-cooling system. In addition, the user can input an override command via a control-interface device.

The same system can be adopted for pressure and vibration measurement and control. A pressure sensor system can typically be used for oil and chemical tank monitoring; while a gyroscope system could be used for vibration monitoring of fast-moving machine heads. These applications share the same AFE, which is fully isolated from the external environment.

A high-voltage, high-resolution, bipolar DAC with low-drift internal reference and software-selectable output range is a practical replacement for multiple DACs or a single-multiplexed DAC. It provides unipolar and bipolar voltages while maintaining the same accuracy with an option of over-range output. The bipolar DAC supports the actuator's different needs, including the adjustment of the control unit through software, thus avoiding hardware modifications. This new industrial control approach also helps to minimize board space and reduce cost.

Programmable-Logic Controllers

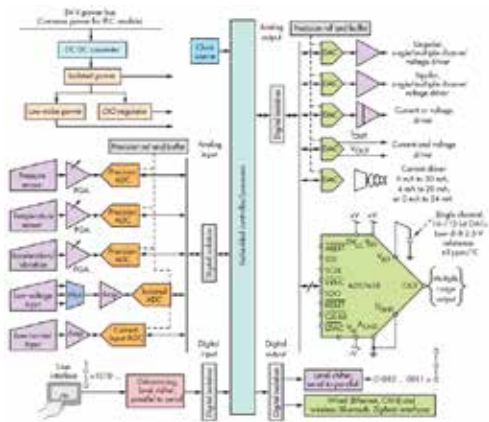
Programmable-logic controllers (PLCs) incorporate power supplies, central processing units, and several analog and digital I/O modules



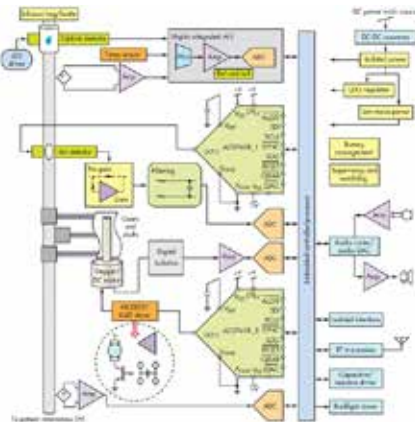
3. A basic PLC process control block consists of an input, MCU, and output module.

to control, actuate, and monitor complex machine variables. PLCs are widely used across industries, offering extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. In a fundamental process-control system building block (Fig. 3), an input signal reporting on the status of a process variable is monitored via the input module and transferred to the MCU to be analyzed. Based on the results of this analysis, a response containing the necessary arrangements is managed by the output module to control the devices in the system.

Figure 4 shows a more complete industrial PLC system, including an embedded controller/processor as the main system controller interfacing to the fully isolated input and output



4. A more-complex PLC control block includes an embedded controller, various sensors, signal-conditioning circuitry, and signal isolation. (Click for larger image.)



5. DACs provide an integral function in motor-control loops, such as this large-volume infusion-pump system.

modules. Excluding the power-supply module, the system is divided into four subsystems that differentiate the analog input, analog output, digital input, and analog output modules.

Several types of sensors are deployed to acquire analog signals of different amplitudes and frequencies. These signals need to be pre-processed and converted into digital form for further analyses. Programmable gain amplifiers condition the small input signals so that they can be accurately measured and converted into their digital representation by analog-to-digital converters (ADCs). Isolation is required to protect the controller or processor from possible unexpected overvoltage coming from the field, for which optical or integrated isolators are placed among the processor and the input and output modules

The accuracy and resolution requirements for the input and output modules are considerably distinct. While the input modules monitor highly precise and accurate data acquisitions from the process, the output modules essentially adjust the output with a 16-bit resolution and accuracy in high-end applications. As a result of these conditions, sigma-delta ADCs are commonly used for input modules in PLC systems from which a wide range of isolated, single- and multichannel and simultaneous sampling ADCs are

available in the market.

Output modules may offer precision voltage DACs, precision current DACs, or a combination of both. Several methods allow current and voltage levels to be generated for the PLC's analog output. The evolution of precision bipolar DACs, providing extra functionality and a high level of integration, significantly benefit PLC systems from reduction of system complexity, board size, and cost.

Motor Controls

DACs perform an integral function in motor-control loops, for example, in infusion pump systems (Fig. 5). Infusion pumps are widely used in human healthcare to provide medical treatment to patients of all ages. The role of an infusion pump is to deliver fluids, medication, or supplements to the patients' cardiovascular system in an intermittent or continuous procedure. Although infusion pumps require a qualified user to program the specific parameters for the treatment, the implicated advantages over manual administration influence greater user confidence. The ability of these instruments to accurately deliver tiny dosages at scheduled intervals in a self-operated mode negates the need for a nurse or doctor to manually control the flow of fluid to the patient.

Doctors and medical administrators can

depend on the safety of infusion pump systems to display real-time system information on dosage limitations for titration safety, or to prevent overdose. It also creates more confidence that the physical delivery mechanism itself will be reliable and accurate.

During operation, the microcontroller receives the monitored speed and direction signals from the dc motor, which are analyzed and adjusted (if required) to meet the set-point. The DAC in the feed-forward path makes system adjustments while the ADC in the feedback path monitors the effect of each adjustment. The desired set-point voltage set by the DAC is amplified through the driver network to provide the required drive current to the dc motor.

Analog Devices (ADI) offers high-performance analog and mixed-signal processing solutions for detecting, measuring, and controlling sensors and actuators used in chemistry analyzers, flow cytometers, infusion pumps, dialysis equipment, ventilators, catheters, and many more medical instruments. In particular, ADI's AD5761R, a high-resolution, bipolar DAC with eight available software-selectable output ranges that maintains a common accuracy, is designed for motor-control applications, supporting the different voltage swings needed by motors.

Conclusion

DACs play a key role in determining the performance and accuracy of many control systems and simple conversion circuits, as well as other complex applications. The AD5761R family, which is a complete 16-bit resolution precision bipolar DAC with multiple programmable output ranges, will find homes in a number of the aforementioned applications. It offers highly configurable ranges (0V to 5V, 0V to 10V, 0V to 16V, 0V to 20V, $\pm 3V$, $\pm 5V$, $\pm 10V$, and $-2.5V$ to $+7.5V$; 5% over-range) to suit DAQ systems, industrial automation, programmable logic controllers, and motor controllers. Integration within the family, including an output buffer and a buffered 2-ppm/ $^{\circ}C$ internal reference, helps simplify board design, reduce board size, and minimize power consumption and cost.



Power Modules Underpin Smart Grid Adoption

› Steven Keeping, DigiKey Electronics

The century-old U.S. electricity grid is said to be the largest interconnected machine on Earth. The grid comprises more than 9,200 generating units producing over 1,000 GW and connected to more than 480,000 km of transmission lines. However, at no time in its history has this grid undergone such rapid change as that which is happening now.

Utilities are investing heavily in “smart grids” to dramatically enhance energy delivery by lowering costs, improving efficiency, offering customers more flexibility, and making the connecting of renewable energy sources easier.

Implementing smart grids demands a range of new technologies including grid protection, power quality enhancement, fast communications, cyber security, and consumer monitoring. That makes these huge machines increasingly reliant on the electronic components that have supported the technology revolution already experienced by many other sectors.

This article looks at the opportunities that are opening up for electronics designers as smart grids gather pace and then describes a range of modules

from major suppliers that have been specifically designed to power the electronic systems, satisfying the unique challenges of these new electricity networks.

Power revolution

The smart-grid revolution has been triggered by a number of factors, including consumer backlash to rising prices, increased raw-energy costs, deregulation, and pressure from the environmental lobby to limit the construction of new fossil-fuel power stations. The disruption is bringing computerization, digital communication, and bi-directional energy flow to a previously ultra-conservative industry in order to dramatically enhance the performance of its networks.

While the smart grid is complex, it can be broken down into four key areas: Infrastructure, communications, metering, and renewable energy.

Engineers tasked with upgrading existing infrastructure to smart-grid status are in turn concerned with protection, monitoring, and power quality. Apart from the wires and poles, that infrastructure comprises

“distribution automation” resources equipped with sensors to gather data, sending information about the grid’s status and performance to the utility’s network operations center to allow operators to adjust and control assets from the central location. In addition, smart grids automatically monitor, protect, and optimize electricity distribution to industrial users and domestic consumers. The built-in intelligence of smart grids also allows rapid automatic intervention in the case of faults, limiting outage duration.

Another key difference between a smart grid and a conventional network is that electricity flows in both directions, which enables utilities to move away from centralized power generation and encourage distributed renewable energy sources such as wind turbines and photovoltaic (PV) panels on domestic consumers’ roofs (Figure 1). Smart grids also limit system losses, thus improving overall efficiency and helping to decrease the generation of carbon emissions and other pollutants[1].

Smart-grid information systems include Power Line Communications (PLC), Ethernet networks, serial links,



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Consumers tend to associate smart grids with smart meters-home-monitoring devices that can provide the consumer with fine-grained data about usage trends-allowing them to modify consumption to, for example, take advantage of cheaper tariffs and allow utilities to smooth demand peaks. However, smart-grid metering comprises much more than the individual devices outside of homes, factories, and offices. Advanced-metering infrastructure (AMI) provides the two-way communications necessary for utilities to automate billing, remotely connect/disconnect individual meters, and implement demand-response programs. AMI networks also provide the ability for real-time monitoring of grid operations and immediate notification of outages to accelerate utilities' response.

What is more, renewable energy is a major challenge as generation extends beyond hydroelectricity and wind farms to "microgrids" comprising groups of households feeding power back into the network from solar panels. The inverter is a critical component responsible for the control of electricity flow between the PV cells making up the panel and the power grid. The challenge for engineers is how to do this in an efficient, reliable, and cost-effective manner[2].

In the U.S., ten states-including California, Florida, New York, Pennsylvania, and Texas-are leading the national effort to deploy the country's smart grid. Together, these states have already been the recipients of \$1.9 billion of the \$4.5 billion earmarked in the American Recovery and Reinvestment Act for investment in the smart grid.

This momentum is set to increase and is fueling demand for the electronics that are the foundation of many smart-grid systems. Silicon vendors have reacted by developing a range of components that enable electronic engineers to design products that underpin smart-grid applications; and

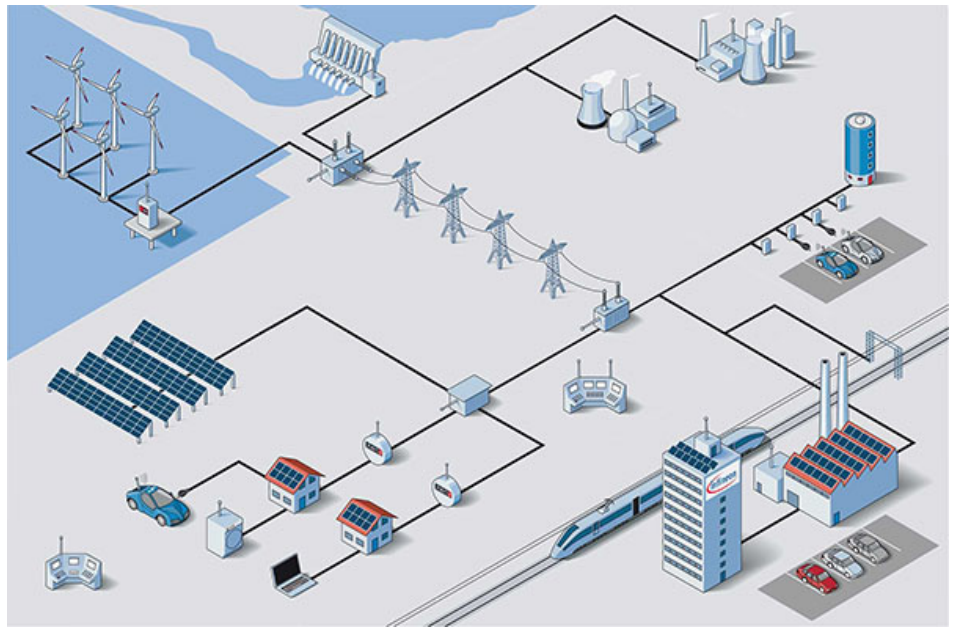


Figure 1: Smart grids will feature conventional and diversified electricity generation. (Courtesy of Infineon)

each of these products demands a power supply uniquely matched to the exacting demands of intelligent electricity distribution.

Reacting to outages

Apart from efficiency improvements, the key advantage of a smart grid is its ability to recover from faults caused by factors such as lightning, high winds, or falling tree branches. Utilities are understandably keen to prevent catastrophic failures such as the Northeast blackout of 2003. This was a widespread power outage that affected an estimated 10 million people in Ontario, Canada and 45 million people in eight U.S. states. Some people were without power for two days.

Smart grids incorporate protection devices such as circuit breakers, which cut the supply when they detect anomalous events such as excess current or voltage. By establishing the location of the fault and taking advantage of the bi-directional energy flows enabled by a smart grid, utilities can isolate the small section of distribution line where the fault has occurred while using alternative lines to quickly restore power to the rest of



Figure 2: Wide-input-range power supply reference design for protection relays from Texas Instruments.

the grid.

Many of these protection devices depend on power supplies from major semiconductor companies. Texas Instruments (TI), for example, offers a small form-factor, 12W power supply reference design to power the protection relays used in smart-grid circuit breakers (Figure 2).

The design is notable because it is able to handle a wide range of both

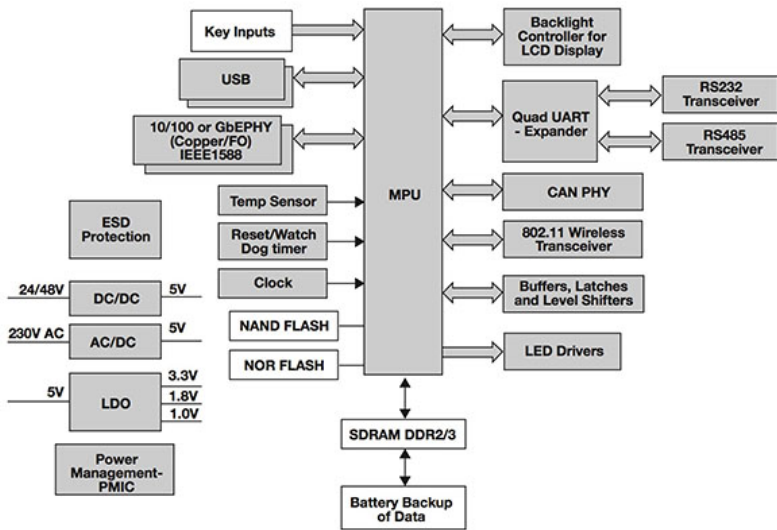


Figure 3: Schematic for IEC 61850 Gateway illustrates requirement for multiple-voltage regulators. (Courtesy of Texas Instruments)

AC and DC inputs (24 to 250VDC or 88 to 276VAC) and provides a 15V, 800mA (12 W) output from a 100 by 100 mm form factor (making the power supply suitable for protection relays that have to be housed in compact housings).

The power supply uses a two-stage converter topology comprising a DC-to-DC step-up (“boost”) regulator designed around a TI TPS40120 current-mode controller which forms the input to a quasi-resonant flyback converter designed around a UCC28740 pulse-width-modulation (PWM) controller. The output of the flyback converter forms the 15 V, 0.8 A output from the power supply.

Enabling interoperability

In conventional electricity distribution grids, infrastructure is operated in isolation and without gathering any information about grid performance or the cause of faults. Full implementation of a smart grid requires these “dumb” devices to be replaced with Intelligent Electronic Devices (IED). In addition to performing essential electrical tasks such as transforming voltages, redirecting energy flows, and isolating sections of the grid in the event of faults, IEDs constantly monitor voltages, currents, power quality, and

other parameters that can affect grid performance.

This information is passed between IEDs (such that they can be automatically activated to correct abnormal grid operation) and back to operators (who can then quickly respond to peaks and troughs in demand or outages) via dedicated communication channels. These communication channels provide rapid and reliable transmission of information and rely on wired- and wireless-technology and Internet, Ethernet, industry standard, and proprietary protocols.

The electricity distribution industry is working hard to adopt a communications standard to enable interoperability between the disparate elements of an electricity grid. The favored standard is IEC 61850, which is already established for communications in electrical substations. IEC 61850 is now being extended beyond the substation to the Intelligent Electronic Devices (IED) that make up smart grids.

IEC 61850’s strength is its ability to rapidly exchange data yet preserve the original meaning of the information. As such, the standard promises to markedly enhance communication between, and coordination of, smart-grid infrastructure.

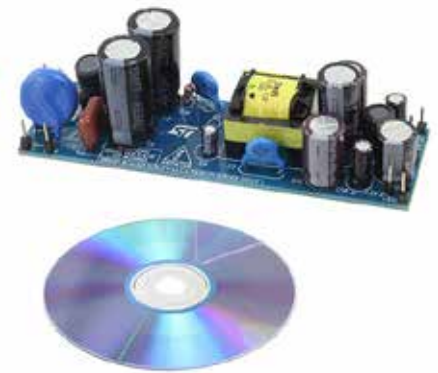


Figure 4: STMicroelectronics power supply reference design for smart-metering applications.

The IEC 61850 Gateway forms a key part of this communication system and again TI has stepped in with chips designed to make the power supply for these products easier to develop. The gateway will likely require multiple power-management chips to deal with multiple AC and DC inputs. Figure 3 shows a schematic with a selection of voltage converters including a 24/48VDC input/5 VDC output switching regulator, a 230VAC input/5 VDC output switching regulator and 5VDC input/multiple DC output low-drop-out linear regulator (LDO).

Another option for gateway power is a power management IC (PMIC) such as the TI TPS69510. The PMIC can accept 5 V Li-ion battery power and provides three step-down (“buck”) converters, one boost converter, and eight LDOs, and is designed to support the specific power requirements of OMAP-based applications.

The eight general-purpose LDOs power the OMAP-based processors, power to other devices in the system, and power to DDR memory supplies in applications requiring these memories.

Managing consumption

Consumers become familiar with the concept of smart grids when utility maintenance crews arrive at their home to replace antiquated meters with intelligent units. According

to the U.S. Energy Information Administration (EIA), by 2013 (the latest year for which numbers are available) U.S. electric utilities had installed 51,924,502 smart meters of which 89 percent were in residential customer installations.

Smart meters are more than just monitoring units that can be interrogated remotely. A key advantage of these intelligent devices is the supply of information that allows both utilities and consumers to manage supply and demand. Utilities are able to use the information to precisely determine peaks in demand and reserve generating capacity for similar future peaks. The utility can also set "dynamic" tariffs, reflecting the costs (and carbon content) of generation and distribution at any particular time, or rewarding consumers for using electricity at times when renewable sources are producing a lot of power. Consumers could even opt for packages that allow appliances to be turned on and off automatically by the grid operator to help maintain virtually a second-by-second balance between supply and demand.

A downside of smart meters is the requirement for them to be "always on." Each unit draws relatively little current, but the combined effect of millions is significant. The silicon vendors have responded by cutting the quiescent current of their high-voltage power solutions for these always-on, non-isolated systems for applications such as smart meters.

Several manufacturers offer AC-to-DC voltage regulators that meet the tough demands of smart metering. For example, STMicroelectronics supplies a power supply module, the VIPER06, that can operate from an 85V to 265VAC input and features an 800V power metal-oxide semiconductor field-effect transistor (MOSFET). The chip can output up to 8W yet consumes just a few hundred microamps quiescent current.

For its part, TI has recently introduced the UCC28880, an AC-to-DC switching regulator for smart-meter applications. The UCC28880 integrates the controller

and a 700V power MOSFET into one device. The chip also integrates a high-voltage current source, enabling start-up and operation directly from the rectified mains voltage.

The quiescent current of the device is less than 100 μ A, improving the efficiency of the solution. TI says that by using the UCC28880 engineers can design most common regulator topologies using a minimum number of external components.

Utilities have also implemented "concentrators" as part of their smart-metering systems. Concentrators gather information from a group of smart meters (for example, those in a single apartment block) and aggregate and analyze the data before transmitting it wirelessly or via a power line modem to the utility. Concentrators can also be used to send information from the central control facility back to the smart-meter group and facilitate maintenance functions such as software updates.

In addition to supplying power modules for smart meters, STMicroelectronics also caters for the power requirements of concentrators. The power requirements for concentrators are similar to those for smart meters, although a little more demanding due to the additional computation performed by the unit.

STMicroelectronics promotes the Altair 04-900 AC-to-DC switching voltage regulator for concentrator applications. It is based on a quasi-resonant flyback topology and is capable of operating from a mains input and features a 900V breakdown power stage. The Altair features low-standby consumption (around 1mA) and overcurrent protection to safeguard against transformer saturation and secondary diode short circuiting. The company also provides a power supply reference design for smart-metering applications, under the part number STEVAL-ISA105V1 (Figure 4).

Huge rewards

Modernizing decades-old electricity infrastructure with computerization

and communications technology in the U.S. and the rest of the developed world is a huge task. The cost of the exercise will run into billions of dollars without even factoring in disruption to customers as sections of the grid are upgraded.

However, the rewards are great. A smart grid will dramatically improve the efficiency of the electricity system by reducing system losses, make it easier to switch in renewable energy sources (thus reducing the requirement for "base load" - fossil-fuel generating capacity that must be kept running permanently to cope with anticipated peaks), and enable utilities to encourage consumers to reduce consumption through flexible tariffs. Higher efficiency and greater contributions from renewable sources also helps authorities meet their commitments to reduce carbon emissions.

Smart grids also limit disruption caused by outages by allowing operators to quickly isolate faults and re-route power to as many consumers as possible while the problem is rectified. The success of smart grids will rely heavily on novel silicon and innovative design engineers; and those products will in turn rely on specialized power modules that meet the particular requirements of smart-grid application such as wide-input voltage ranges and low-quiescent currents. The good news is that there are already many integrated solutions commercially available for engineers looking to take a slice of this lucrative market sector. For more information about the parts discussed in this article, use the links provided to access product pages on the Digi-Key website.

References:

1. "Carbon Emission Reductions by the Implementation of a Smart Grid," Steven Keeping, NOJA Power, 2013.
2. "Smart Grid & Energy Solutions Guide," Texas Instruments, 2015.

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Why IoT? Three Big Reasons Emerge from Customer Interviews

> Jerry Lee, Microsoft

You may have read how Microsoft customers such as ThyssenKrupp Elevator and Rockwell Automation are applying Internet of Things (IoT) concepts to transform their business. Their deployments reflect the bottom-line impact that is possible with advanced IoT initiatives. For instance, ThyssenKrupp's preventative maintenance for elevator uptime paved the way for reduced costs and a major competitive advantage.

And while there's much to be learned from advanced players in IoT with complex concepts and solutions, there is also plenty of opportunity for companies that are just starting out with IoT. When you look at new IoT deployments in this emerging technology landscape, there are three key business fundamentals where companies of any size can gain.

No. 1: Reduce costs

In most industries, it's easier to save on expenditures than to build revenue, and the same principle holds true when it comes to building value with IoT. So it shouldn't be too surprising that creating efficiency and reducing the costs of doing business was the

number one answer customers gave to the question of what they think they can gain from IoT in our recent study by Keystone Strategy*.

For companies struggling to streamline their vision for IoT and focus on the fastest time to value, reducing costs provides the shortest path to success. With ROI realizable within the first year, cost reduction is also one of the most influential ways for business group leaders to drive alignment when board approval is required for their IoT investment.

While nearly every company could benefit by automating data collection for analysis, other common IoT scenarios for increasing efficiency and reducing costs include real-time inventory tracking to reduce the time wasted searching for parts and ensure the right ones are always on hand. IoT is also being used to create some of the world's most reliable factory lines. In healthcare, IoT can be used to vastly improve patient care, by automating medication systems. And in some cities, IoT is transforming life in urban areas by creating smarter traffic solutions. The

reality is, scenarios to reduce costs are as many and varied as companies and industries themselves.

No. 2: Increase revenue

Increasing revenue is another big reason companies are looking to the Internet of Things today, but because it often involves building out the organization to accommodate the new business, it generally takes longer to realize ROI from the effort.

The rewards, however, can be substantial, and we've seen several customers leverage their initial IoT work into new services that can be added on top of products to generate post-sale revenue streams.

Remote monitoring and predictive maintenance scenarios are a prime example. We've seen how both Rockwell and TKE have expanded their business to become service and software providers as much as they are equipment manufacturers.

Rockwell uses their solution to monitor petroleum equipment in remote locations, with a team of support engineers at Rockwell headquarters keeping tabs on the health of their

customers' systems. In the case of a deep-sea petroleum pump that powers and offshore oil platform, any failure can be very expensive. But because of the instant flow of data allowed by connecting the pumps through intelligent sensors, Rockwell engineers are able to head off potential problems or drastically reduce downtime if an issue does occur.

No. 3: Transform the business

Over the decades, very few of our customers have told us that transforming their business was a key goal at the outset of their IoT initiatives, but many adopters have said they now see the potential for a data-driven transformation arising from their efforts.

The most common scenario for such a transformation is the ultimate maturation of additional revenue streams into a new business division, and certainly companies like TKE



and Rockwell fall into this category. These companies are no longer selling equipment, but uptime, which is what their customers care about most.

Down the road, as more companies think through the application of IoT principles in their industry, there is the potential for this approach to be a truly disruptive force across many industries. It wasn't long ago that nobody would have imagined a fleet of taxis carrying GPS devices connected to a central user app could revolutionize mass


transit, but today it has.

But most companies don't start out with IoT looking to disrupt an entire industry - They want to disrupt their own processes and work smarter. The key to doing so is to start small and be very focused at the outset. As the solution matures and capabilities grow, new opportunities will emerge.


Jerry Lee is Microsoft's director of product marketing, Data Platform and IoT.

IoT Antennas from Raltron


Antenna




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Antenna Exterior




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GPS Patch
Antenna Interior




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Macronix Expands Flash Portfolio for Wearables

› Heko Arndt, Macronix

Serial NOR Flash Memory Series MX25R Offers Ultra-Low Power and Wide Voltage Range

Macronix International Co. Ltd., a leading global vendor of non-volatile semiconductor memory devices, has recently introduced its new MX25R Serial NOR flash product family. The devices are specifically aimed at next-generation consumer wearables in the context of the 'Internet of Things' (IoT). The MX25R product family features an ultra-low-power mode and densities ranging from 512Kb up to 64Mb, with plans to move up to 128Mb, 256Mb and 512Mb in the near future. Power consumption in the MX25R family is 60 percent lower than traditional solutions, with a wide Vcc span of 1.7V to 3.6V to support diverse requirements of wearable devices. The new family fits within the Macronix portfolio of serial NOR flash products ranging from 512Kb to 1Gb.

Serial NOR Flash Memory for Wearables

Macronix's MX25R series caters

specifically to next-generation consumer wearables. It supports the standard Serial NOR flash memory interface and industry-standard 8-pin layouts. With its very compact die, this allows for very small package dimensions such as the USON (Ultra Thin Small Outline No Lead), WSON (Very Very Thin Small Outline No Lead), WLCSP (Wafer Level Chip Scale Package), and also KGD (Known Good Die) solutions for stacked-die SIPs (System in Package).

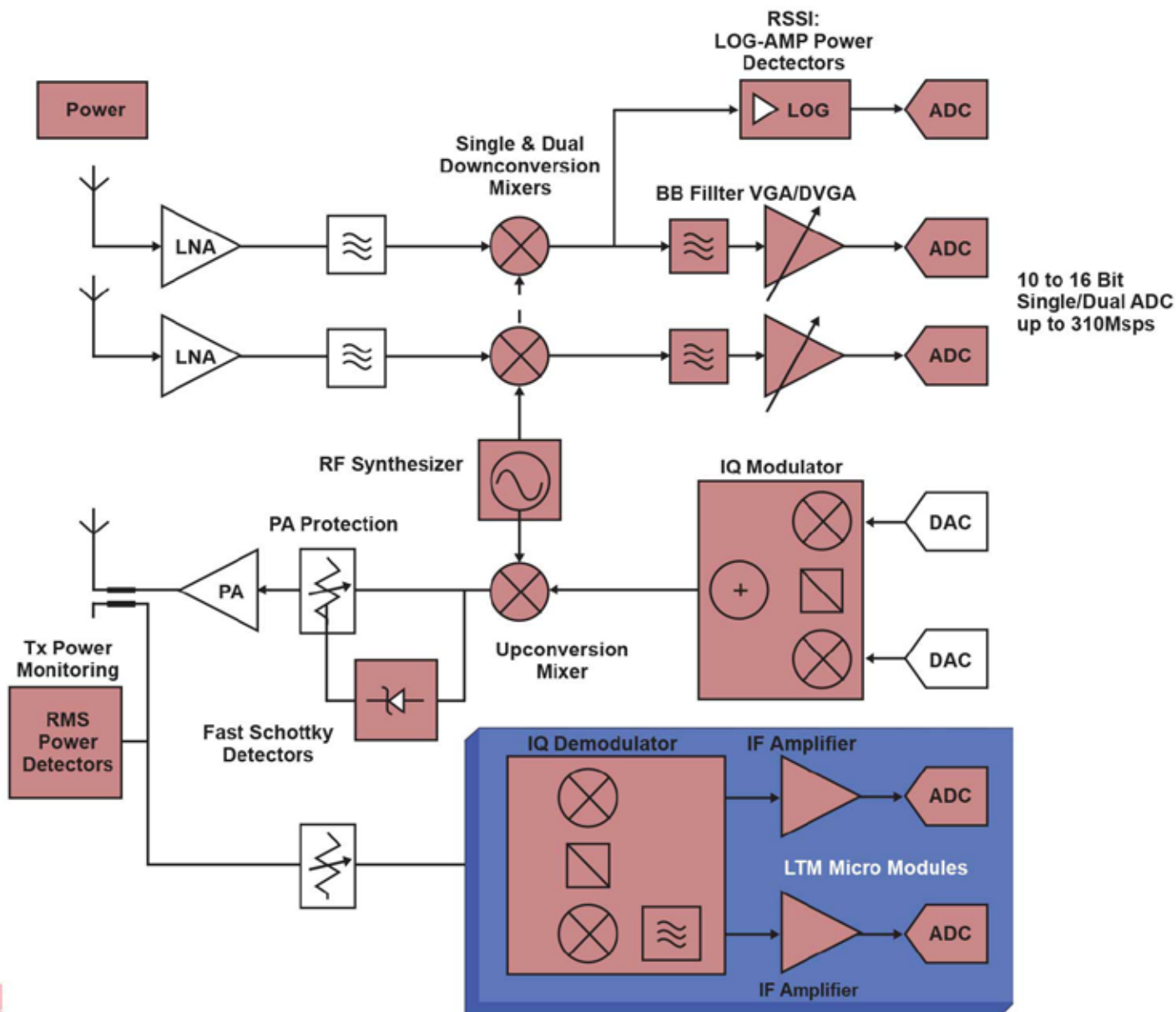
The market prospects for wearables, in their first incarnations coming as sensor-enabled wristbands and rings, or smart watches equipped with fitness and location trackers, are a promising sub-segment of the IoT category of systems and services. According to new research from International Data Corporation (IDC), IoT systems and services promise a potential compound annual growth rate (GAGR) of 78.4 percent. By 2018 annual sales for wearables may exceed a total unit volume of 112 million units according to a recent report published by US market researcher IDC. This market dynamic has encouraged Macronix to develop

novel product solutions of memory devices for wearable applications to further expand its leading position as a vendor of non-volatile memory devices. "The key factor for wearables to gain rapid popularity is designing them with ultra-low power consumption and in a small form factor," states Min-Cheng Lin, Deputy Director of Macronix's Segment Marketing Department. "The next generation of memory devices will progress in the following directions: standardized interfaces prioritizing ease of data import, smaller and slimmer form factors and a power supply design focusing on ultra-low voltage and energy consumption."

Internet of Things and Wearables

Judged by its dominating presence at the 2015 Consumer Electronics Show (CES) in Las Vegas, NV, the 'Internet of Things' (IoT) provides a forward-looking perspective for the anticipated wide-area networking between people and things in a real-world environment. In this view, IoT should be understood as a generalized category and a

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8-SOP (200 mil)					●	●	●	●
8-SOP (150 mil)	●	●	●	●	●	●	●	
8-WSON (6x5)							●	●
8-USON (2x3)	●	●	●	●	●	●		
8-USON (4x3)						●	●	
8-USON (4x4)							●	●
WLCSP	●	●	●	●	●	●	●	●
KGD	●	●	●	●	●	●	●	●

Fig 1: Available package formats for MX25R serial NOR flash devices.

driver to build a consensus for a comprehensive data network and its step-by-step implementation. The need for consensus-building results from the multitude of competing processor platforms and operating systems, in addition to the various protocols for radio interfaces and data security measures. This pertains to the consumer realm as well as to its industrial-use counterpart in the guise of 'Industry 4.0'. All these developments involve an extraordinary systems complexity.

Accordingly, Macronix sees several large, distinctive market segments for IoT devices and systems: cloud services and data centers, gateways for mobile telephony, automotive connectivity, home media, and a myriad of consumer-oriented IoT nodes for consumers in the form of ultra-compact, sensor-enabled terminal devices for data acquisition and wireless transmission over short distances to their personal base stations, such as smart phones and tablets.

Most attractive from a current market perspective are the wearables, since they will establish large consumer markets. This is clearly indicated by the number of the semiconductor vendors focusing on wearables and smart home systems and the prioritization they are giving this segment. Among them are NXP, Freescale, Qualcomm, TI, Sony,

MTK, Intel, Infineon and others. Of course, ARM as a licensor is heavily engaged in this realm as well.

Another market segment offering good prospects for high sales volumes, which could gain in importance in the mid-term, is smart lighting and smart metering, plus home security and home control systems equipped with thermostats and related equipment. However, this segment may attract a smaller number of device vendors since it involves different, somewhat higher demands on product quality.

Macronix is set to contribute to these emerging markets through specific incremental improvements of non-volatile memory devices, especially in regard to ultra-low power and standby modes. In stark contrast to the more broadly defined Internet of Things, with its complex infrastructure and fast transfer of large amounts of data, the wearable devices segment calls for a pragmatic system partitioning. Wearables, per definition, are the smallest possible data systems to be worn close to the human body. If they were larger they wouldn't be wearables anymore. Wearables, in contrast to smart phones and multimedia systems, don't require high memory densities and large memory spaces since they connect wirelessly with their dedicated base stations.



Fig 2: USON and WLCSP packages for the Macronix Serial NOR Flash MC25R Series

Specific NOR Flash Configurations for Wearables

Macronix's new Serial NOR flash MX25R Series was specifically designed and laid out for the relevant performance requirements of wearable devices – that is, eliminating all non-essential structures and features. Among other measures, the internal buffers were tailored to the envisioned applications, whereas a typical high-performance memory cell would comprise large internal RAMs. In wearable applications, when focusing on frequencies of just a few Megahertz, there are further routes for optimization to reduce die size and power consumption, while maintaining all options for system designers to still utilize special 'performance modes' – at the cost of higher power consumption. In its deep-power-down (current-saving) mode the MX25R devices offer a very favorable power budget, with savings of more than 90 percent compared to traditional solutions.

In regard to connecting the memory device with the system environment, the MX25R is compatible with the well-known and widely-used standard Serial NOR Flash Interface. This eliminates additional development efforts on the user's side and it accelerates time to market. With regard to active current, the Macronix MX25R device - drawing 4 mA (8 mA peak) - is situated at the lower end of the range available in the market. As a first estimation the active current of the MX25R device is

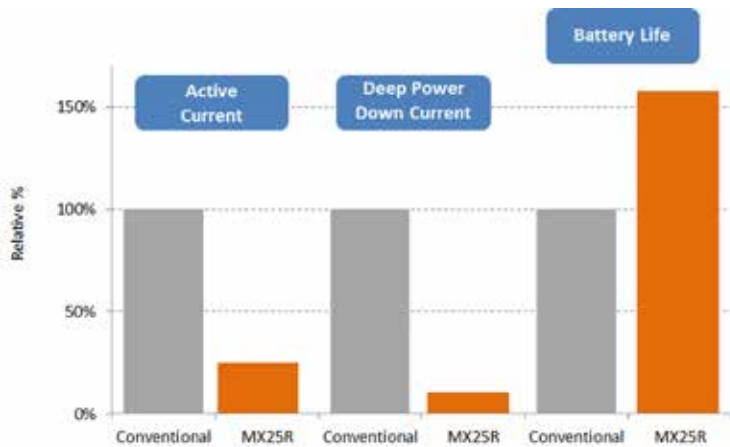


Fig 3: Performance overview of the Serial NOR Flash Series in regard to active current, deep-power-down consumption and battery lifetime in wearables



Fig 4: Inspecting a batch of memory devices at Macronix in HsinChu, Taiwan

70 percent lower than with traditional last-generation memory solutions: in deep-power-down mode the difference goes up to more than 90 percent. With its wide supply voltage range of 1.7V to 3.6V, the new MX25R series not only consumes less power during

standard operation but enables designs to operate over the full Vcc range of the battery, thereby eliminating the need for external regulators. MX25R-based applications continue to operate even when the remaining battery capacity goes

down to voltages below 2.7V. This further extends battery life by up to 50 percent.

Heiko Arndt is Senior Field Application Engineer at Macronix Europe N.V.



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4th Generation Field Stop (FS) IGBT with High Performance and Enhanced Latch Up Immunity

› Kyuhyun Lee, Sungmin Yang, Sekyeong Lee, Jiyong Lim and Youngchul Choi - Fairchild Semiconductor

Thanks to their low conduction and switching energy loss, IGBTs are widely used in high power applications such as power supplies, motor driving inverters, electrical vehicles, etc. The requirement for more state of the art power devices for power applications has triggered efforts around novel silicon based development, as well as wide band gap material development, to achieve characteristics that stretch the ideal limit of silicon. The theoretical silicon limit for IGBTs was investigated by A. Nakagawa, [1] and in order to realize optimal silicon characteristics, various injection methods to enhance IGBT structures were proposed, such as CSTBT, IEGT, and narrow mesa IGBT [2-4].

In order to push IGBT silicon to the limit, extremely high electron injection efficiency from the MOS gate is required, while the hole carrier injection should be restricted to the level of contribution only for the conductivity modulation. [1] For Fairchild's 4th generation FS IGBTs, electron injection was enhanced

by a very fine cell pitch design and hole carrier injection was restricted by a new buffer structure, achieving remarkably better trade off performance as well as strong latch up immunity. To realize the narrow mesa or high-density cathode design of the trench IGBT, a self-aligned contact process was applied. This proved to be very effective in optimizing the critical dimension of active cell design for the enhanced on-state performance, as well as to maximize the latch up current capability. In addition, multiple buffer layers were adopted for the anode side of the IGBT in order to not only effectively control the minority carrier injection during the on state, but also to completely block the electric field during the off state [5].

The vertical structures of the proposed IGBT are illustrated in Fig.1 for the cathode and anode side. Figs.1(a) and 1(c) show that the high density cell design with submicron narrow mesa width is successfully realized by employing a self-aligned contact process, without any photo misalignment. The higher density active pattern shown in this figure is beneficial for extremely enhanced electron injection from the cathode

side and, as a result, the higher electron current density. The new buffer structure with multiple layers, as shown in Fig.1(b), is very helpful for the ideal carrier distribution during IGBT operation. Generally, a single buffer layer with $1 \sim 5 \times 10^{15} \text{cm}^{-3}$ is used for both hole injection control and electric field blocking efficiently. In this experiment, a thin buffer layer with a much higher doping concentration was additionally embedded for better trade-off performance. In other words, the higher doping concentration in the double buffer layer is even more effective for the electric field blocking and hole carrier injection control by the first FS layer (L1). The lower doping concentration for the second buffer layer (L2) is preferred for forming a lightly doped p-type collector for high-speed switching performance without any lifetime killing process. In addition, the device switching waveform can be effectively improved by varying the doping concentration and thickness of the double buffer layers, due to proper carrier distribution control during switching ON/OFF operation.

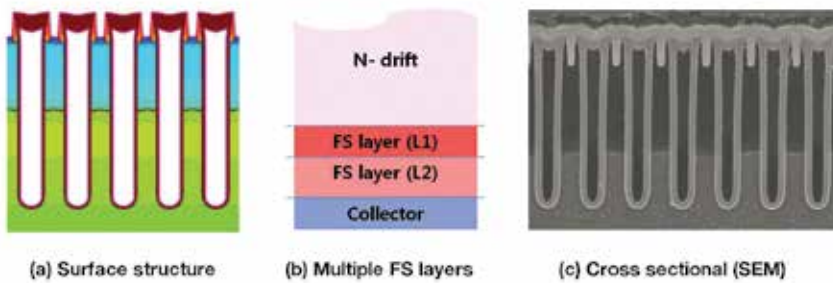


Fig. 1 Proposed structure

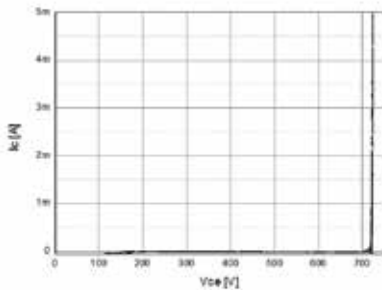


Fig.2 Measured breakdown voltage

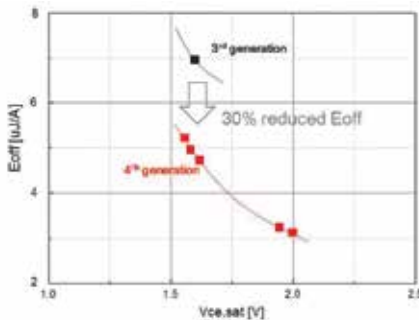


Fig. 3 Trade-off performance comparison

As is illustrated in Fig. 2, the measured static breakdown voltage is about 720V with hard waveform. It means that the double buffer layer is sufficiently blocking the electric field in the off state. In this work, 650V-50A-rated 4th generation FS IGBT was developed and evaluated. The trade-off performance was also compared with the 3rd generation FS IGBT, as shown in Fig.3, under a current density of 470A/cm² for on-state voltage drop and turn-off hard switching. The proposed 4th generation FS IGBT shows better trade-off performance,

compared with previous generation IGBT technology. (About 30% turn-off energy loss (Eoff) reduction at the same on-state voltage)

The latch up immunity is evaluated under static and dynamic conditions, as shown in Figs.4 and 5 respectively. Fig.4 shows that the maximum static saturation current is around 4000A/cm² with no latch up phenomenon. In particular, for the dynamic latch up characteristics shown in Fig.5, the proposed FS IGBT shows a very strong ruggedness and also safely operates over 3000A/cm² current density without failure under the severe hard switching condition (T=150C, Rg=0ohm, Vge=+-15V to induce very high voltage slop (dv/dt) between collector and emitter). This is because the self-aligned process removes possible local weak points from the contact photo misalignment so that the injected minority carrier can evenly flow without crowding into any specific area.

In summary, 4th generation FS IGBT technology was successfully developed based on the injection enhanced carrier profile that was optimized with an effort to approach the limits of IGBT silicon. This new generation of FS IGBTs with a high-density cell structure and well-designed double buffer layer shows superior device performance under static and dynamic states as well as strong latch up ruggedness. We've confirmed that the self-aligned process is a very effective method for the embodiment of submicron trench

and mesa active design, as well as for realizing strong latch up immunity. For the following generation of IGBT development, the mesa width will be narrowed further using the self-aligned process. This will further maximize the injection enhancement and accordingly the buffer structure for the minority carrier injection control should be optimized.

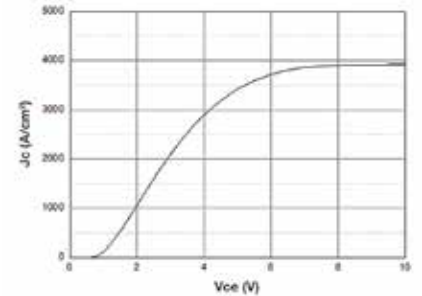


Fig. 4 Static latch up characteristics

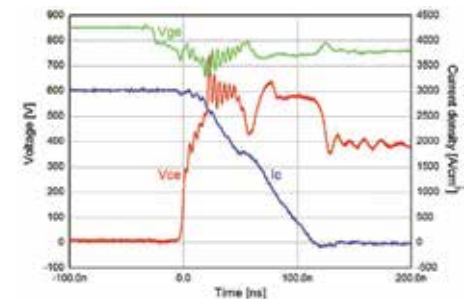


Fig. 5 Dynamic latch up characteristics

References

- [1] A. Nakagawa, "Theoretical Investigation of Silicon Limit Characteristics of IGBT", Proc. ISPSD'06, pp5-8, 2006
- [2] Z. Chen, "Next Generation 600V CSTBTMM with an Advanced Fine Pattern and a Thin Wafer Process technologies", Proc. ISPSD'12, pp25-28, 2012
- [3] K. Matsushita "Low Gate Capacitance IEGT with Trench Shield Emitter (IEGT-TSE) Realizing High Frequency Operation", Proc ISPSD'13, pp. 269-272, 2013
- [4] M. Sumitomo, J. Asai, H. Sakane, K. Arakawa, Y. Higuchi, and M. Matsui, "Low loss IGBT with Partially Narrow Mesa Structure (PNM-IGBT)", Proc. ISPSD'12, pp17-20, 2012
- [5] K. Lee, "Optimized buffer layer for the high performance and enhanced short circuit immunity of Trench IGBT", Proc. PCIM'13, pp351-356, 2013

Samsung to Showcase Three Creative Lab Projects for the First Time, at CES 2016

> samsung

Samsung Electronics announced that it will be demonstrating three Creative Lab (C-Lab) projects for the first time, at CES 2016. C-Lab is one of Samsung's innovation programs, which helps its employees to nurture their own creative business ideas. The three projects are WELT - a healthcare belt that helps people manage their waist size by measuring their daily habits and behaviors, rink - a hand-motion controller for mobile VR devices, and TipTalk - a remarkable new user experience (UX) that enables users to hear sounds, transmitted through their own body.

These C-Lab projects will be showcased at Eureka Park, the flagship destination for startups at CES, in Hall G, Level One of the Sands Expo, from January 6 to January 9, 2016. As the projects are still in the development process, they are being showcased to assess their market potential and to gather hands-on feedback from CES attendees, enabling further improvements to be made.

WELT - A More Discreet Way to Track Personal Health

WELT is a smart wearable healthcare belt that looks like a normal belt, thus offering consumers a more discreet way of using smart sensor technology to monitor their health. WELT is capable of recording the user's waist size, eating habits and the number of steps taken, as well as time spent sitting down. It then sends this data to a specially-designed app for analysis, and the production of a range of personalized healthcare and weight management plans.

rink - Taking Mobile VR to the Next Level with Hand-Motion Control

rink is an advanced hand-motion



controller for mobile VR devices which offers a more intuitive and nuanced way to interact with the virtual world. The ability to intuitively control the game or content just by using their hands provides consumers with a much deeper level of mobile VR immersion.

TipTalk - The Future of Wearable Communications Offer Greater Call Clarity

TipTalk is a remarkable new UX that enables people to listen to the sound from their smart devices, such as the Samsung Gear S2, without headsets or earphones, simply by touching their finger to their ear. This enhances the clarity of calls, enabling them to be taken in public, even in noise-sensitive or loud environments, such as a concert hall or building site – without the risk of being overheard.

Shaped like a watch strap, 'TipTalk' can be added to watches – analog or smart

- and sync with smartphones, enabling Text-to-Speech (TTS) functionality.

C-Lab: Empowering Samsung Employees with a Culture of Innovation

Since being founded in 2012, Samsung's C-Lab has fostered creative thinking throughout the company and supported more than 100 projects. Of these C-Lab projects, around 70 have already been completed, 40 of which are currently being further developed by Samsung's business units.

This year, nine of these projects have been identified as having an especially high potential. As such Samsung has helped these project teams launch fully-fledged external startups - with one example being the inventor of Tip Talk, Innomdle Lab, which launched as a new, independent company in August 2015.

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Industrial robot

Energy-Conscious Sensing for Mobile Motor Drives

> Jeff Smoot, CUI Inc.

Battery-powered mobile applications can now operate for longer per charge using an efficient new encoder technology

Until recently, autonomous robots and aerial drones have been more or less the sole preserve of large corporations and government agencies such as the military. Now, however, the technologies are becoming more affordable and a wide variety of low-cost commercial applications are hitting the market. Potential uses for civilian drones include surveying crops, inspecting power cables, monitoring the environment or studying wildlife. Forecasters suggest these markets could grow to several billion dollars within the next 10 years..

On the ground, affordable, agile, mobile robots are attractive for a variety of duties such as warehouse automation and autonomous agricultural applications. Moreover, small robotic devices are already providing help with domestic tasks such as vacuuming and lawn-mowing. In the future, smarter robots with more sophisticated movement and positioning capabilities could provide

further assistance in the home or in an office environment, including additional cleaning tasks, security, productivity, or delivery of goods.

So, after years of science-fiction fantasy, today's robotics applications really are going mobile. With mobility comes the need for battery-powered operation, and as markets develop and end users become more demanding, every milliamper-hour of battery energy will become increasingly precious. Careful management of a limited power budget is essential to enable the robot to do more work and operate for longer on each full charge. Moreover, as greater efficiency minimizes energy waste, engineers can exploit the opportunity to specify smaller and lighter batteries, thus realizing further improvements in operation and reducing application size. The mobile and aerial platforms now emerging incorporate large numbers of electric motors, not only for driving wheels or rotors, but also in various positioning mechanisms and actuators that often require motion control in multiple axes. Motor power consumption may range from several watts in a small positioning mechanism to tens of watts or sometimes

considerably more for traction or lift. Each motor has an associated driver/controller unit that also dissipates significant power. Minimizing the power consumed by each motor system liberates more battery energy for useful work, and the cumulative effect across multiple motors can deliver a valuable advantage in the quest to build robots that can go further on smaller batteries.

The choice of encoder, used to capture the position information the controller needs to execute the motor's vector-control algorithm, can have an important influence on the system's energy efficiency. In multi-motor systems, the energy savings achievable by selecting an efficient encoder can have an appreciable effect on the power budget. Among the encoder technologies available today, capacitive encoders can not only boost efficiency but also enable greater reliability, reduce maintenance, lower development costs and accelerate time to market.

Improving Motor Controls

Today, the most commonly used

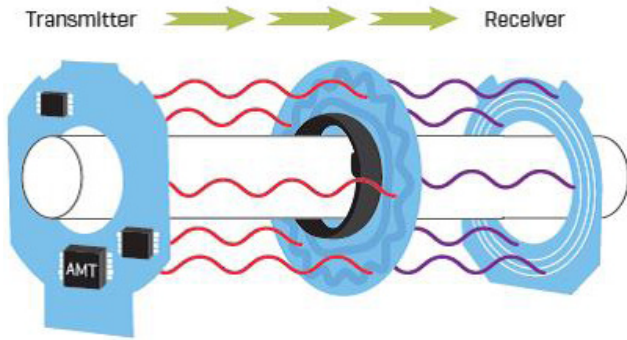


Figure 1. Optical encoder comprising LED sources, receiver and code wheel.

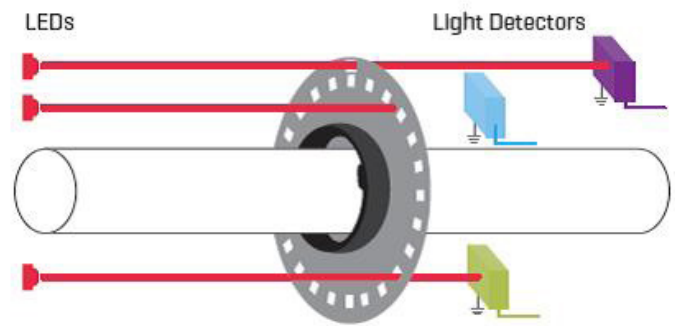


Figure 2. Capacitive encoder using the same principle as the digital Vernier caliper.

encoder types are optical encoders and magnetic encoders. An optical encoder comprises an LED-source and optical-sensor combination that detects light transmitted through or reflected from a code wheel mounted on the motor shaft, as illustrated in figure 1. Two LEDs positioned in quadrature enable detection of both motor speed and direction. A third LED may be used to monitor a single marking on the code wheel, to provide an indexing pulse to the motor-control system.

The encoder resolution, in terms of pulses per revolution (ppr) is dependent on the number of precision-spaced markings on the code wheel. Optical encoders can have very high resolution, but also suffer from several weaknesses. These include vulnerability to dust, grease or condensation, which can collect on the code wheel and cause missed or false readings. In addition, LED brightness will lessen over time and ultimately burn out, leading to failure that can only be remedied by replacing the encoder.

As far as energy efficiency is concerned, it is true that optical encoders draw relatively high current, which increases at higher resolution settings and with more complex output-signal formats. In fact, the current consumption can more than double from lowest to highest resolution. Some encoders can draw as much as 85mA at the highest resolution. This may not

sound important next to the power consumed by the motor, but at 5V and 85mA the encoder is consuming 0.425 watts. In a four-motor system the encoders alone are responsible for 1.7 watts. Reducing this drain on the battery's energy could allow the application to run other systems such as an on-board camera, sensors or small actuators for a considerable length of time.

Magnetic encoders provide an alternative that does not require line of sight and therefore are not vulnerable to errors due to contamination. In addition, magnetic encoders are able to operate even when immersed in non-conductive fluids such as gear oil. On the other hand, the positional resolution and accuracy is typically lower in comparison with optical encoders. Depending on the type of magnetic encoder, the maximum current can range from about 20mA to 160mA or more.

As a more competitive alternate to optical or magnetic technology, new capacitive rotary position encoders deliver valuable savings in power consumption for motor-rich applications such as mobile robotics. This type of encoder can also be aligned more easily and accurately when the motor is initially set up, which can yield further energy savings and may allow use of smaller, lighter, lower-power motors.

Capacitive Encoder Principles

Capacitive encoders use the same principle as the digital Vernier caliper, which is known to be reliable, cost effective, accurate and precise. CUI's AMT capacitive encoders comprise a fixed body and one moving element, as shown in figure 2. Each of these elements has two patterns of bars or lines that together form a variable capacitor configured as a transmitter/receiver pairing. As the encoder rotates, the movement of the element attached to the motor shaft modulates the output to produce a unique but predictable signal. The encoder contains an ASIC that interprets this signal and uses it to calculate the position of the shaft and direction of rotation to create the standard quadrature outputs. With the help of an onboard processor the ASIC and a microprocessor can work together to generate more complex outputs such as the commutation pulses necessary for brushless dc (BLDC) motors or serial outputs in absolute encoders.

+The capacitive operating principle allows the encoder to maintain accuracy in dusty or dirty environments, such as in a warehouse, on a factory floor, or in equipment deployed outdoors. Similarly to magnetic technology, capacitive encoders can also be submerged in non-conducting fluids such as gear oils. This can save expensive sealing of the code wheel enclosure and minimize demand for routine cleaning or replacement of the

Power in 4-motor system	Current at highest resolution	Operating voltage	Type	Encoder model
0.12W	6mA	5V	Capacitive	AMT10
1.7W	85mA	5V	Optical	Competitor 1
3.2W	160mA	5V	Magnetic	Competitor 2

Table 1. Encoder power consumption comparison

disk, which is often needed when using optical encoders. At the same time, the capacitive encoder provides equivalent or superior accuracy compared to other encoder technologies, with a typical accuracy value of 0.2 degrees.

Another advantage of the capacitive encoder is that resolution can be adjusted dynamically, whereas optical encoders are fixed such that changing the resolution requires fitting a different encoder. Adjustable resolution delivers advantages in development, by allowing engineers to make any changes to prototypes quickly and easily, and also aids production supply-chain management by allowing a single stock-keeping unit (SKU) to be used in multiple motor controls of different resolutions. The encoder housing is designed for easy assembly and supports multiple mounting options. In addition, multiple sleeve sizes are provided to suit commonly used motor shaft diameters.

Energy Savings and Efficiency Gains

The AMT encoders have very low current requirements, with some series drawing less than 10mA of current at the highest resolution. This corresponds to 0.2W in a four-motor system operating at 5V. Recall that optical and magnetic encoders can draw considerably higher current, thereby significantly increasing overall power consumption in a multi-motor system. Table 1 shows the power consumed purely by the encoders of a four-motor system such as a drone or mobile robot, comparing the performance of CUI AMT capacitive encoders with optical and magnetic alternatives.

Capacitive encoders are shown to offer a superior energy-efficient solution, and can give designers more freedom to manage the limited power budget in mobile and battery-

operated applications. Moreover, the capacitive encoder's operating current is independent of the resolution setting, which allows the encoder settings to be optimized without compromising application power consumption.

When paired to a brushless dc motor, capacitive encoders also allow faster and easier digital "zeroing" to align the encoder U, V and W signals with the rotor windings. To align an optical encoder, the rotor is usually locked in a known position and the code wheel is physically aligned. The motor is then back-driven while using an oscilloscope to verify correct alignment of the back-EMF and encoder zero-crossing points. This is an iterative process that can take 15 to 20 minutes, although small errors may remain. These errors prevent the motor running at maximum efficiency, thereby wasting precious battery energy. It is even possible that the inability to optimize alignment may force the engineer to over-specify the motor to ensure the desired torque.

In contrast, digital zeroing by programming the encoder using a software application ensures perfect alignment every time. The process takes seconds to complete and eliminates unit-to-unit variability. The motor is energized to lock the rotor in the desired position, and the encoder is set to zero at this position using a single command. No additional instruments are required. By allowing accurate, repeatable alignment, this technique ensures that the motor is able to run smoothly at optimum efficiency thereby delivering best performance and maximizing battery life in mobile applications.

Benefits Beyond Battery-Operated Applications

Market demands for better performance

may provide enough encouragement for designers of battery-operated appliances to take advantage of capacitive encoders to boost the efficiency of next-generation drive systems. On the other hand, the emergence of new regulations governing efficiency of electric motors show that regulators are taking a progressively tougher attitude toward the efficiency of electric-motor systems. These include the EU's latest IEC 60034-30-1 standard, which has introduced a new Super Premium Efficiency level for three-phase induction motors. In the US, the Department of Energy (DoE) will bring new legislation into force in mid 2016 that both increases minimum efficiency standards and includes types of motors not previously covered.

The DoE's analysis estimates that more than 70% of the total potential energy savings achievable through the new legislation can be realized through system-level savings such as improving component efficiency and using smaller motors where possible. Capacitive encoders can help towards using smaller motors, and allow designers to reduce the power draw of their entire systematic government agencies continue to focus more sharply on this area.

Conclusion

Affordable automation in the form of small mobile robots and civil drones could revolutionize activities such as manufacturing, distribution and asset management.

Low-power, precision capacitive encoders can deliver valuable savings in overall energy consumption for these motor-rich mobile applications, while also streamlining development and manufacturing as well as reducing maintenance overheads so helping to reduce ownership costs. As emerging government regulations indicate an increasingly strict attitude to the energy efficiency of motor systems, designers could find even more incentives to adopt this technology.



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Why Voice over Wi-Fi?

> CJ Platino, Alcatel-Lucent

You are working from home, making a presentation from your mobile phone to 50+ attendees and - BAM - the call drops! You quickly try to redial and there's NO SIGNAL! Why did you cancel your landline service? Wouldn't Wi-Fi® calling come in handy right now?

What is Wi-Fi calling? Voice over Wi-Fi (VoWi-Fi) or Wi-Fi calling is a completely wireless voice over IP (VoIP) service that complements voice over Long Term Evolution (VoLTE) deployments by providing expanded coverage and service continuity utilizing Wi-Fi networks. One of the features to come out of Apple's iOS 8 launch was the iPhone's support for Wi-Fi calling. While there are plenty of apps that allow phone calls over the iPhone's data connection, they don't work with the iPhone's native dialer. Since Apple's announcement VoWi-Fi has experienced a surge of interest from service providers such as mobile, fixed, mobile virtual network operators (MVNOs), cable operators, and wireless access providers, as well

as from subscribers.

Consumers have been using VoIP for a while, and voice and video calls have been transmitted over Wi-Fi in the form of over-the-top (OTT) applications such as Skype and Viber, which allow local or international calls at minimal cost. All it requires is data - a connection to the network. As consumers, we try to conserve as much data usage as possible so we can put it to use when it is really necessary like when we need to find directions, search for a recipe, or reconnect with an old friend on Facebook. And because we are such data hogs, we try to connect to free Wi-Fi whenever possible - in our homes, coffee shops, airports and hotels. With that being said, even though we do value data preservation, the quality of the service still stands as a priority.

Voice over Wi-Fi is exactly what the term means - using Wi-Fi to conduct capabilities such as calling and messaging. Although VoIP is not new, what makes it so special now?

What does VoWi-Fi have to offer?

1. VoWi-Fi offers the user the same

phone number and the native dialer of the phone without moving in between applications. No more swiveling in between applications in search of the best connection.

2. Better coverage - VoWi-Fi selects the best service across 2G/3G/VoLTE and Wi-Fi wherever you may be. Consumers can be confident that they are connected to the strongest connection available.

3. And the best part is the call continuity, delivering seamless transitioning between networks - no dropped calls.

According to research from North Carolina State University, 70 percent of users are in Wi-Fi zones over a 24-hour period and 65 percent of cellular traffic today can be offloaded using Wi-Fi. This data builds a further case for VoWi-Fi service.

Without a doubt there is a market for VoWi-Fi. A recent Alcatel-Lucent market research conducted by Penn Schoen Berland (PSB) shows that all four participating countries - Japan, United States, United Kingdom and Brazil - indicate a significant interest in Wi-Fi calling within their markets

(Japan 78%, U.S. 74%, U.K. 89%, Brazil 97%). The same research reflects an opportunity for operators to capitalize on VoWi-Fi to improve or expand their coverage area. Fifty-two percent of subscribers in Brazil believe VoWi-Fi offers a way to improve service in areas where they have poor or no cellular coverage.

Three out of four subscribers would use a secure VoWi-Fi service if it was available in their area. And many - from 38 percent in Japan to 82 percent in Brazil - reported that they would make more or longer calls over secure Wi-Fi connections. Brazil's high percentage is probably due to the fact that they still have a large base of prepaid calling customers and see VoWi-Fi as an opportunity to minimize the use of their plan minutes when calling over Wi-Fi. In addition, Japan may just be happier with their current service overall than the other countries. Or it is due to a larger base of unlimited calling plans and their passion for texting.

With regard to call continuity, a large majority of consumers in four countries expect their calls will smoothly and successfully move from their cellular network to Wi-Fi when Wi-Fi is available. Only a very small percentage expected their calls to drop when moving between Wi-Fi and cellular networks. This is really an important area to focus on for the operators. If handoffs between the networks are not smooth and calls are dropped, trouble tickets into the call center will be increasing. Consumers' perception (true or otherwise) is that the handoff is the operator's problem, not the public or home Wi-Fi network's error.

The perception of security is borderline and based on consumer experiences. Even though a high percentage of the consumers in the four countries believe there is enough security on the Wi-Fi networks (such as those outside of the home or workplace) for voice calls, security does continue to be a major concern. Consumers will not



use Wi-Fi when they have concerns regarding security. For an operator offering a secure connection using Wi-Fi, this will be a differentiator.

Introducing VoWi-Fi presents service providers with an opportunity to add value to their VoLTE launches and solidify their WLAN strategies. By incorporating VoWi-Fi into their network infrastructure, service providers can also offload aggressive video call traffic onto Wi-Fi to preserve capacity for LTE data services. This increases network efficiency and frees up capacity for more revenue generating services. It also gives service providers the opportunity to reduce costs for subscribers, thereby increasing customer loyalty and reducing churn.

As optimistic as all this sounds and to get the full benefits of VoWi-Fi, service providers must overcome some significant challenges:

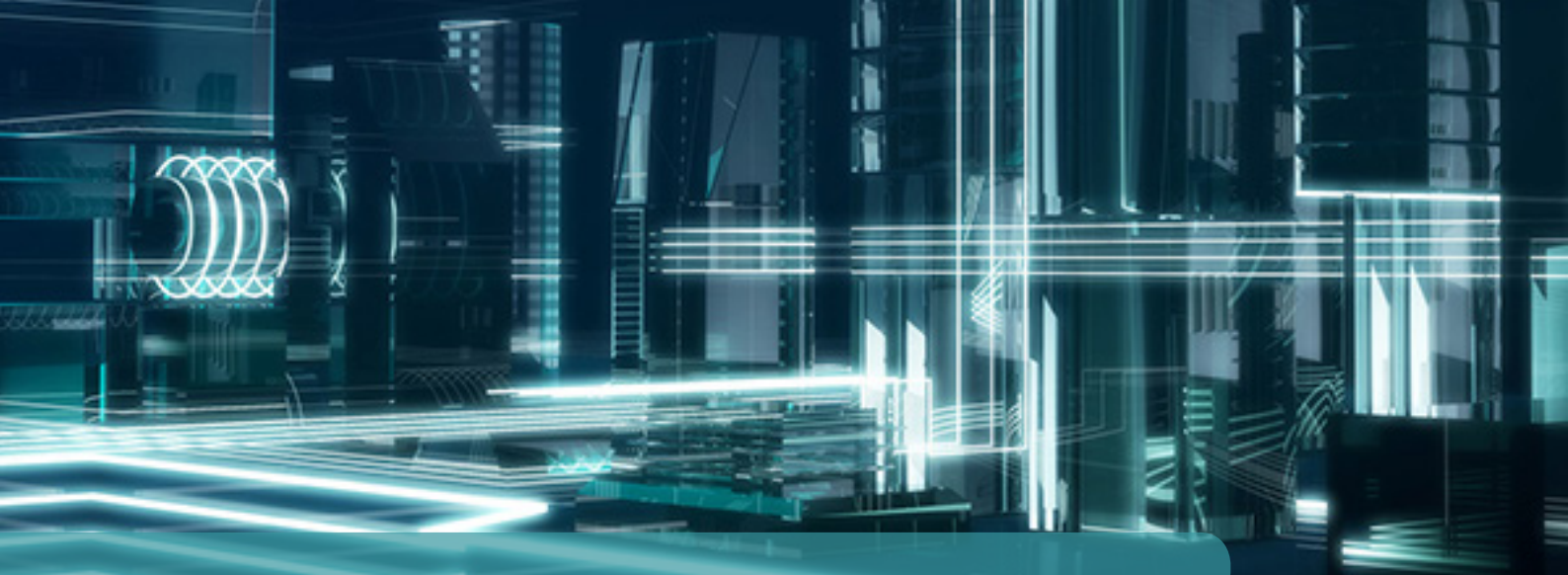
- **Service continuity:** Moving calls between 4G LTE and Wi-Fi can create service disruptions because of IP address changes. Possible impacts include the failure of call handovers between VoWi-Fi and VoLTE, the need to reinitiate enterprise VPN sessions, and disrupted file downloads.

- **Service consistency:** Customers expect consistency in service offerings across any network - whether LTE or Wi-Fi. Generally, network voice and

video are not securely accessible from Wi-Fi today. Therefore, content may be susceptible to snooping, and the core network of the service provider could be exposed to public IP access. By utilizing the service provider's inherent network capabilities to offer seamless service continuity and consistent experience, service providers have an opportunity to further differentiate their offering from the competition.

Alcatel-Lucent and Motive can help service providers make a smooth transition into VoWi-Fi. To learn more about improving the customer experience of VoWi-Fi, watch this interview by Yves Tjoens, Vice President Research & Development. Furthermore, join our on-demand webinar or read our bonus white paper to discover current market research findings and trends related to VoWi-Fi.

CJ Platino, Senior Marketing Manager, IP Platforms and Vivian Chan, Integrated Marketing Assistant, IP Platforms, Alcatel-Lucent



Why Use a DC Motor Controller?

> Maxon

For most applications involving a DC or BLDC (brushless DC) motor, it is advisable to use a motor controller, in fact if you are using a brushless (electrically commutated "EC") motor, then you have to use a controller to fire the correct phase winding at the right time.

For all DC motor brushed types here are the common reasons why:

Motor protection: Most modern controllers have the following protections; under-voltage, over-voltage, short circuit protection, current limit protection, thermal protection and voltage transients. Without these protections the motor is "exposed" to threats that will possibly result in permanent electrical or mechanical damage.

Speed control: All DC motors will lose speed as they are loaded and increase in speed when they are unloaded, in a linear fashion, according to their speed/torque gradient. For applications where a specific speed is required, with an unknown load (so a final speed cannot be calculated), or a fluctuating load (conveyor belt, pump, grinding tool, reel / converter, Cam) a controller is a must.

In the cam application in particular,

where the motor is operating as a "motor", for half the cycle and a "generator" for the other half, as the load "pushes" the motor a four quadrant drive must be used. This provides dynamic braking control, to ensure the motor remains under control and at the constant speed. It is not possible to achieve this with a simple supply or a simple single quadrant controller. The controller must also cope with the varying load, yet maintain the motor at a constant speed, by varying the voltage to the motor as the load changes to compensate.

In fan and pump applications the power curve follows the "square law" i.e. for an incremental increase of the speed the power increase is to the second power. Using a speed controller to lower the speed of the motor to meet the demands of a system, in place of constricting the flow from the pump or fan whilst running the motor at full speed will reduce the power consumption. That said there are losses across the controller, typically 1-5%, but these are minimal in comparison to the motor or the mechanics it is linked to.

Torque control: A DC motor's current is proportional to the torque delivery. Having control over the current to the

motor will govern its torque delivery. Without control of the DC motor torque/current, the motor is allowed to pull large currents that can often result in torques delivered in excess of what is mechanically viable for the system, leading to imminent failure (especially when gear with a large reduction ratio is used). Also failure can be in the form of burn out from stalling the motor, for instance when the mechanics are jammed. In this condition, unless the current is limited, the motor pulls the stall current. As you can see from the diagram, the stall current is far from the operating area of the motor and will cause a thermal failure in normally few seconds.

Summary

The benefits of using a controller.

- Electrical protection of the motor and subsequently the mechanics.
- Maintains constant speed, even when loads are changing.
- Dynamic response to changing system demands, even in a braking condition with 4 quadrant drive.
- Monitoring to evaluate machine performance / diagnostics.
- Energy saving.
- Accurate speed control.

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The Benefits of Transmission Grating Based Spectroscopy

› Thomas Rasmussen, Photonics in Copenhagen

During the past 15 years compact, low cost spectrometers have grown to a fairly large market size of hundreds of millions of dollars, with applications ranging from medical haemoglobin content analysis over accurate color determination of textiles to sorting of LEDs in large semiconductor manufacturing plants. The majority of these compact spectrometers have been based on the Crossed Czerny-Turner configuration with a reflective diffraction grating as the dispersive element separating the wavelength content onto a linear detector array. The success of this configuration is based on the facts that a) the configuration provides a compact and folded beam path and b) the reflective grating can be mass-produced at relatively low cost. In this white paper I will present two alternative compact spectrometer designs based on transmission gratings rather than reflective gratings and explain the distinct benefits of the transmission grating based geometries

- A spectrometer design that allows easy access to the detector plane and thereby provides larger flexibility for OEM integrators

- A higher throughput that enables higher sensitivity, shorter integration time, faster spectral scan, and/or lower light source power consumption

In all fairness, high quality transmission gratings have traditionally been expensive to manufacture and this is probably one of the key reasons that they have not really been considered for compact spectrometer designs. However, recent advances in manufacturing techniques at for instance Ibsen Photonics have led to sales prices in volume of holographically produced, fused silica gratings comparable to reflection gratings. So, combining the attractive benefits with a competitive price has led to a renewed interest in transmission grating based compact spectrometer designs.

Spectrometer configurations

Any spectrometer consists of three basic optical components:

- 1.a) collimating optics at the input
- 2.b) a diffraction grating
- 3.c) focusing optics that focus different wavelengths of the spectrum onto different pixels on the detector array

Both the Crossed Czerny-Turner (CCT) and the Transmission Grating based Spectrometer (TGS) include these three elements.

For the TGS, we will consider two basic designs which have slightly different characteristics – the Lens-Grating-Lens (LGL) using two lenses and a grating, and the Mirror-Grating-Mirror (MGM) using two mirrors and a grating.

Figure 1 shows the CCT, the LGL, and the MGM spectrometer lay-outs and schematic beam paths.

Some words on spectrometer comparison Before we dive into a comparison of reflection grating based with transmission grating based spectrometers, I would like to mention some important design consideration. The key parameters to consider when specifying (the optical

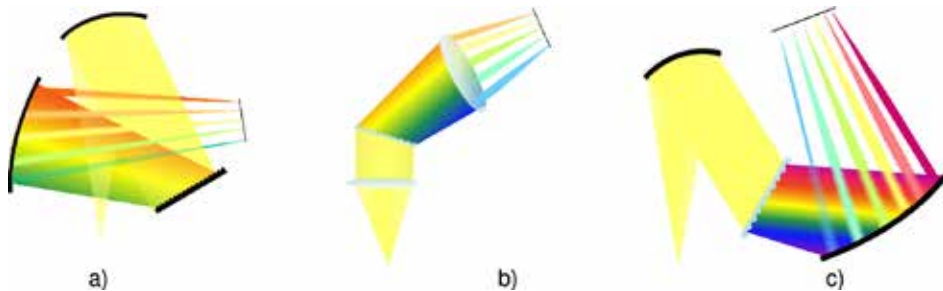


Figure 1: Spectrometer configurations: a) Crossed Czerny-Turner, b) Lens-Grating-Lens, c) Mirror-Grating-Mirror

part of) a spectrometer are:

- the wavelength range
- the resolution •
- the signal-to-noise ratio and stray light level requirements
- the dynamic range requirements •
- the linearity requirements
- the power coupling into the spectrometer (Etendue)
- the physical size of the spectrometer

A spectrometer can in general not be optimised for all parameters, so it is important to compare only spectrometers that are designed for the same application.

As an example let us consider why good resolution and high power coupling (Etendue) are opposite design criteria. The Etendue is a measure of how much light can be coupled into a spectrometer and is given by the area of the input slit times the numerical aperture squared. The resolution is defined as the Full Width at Half Maximum (FWHM) of the peak that the spectrometer measures when the input is a monochromatic light source. The minimum obtainable resolution of a spectrometer is equivalent to the spot size on the detector of a monochromatic point source at the entrance of the spectrometer. This minimum spot size is theoretically determined by the diffraction limited spot size that can

be obtained on the detector. However, in most compact spectrometers the minimum spot size is determined by aberrations in the optics inside the spectrometer (the lenses/mirrors and grating). So, in order to obtain a very good resolution the spectrometer should be designed with a near on-axis beam path to reduce aberrations as much as possible. This means that the opening angle of the spectrometer (the numerical aperture) will be very small and the input beam will have to pass through a small slit. Both the low numerical aperture and the small slit means that only a fraction of the input light to the spectrometer will be used as depicted in Figure 2.

In the following we compare spectrometers with the same Etendue (numerical aperture = 0.11 and infinitesimal small slit width) to make sure we compare apples with apples. Comparison of spectrometer configurations.

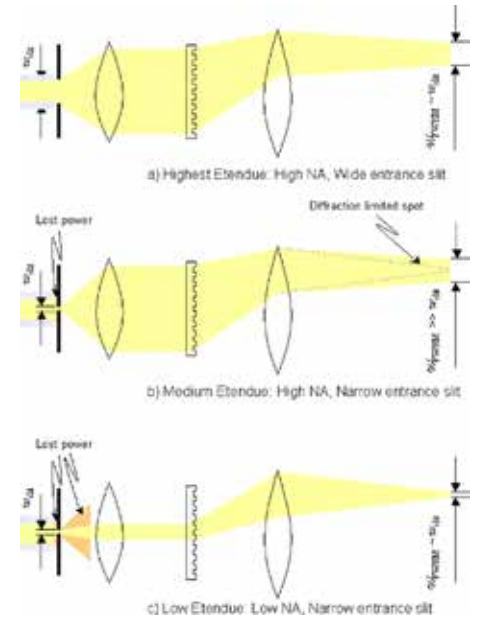


Figure 2: Illustration of the relation between Numerical aperture, entrance slit width and resolution for a spectrometer.

spectrometer configurations

Table 1 provides a rough comparison of the overall characteristics in terms of resolution, throughput, and detector flexibility for the three spectrometer platforms. The table has been compiled using data from realized Ibsen spectrometers like the ROCK VIS series as well as spectrometer data from for instance Ocean Optics USB4000 and Avantes Avaspec2048. As can be seen, all three platforms provide the same resolution relative to the wavelength range to be covered. This is a consequence of the fact that

Platform	Grating type	Minimum resolution (NA = 0.11)	Throughput λ_{st} to $2 \cdot \lambda_{st}$	Easy detector access
CCT	Reflective	~Range/700	~40 – 60%	No
LGL	Transmission	~Range/700	~60 – 90%	Yes
MGM	Transmission	~Range/700	~60 – 90%	No

Table 1: Comparison of Czerny-Turner with the two transmission grating based width and resolution for a spectrometer.

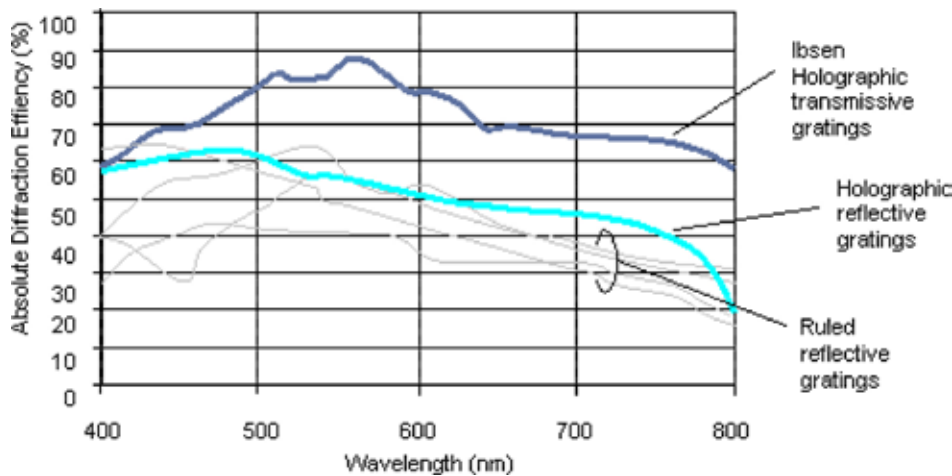


Figure 3: Diffraction efficiency of reflective and transmission gratings

the sizes of the beams relative to the optical components are roughly the same in all compact spectrometers and therefore the aberrations (determining the minimum resolution) are also roughly the same. Platform Grating type Minimum resolution (NA = 0.11) Throughput 1st to 2*1st Easy detector access CCT Reflective ~Range/700 ~40 - 60% No LGL Transmission ~Range/700 ~60 - 90% Yes MGM Transmission ~Range/700 ~60 - 90% No Table 1 clearly shows that the LGL and MGM platforms result in the highest throughput as will be further explained in the next section. The choice between the LGL and MGM platforms depends mostly on the following considerations. If high power collection from the sample (high Etendue) is more important than a small resolution, one should consider a high NA spectrometer. This is best obtained with the LGL design since the optics and beam sizes can easily be expanded without the risk that beams overlap. On the other hand, if an ultra-small resolution is required and power collection is less important the MGM might prove to be the best option because mirrors tend

to be less costly than lenses. Finally, in the UV range the MGM platform may be preferred over the LGL since UV-grade glass can be more expensive than mirrors.

Optical throughput

The choice between the LGL and MGM platforms depends mostly on the following considerations. If high power collection from the sample (high Etendue) is more important than a small resolution, one should consider a high NA spectrometer. This is best obtained with the LGL design since the optics and beam sizes can easily be expanded without the risk that beams overlap. On the other hand, if an ultra-small resolution is required and power collection is less important the MGM might prove to be the best option because mirrors tend to be less costly than lenses. Finally, in the UV range the MGM platform may be preferred over the LGL since UV-grade glass can be more expensive than mirrors. Figure 3 shows a comparison of typically used commercial diffraction gratings for the visible range (400–800 nm). As can be seen, the Holographic,

fused silica transmission gratings provide 50 – 100 % more absolute throughput over the wavelength range than reflective gratings. This difference is a consequence of several factors.

The reflective gratings are coated with a metal coating which can have a reflectance as low as 90%. In contrast transmission gratings are typically etched directly into a pure fused silica substrate and provided with an AR coating on the surface opposite to the grating. Thus, the inherent transmission is very close to 100% since there are no metal coatings and the AR coating can provide more than 98% transmission.

Furthermore, transmission gratings contain more design parameters than reflective gratings. The line shape of a transmission grating can be optimized in both the duty cycle and the etching depth as shown on Figure 4 a). Therefore, a transmission grating can be optimized to high efficiency over a broad wavelength range. In comparison, reflective blazed gratings have only one design parameter – the blaze angle and indicated on Figure 4 b). The grating line profile is determined by the blaze angle and line density and therefore any blazed grating will have almost the same diffraction efficiency as indicated on Figure 4 b). Maximum efficiency is naturally obtained at the blaze wavelength (the wavelength the grating was optimized for) but the efficiency falls off quite rapidly especially on the short wavelength tail.

Detector size flexibility

From the schematic drawings of the three spectrometer platforms in Figure 1, it is quite obvious that the unfolded LGL platform provides the best flexibility for changing detector since the detector is well separated from the rest of the optical components and beam paths. This actually also goes



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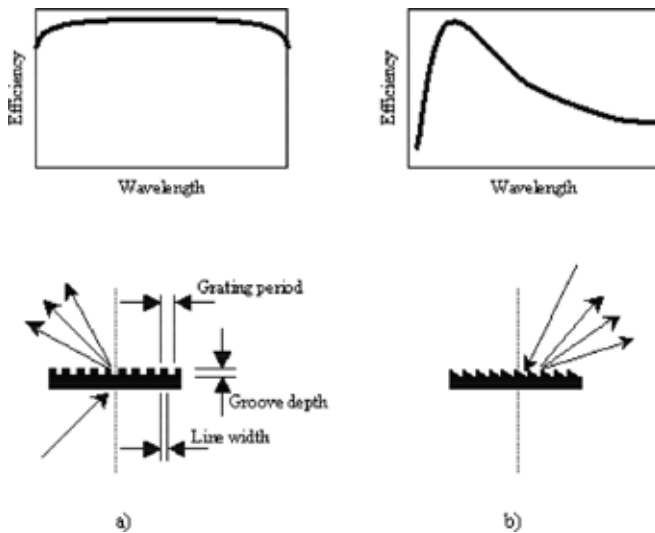


Figure 4: Geometry and typical wavelength dependent 1st order diffraction efficiency for a) transmission grating and b) blazed reflection grating.

for other components such as optical filters and apertures that are much easier to fit into the LGL platform than the CCT and MGM.

Temperature stability

The TGS platform uses a transmission grating made from pure fused Silica and is as such useable in a very wide temperature range. Furthermore, fused Silica has a very low thermal expansion coefficient, and therefore the thermal stability of a spectrometer based on such a grating is extremely good.

Application examples

In this section I will highlight some application examples where a transmission grating based spectrometer can provide important benefits. These examples are just meant as appetizers and I am sure you will be able to find many more examples within your own specific application area of interest.

Increasing battery life time for portable spectrometers
Handheld, battery operated spectrometers are becoming quite popular for various applications like fast color checks of textiles or

identification of chemicals in the pharma and security industry using Raman spectroscopy. Naturally, one of the key parameters for such devices is the battery life that is determined by the power consumption. By implementing an LGL system with an NA of 0.22 and a fused Silica transmission grating it is easily possible to obtain 4 times higher throughput than traditional CCT spectrometers on the market¹. This better sensitivity can be used to lower the power consumption of the light sources in the system.

Increasing productivity for in-line process spectroscopy Many industries are using spectrometers for quality/process control in manufacturing. One example is the LED industry where LEDs are tested on wafer level for their spectral emission properties. Obviously, there is a desire for such processes to run as quickly as possible. For the spectrometer this means running with as short integration times for the detector array as possible. Detector arrays allowing integration times as short as 1 microsecond do exist, but in most cases the detector will not collect enough light in such a short time period to measure anything but noise. However, with a high NA

spectrometer using a high throughput transmission grating the integration time can easily be shortened by a factor of 10 - 20 times over traditional spectrometers.

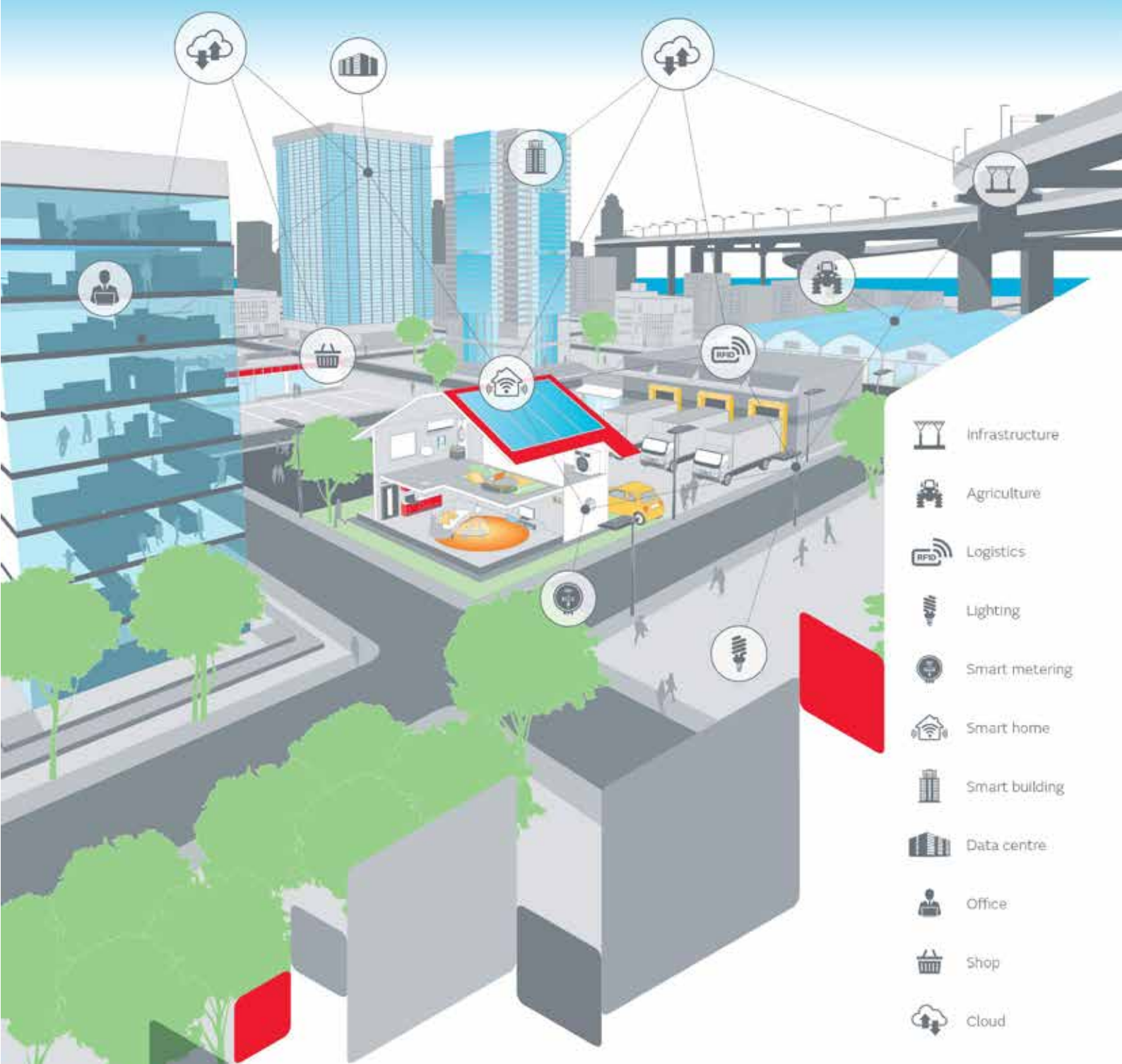
Summary In this white paper I have reviewed two generic, compact spectrometer designs based on transmission diffraction gratings, and described the distinct benefits that such spectrometers have over traditional reflection grating based spectrometers.

In general, transmission grating based spectrometers (TGS) should be considered for spectroscopy applications and instruments where one or more of the following requirements are important

- Low light levels
- Short integration time/fast spectral scans
- Access to detector for OEM integration
- High thermal stability

With recent developments in grating manufacturing, prices of transmission grating based and reflection grating based compact spectrometers are in the same range. So, the choice of spectrometer platform really has to be done based on technical requirements. Hopefully, this paper has opened your eyes to the fact that the optimum choice for your next spectroscopy platform might very well be a transmission grating based one.
1 Obtained from a direct comparison of the ROCK VIS RSV-300 and Ocean Optics USB2000

About the author Thomas Rasmussen is a Ph.D. in Integrated Optics from the Technical University of Denmark and VP of Business Development, Sales, and Marketing at Ibsen Photonics in Copenhagen, Denmark.



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Europe has an Opportunity to Catch Up on the Mobile Front

> Wassim Chourbaji, Qualcomm

The European Union's Digital Single Market plan offers an opportunity to foster the investment-friendly environment for mobile network operators and technology companies needed to bolster wireless commerce across the region and prevent the EU from falling further behind other regions in the use of wireless tech.

That is the conclusion of a new white paper from the French consulting firm IDATE, which examined the level of mobile revenues, investments and mobile usage in the so-called EU5 (France, Germany, Italy, Spain and the U.K.), the United States, Japan and South Korea. The study was in part funded by Qualcomm and Ericsson.

The IDATE report touches on an important set of policy questions for the European Union, which is taking major steps toward creating what it calls a Digital Single Market

(DSM) that depends on reliable, cutting-edge wireless technology and infrastructure.

"More than ever, Europe needs top-class connectivity. This will ultimately determine the success of the Digital Single Market," Günther H. Oettinger, Commissioner for the Digital Economy and Society, said earlier this year. "We therefore need rules that underpin sustainable, market-based, high-performance fixed and wireless broadband infrastructures for 2020 and beyond. And it is not just about the telecoms sector; every part of our economy and society has a vital stake in these issues."

But the current economic state of mobile technology in Europe could place those ambitions at risk. In Europe, there is simply not enough investment in mobile communication infrastructure to keep up with the rest of the world, let alone deliver top-

class connectivity. The reasons aren't complicated:

While the populations of the EU5 and the United States are roughly the same, and mobile revenue was roughly equal in 2008, over the next six years U.S. mobile revenue grew steadily and European mobile revenue declined. Average mobile revenue per user also decreased in Europe at that time while rising across the Atlantic—at least in part because European Union and national regulators on the Continent made efforts to transfer the economic benefits of mobile to end consumers. And while the evolution of mobile revenue followed the growth of private consumption in Japan and South Korea, and exceeded consumption in the United States, it declined significantly in the EU5.

"This indicates that Europe dedicates an ever smaller fraction of private consumption to mobile services, even

though consumers benefit from much improved services," IDATE says. "In other regions consumers maintain or even increase their expenditure on mobile network services, in relation to their overall consumption."

The consequence is that European mobile network operators' investment in infrastructure to update their networks and deploy new technologies—has been almost flat even as such capital expenditures per capita grew sharply in the United States, Japan and South Korea.

"This reflects the fact that MNOs are large corporations who cannot commit to investments that are not correlated to increasing revenues. In other words, MNOs worldwide are subject to the same constraints set by investors," IDATE says. "EU MNOs are investing as much as they can, but their declining revenues simply prevent them from keeping up in the innovation and investment race with other regions."

But Europe's wireless future is brighter than it seems: The cause of the present situation is known and can be fixed. The root of the problem lies in the EU telecommunication market regulatory framework that was adopted in the early 2000's.

"The relative decline of revenue in recent years for [European] Mobile Network Operators (MNOs) appears to be due to policy decisions aimed at maximizing short-term consumer benefits at the expense of long-term investment incentives," IDATE says. "The data suggest this strategy is backfiring. The lower revenues in Europe have deterred MNOs from investing, which in turn delays the roll-out of networks and the adoption of



services by consumers. Consequently, the unit costs of some services to consumers are higher than in other regions."

But that framework is currently under review as EU officials stake out an ambitious effort to make Europe a technological leader. And the findings of the IDATE study suggest the effort would pay off.

"Investment in mobile communication infrastructure creates local employment and significantly contributes to growth, as an enabling factor for the digitalization of other industries," IDATE says.

So with the EU making the DSM a top priority and politicians acknowledging the importance of investment and top-class connectivity there is hope the new regulatory framework will address these issues. IDATE expresses optimism that Europe can find ways

to "put investment at the heart" of its regulatory strategy.

"The Digital Single Market initiative is an opportunity to adopt a pro-investment and pro-innovation mobile regulatory framework, enabling Europe to lead in mobile communication through its attractive market size, growth potential and technology expertise," IDATE says. "The findings and data of this study suggest consumers, businesses and individual European economies will benefit from policy makers' adoption of a balanced regulatory framework that encourages investment in mobile infrastructure and technologies."

Wassim Chourbaji is vice president and head of Qualcomm Government Affairs for Europe, the EU and MENA.



DiACardio Ultrasound of the Heart

› Shirley Mayzlish, *New-Tech Europe Magazine*

DiACardio, a Software company, revolutionizes the practice of evaluating “Ultrasound of the heart” (“Echocardiography”). Ultrasound devices are being used increasingly in many types of Point-of-Care locations, including cardiology departments, emergency rooms, rural medical facilities, and even ambulances. In the near future, even GPs will begin using ultrasound devices. The medical staffs at these Points of Care locations find it difficult to evaluate the images on the screen.

Coronary artery disease (CAD), the most common cardiac disease, is caused by atherosclerosis in the coronary arteries, a condition which causes a decrease in the blood supply to the heart muscle. CAD may cause an impairment of the cardiac muscle function that significantly affects the left ventricular systolic function that performs as the main pump of the heart. Accurate evaluation of

the left Ventricle (LV) function and other parts of the heart is crucial for correct patient diagnosis, treatment decisions and prognosis assessment. Ultrasound imaging of the heart, or Echocardiography, is the most widely used imaging technique for evaluation of cardiac heart function. Today, approximately 15 million echo procedures are carried out worldwide each year.

Over the past few years, echocardiography systems have begun to offer better and faster imaging capabilities, coupled with measurement tools intended to assist with evaluation of heart function. However, these tools are manual or semi-automated, and are therefore slow, cumbersome to use and error-prone. For example, the evaluation of LV function is done by subjective “eyeballing” (just by looking) of the LV, or by manually tracing the LV borders on manually-selected frames. Both

techniques require the evaluator to draw on vast echo experience in order to achieve an accurate evaluation.

Manual tracing is both insufficiently accurate and time consuming (taking 15-30 minutes to perform). Even the semi-automatic measurements now provided on high-end machines have not proven to be sufficiently reliable. Using the tools currently available are limited in function evaluation. Some of the other parameters such as movements of ventricular wall segments (17 singular areas), can only be performed on most machines through “eyeball”-based evaluation. In contrast, DiACardio’s technology enables a fully automatic dynamic analysis of the heart in action, including full automation of both tracing and analysis processes - performed in several seconds via a single click of the mouse - across the complete heart cycle. This is a revolutionary improvement compared

LVivo SG



LVivo EF



with the conventional evaluation method, which use manually-selected still images as the basis for calculation. The ease and speed of DiACardio's tools also make it practical to carry out short-cycle, repeatable measurements of patients associated with the risk of the cardiotoxicity effect that may be caused by chemotherapy. DiACardio's tools are able to analyze patient data online within the echo unit and/or offline on the PACS's DICOM video file, taking into account the dynamic nature of the heart. DiACardio technologies are protected by patents (currently at the national phase).

Road map

Our target customers are Ultrasound manufacturers, Healthcare IT (PACS) companies and other medical imaging software companies. We sell our software tools on an OEM basis as an integrated plug-in solution.

R&D Road map -During 2016 we intend to finish the development of additional 4 cardiac automated tools, obtain FDA/CE for LVivo SG and publish academic articles.

M&S road map- we intend to increase

dramatically the marketing and sales of LVivo platform and detect potential partners for our current and upcoming tools.

Financial round map - until the end of the first half of 2016 we intend to close an A Round of investment of \$5M-\$10M that will allow us to expand our technology to other medical imaging platforms and application

Awards

DiaCardio won 1st place at the ICI innovation awards, just few months after winning 1st place at GIA2015 in China. DiACardio, a Software company, revolutionizes the practice of evaluating "Ultrasound of the heart" ("Echocardiography"), by evaluating the heart performance automatically, at the click of a mouse, in just a few seconds. DiaCardio's software can easily be integrated into any ultrasound unit and healthcare IT (PACS) system. The software is FDA cleared and CE approved and initial sales have been obtained. Co-founders, Hila Goldman-Aslan, the company's CEO and Co-Founder and

Dr. Noah Liel-Cohen M.D., Head of the Echocardiography Unit at Soroka University Medical Center in Beer-Sheva, presented DiaCardio. The ICI is a global innovation in cardiology conference held for the 20th time. This time a specific focus was on revolution of digital/mobile health technologies. Each year more than 70 applications from 22 countries around the world send their application. Only 10 selected companies are invited to present. DiACardio was evaluated by expert panel judges based on 3 principal criteria: the impact on patient care, the impact on novelty and business potential. "Winning this award is a recognition from the cardiology community of our ground-breaking technology that we have developed at DiACardio" said Hila Goldman-Aslan, the company's CEO and Co-Founder. Part of winning, DiACardio also gets the chance to present at Europe's largest cardiovascular conference - EuroPCR 2016 (Paris).



Making Quick and Easy Measurements of Cables in the Field with FieldFox

> Tom Hoppin, Keysight Technologies, Inc.

Today, engineers and technicians typically experience multiple cable testing challenges in the field. Keysight Technologies recently introduced two innovative measurement options that make its FieldFox handheld analyzers the industry's most comprehensive and effective cable test solution to meet these challenges head on.

Common Cable Test Challenges

Cables (e.g., waveguide, coaxial and twisted-pair) are by far the most widely used components in modern RF and microwave systems like wireless and data communication, satellite communications and RADAR. They are also the leading cause of failure in these types of systems. That's why their proper maintenance and using the right tool for testing in the field is so critical.

The typical cable test process starts by determining whether or not a cable is faulty or performing outside the desired specification. If it is, the failure's physical location along the cable must then be located. Once the

location is determined, the next step is to understand what the error is and repair it. During troubleshooting and maintenance, engineers and technicians can identify a fault's location with Return Loss (RL) and Distance-to-Fault (DTF) methods, but they are unable to determine the cause or type of fault, making it difficult to repair. In many cases, the failures (e.g., loose or damaged connectors, water ingress or broken solder joints) can't be seen by just looking at the cable.

Also problematic is that measuring cable performance has traditionally required engineers and technicians to transport a cable and antenna analyzer, network analyzer, signal generator, and power meter into the field. That process is all the more complicated when the cables are used in systems located in hard to reach or even potentially hazardous environments. Once in place, the instruments would need to be correctly set up for testing. While effective, the process is error prone and leaves the instruments subject to accidental damage.

Further complicating matters,

traditional vector network analyzers (VNAs) have difficulty making precise and repeatable high-loss measurements for in-situ microwave cables where test ports are long distances apart.

Easier Cable Measurements with FieldFox's Enhanced Cable Test Suite


FieldFox's new Time Domain Reflectometry (TDR) cable measurement option (Option 215) complements the analyzer's current RL and DTF measurements. The RL measurement capability exposes mismatch of cable connections, while the DTF capability indicates the location of any faults or poor connections along the cable. The new TDR option provides engineers with new insight to help measure the impedance changes along the cable and identify the cause (type) of specific faults, such as short, open or water ingress. To date, FieldFox is the only handheld analyzer that can perform RL, DTF and TDR measurements in the same instrument.

FieldFox's TDR or step measurement



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Samtec is the only interconnect company in the world offering full channel high speed solutions: from the bare die to an interface 100 meters away, and all insertion points in between.



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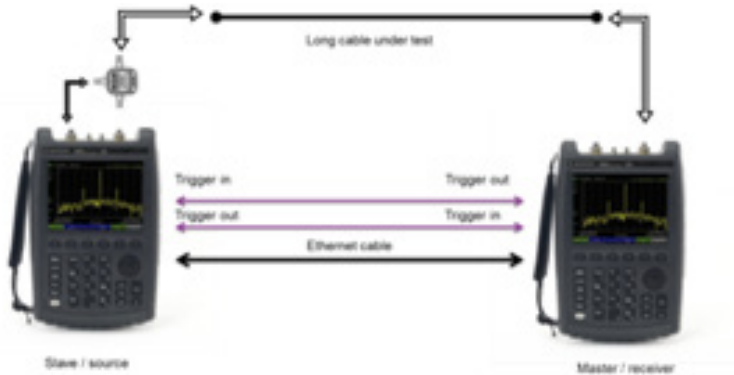


Figure 1. FieldFox can be easily upgraded with the new ERTA Option to make highly accurate cable loss measurements.

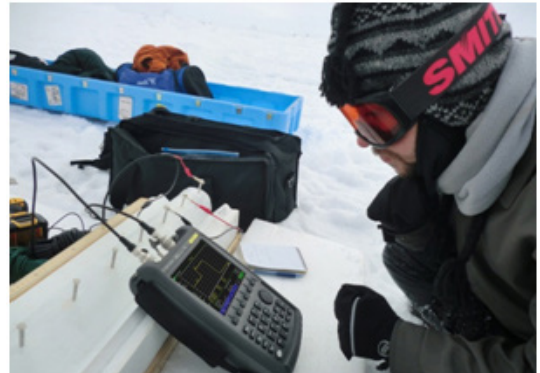


Figure 2. FieldFox provides the industry's most comprehensive handheld cable test solution that is precise enough for the lab and rugged enough for the field.

captures data using the same process as DTF. However, unlike DTF, the measurement is used to characterize the type of fault, including inductive or capacitive discontinuities. It does so by observing reflected waveforms from a step propagating through a cable. By analyzing the duration, magnitude and shape of the reflections, the nature of the impedance variation in the cable can be determined. FieldFox's TDR measurement mode is only useful for cables that operate down to DC (e.g., two-conductor transmission lines).

When measuring a waveguide, FieldFox utilizes a bandpass time-domain transform technique. This is necessary because of the waveguide's narrowband response, which restricts the type of time-domain measurements that can be made. The bandpass measurement is ideal for frequency limited DUTs; however, it only provides the location of the fault. Determining the type of discontinuity, such as inductive, capacitive or resistive, is not possible.

Another new FieldFox option, Extended Range Transmission Analysis (ERTA, Option 209), helps overcome the challenges of measuring long microwave cables in the field. This portable solution measures scalar insertion loss of in-situ microwave cables with long distances between test ports, and makes it possible to access both ends of the cable or waveguide simultaneously.

Using a scalar analyzer as the signal source with a broadband detector or power sensor to measure cable loss can also be a slow process; one that is prone to external interference and does not offer high levels of dynamic range. Deploying a benchtop solution in the field is also non-ideal due to its large size and cost.

With ERTA, two FieldFox analyzers are deployed at each end of the measured cable. One analyzer acts as a source, while the other acts as a receiver. Both instruments are step synchronized with hardware triggers. By taking advantage of Keysight's proprietary InstAlign spectrum analysis technique, engineers and technicians can use this configuration to make very accurate cable loss measurements without calibration and warm up (Figure 1). It also offers industry's best dynamic range for long, lossy cable measurement. This option can also be configured with frequency-offset to measure devices such as mixers and converters.

FieldFox: Offering the Most Comprehensive Handheld Test Suite

In addition to FieldFox's new TDR and ERTA options, the analyzer provides a number of additional measurements; all of which give FieldFox the most comprehensive test suite in a single handheld instrument (Figure 2). These additional measurements include:

- RL, VSWR, and DTF for broadband and band-pass cable subsystems
- S-parameter, group delay, phase, Smith chart, and time-domain analysis
- Frequency converter conversion gain/loss
- Mixed-mode, 1-port S-parameter, time-domain analysis

Real-World Examples

To better understand how FieldFox's time-domain measurement techniques help identify the location and cause of cable faults, consider the example of two short 50-ohm coaxial cables connected together with a coaxial adapter. The shorter cable is connected to port 1 on FieldFox, while the second cable is terminated in a 50-ohm load. As shown in Figure 3, a DTF measurement of the cables is very helpful in locating any discontinuities. Notice that markers are placed at the three peaks in the measured DTF response. The peaks represent the magnitude of single reflections from a discontinuity. Marker 1, which represents the interface between the calibrated FieldFox and the first coaxial cable, reports a distance of 0 meters. Marker 2, located at the adapter between the two cables, reports a distance of 4 meters. It also indicates that the length of the first cable is 4 meters. Marker 3, located at the 50-ohm load, reports a distance of 13.8 meters. With this measurement, the length of the second cable can be

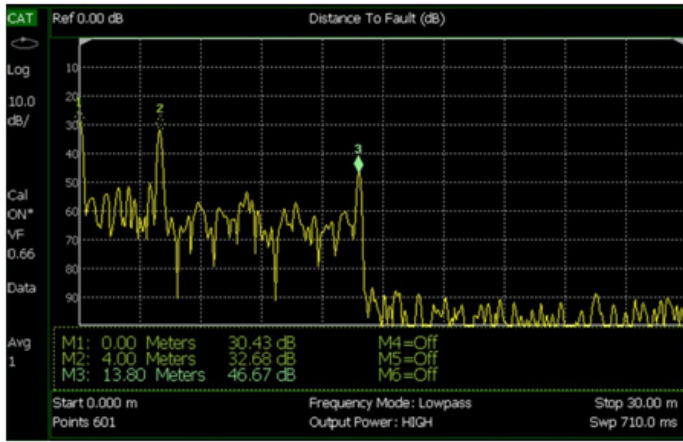


Figure 3. Shown here is a FieldFox DTF measurement for two connected coaxial cables terminated in a 50-ohm load.

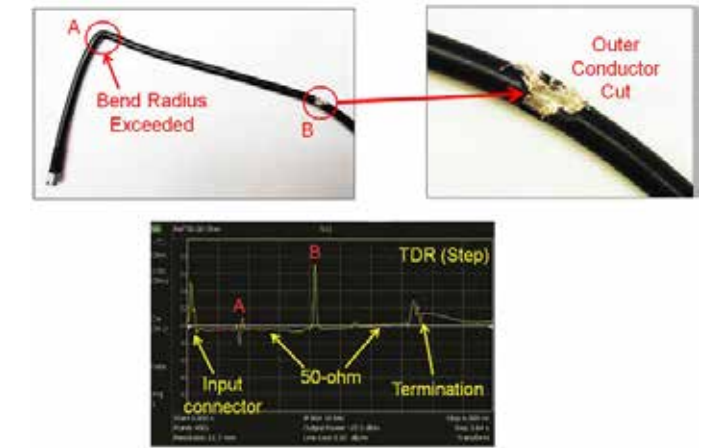


Figure 4. The top left-most and right-most images, A and B, respectively, depict damage in a coaxial cable. The bottom image, 2C, is the result of a TDR measurement of the damaged cable using the FieldFox TDR option. FieldFox can identify various types of discontinuities in TDR mode, including: $R > Z_0$, $R < Z_0$, inductive, and capacitive

calculated (e.g., 13.8 m - 4 m = 9.8 m). The noticeable drop in measured amplitude to the right of the 50-ohm load signifies the end of the cable. As this reflection measurement represents two-way signal paths, FieldFox properly adjusts the marker values and x-axis formatting to the appropriate one-way lengths.

Now, consider a coaxial cable that has been damaged in two areas (Figures 4A and 4B). Fault A is a bend in the cable that has exceeded the manufacturer's specification for minimum bend radius of 1-inch. The bend at Fault A is well below this radius, creating an undesired reflection from this part of the cable. Fault B is a cut through the outer conductor of the cable. The braided shield has been partially removed, exposing the inner dielectric of the coax. Both faults can be examined using the DTF and TDR modes on FieldFox; however, only the TDR measurement will characterize fault type.

Figure 4C shows the measurement for the damaged cable with FieldFox in TDR mode. As can be seen from the TDR response, the cable impedance is generally 50-ohms across most of the time-domain response until

a discontinuity is encountered. Discontinuities occur at the input connector, the bend at fault A, the cut at fault B, and the 50-ohm termination at the end.

Of all discontinuities on the cable, the cut at fault B has the largest mismatch. This is demonstrated by the magnitude of the associated peak. The cut on the TDR response has a single peak in the positive direction, indicating an inductive mismatch. This is typical for cuts in the outer conductor of a coaxial cable. Generally speaking, if the cable terminated in a load with a resistance smaller than the characteristic impedance, the TDR response would show a step in the negative direction. If the load resistance were larger than the characteristic impedance, the TDR response would show a step in the positive direction.

Summary

Cable measurement in the field can be tricky. Determining that a cable is faulty is just the first step in the process. Engineers and technicians then need to identify the fault's physical location and its cause. This is accomplished using various

time-domain techniques. FieldFox's comprehensive suite of cable test measurements, including the new TDR and ERTA options provide the ideal solution for testing any cable system in the field. FieldFox's DTF and TDR time-domain measurements identify fault locations and causes in coaxial cables, while its bandpass measurement finds the physical location of faults in a waveguide. Using FieldFox, today's engineers and technicians now have a faster, easier way to test cable systems in the field.

About the Author

Tom Hoppin is an application consultant on contract to Keysight Technologies. Tom started his career as an electronic aviation technician in the U.S. Marine Corps. He joined Hewlett-Packard after his service ended in 1973. Through the years he has held a number of engineering and management roles at HP/Agilent and now Keysight, focused on test system design and spectrum analysis. Tom retired in 2009. He has since returned to Keysight as an application specialist for its RF and Microwave Handheld Analyzers.



Power Management Tips for Energy Harvesting Systems

> European Editors

Designing a power management system for a source that harvests energy from the environment can be challenging. These sources, from solar cells to vibrational energy, and even power from thermal differences, are all small amounts of power that vary unpredictably. This creates a significant challenge for a power management system that has to run efficiently and provide a steady output. The voltage and power requirements of the sensors and processors in the node being powered have dropped, so using an energy harvesting source has become more practical; but there are still different ways to manage these power sub-systems.

It is obviously necessary to optimize the design for the low average power in the system, but it is also necessary to understand the lower and upper limits of the energy harvesting source. A buck/boost converter will have a

lower limit below which the power stage may either shut down or not start, interrupting the operation of the system. This also means the power up sequencing must understand implications of when to power each device along with other devices so that the power drain does not push the power conversion stage below that lower limit.

However, it is also necessary to be aware of the potential peak power to avoid overwhelming the additional energy storage element such as a capacitor or battery.

Using hardware timers and interrupts rather than software reduces the overall power requirement, and having status indications and alerts implemented across the systems are essential so that power management choices can be made with the right information.

Isolating all the loads in the system and making them switchable gives the

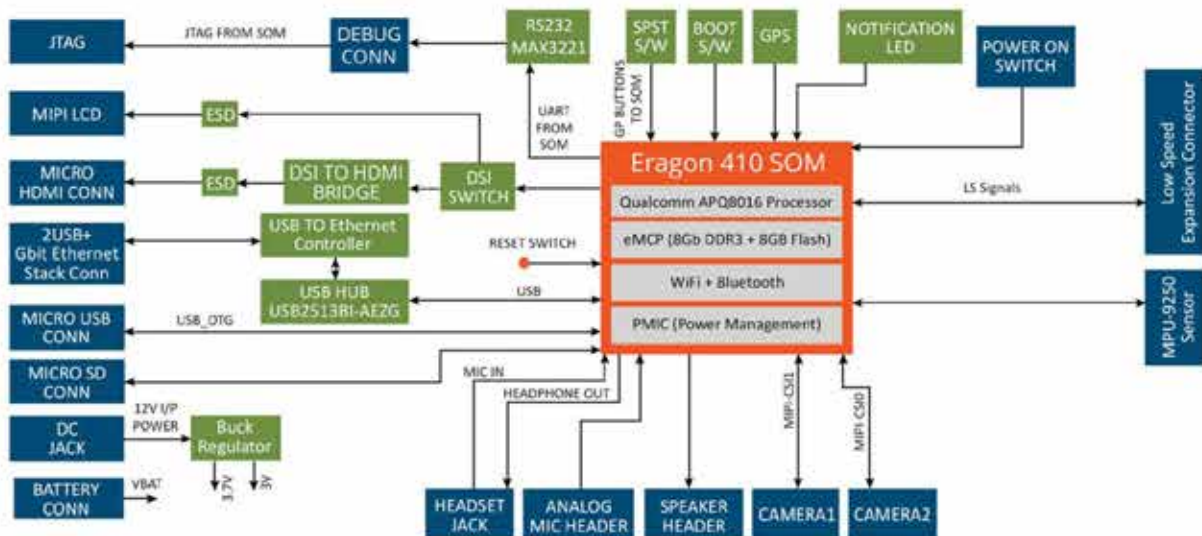
power manager more opportunities to avoid problems and optimize the performance. This also helps isolate any devices that are consuming too much power.

A buck/boost converter is a suitable architecture for harvesting energy from movement or vibration via a piezoelectric transducer. A protective shunt at the input allows the power manager to accommodate a variety of different piezoelectric elements, which can have short-circuit currents around 10 μ A.

An example of a typical power manager for a piezoelectric source is the LTC3588 from Linear Technology. This is designed to interface directly to a piezoelectric or alternative power source, rectify a voltage waveform and store the harvested energy on an external capacitor, as well as bleed off any excess power via an internal shunt regulator.

It integrates a low-loss full-wave

eragon 410



Five Years Out

bridge rectifier with a high efficiency buck converter that is optimized for high output impedance piezoelectric sources, and maintains a regulated output voltage with a high efficiency synchronous buck regulator.

An ultralow quiescent current undervoltage lockout (UVLO) mode with a wide hysteresis window allows charge to accumulate on an input capacitor until the buck converter can efficiently transfer a portion of the stored charge to the output, and the buck converter turns on and off as needed to maintain regulation.

Solar power

An example of the importance of knowing the lower limit comes with the buck converter, which starts when the input voltage moves above the UVLO rising threshold to transfer charge from the input capacitor to the output capacitor. The 1V UVLO hysteresis window has a lower threshold of around 300 mV above the selected regulated output voltage, and this prevents short cycling during the buck power-up.

When the input capacitor voltage is depleted below the UVLO falling threshold, the buck converter is disabled and the extremely low quiescent current of 450nA allows energy to accumulate on the input capacitor from the piezoelectric source. The hysteresis is determined by an algorithm that controls the output through internal feedback from the voltage sense pin.

The four output voltages in the LTC3588 show the lower voltages that the energy harvesting source is expected to power, from 1.8V, 2.5V and 3.3V to 3.6V, and these are pin selectable with up to 100mA of

continuous output current. An input protective shunt set at 20V enables greater energy storage for a given amount of input capacitance.

The low-loss bridge rectifier has a total drop of about 400mV, with typical piezo generated currents of around 10µA, and the bridge is capable of carrying up to 50mA. All of this allows the charge in the capacitor to smooth out the intermittent nature of the source of power and provide the required voltage to the sensor or controller.

Batteries are often used to collect the charge from the energy source, but these also need to be protected from overcharging or undercharging. The MAX17710 from Maxim Integrated can manage the poorly regulated energy harvesting sources with output levels ranging from 1µW to 100mW. For a 0.8V harvest source and a 4.1V cell, the device can deliver over 20 mA (80mW) for as long as the harvest source can support it.

To do this, the device includes a boost regulator circuit for charging a lithium battery from a source as low as 0.75V, while an internal regulator to protect the cell from overcharging and an internal voltage protection prevents the cell from over discharging. The selectable output voltages from 1.8V through 2.3V to 3.3V are regulated using a low-dropout (LDO) linear regulator.

An increasingly popular source for energy harvesting is a solar cell, and there are several different ways to manage the power coming from such cells. These different approaches are freely available through digital libraries, and can be tested out on a range of evaluation boards.

The digital power software libraries

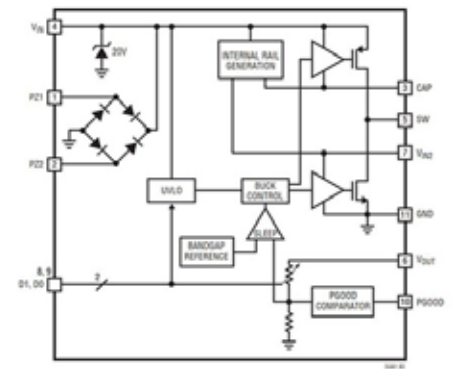


Figure 1: The quiescent current undervoltage lockout (UVLO) uses a hysteresis algorithm to protect the power delivery in a piezoelectric energy harvesting system.

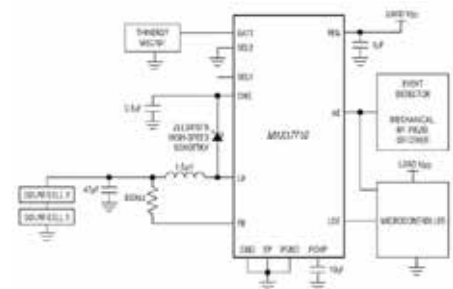


Figure 2: The MAX17710 integrates a low-dropout regulator to protect a capacitor or lithium battery cell from undercharging.

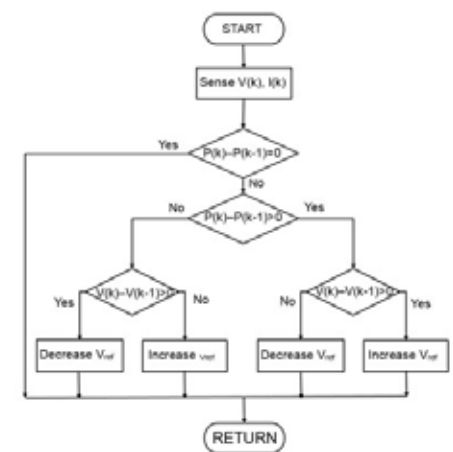


Figure 3a: The basic P&O algorithm (Source: MATHWORKS)

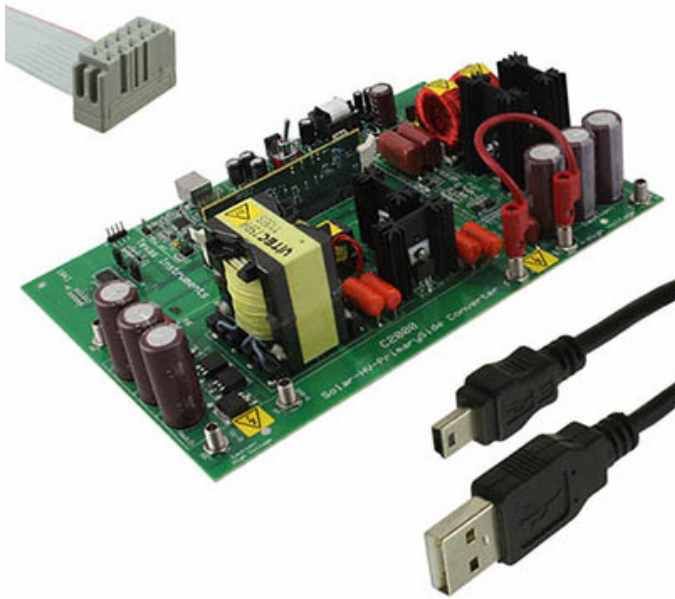


Figure 4: The Solar Micro Inverter development kit from Texas Instruments allows digital libraries of MPPT algorithms to be evaluated.

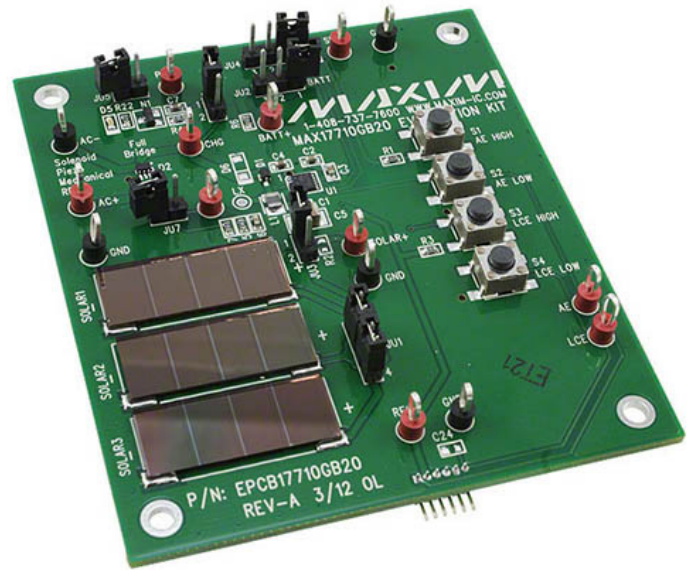


Figure 5: The MAX17710 evaluation board allows developers to charge a protected lithium battery cell from an energy source such as a solar cell

for solar cells provide code-optimized building blocks to implement a variety of power topologies and algorithms such as maximum power point tracking (MPPT) and Software Phase Locked Loops (PLL) to help design optimized solar inverters to power equipment. There are three basic MPPT algorithms that can be easily tested out in a microcontroller. The most popular is the perturbation and observation (P&O) algorithm, also called the 'hill climbing method', where the controller moves, or perturbs, the voltage coming from the array by a small amount and measures power. If the power increases, the voltage is changed a little more in the same direction until

A third MPPT approach is the fractional open-circuit voltage: This algorithm is based on the principle that the maximum power point voltage is always a constant fraction of the open circuit voltage. The open circuit

voltage of the cells in the solar cell is measured and used as an input to the controller. These power management algorithms can be tested out on the Solar Micro Inverter development kit from Texas Instruments, which is based on the Piccolo TMS320F28035 microcontroller and serves as a complete grid-tied solar micro inverter. The topology of the micro inverter consists of an active clamp fly-back DC/DC converter with secondary voltage multiplier, maximum power point tracking (MPPT), and a grid-tied DC/AC inverter. The single Piccolo controller handles both power stages and the execution of the MPPT algorithms. Other evaluation boards, such as the MAX17710, allow the different topologies and algorithms to be tested, varying the energy storage elements and the control algorithms. Operating at the ultralow power levels

of an energy harvesting source brings a number of challenges to the power systems developer. Keeping a close eye on the lower and upper limits of the energy source make the system design significantly easier. Developers can also evaluate the different control algorithms and tweak them to provide the most

Conclusion

efficient power conversion for the chosen energy source, whether that is an array of solar cells, a piezoelectric vibration transducer, or a thermal energy source. These can be easily tested out, alongside the right choice of a battery cell or a capacitor, with a choice of evaluation boards.

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Out Of the box

3rd Generation Nest Learning Thermostat Now Available in Europe

Nest Labs, Inc. architect of the thoughtful home, brings the 3rd generation Nest Learning Thermostat to the UK, France, Netherlands, Belgium and Republic of Ireland. In addition to its new design, the 3rd generation Nest Thermostat offers improved boiler support that now delivers remote hot water control and advanced compatibility with OpenTherm heating systems. New design features include a slimmer profile, a high-resolution screen that's 40 percent larger and an updated user interface that makes it easier to read temperatures, alerts and messages. And Farsight, a new software feature, automatically displays the target temperature or time when movement is sensed across the room

"Millions of Nest homes around the world have saved approximately four billion kilowatt hours of energy compared to what they would have used if they'd left their thermostats at a consistent temperature. And today, with brand new software and hardware, our European customers can save even more whilst staying comfortable, thanks to remote hot water control and OpenTherm compatibility," said Lionel Paillet, General Manager of Europe for Nest. "And we are continuing to expand our presence in Europe – the 3rd generation Nest Thermostat will be available through thousands of retail locations, professional distributors, and directly through Nest Pro installers, and at a discount or at no cost at all



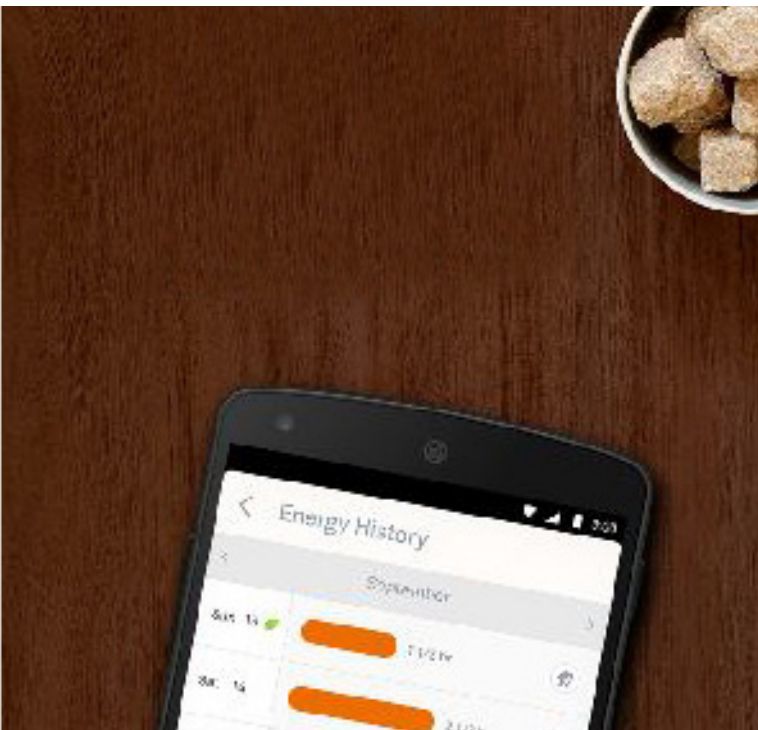
through energy partners."

The 3rd generation Nest Thermostat learns the temperature you like, then programs itself. It knows how long it takes to heat your home so you're comfortable when you get there. When you leave, it automatically turns down your boiler and hot water tank so you save energy.

New features for the 3rd generation Nest Learning Thermostat

- **Hot water (exclusive to Europe)** - The Nest Thermostat can now control your hot water tank, in addition to central heating. You can adjust the hot water schedule from your phone or thermostat, boost from anywhere, and Auto-Away works with your hot water tank to help save energy when no one's home (after 2 days).
- **Advanced modulation with OpenTherm (exclusive to Europe)** - Nest now uses

Out Of the box



OpenTherm to enable two-way communication between compatible boilers and the 3rd generation Nest Thermostat to work out the precise amount of gas to burn to reach or maintain the requested temperature, rather than simply turn the boiler on or off, helping to save energy, increase comfort and prolonging the life of your heating system.

- **Sleek new design** - The Nest Thermostat has a 40 percent larger, brighter, high-resolution screen and new graphics so you can see it easier from far away. The crisp screen has 229 pixels per inch (ppi), 25 percent more than the current generation Nest Thermostat. The 3rd generation Nest Thermostat also has a slightly thinner profile so it can sit flush against the wall.

- **Farsight** - Previously, you had to be pretty close to get the Nest Thermostat to wake up and turn on the display. Farsight takes advantage of the new high-resolution screen so that you can see useful

information on the Nest Thermostat from across the room. You can set the thermostat to display target temperature, an analog clock or digital clock, or turn Farsight off.

We've also created a brand new stand for the Nest Thermostat. This was designed for homes that don't already have a thermostat, or where the old thermostat was in a room where the temperature wasn't regulated, so it can be put in the best place to sense the temperature and activity in your home.

Creating a More Thoughtful Home

Just like the current generation, the 3rd generation Nest Thermostat will also include the following integrations with Nest Protect and Nest Cam:

- When Nest Protect sounds a Heads-Up or Emergency Alarm for smoke or carbon monoxide (CO), you'll see a message on the Nest Thermostat display to help you know what's going on in addition to a Nest app notification. The Nest Thermostat can automatically stop your gas or oil boiler from heating your home - the most common source of CO in the home. This can prevent your boiler from making the situation even worse
- Nest Protect enhances the Nest Thermostat's Auto-Away feature by improving Nest's knowledge of when you're home or away
- You can set your Nest Cam to turn on automatically when you switch your Nest Thermostat into Home or Away mode

In addition, the 3rd generation Nest Thermostat speaks with other connected products in the home from household brands including Philips Hue, Osram, Bosch, Logitech and LG, to work together, learn from one another and help you out – all on their own - helping the home to be safer, more secure, or help save money.

<https://nest.com/press/3rd-generation-nest-learning-thermostat-now-available-in-europe/>

A new series of film capacitors from TDK for EMI suppression in X1 circuits is now available through TTI, Inc.

Mini-available in Europe through TTI, Inc., a world leading specialist distributor of electronic components, is TDK's new series of EPCOS X1 capacitors which have been designed for an extended operating voltage of up to 530V AC. The new parts are ideally suited for EMI suppression in X1 circuits (L-N). The types in the B32911 through to B32918 series cover a broad capacitance range from 1nF to 5.6µF.

Featuring a very compact design, the dimensions of the X1 series film capacitors range from 4.0mm x 9.0mm x 13.0mm up to 35mm x 50mm x 57.5mm, depending on the capacitance. Lead spacings vary between 10mm and 52.5mm. The types with capacitance values of 4.7µF and 5.6µF are equipped with 4 pins for improved mechanical stability on the PCB.

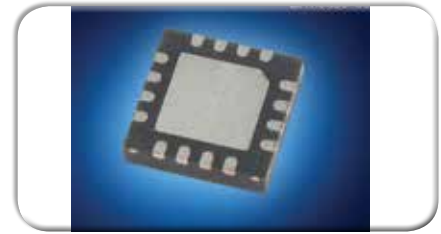
The components have been designed for an operating temperature range from -40°C up to +110°C. Like all EPCOS MKP capacitors, the new types also feature high rated voltages and excellent self-healing properties. The series is certified according to ENEC, UL and CSA. Typical applications include power supplies of all kinds as well as frequency converters.



Mouser Offers Microchip's USB Type-C Controller for Quick Transition and Implementation

The Microchip UTC2000 USB Type-C controller, available from Mouser Electronics, is designed for USB 2.0/3.0 downstream facing port (DFP) and upstream facing port (UFP) applications and performs all of the necessary detection and control required for implementing a basic USB Type-C connector. In DFP applications, the controller can detect passive cables, powered cables, and USB audio adapters, and includes features such as host enable control and overcurrent detection. In UFP applications, the UTC2000 controller detects a valid USB Type-C connection, the plug orientation, and the charging capability of the DFP. The UTC2000 also monitors VBUS to ensure a valid range and to detect overcurrent.

Housed in a 16-pin QFN package, the UTC2000 controller's small form factor allows designers to add USB Type-C to a variety of products, including computers, docking stations, battery chargers, and mobile devices. The UTC2000 can operate from a single 4.5V–5.5V supply, supporting up to 15W, and is available in two temperature range options: commercial (0 to +70 degrees Celsius) and industrial (40 to +85 degrees Celsius). The controller is supported by the UTC2000 Evaluation Kit, which demonstrates the form factor and reversibility of the USB Type-C cable. The kit includes a DFP board and a UFP board - both with onboard UTC2000 controllers - and a USB Type-C cable.



Cost competitive connection system from Molex for vehicle-wiring applications now available from TTI, Inc.

The sophisticated seal technology used by Molex's ML-XT connection system is proven to prevent ingress of fluids under extreme conditions. An advanced two-shot LSR (liquid silicone rubber) molding produces a one-piece plug and seal that provides optimum seal positioning at all times, including during mating and un-mating of the header and receptacle. The result is a solution that achieves superior reliability over de-facto-standard systems in the industry.

Further technical details include rear seals made from HCR (high consistency rubber) to prevent damage to the rear seal during terminal insertion/extraction. Latched rear covers allow for flexible cable exits and cable movement whilst maintaining optimum seal position to prevent leak paths. A high terminal retention force exceeding 111N helps withstand high axial pull-out forces per J2030 specification. The plug housing features an integral locking latch to ensure secure mating of the plug and receptacle.

The plug and receptacle housings are supplied pre-assembled with internal HCR rear seals locked-in by rear covers. This reduces inventory, assembly time and costs

for harness manufacturers and prevents the loss of rear seals for a cost-competitive mated system. The connection system is available with nine different colour-coded housings to enable easy visual mating of harnesses and to prevent mis-mating.



R&S Scope Rider: first portable, mobile use oscilloscope with the performance of a lab instrument

Rohde & Schwarz is presenting the first handheld oscilloscope with the functionality and touch and feel of a state of the art lab oscilloscope. The R&S Scope Rider combines five instruments in a compact format, and its rugged design makes it perfect for mobile installation and maintenance work. The instrument features isolated input and communications interfaces. It meets CAT IV standards and can carry out measurements on low voltage installation sources up to 600 V.

The R&S Scope Rider from Rohde & Schwarz is equally impressive in the lab and in the field. With an acquisition rate of 50,000 waveforms per second, a 10 bit A/D converter developed by Rohde & Schwarz and a maximum bandwidth of 500 MHz for the analog input channels, this portable oscilloscope clearly outperforms comparable instruments. The R&S Scope Rider integrates five functions to offer a level of versatility not found in any other instrument. It is based on a high performance oscilloscope featuring a precise

digital trigger system, 33 automatic measurement functions, mask test and XY diagram mode. Plus, the R&S Scope Rider can function as a logic analyzer with eight additional digital channels, as a protocol analyzer with trigger and decoding capability, as a data logger and a digital multimeter.



New Grid-EYE infrared array sensor Evaluation Kit from Panasonic

Grid-EYE is an infrared array sensor and the first ever 64 pixel IR camera in an all-in-one compact SMD package. Based on Panasonic's MEMS (Micro Electro Mechanical Systems) technology, Grid-EYE combines the MEMS sensor chip, a digital ASIC (I2C interface) and a silicon lens. It has 64 thermopile elements in an 8x8 grid format that detect absolute surface temperature without any contact. Unlike conventional sensors, Grid-EYE uses a patented 60° silicon lens etched out of a silicon wafer, which is (with less than 0.3mm height) the smallest available lens in the market. The combination of these modern and sophisticated technologies from Panasonic enables to reduce the sensor package size to only 11.6mm x 8mm x 4.3mm, which is around 70 % smaller in size than competitor products. Compared to pyroelectric sensors, it is not only possible to detect moving people and objects but also the position and presence of motionless people and objects, the direction of

movements and the accurate surface temperature from -20°C up to +100°C. With this wide range of temperature measurement Panasonic is able to reach a NETD (Noise equivalent temperature difference) of +/- 0.5°C at room temperature.



IZT RF Receiver R4000 Combines 120 MHz Bandwidth with 32768-Point FFT

The IZT GmbH launched a new option for its powerful R4000 RF receiver. The 32768-point FFT option in combination with the 120 MHz real-time bandwidth ensures reliable detection of fast bursts and frequency-agile signals. Even the most advanced hoppers with extremely high hop rates are detected under demanding SNR environments. The Hopper Detector plugin provides real-time information about detected hoppers containing bandwidth, dwell time and time-of-arrival information.

Using the 32768-point FFT, the real-time frequency resolution is less than 5 kHz over the full 120 MHz bandwidth. The transformation is processed in a high-performance FPGA. The continuous detection without any gaps makes the R4000 a very powerful real-time signal analyzer.

In parallel to the PSD (Power Spectral Density), IQ content of sub-bands or even the full bandwidth can be retrieved and forwarded to

the sensor controller. This allows to detect and analyze thousands of signals in parallel.

Utilizing the 4096-point FFT option, the time resolution of the spectrum can be as fast as 25.6 μ s per spectrum.



congatec introduces Server-on-Modules with new Intel® Xeon®/Core™ processors

congatec AG, a leading technology company for embedded computer modules, single board computers (SBCs) and embedded design and manufacturing (EDM) services, has expanded its COM Express Basic portfolio with new server-class embedded modules. The new Server-on-Modules are equipped with 6th generation Intel® Xeon® and Intel® Core™ i3 / i5 / i7 processors (codenamed Skylake). The DDR4 memory of the conga-TS170 modules provides up to twice as much system memory performance for data-intensive applications while consuming 20 percent less energy and requiring only half the footprint of DDR3 RAM that is expected to become legacy in future applications. In addition, the modules offer faster processor speeds, a 60 percent accelerated system bus and an enlarged Intel® Smart Cache (up to 8 MB) as well as the PCIe Gen 3.0 support for all

PCIe Lanes and the new Intel® HD Graphics P530. Overall, users can expect to benefit from enhanced system performance and packing density with lower space and energy requirements.



LATTICE SEMICONDUCTOR LAUNCHES ICE40 ULTRA™ PLATFORM FOR WEARABLE DEVICE DEVELOPMENT

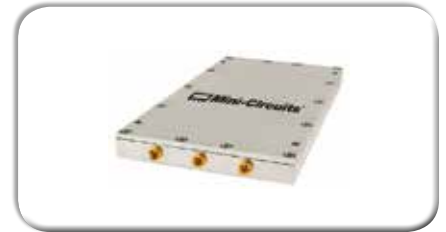
Feature Rich, Low-Power Platform in Compact Wrist Watch Form Factor Supports Multiple Wearable Applications

- iCE40 Ultra FPGA featured in platform is 60 percent smaller than alternative microcontrollers
- Broad range of hardware features make platform a fit for almost any consumer wearable device
- Platform comes with user guide and demos to help expedite device design

The iCE40 Ultra FPGA uses a package that is 60 percent smaller than alternative microcontrollers. The iCE40 Ultra FPGA also supports a low power standby mode for always-on functionality, making it an ideal choice for consumer wearables that need to operate for days between charges.

Hardware features and sensors supported by the iCE40 Ultra Wearable Development Platform include a 1.54-inch display, MEMS microphone, high-brightness LED, IR LED, BLE module and 32MB of flash memory. The platform also supports sensors capable of measuring heart rate/SpO2, skin temperature, and

pressure as well as an accelerometer and gyroscope. The platform comes in a wrist watch form factor (1.5-inches wide x 1.57-inches long x 0.87-inches high) with a wrist strap and a built in battery.



Mini-Circuits' Coaxial 4-Way 0° Splitter/Combiner Provides High Power and Low Loss from 380 to 4600MHz

Mini-Circuits' ZB4PD-462W+ is a 4-way 0° splitter/combiner covering applications from 380 to 4600 MHz with 30W RF input power handling, DC passing up to 1A (250mA each port), 1.3dB insertion loss, 25dB isolation, 0.1dB amplitude unbalance and 1° phase unbalance. The unit comes housed in an aluminum alloy case (5.00x5.00x0.88") with your choice of SMA or N-type connectors.



Mini-Circuits' MMIC Splitter/Combiners Provide 5 to 20GHz Coverage in a Single Device

Mini-Circuits' new EP2K+ MMIC 2-way 0° splitter/combiner offers industry-leading bandwidth, covering

applications from 5 to 20GHz in a single device. This model is ideal for wideband systems like defense and instrumentation which require full coverage in a single device, and it delivers consistent performance across its entire frequency range, allowing users to reduce part numbers on their bill of materials with one model. The splitter/combiner provides 1.1dB typical insertion loss, 20dB isolation, 0.1dB amplitude unbalance and 2-4° phase unbalance. It handles up to 2.5W RF input power as a splitter and is capable of passing up to 1.2A DC current from input to output. It comes housed in a tiny 4x4mm QFN, giving designers both a new level of performance and the flexibility to add these capabilities almost anywhere on their PCB.



Mini-Circuits' Tiny 100W Bi-Directional Coupler Supports Applications from 50 to 6000MHz

Mini-Circuits' SCBD-16-63HP+ wideband bi-directional coupler

handles RF input power up to 100W for applications from 50 to 6000MHz including cellular, WiMax, GSM, ISM, test labs and more. This model provides an outstanding combination of performance parameters over its full frequency range with mainline loss as low as 0.2dB, 23dB directivity, 25dB input/output return loss, ± 0.6 dB coupling flatness (specified over various bandwidths), and DC current passing up to 2A. The coupler is designed with open-style printed wire laminate construction (0.70x0.32x0.20") for easy integration into dense PCB layouts.



Cypress Introduces the Industry's Fastest 64Mb Quad Serial Peripheral Interface NOR Flash Memory with Extended Temperature Range Support

New FS-S Family Device Provides High Read Bandwidth to Enable Faster Access Times in High-Performance Embedded Systems
Cypress Semiconductor Corp.

(Nasdaq: CY), a global leader in embedded systems solutions, today introduced a 1.8V, 64Mb NOR Flash memory with a Quad Serial Peripheral Interface (Quad SPI). The newest device in the Cypress FS-S NOR Flash family combines the Quad SPI interface with the industry's highest read bandwidth and fastest program time while enabling a small PCB layout. The device is ideal for high-performance applications, such as video game consoles, Advanced Driver Assistance Systems (ADAS), automotive instrument clusters and infotainment systems, networking equipment and set-top boxes.

High-performance system designs require the highest read bandwidth for program execution, a small, low-pin-count package, and the fastest program and sector erase times. The 64Mb FS-S Quad SPI NOR Flash memory leverages an 80-MHz Double Data Rate (DDR) mode to deliver read bandwidth of 80 MBps and enables the fastest program execution for high-performance systems. Available in industry-standard compact 8-lead SOIC and 24-ball BGA packages, the device saves board space and simplifies layout. The device provides a 0.475-ms program time per 512 bytes, increasing manufacturing throughput and enabling new data to be written quickly. For battery-

FREE STM32L4 Samples

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powered applications, the memory extends battery life by providing low standby current and a deep-power-down mode. The FS-S NOR Flash family offers AEC-Q100 automotive qualification and supports an extended temperature range of -40°C to $+125^{\circ}\text{C}$.

“Our new 1.8V, 64Mb FS-S NOR Flash device has a low pin count that is ideal for space-constrained wireless applications, and it is optimized for other high-performance applications, expanding the reach of the family,” said Hiro Ino, Senior Director of the NOR Flash Product Family at Cypress. “This product marks a continuation of Cypress’s strategy to expand our high-performance memory portfolio and our NOR Flash market leadership.”

Availability

Cypress’s 64Mb FS-S Quad SPI NOR Flash memory is now sampling in 8-lead SOIC and 24-ball BGA packages. Production will start in the second quarter of 2016.

Diodes Inc. AP9234L, Now at Mouser, Puts High-Accuracy Li+ Protection on Single Chip

Mouser Electronics, Inc. is now stocking the new AP9234L battery protection IC from Diodes Incorporated. This single-chip protection solution provides a rich set of protection features for single-cell lithium-ion or lithium-polymer rechargeable battery packs in smartphones, cameras, and other electronic equipment.

The Diodes Inc. AP9234L battery protection IC, now available at Mouser Electronics, integrates a high-accuracy battery protection

circuit with a dual N-channel, common-drain MOSFET that features an ultra-low $R_{\text{DS(ON)}}$ specification, typically just 13 mOhms (at $V_{\text{DD}} = 4.0\text{V}$, $I_{\text{D}} = 1.0\text{A}$). The AP9234L device safely charges and discharges the battery by turning the MOSFET off when overcharge voltage/current, over-discharge voltage/current, or load short-circuit conditions are detected. The circuit also includes a built-in fixed, delay time to protect external components. The device delivers power savings through a low quiescent current, typically $3.0\mu\text{A}$ in normal mode and $0.1\mu\text{A}$ in power-down mode. Additionally, an over-current detection voltage compensation circuit assures current limit accuracy. The AP9234L features power-down capability, as well as a selectable auto-wake-up function, and offers protection voltage customization for different cell-type specifications.

The AP9234L is available in a UDFN2535-6 surface-mount package and capitalizes on a high-voltage CMOS process to withstand extreme transient and surge voltages from adapters. With an integrated compensation circuit, it can ensure highly accurate charge/discharge current limit range in the full operating temperature range of -40 to $+85$ degrees Celsius.

With its broad product line and unsurpassed customer service, Mouser caters to design engineers and buyers by delivering What’s Next in advanced technologies. Mouser offers customers 21 global support locations and stocks the world’s widest selection of the latest semiconductors and electronic components for the newest design projects. Mouser Electronics’

website is updated daily and searches more than 10 million products to locate over 4 million orderable part numbers available for easy online purchase. Mouser.com also houses an industry-first interactive catalog, data sheets, supplier-specific reference designs, application notes, technical design information, and engineering tools.



Toshiba Launches DMOS FET Transistor Arrays with Industry’s First 1.5A Sink-Output Driver

Toshiba Corporation’s (TOKYO: 6502) Semiconductor & Storage Products Company today announced the launch of a new generation of highly efficient transistor arrays, the TBD62064A series and TBD62308A series, with a DMOS FET[1] type sink-output[2] driver. The new series succeed the TD62064A series and TD62308A series of bipolar transistor arrays that found wide use in applications including motors, relays and LED drives, and are the industry’s first[3] DMOS FET transistor arrays with a 1.5A sink-output driver.

TBD62064APG

Mass production of TBD62064A series products is scheduled to start in February 2016. Sample shipments of TBD62308A series products start today, with mass production slated for March 2016.

The new products are equipped with 4 channels of 50V/1.5A rated

output, suitable for driving constant voltage unipolar stepping motors. Toshiba adopted DMOS FET output drivers for its new products to secure the high efficiency customer requires to reduce power loss-DMOS FET do not require a base current, and can accept high current density per device area, keeping on-resistance low.

Main Features of New Products

High efficiency drive

TBD62xxxA series transistor arrays cut power loss by about 38%^[4] compared with the TD62xxxA series.

High-voltage, large-current drive

The absolute maximum output rating is 50V/1.5A.

Packages to suit various needs.

The line-ups include a DIP type, strongly demanded by the equipment market for hobbies, amusements and industrial fields, and an HSOP type with a heat sink that realizes both high current(1.5A) drive and surface mounting.



Panasonic new FKS series aluminium electrolytic capacitors delivers more capacitance while reducing can size

Saves space; increases system reliability

Panasonic Automotive & Industrial Systems is launching a new series of miniaturized, cost-effective, aluminium electrolytic capacitors

that not only save space, but also increase system reliability. New FKS series features an increase in capacitance of up to three times when compared to Panasonic most popular FK series in the same can size.

For example, the new 25V 33 μ F FKS capacitor, which comes in a 4 \times 5.8mm can size, uses just 62% of the space of previous generation parts; in fact the highest capacitance achieved by FK series in a 4 \times 5.8mm can is 10 μ F. So, one of the new parts can replace three of the FK devices.

Comments Dr. Martina Ciacchi, head of Panasonic capacitor team in Europe: "By increasing the capacitance density we simplify our customer's design, enabling a reduction in parts count and therefore we increase the design reliability. Additionally, the FKS series features a price decrease of about 10% when compared to an FK product with the same capacitance value."

Panasonic is launching 25 new part numbers in the FKS series aluminium electrolytic capacitor family this quarter, in voltage classes between 6.3V and 50V and capacitance range from 33 μ F to 1800 μ F. Can sizes vary from 4 \times 5.8mm to 10 \times 10.2mm. Target markets include industrial automation, automotive, power management, audio and white goods.



TE Connectivity's UIC series connectors, now available at TTI, provide robust reliability for railway and mass transit applications

TE Connectivity's UIC series connectors, now available at TTI, provide robust reliability for railway and mass transit applications

August 2015 – Three new series of heavy-duty interconnects from TE Connectivity (TE), a world leader in connectivity, are now available in Europe through TTI Inc., a world leading specialist distributor of passive, connector, electromechanical and discrete components. TE's UIC 552, 568 and 541 series of connectors are designed for rail and mass-transit applications.

TE's UIC 552 series of high power, single pole connectors with automatic cover locking is designed to connect the main line's rolling stock. This series includes a plug with crimp contacts, distribution box (back or lateral cable outlets), junction box with safety lock, intermediate derivation box and dummy socket with cover. UIC 552 series connectors are robust and durable, providing more than 500 mating cycles, while offering a nominal current of up to 800A (with 185mm² cable) and nominal voltage of 3000V AC/DC. IP56 certified against high-pressure water jets and salt-spray resistant up to 96 hours, these connectors can be used in temperatures ranging from minus 50 degrees Celsius up to 120 degrees Celsius.

Providing more than 500 mating cycles, the highly durable UIC 568 series connectors are pull-apart circular interconnects featuring a painted aluminium socket,

automatic cover and composite plug with removable insert and dummy socket. This series provides audio coupler connection for railway rolling stock and includes a receptacle shell with a removable insert containing 13 or 18 crimp contacts for UIC 568 or UIC 558 cables. Nominal current for this series is 5A while service voltage is 110V. The UIC 568 series is rated at IP67 for water ingress according to the EN 60N 529 standard and is fire resistant according to NF F 16-101 and NF F 16-102 standards.

For applications requiring a low-voltage connector with full environmental sealing, TE's UIC 541 series is suitable for use up to 1500V test voltage and 72V service voltage. The UIC 541 series meets NF F 16-101 and NF F 16-102 fire resistance standards, resists salt spray for up to 96 hours (which can be increased on request), and offers a life cycle of over 500 mating cycles, providing a RoHS compliant solution.



Ultra-Compact 5 W USB Wall Plug Adapters Meet Level VI Standards

CUI Inc announces a line of ultra-compact 5 W wall plug adapters for the US, Japanese and European markets featuring an integrated USB connector. The SWI5-5-N-I38 and SWI5-5-E-I38 are designed to meet the stringent average efficiency and no load power

requirements mandated by the US Department of Energy (DOE) set to go into effect on February 10, 2016. The new Level VI standards aim to significantly lower the amount of power consumed when the end application is not in use or is no longer connected to the system. Any domestic or global manufacturer seeking to market their end product with an external adapter in the US must meet these new performance standards.

With a footprint as small as 2.56x1.42x0.89 inches (64.92x36x22.5 mm) these adapters are among the industry's smallest ac-dc power supplies to integrate a USB connector. The ultra-compact design makes it ideally suited for a wide range of consumer applications, including media players, e-readers, GPS and other mobile devices.

The 5 W adapters both feature 5 Vdc single regulated outputs with a wide universal input voltage range from 90~264 Vac. The series also features no load power consumption <0.075 W and provides over voltage, over current and short circuit protections.

Designed with input blades for North American and Japanese applications, the SWI5-5-N-I38 offers 60950-1 UL/cUL and PSE safety approvals while the SWI5-5-E-I38 with European input blades offers GS safety approvals. All models meet Class B limits for conducted and radiated emissions. The new SWI5-5-N-I38 and SWI5-5-E-I38 are available immediately with prices starting at \$5.36 per unit at 100 pieces through distribution. Please contact CUI (<http://www.cui.com/contact>) for OEM pricing.

For more information on the DOEs

upcoming Level VI regulations, click here: <http://www.cui.com/efficiencystandards>

Summary

Product name: SWI5-N-USB, SWI5-E-USB

Availability: Stock to 12 weeks

Possible users: Consumer and mobile device designers

Primary features: Level VI efficiency, ultra-compact design



New FCI USB 3.1 Type C connectors are reversible for quick and easy USB, power, audio and video connection: now available through TTI

Now available in Europe through TTI, Inc., a world leading specialist distributor of electronic components, FCI's new USB 3.1 Type C Connectors boast a small form factor design that is reversible for quick and easy connection whichever way it is inserted. The USB 3.1 Type C Connector is a new standard plug and receptacle which provides a multi-function single cable solution for USB, power, audio and video and is specifically designed by FCI to suit a wide range of emerging and future product applications.

The FCI USB 3.1 Type C connector provides outstanding performance that minimizes user waiting time – it supports SuperSpeed 10Gb/s speeds in each direction and power delivery up to 100W. It is extremely robust for applications such as laptop computers, tablets,

and portable game stations. Its small form factor also suits very thin platforms like mobile phones and emerging devices such as smart watches and wearables. In addition to these consumer applications, FCI's USB 3.1 Type C connector is also targeted at the industrial and instrumentation markets.

Manufactured with a high-temperature thermoplastic housing, stainless steel shell and with copper alloy terminals, the devices have low-level contact resistance and deliver up to 5A maximum current, with configurable voltage of up to 20V. Operating temperature is -55degC to +105degC. RoHS compliant, lead-free and halogen-free, the new USB 3.1 Type C meets environmental, health and safety requirements. Plugs and receptacles are available with vertical or right angle orientation and are supplied packaged on tape and reel for automated assembly.



TI's new oscillator family offers the industry's lowest jitter to optimize signal integrity in performance-critical applications

Texas Instruments (TI) (NASDAQ: TXN) today introduced a family of fully programmable, pin-selectable and fixed-frequency 7-mm-by-5-mm differential oscillators that provides the industry's lowest jitter of 90 femtoseconds (fs), which enables designers to optimize

signal integrity and reduce data-transmission errors in performance-critical applications. The LMK61xx family enables easy customization, frequency margining and support for multiple frequencies on one device to clock field-programmable gate arrays (FPGAs), analog-to-digital converters (ADCs), digital-to-analog converters (DACs) and high-speed serial links. For more information, visit <http://www.ti.com/lmk61xx-pr-eu>.

Key features and benefits of LMK61xx oscillators

Industry's lowest jitter: 90-fs typical root-mean-square (RMS) jitter performance over 12 kHz to 20 MHz is less than half that of competing oscillators, allowing designers to improve reliability and system margin in communications, test and measurement, and medical equipment.

Flexible and easy to customize: The family of 11 oscillators includes programmable, pin-selectable and fixed-frequency devices, offering low-voltage pseudo emitter-coupled logic (LVPECL), low-voltage differential signaling (LVDS) and high-speed current-steering logic (HCSL) output formats, and frequencies ranging from 10 MHz to 1 GHz. The family provides a variety of options to meet designers' needs. The programmable device offers ultimate flexibility, with an I2C interface as well as an on-chip electrically erasable programmable read-only memory (EEPROM) with 100 write cycles, enabling designers to easily customize the start-up frequency.

The pin-selectable device offers design flexibility by consolidating up to seven unique frequencies and output formats on one device.

The fixed-frequency oscillators support fast, frequency-independent lead times.

Reduced design cycle time:

Glitchless fine/coarse frequency margining enables designers to ease compliance and stress testing of their systems during prototype design verification.

Industry-standard 6-pin and 8-pin oscillator footprints simplify adoption and evaluation in existing designs without the need for board redesign.

Tools to speed design-in process

TI offers the following tools to help designers quickly select, evaluate and design with the new LMK61xx oscillators.

The oscillator customization tool can recommend an LMK61xx oscillator based on an application's programmability, output format and frequency needs. The tool also helps designers place custom sample requests for applications that have unique requirements.

LMK61xx oscillator evaluation modules (EVMs) are available from the TI store and authorized distributors, priced as follows: the programmable LMK61E2EVM, \$US99; the pin-selectable differential LMK61PDEVM, \$79; several fixed-frequency EVMs, \$79. TI's WEBENCH® Clock Architect tool simplifies designing with TI clock and timing devices. The tool can recommend a single- or multiple-device clock-tree solution from a broad database of devices to meet system requirements. It features a phased-locked loop (PLL) filter design and phase-noise simulation to allow designers to simulate and optimize clock-tree designs to meet their system needs.

Engineers can search for solutions, get help, share knowledge and solve

problems with fellow engineers and TI experts in the TIE2E™ Community Clocks and Timing forum.

Würth Elektronik eiSos expands its series of terminal block push-on connectors

Würth Elektronik eiSos expands its series of terminal block push-on connectors: new products and additional contact-space pitches. Würth Elektronik eiSos is expanding its range of terminal block push-on connectors in the WR-TBL series, based on the wire-protection principle, with a number of new products. A total of eight new series now complement the already available product portfolio both in the classic 5.00 mm pitch as well as in the form of new push-on connectors in the contact-space pitches 7.5 and 10 mm. The terminal blocks are all UL/cULus- and VDE-listed. They feature a current-carrying capacity of up to 24 A/750 VAC and are suited for applications involving operating temperatures between -30 and +120 °C.

The terminal blocks, some of which can be modularly connected in series, support a broad spectrum of cable cross-sections from AWG30 (0.05 mm²) up to a maximum of AWG12 (3.31 mm²).

All products are directly available from stock; free-of-charge samples of the new WR-TBL products can be sent out on request.



New extended Harwin Spring Contact Connector range now includes 13 types in extended C and Positive Stop styles, plus low profile 1.1mm model

Harwin, the leading hi-rel connector and SMT board hardware manufacturer, announces a significant extension to its popular Spring Contact Connector range, with thirteen new models offering design engineers more options to select the best design for each application. The new range includes extended C and Positive Stop models in nine different heights, ranging from 4.5mm down to low profile designs a mere 1.1mm above board level, enabling smaller, lighter, low-profile PCB designs to be achieved. Harwin Spring Contact interconnects suit a wide variety of applications and markets, including antenna contacts in wearable and mobile applications, RFI screening, LED lamp connections, RF ID tags, vision systems, PCB grounding and board-to-board contact.

Harwin Spring Contact connectors maintain a positive force against a mating surface and are available in different widths to offer a choice of spring contact forces. Tolerant to significant mating misalignment, the new design incorporates “positive stop” to prevent damage caused by over compression. A contact anti hook up feature is a further benefit. Specifications include gold-plated contacts and current rating up to 1.0A. Reliable and durable, Harwin Spring Contacts can withstand up to 10,000 mating cycles and operate over a temperature range of -40 to +85 degrees Celsius. Supplied on

tape and reel, the Spring Contact Connector range enables low-cost assembly with automatic pick and place machines.

Comments Harwin Product Manager, Graham Cunningham, “The extended Spring Contact range builds on an already enormously popular product line and now brings even wider choice to design engineers. Today, the pressure is on to fit ever more functionality into less space, and our ultra-low profile 1.1mm Spring Contact in particular helps designers meet “smaller and lighter” demands.”



Amphenol Industrial's Amphe-RXS

The Amphenol Industrial Products Group now offers a connection system that incorporates both power and signal contacts in one connector. Amphe-RXS uses Amphenol's RADSOK® terminals as power contacts and either standard or high vibration (AHVB) signal terminals to produce an all-inclusive connector.

Because of its unique design, this new robust, mixed connector is perfect for devices and systems where space is at a premium, such as 3-phase electric motors, hybrid or electric vehicles, motorcycles, scooters, as well as material handling systems to name a few.

The Amphe-RXS incorporates Amphenol's RADSOK® technology for higher amperage, lower t-rise,

less resistance and lower mating forces. These power terminals can range in size from 2.4 mm to 5.7 mm (up to 120 A continuous), while its signal terminals can range from size 22 to size 16.

The all-in-one connection system can accommodate a variety of easy locking solutions ranging from plastic lock tabs to small screws. Lever locks or large jack screws, which are bulky, complex and often unreliable, are not needed due to the lower mating forces of the RADSOK®.



IAR Systems supports Ambiq Micro's Apollo MCUs targeted for wearables and IoT

IAR Systems® announces that the latest version of the complete embedded development toolchain IAR Embedded Workbench® for ARM® supports the Apollo family of ARM Cortex®-M4F microcontrollers from the semiconductor company Ambiq Micro.

Since the start in 1983, IAR Systems has been building and expanding a strong network of partners. The company is the hub of a powerful partner ecosystem, including all leading semiconductor vendors worldwide. Thanks to this, the complete C/C++ compiler and debugger toolchain IAR Embedded Workbench supports more microcontrollers in more architectures than any other tool on

the market. All available ARM cores from all major vendors, in total more than 4,000 devices, are supported by IAR Embedded Workbench, and IAR Systems continually adds support for new devices.

The Apollo family of microcontrollers from Ambiq Micro offers leading power numbers in both active modes and sleep modes. These power savings combined with a high-performance processing engine make the Apollo MCUs a good choice for battery-powered devices including wearable electronics, activity and fitness monitors, and wireless sensors.

"We are really pleased that our Apollo MCUs are supported by IAR Systems' complete development tools," says Mike Salas, Vice President of Marketing and Strategy, Ambiq Micro. "The combination of the ultra-low power performance of the Apollo MCUs and the high-quality development toolchain IAR Embedded Workbench for ARM will help developers worldwide to bring new innovative products to life."

IAR Embedded Workbench is a powerful development toolchain that incorporates a compiler, an assembler, a linker and a debugger into one completely integrated development environment. The toolchain provides extensive debugging and profiling possibilities such as complex code and data breakpoints, runtime stack analysis, call stack visualization, code coverage analysis and integrated monitoring of power consumption. For complete code control, IAR Systems also offers integrated add-on tools for static analysis and runtime analysis. More details about IAR Embedded Workbench for ARM and trial versions are available

at www.iar.com/iar-embedded-workbench/arm/.



300mV Start-Up, 1.6µA IQ Synchronous Buck-Boost DC/DC Converter with Integrated PowerPath for Low Power Wireless Sensor Applications

Linear Technology announces the LTC3106, a highly integrated, 1.6µA quiescent current 300mV start-up buck-boost DC/DC converter with PowerPath™ management, optimized for multisource, low power systems. The LTC3106 is ideal for powering low power wireless sensors from rechargeable or primary batteries supplemented by energy harvesting. The LTC3106 incorporates maximum power point control (MPPC) making it compatible with common high impedance power sources, including photovoltaic cells, thermoelectric generators (TEGs) and fuel cells.

The LTC3106 is available in 20-lead 3mm x 4mm QFN and TSSOP-20 packages. Prices start at \$2.94 each in 1,000-piece quantities. Both are available from stock. For more information, visit www.linear.com/product/LTC3106.



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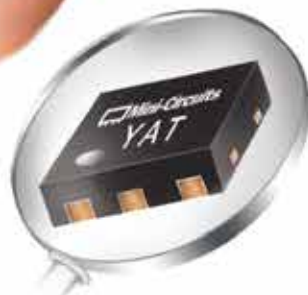
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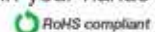
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