New-Tech Europe February 2017

February
2017

New-Tech Magazine Europe

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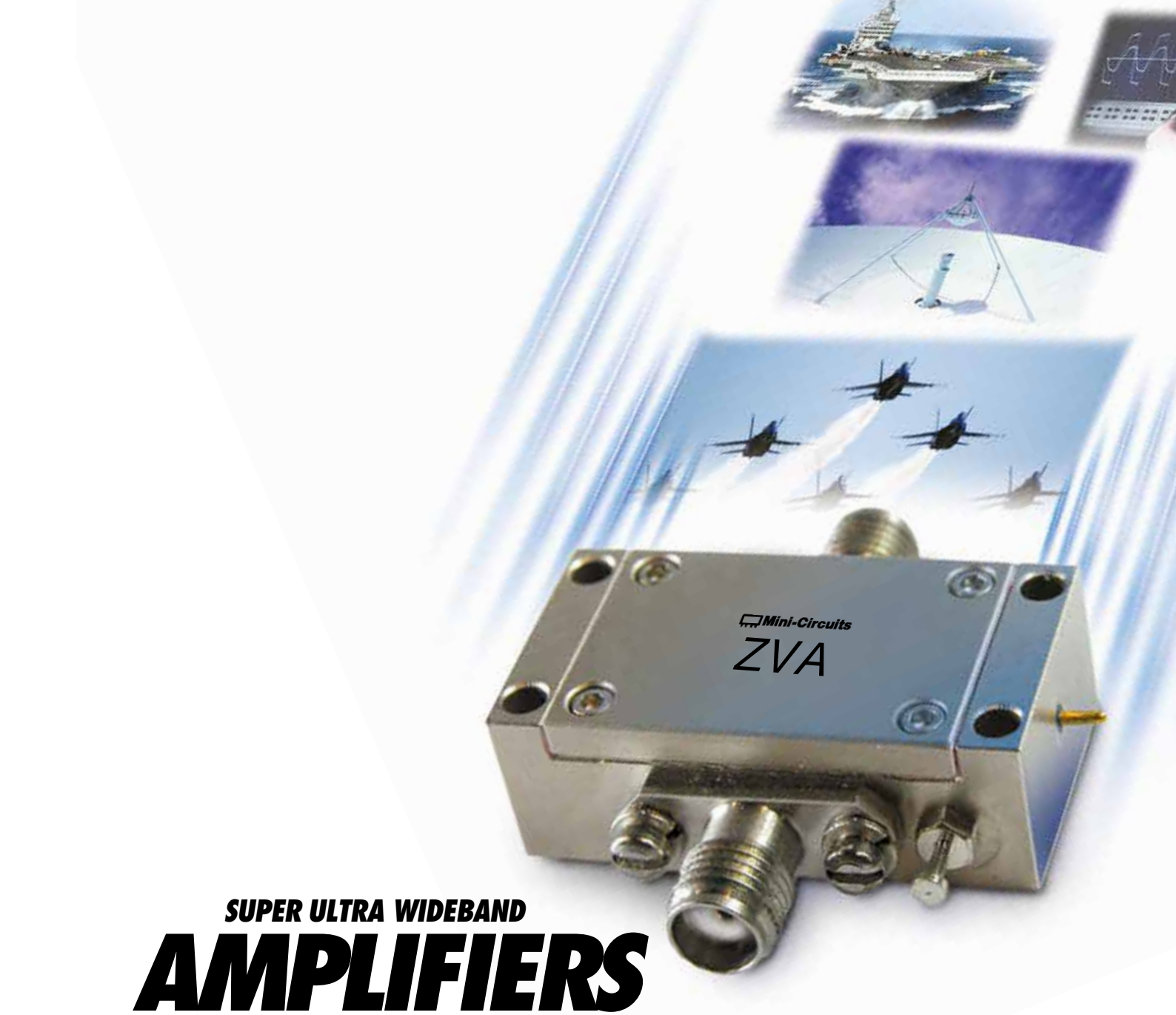

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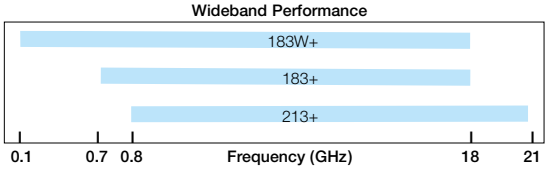

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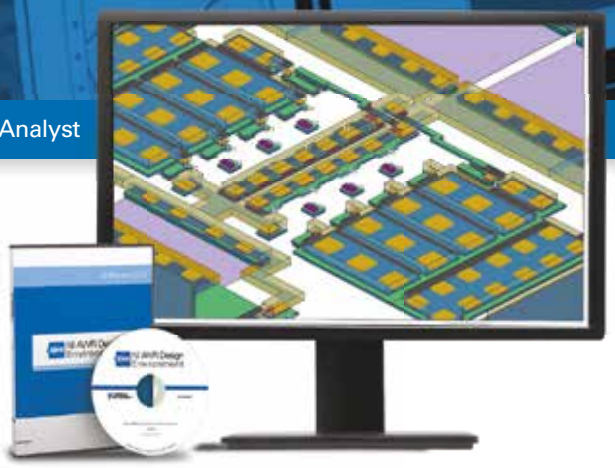

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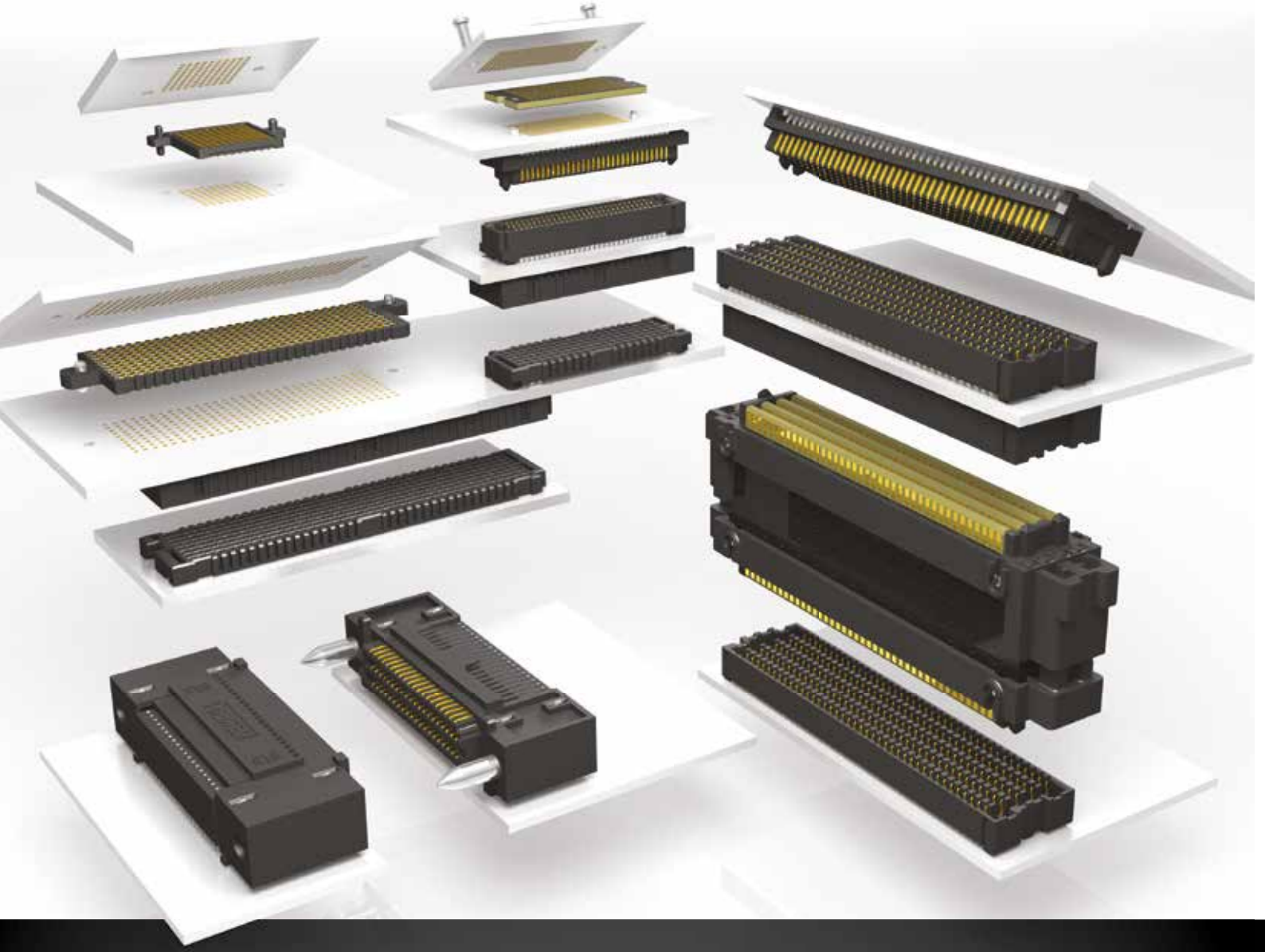

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New Tech Magazine

New-Tech Europe

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February 2017

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

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

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

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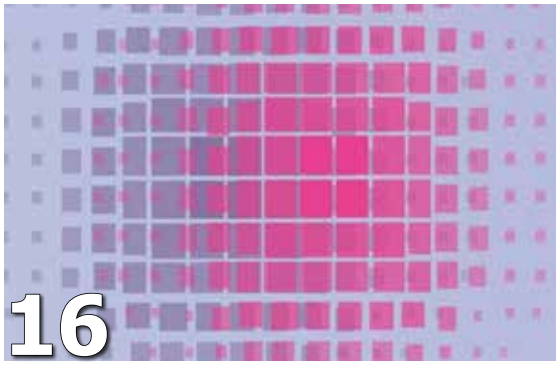
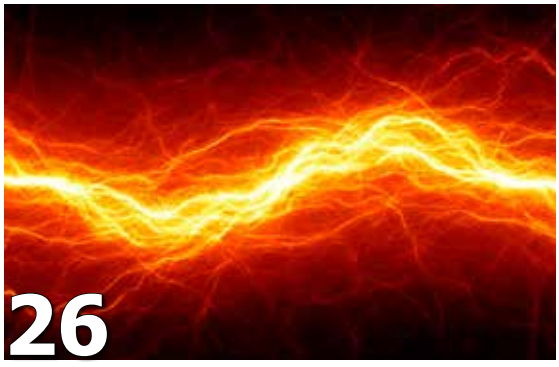




Nokia and Sky enhance on-demand video services in the UK

Nokia announced that its Velocix Content Delivery Network (CDN) has been deployed by Sky, Europe's leading entertainment company. The alliance enhances Sky's high-speed video and data services for the company's millions of UK customers

Sky's expansion of on-demand premium video content is creating unprecedented growth in customer traffic. This increasingly challenges delivery resources and operational costs across the company's entertainment and communications service networks. Deployment of the Nokia Velocix CDN allows Sky to temporarily cache content closer to customers in localized cloud data centers to reduce transportation costs and improve the customer experience.

Nokia is providing its Velocix Managed Service expertise – via its CDN Network Operations Center – to assure faster time-to-market for Sky, which will gain fuller control of design, implementation, and operations. In particular, the new solution provides better visibility for traffic demands and flows, ensuring greater predictability of performance and network usage compared to its current CDN service.

The migration of existing Sky services to the Velocix CDN was seamless. Using the advanced features of the Velocix Proxy Language, call flows were easily customized without requiring product development.

Deployment of Nokia's Velocix CDN across the Sky UK network satisfies the content demands of millions of customers subscribing to both broadband and satellite services. Traffic has been live in the network since the end of 2015.

Sky can modify how a request for content from subscribers is treated depending on a user's location or device. This opens up a wealth of personalization opportunities to improve the customer experience, or traffic management on the network.

Nokia solution currently serves the Sky On Demand service content. Sky and Nokia are jointly working to expand the Velocix solution to also support Sky Go and Now TV services for live TV and video on demand.

The Velocix solution gives Sky greater deployment efficiencies in terms of data center density and footprint, as well as power and connectivity options.

Mohamed Hammady, UK Chief Technology Officer, Sky said: "Nokia is a trusted partner of Sky. Using Nokia's Velocix CDN, we have greater traffic visibility in the network, allowing us to regain control of managing the network capacity. Deploying the solution deep in the network also ensures we can manage delivery more effectively to improve performance and the customer experience. The introduction of Velocix CDN to support growth of our video on demand services was seamless."

Demanding production program and focus on future technologies: Mercedes-Benz plant Bremen creates 150 new jobs

Bremen – The Mercedes-Benz Bremen plant operates at full capacity and currently prepares for the series production of electric vehicles of the new product brand EQ. 150 new permanent jobs are therefore being created at the site. "Our vehicles 'Made in Bremen' have never been more diverse and globally demanded," states Peter Theurer, Site Manager of the Mercedes-Benz Bremen Plant. "To manage the demanding production program and to integrate our future technologies in series production, we need to produce highly flexibly and make full use of our capacities. Therefore, we are again creating new jobs." The new positions will be filled with employees previously employed as temporary workers at the Bremen plant.

"We are very happy to have 150 temporary workers,

who have been with us for some time now, safely on board. We are now offering them long-term prospects," says Michael Peters, Chairman of the Works Council Mercedes-Benz Bremen plant. "We need all our new colleagues to meet the demanding production program and to be trained and qualified for the increasing electromobility in the future. The decisions of the last months have clearly shown that the Bremen team convinces through competence and quality. We are very proud and are looking confidently into the year 2017."

Mercedes-Benz has completed the year 2016 as successful as never before and has delivered over two million vehicles to customers worldwide. The Bremen plant has contributed both with the volume series C-Class and the GLC as well as with the models that are exclusively built for the world market in Bremen. Already in March 2016, the plant management and the works council had created 200 additional permanent jobs. The product portfolio of the Bremen plant currently consists of ten different models. Next to vehicles with conventional combustion engines, plug-in hybrids of the C-Class and the GLC are also rolling off the production line. In addition, the GLC F-CELL – the worldwide first fuel-cell vehicle with plug-in technology – will be produced in Bremen. With the confirmation for the new electric SUV of the EQ brand, cars "Made in Bremen" will cover the entire range of intelligent drive technologies in the future. The site is preparing intensively for the EQ series production. „We are happy and proud to build two vehicles with future-proof cutting-edge technology and zero emissions in the next years," states Theurer. " We intensively prepare our plant and our employees and thus continue to be a highly attractive employer in Northern Germany."

Electric Offensive by Mercedes-Benz Cars

Mercedes-Benz Cars is consolidating all activities in connection with electric mobility under the new product brand EQ, and the Concept EQ gives a clear outlook onto a completely new generation of vehicles. Mercedes-Benz Cars plans to launch more than ten electric vehicles by 2025: in all segments from smart to large SUVs. The company assumes that until 2025 the proportion of electric vehicles in total unit sales of Mercedes-Benz will be between 15 and 25 percent. The EQ product brand is an elementary component of the corporate strategy for the mobility of the future, which is summarized under the acronym CASE. The four letters stand for the strategic pillars of connectivity (Connected), autonomous driving (Autonomous), flexible use (Shared & Services) and electric drive (Electric), which Daimler is systematically developing and intelligently linking.

NXP Supports the Philippines with eGovernment Solutions

Philippines highly secure ePassport and multi-purpose ID program based on NXP SmartMX2 microcontroller

NXP Semiconductors N.V. (NASDAQ:NXPI) announced that the Philippines government has chosen NXP's SmartMX2 secure microcontroller for its modernized electronics passports (ePassports) and unified multipurpose identification card (UMID) program. The ePassports program enhances national security with secure biometric data, encryption and authentication technology to help reduce document reproduction and identification fraud for approximately 93 million Filipinos.

According to the standards of the International Civil Aviation Organization (ICAO), the new Philippines ePassports and multipurpose ID cards will allow Filipinos a more convenient and secure way of international border crossing and access to government services.

As a global leader in eGovernment solutions, the NXP SmartMX secure microcontroller family with world-class security features make up the core component for secure identity programs. SmartMX products contain the IntegralSecurity architecture with more than 100 security mechanisms ready to support custom-specific electronic forensic features.

Unified Multipurpose ID Card Enables More Convenience and Functionality

The new Philippines electronic multipurpose identification

cards, based on NXP's SmartMX microcontroller with Javacard operating system (JCOP), enable convenience and functionality. The cards, which are issued by social security insurance companies Social Security System (SSS), Government Service Insurance Group (GSIS), PhilHealth and Pag-IBIG, allow citizens to use one card instead of four to represent their proof of identification for social security, insurance, health programs and other government services.

Highly Secure ePassports for Convenient and Fast International Border Crossing

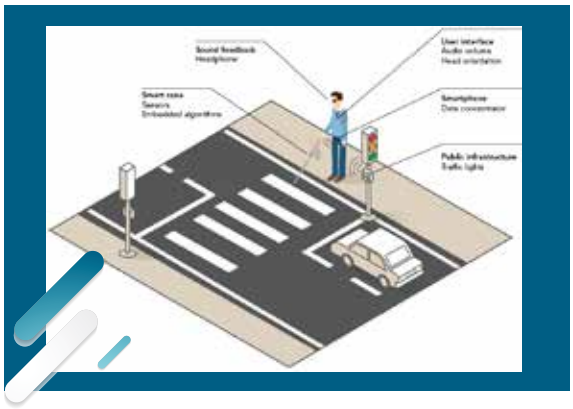
Filipino ePassports, based on NXP technology, are designed to be highly secure, tamper-resistant and can offer more convenience when crossing borders. The ePassports provide travelers benefits such as automated border clearance or "e-gates," automated issuance of boarding passes and faster travel arrangement with airlines.

The increased need of ePassports is also reflected in the increase of identity fraud and the EU-refugee crisis where some countries are already reacting and implementing new travel requirements with the need of biometric passports to enter a country such as the U.S.

"The Philippines is on its way to establishing a secure identification solution which is key for a stable society and state-of-the art government service," said Sébastien Clamagirand, senior director and general manager of secure identification solutions at NXP. "NXP is already supporting more than 120 countries like Brazil, China, Germany, India, Indonesia, Nigeria and U.S. for a secure and convenient government scheme."

LETI ANNOUNCES PROJECT TO ADAPT OBSTACLE-DETECTION TECHNOLOGY USED IN AUTONOMOUS CARS FOR MULTIPLE USES

INSPEX to Combine Knowhow of Nine European Organizations to Create Portable and Wearable Spatial-Exploration Systems



Leti, a technology research institute of CEA Tech, today announced a European project to develop a portable and wearable, multisensor and low-power spatial-exploration and obstacle-detection system for all conditions of weather and visibility.

The INSPEX system will adapt obstacle-detection capabilities common in autonomous cars for portable and wearable applications, including guidance for the visually impaired and blind, robotics, drones and smart manufacturing. It will be used for real-time, 3D detection, location and warning of obstacles under all environmental conditions. These include smoke, dust, fog, heavy rain/snow, and darkness, and in indoor and outdoor environments with unknown stationary and mobile obstacles.

Applying expertise and technologies of the nine partners in the three-year project, the system will be based on state-of-the-art range sensors such as LiDAR, UWB radar and MEMS ultrasound.

Coordinated by Leti, INSPEX will miniaturize and reduce the power consumption of these sensors to ease their integration in the new system. They will then be co-integrated with an inertial measurement unit (IMU), environmental sensing, wireless communications, signal-and-data processing, power-efficient data fusion and user interface, all in a miniature, low-power system designed to operate within wider smart and Internet of Things environments.

The main project demonstrator will embed the INSPEX system in a white cane for the visually impaired and provide 3D spatial audio feedback on obstacle location.

"Sophisticated obstacle-detection systems such as those in autonomous vehicles are typically large and heavy, have high power consumption and require large computational capabilities," said Suzanne Lesecq, project coordinator at Leti. "The INSPEX team will work together to miniaturize and adapt this technology for individual and personal applications, which will require even greater capability for all-conditions obstacle detection. The project is

a strong example of European innovation to bring leading-edge technology to a broader segment of users."

In addition to applications for the visually impaired, drones and robots, the INSPEX system application domains are expected to include:

Human mobility – First responders, disabled persons

Instrumentation – Distance-measuring tools

Smart homes and factories – Assembly machines, security surveillance systems

Joining Leti in the project are:

University of Manchester, UK

Cork Institute of Technology, Ireland

STMicroelectronics SRL, Italy

Swiss Center for Electronics and Microtechnology CSEM, Switzerland

Tyndall National Institute University College Cork, Ireland

University of Namur ASBL, Belgium

GoSense, France

SensL Technologies Ltd., Ireland

Rohde & Schwarz is named official supplier for the 67th Berlinale

The Munich-based company supports the festival as an official supplier. This year, Rohde & Schwarz is providing three R&S CLIPSTER mastering stations, one four-channel R&S VENICE 2U ingest and playout platform and its reliable R&S SpycerBox Cell storage solution. The systems will be installed at the Colt Technology Services data processing center as part of the core of the Berlinale's digital workflow. R&S CLIPSTER quickly and reliably generates digital cinema packages (DCP) for the screenings, ensuring that the quality of the videos keeps festival guests spellbound.

About 1100 films in total will be played at the Berlinale, including the European Film Market screenings. Some of the film material will be delivered in file formats other than final DCP, a few will even be delivered on reels. The R&S VENICE ingest and production server digitizes such material and exports it for further processing. R&S SpycerBox Cell buffers the video files to ensure that R&S CLIPSTER is able to quickly and efficiently process the immense amount of data. The mastering station supports a number of video formats, allowing previously digitized films to be quickly converted and processed. The mastering station generates high-quality DCPs faster than in realtime, so last-minute adjustments such as subtitle changes are easy to make.

Ove Sander, Technical Manager – Digital Cinema, Berlin International Film Festival: "Once again this year we are placing our trust in the systems from Rohde & Schwarz – especially due to the hectic environment during the festival. The VENICE servers help us by reliably digitizing the various input media and preparing them for further processing. With its incredible speed, the CLIPSTER mastering station lets us generate all DCPs in plenty of time before the festival starts."

Stefan Weidner, Director of File Based Media Solutions at Rohde & Schwarz: "It's our pleasure to partner with the Berlinale and to demonstrate the reliability and quality of our products to a wide audience of professionals. We have a close bond with the German film industry and want to express that with our dedicated involvement."

The Berlinale is one of the international film industry's most important events. Ticket sales hover around 325,000, and more than 20,000 industry visitors are expected from 124 countries, including some 4,000 journalists. The public program shows around 400 films each year, most of which are world and international premieres. Films of all genres, lengths and formats are presented in the various sections of the festival. The European Film Market (EFM) is the business epicenter of the Berlinale and one of the world's most important international film markets. Up to 800 more films will be presented during the EFM.

Wind Satellite Heads for Final Testing

The road to realising ESA's Aeolus mission may have been long and bumpy, but developing novel space technology is, by its very nature, challenging. With the satellite now equipped with its revolutionary instrument, the path ahead is much smoother as it heads to France to begin the last round of tests before being shipped to the launch site at the end of the year.

Aeolus carries one of the most sophisticated instruments ever to be put into orbit: Aladin, with two powerful lasers, a large telescope and very sensitive receivers. It shoots pulses of ultraviolet light down into the atmosphere to profile the world's winds.

This is a completely new approach to measuring the wind from space, which usually involves tracking cloud movement, measuring the roughness of the sea surface or inferring wind from temperature readings.

Profiling the world's winds

Aeolus has been built mainly to advance our understanding of Earth. These vertical slices through the atmosphere, along with information on aerosols and clouds, will advance our knowledge of atmospheric dynamics and contribute to climate research.

However, Aeolus also has a very important practical role to play because its measurements will be delivered rapidly, improving weather forecasts.

After its long development, Aladin was finally ready to join the satellite at Airbus Defence and Space in Stevenage in the UK in August last year.

Standing proud

ESA's Aeolus project manager, Anders Elfving, said, "Over the last months, the UK team with support of their colleagues from Toulouse in France have worked tirelessly to integrate Aladin into the satellite, to check that all is aligned and that the complete satellite is working flawlessly."

With the satellite now complete, it is time move it to Toulouse where it will be tested to make sure that it can withstand the vibration and noise of liftoff. "This next round of tests is very important and I know the team is raring to get the opportunity to show that their proudly built satellite can withstand the tough ride on the launcher," added Anders.

After this, Aeolus will go to Liege in Belgium to be checked in a thermal–vacuum chamber.

Aeolus on the road

Anders said, "We still have some critical steps ahead. We need the ultimate proof that the laser and the complex optical system performs well with the satellite thermal radiators and in vacuum conditions, but I am confident that the satellite, operation and launch teams will deliver as planned."

Once all this is done, towards the end of the year, it will be shipped across the Atlantic to Europe's Spaceport in French Guiana for launch on a Vega rocket.

Electric Vehicle Charging Interface Initiative Welcomes STMicroelectronics

The Charging Interface Initiative e. V., CharIN, an open association founded to develop and establish the Combined Charging System (CCS) as the standard for charging all kinds of battery-powered electric vehicles, and STMicroelectronics, a global semiconductor leader serving customers across the spectrum of electronics applications and a pioneer in making vehicles safer, greener, and more connected, have announced that ST has become a member of the initiative.

With an unparalleled portfolio of automotive and secure microcontrollers, industry-leading sensing and power technologies-including advanced silicon carbide (SiC), and top-tier secure connectivity expertise, ST brings to CharIN its unique ability to address and industrialize sophisticated, secure, yet easy-to-use interfaces for hybrid and electric-vehicle (HEV/EV) charging.

"ST brings valuable automotive, security, sensing,

power, and processing expertise to CharIN, along with its strong relationships across the industry that complement and supplement the already-strong CharIN roster of members and partners," said Claas Bracklo, Chairman of the CharIN e.V.

"Standardizing the technical setup and charging of hybrid-electric and electric vehicles globally will reduce range anxiety and be a powerful accelerant for EV adoption," said Marco Monti, Executive Vice President Automotive and Discrete Group, STMicroelectronics. "ST's long experience, leadership, and broad portfolio of products in the automotive and power-electronics sectors, together with our recognized strengths in sensors, secure payment and secure communication, mean that we are perfectly placed to contribute strongly to the CharIN initiative and to help meet industry needs by delivering the technology to the market at the appropriate time."

Swedish solar energy expert Midsummer's client now produces lightweight flexible solar modules with conversion efficiency at 14 per cent

Midsummer, a leading supplier of production lines for cost effective manufacturing of lightweight flexible CIGS solar cells, today announced that its Asian client now manufactures lightweight flexible solar modules with conversion efficiency of 14 per cent.

Midsummer previously announced that they have sold their compact DUO solar cell manufacturing system to an Asian client. The system is in production and it produces flexible solar modules at record levels. The flexible solar module is made of cells from the client's factory in Asia.

Midsummer's client has now have passed 14 per cent in conversion efficiency (corresponding to 15.4% aperture area efficiency). The modules tested at the independent research institute Chemitox Inc. in Yamanashi, Japan, were made in the client's mass production line in normal production conditions and with standard process settings with a CIGS layer less than 1 micron in thickness.

"I am happy to announce that our solar modules indeed have increased the conversion efficiency to 14 per cent as verified by an independent testing laboratory. The DUO system is now the most widely spread manufacturing tool for flexible CIGS solar cells", said Sven Lindström, CEO, Midsummer AB. "We have yet again shown that we are the leading provider of turnkey production lines of flexible thin film CIGS".

Inexpensive lightweight flexible solar modules

The Midsummer DUO is a compact, fully automatic deposition system for CIGS solar cell manufacturing. It is designed for operational stability and superior material utilization.

With the production system from Midsummer, the solar cells are manufactured individually and then stringed together into modules just like crystalline solar cells. This way, lightweight flexible modules can easily be made in any size and shape.

A dry, all-vacuum process has less stringent requirements for clean rooms. Avoiding cadmium in the manufacturing process is desirable for the sake of the production staff and also makes it easier to commence low cost manufacturing of CIGS solar cells.

"As always, our clients can rely on Midsummer being at the forefront of advanced solar technology and efficiency requirements. Our objective is that our technology shall be a leader in the market segment of lightweight, flexible solar modules", said Sven Lindström, CEO, Midsummer. "Lightweight, flexible solar modules are the future of solar energy since they fit in to the 'distributed energy' trend and can be fitted on buildings, vehicles etc."

From 14 to 16 March 2017, the international embedded community will once again gather in Nuremberg, where the world's biggest trade fair for embedded technologies is taking place for the 15th year running. Trade visitors and conference delegates can already look forward to three exciting days at an event that is unrivalled in its compactness and offers direct contact with the most important trends and trendsetters.

Be it security for electronic systems, distributed intelligence, the Internet of Things or e-mobility and energy efficiency – the embedded world trade fair in Nuremberg enables you to experience the whole world of embedded systems.

Discover the innovations from the embedded sector, meet experts and acquire new customers: Over 930 exhibitors and numerous speakers from 42 countries will be presenting the entire spectrum – ranging from construction elements through modules and full systems, operating systems, hard and software to services – to more than 30,000 trade visitors and approximately 1,700 conference participants from 73 countries.

Extreme miniaturization coupled with increasingly higher computer performance, efficient communication of networked, often also mobile systems – the developers of embedded systems have to meet enormous requirements. The reliability of electronic systems, distributed intelligence, the internet of things and solutions for future themes such as e-mobility and energy efficiency are the main topics right at the top of the agenda for the embedded sector and industry.

Each year the embedded world Exhibition&Conference in Nuremberg offers the embedded community the opportunity to obtain information about new products and innovations, enter into an exchange and to maintain and develop valuable contacts. Around 900 exhibitors are presenting state-of-the-art technology in all facets of embedded technologies, from construction elements, modules and complete systems through to operating systems and software, hard and software tools right up to services covering all aspects of embedded systems.

Embedded World Conference

For years now the embedded world Conference has been the equivalent of a transfer of knowledge par excellence, as the meeting place of the most innovative embedded systems developers from all over the world, and at the same time the biggest European conference devoted to embedded systems development.

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Pictures from Previous years

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Using a Complementary Waveform Generator

› Mike Gomez, Microchip Technology

How a complementary waveform generator found in 8bit microcontrollers can help in motor driver applications

A complementary waveform generator (CWG) can be handy for when half-bridge and full-bridge control is needed, such as in motor driver applications, for example. Even better if the generator also has selectable input sources, polarity control, auto-shutdown and auto-recovery.

These functions can be provided as a peripheral in some 8bit microcontrollers with no processor overhead. Fig. 1 shows a block diagram of such a peripheral.

Each block in this diagram represents a feature of the CWG, which generates a complementary output from one of several selectable inputs. The output can be modified in different modes of operation, such as push-pull, half bridge, full bridge and steering PWM.

The clock source can be selected and used to insert a dead-band delay between the pair of complementary output waveforms. Each output pin has individual output enable control and the polarity of these pins can be controlled individually. The output can also be terminated immediately during a fault and recovered when the fault is removed.

Selections

Input sources can be external inputs to the CWGxIN pin or outputs from other internal peripherals. The input source selection bits are used for selecting the input source. The input sources and bit selection settings may vary from device to device.

Some of the available peripherals that can be used as input sources are the comparator, capture compare PWM (CCP), numerically controlled oscillator (NCC) and configurable logic cell (CLC). First, though, the selected peripheral should be configured as the CWG's input. For devices that have peripheral pin select (PPS), the CWGxIN input pin can be moved to any other pin with the PPS input selection register (xxxPPS). By changing the "xxx" notation in the register name to CWGxIN, any available IO pin can be selected as CWGxIN.

The CWG output can be modified to operate in any of the following modes: half bridge; forward full bridge; reverse full bridge; push-pull; and steering PWM. Mode selection is only available in some devices, where it can be selected by setting the mode selection bits. For example, Fig. 2 shows the output of the CWG in different modes of operation for the Microchip PIC16F161X family.

In half-bridge mode, two output signals are generated as true and

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inverted versions of the input. In forward and reverse full-bridge modes, three outputs drive static values while the fourth output replicates the input data signal. Toggling a bit in the register switches between forward and reverse mode. In push-pull mode, the output signals generated are alternating copies of the input. In steering PWM mode, enabling the steering enable bits allows the input event signal to be replicated to any or all of the four CWG outputs. When steering enable bits are cleared, the CWG output signal is determined by the steering data bits. When using a synchronous steering mode, the next rising input event is required before the changes on the steering enable bits take effect. While in non-synchronous steering mode, changes on the steering enable bits take effect on the next instruction cycle.

The reference clock for the dead-band control can be selected from several different clock sources using the clock selection bits. As with the input sources, the available clock sources may vary from device to device.

Dead-band control

Dead-band control provides non-overlapping output signals during half-bridge mode and direction changes during full-bridge mode. The signal prevents the cross conduction of external power switches. The selected clock source is used as a reference to create a delay.

A maximum of a 6bit value can be placed in the rising and falling dead-band counter registers to indicate the count of clock delay periods. When CWGxB goes low, the rising edge dead band starts to count and delays CWGxA for a ten-clock period before it goes high. Likewise, when CWGxA goes low the falling edge dead band starts to count and delays the CWGxB for a ten-clock period before it goes high.

Dead band is timed by counting the clock periods from zero up to the value in its respective count registers. There are instances when this time calculation may not be accurate and this is referred to as time uncertainty, as shown in Fig. 3. When the rising and falling sources that trigger the dead-band timer come from asynchronous inputs, such as the external input to the CWGxIN pin, it creates an uncertainty in the time.

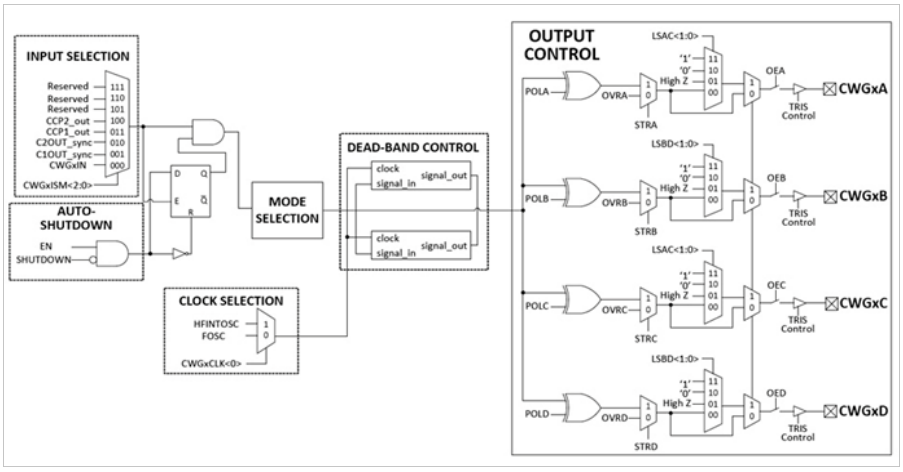


Fig. 1: Simplified block diagram of a complementary waveform generator

Auto shutdown

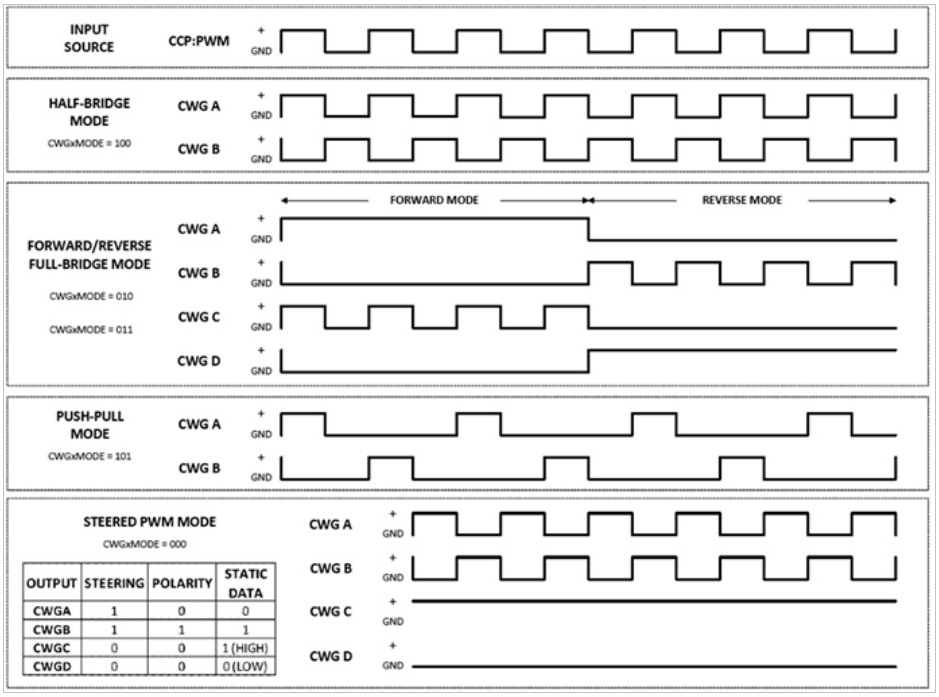
Auto shutdown – an active-low operation – can be triggered by a fault event source or by software execution. The fault event source can be selected using the auto-shutdown control register.

When the selected fault event goes low, the output pin will be in shutdown state. The output pin shutdown state can be selected as forced low, forced high, tri-state or inactive by selecting the auto-shutdown state control bits. Also, setting the shutdown bit of the auto-shutdown control register in software will force the output into shutdown state.

The shutdown state can be held until cleared by software or cleared automatically, which requires enabling auto-restart using the auto-restart enable pin.

Output enable

Each CWG output pin has its own enable control. When an output pin enable bit is cleared, the CWG has no connection to the output pin. When the output enable is set, the override value or active waveform is applied to the pin as per the internal port priority selection.



OUTPUT	STEERING	POLARITY	STATIC DATA
CWGA	1	0	0
CWGB	1	1	1
CWGC	0	0	1 (HIGH)
CWGD	0	0	0 (LOW)

Fig. 2: CWG modes of operation

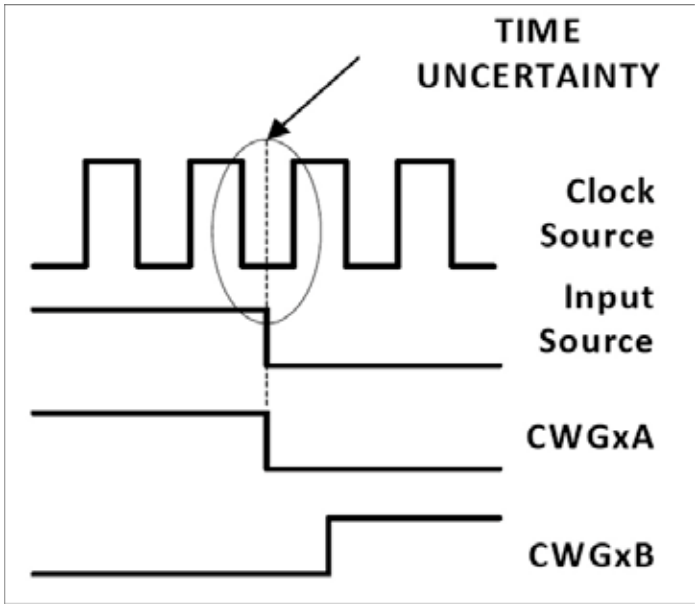


Fig. 3: Time uncertainty

Output control can be completely disabled by clearing the module enable bit. Output enables are selected in the CWG using the output enable bits. Setting the bit enables the output. By default, the complementary drive is configured as inactive in output while the complimentary drive is configured as active in output.

Some devices let the CWG output be moved from default pins to alternative pins using the alternate pin function. For devices that have PPS, there is no output control available. Instead, each device pin has an individual output selection controlled by the PPS register. When the output is not selected in the PPS register, the peripheral has no connection to the output pin.

Polarity control

Polarity control can be set to invert the output signal and the polarity of each CWG output can be selected independently. When the output polarity bit is set, the corresponding output will become active low. Clearing the output polarity bit configures the corresponding output as active high. Inverting the polarity of the output signal would allow two outputs to produce the exact same signal.

Configuration

Microchip's MPLAB code configurator (MCC) can be used to configure the CWG module. This user-friendly plug-in tool for the MPLAB X IDE generates drivers for controlling and driving peripherals of PIC microcontrollers based on settings and selections made in the GUI.

Conclusion

The complementary waveform generator found in Microchip's 8bit microcontrollers provides precise half- and full-bridge control for motor driver applications. There are selectable input sources as well as dead-band and polarity control. It can also provide auto recovery and shutdown.

Power Efficient Design for Wearable Electronics

› Mark Patrick, Mouser Electronics

There are not many people who doubt that one of the next big growth areas in the electronics industry will be wearables. Some predictions claim that the market for wearables could increase to $10bn by 2020. Reaching that target will depend on the user experience of the wearable, and one of the main attributes that users use to judge portable products is battery life. Squeezing every last drop of available life from the batteries is vital for designers of wearable devices. Users are looking for batter life measured in months, rather than hours.

To meet these exacting targets requires the designer to look into every aspect of the design, from the start up time of clocks, to the MOSFET switching times. This article will look at some of the methods that designers can use to save every joule of energy possible. Some advice will look at larger savings, and some on small. After all multiple small savings, soon add up to an overall larger one.

Sleep Mode

Sleep mode is a natural first step for any designer looking for a low power usage design. This will be especially important for wearable designs as they usually won't be powered totally down. Most wearables will take periodic sensor readings and either store the reading till it can be sent, or send the reading immediately. It makes sense to put the design into sleep mode between active periods. The device can be brought out of sleep mode by an interrupt, or by a physical input, such as a button push. How often the device is awake will depend on the application. Even within the application, sleep times can vary quite considerably. Dynamic sleep intervals are often used to allow the device to judge how often it needs to make measurements. In the case of a fitness device, it can wake and check for movement. If there is movement, it will intelligently narrow the time between measurements. In contrast, if there is a lack of movement, it can extend the time till the next measurement, prolonging battery life.

Communications between ICs

The communications protocol between devices can be important for energy saving. I2C uses pull-up resistors, which dissipate energy. SPI doesn't have pull-up resistors, so may prove a better choice. Another way that energy can be lost in communications is pin capacitance. To minimize this figure, reduce the

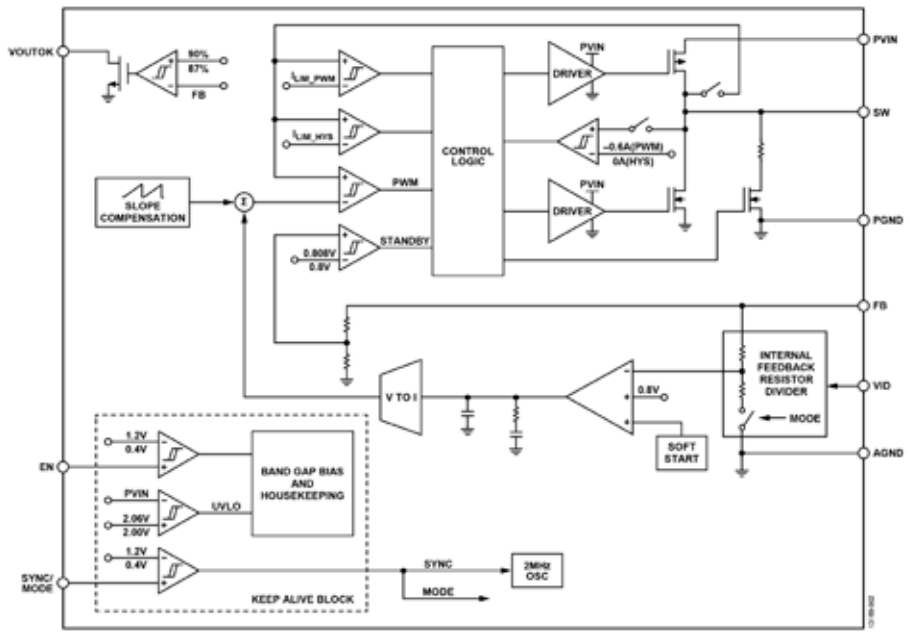


Figure 1: ADP5301 functional block diagram

data to be transferred as much as possible. To demonstrate how much energy can be lost, if four pins have a capacitance of 5pF in a system running at 20MHz from a 3.3V supply, 660µA will be drawn from just pin capacitance. This figure can be determined from the equation I = 0.5CVf. The current drawn will be the total of both the data sent and received, which can mount up. This figure can be cut by using a highly integrated chip. Internal communications don't suffer from pin capacitance, therefore having more peripherals on-board is better from a power consumption point-of-view. On-chip RAM and flash memory offer the same power savings.

An Efficient Power Supply

Choosing a switching regulator for a switched mode power supply is a key factor in maximizing efficiency. This is particularly true for synchronous regulators where efficiencies of over 95% are possible. However, it is not just headline efficiency, or even standby efficiency, that is necessarily the most critical factor. It is necessary to look at the current in different modes for the device and determine the contribution to overall power consumption from each mode after taking into account the switching regulator efficiency at each current level. There are some quite impressive regulators around though, such as the new Analog Devices ADP5301 Step-down Regulators.

The quiescent current of these devices is down as low as 180nA when not-switching, but still operating in hysteresis mode. It will switch for a short burst to add charge to the output capacitor using the inductor at very light loads, then return to just the quiescent current. The low quiescent current can give efficiencies as high as 80% at 1µA depending on the input and output voltages. It is more likely that there will be lower figures in practice than this optimum value, but they should still be above 40%. The devices also deliver up to 0.5A and have a single pin programmable output with a fixed resistor. These figures are very impressive compared to older regulators, which would take a few milliamps with no load.

If you are using a switching regulator with an external MOSFET, bear in mind that the MOSFET switching time can result in significant losses. The transition from non-conducting to conducting is the time when a switching MOSFET dissipates the most power. When it is turned fully on, the voltage drop will usually be very small and hence power dissipation will be low. However, partly turned on there will be a significant voltage drop across the MOSFET accompanied by significant current. You therefore want to minimize the time that the transistor spends in that state by choosing a fast switching device and low gate capacitance. Low ON resistance is a must.

Power Supply Shutdown

You can keep power supply capacitors small if power supplies are shut down in sleep mode. It takes energy to charge them and if the power supply is shut down when in a sleep mode then the energy in the capacitors is normally wasted. For example, a 1µF capacitor on the power supply of circuitry which is shut down 100 times per second will consume 165µA at 3.3V (same calculation as before). Many ICs will take less than that in shutdown or sleep mode, so it is often better to keep circuitry powered but in a sleep state than to actually do power switching to save power. The exception to this advice would be if the device used didn't have a sleep mode or if its sleep mode was not

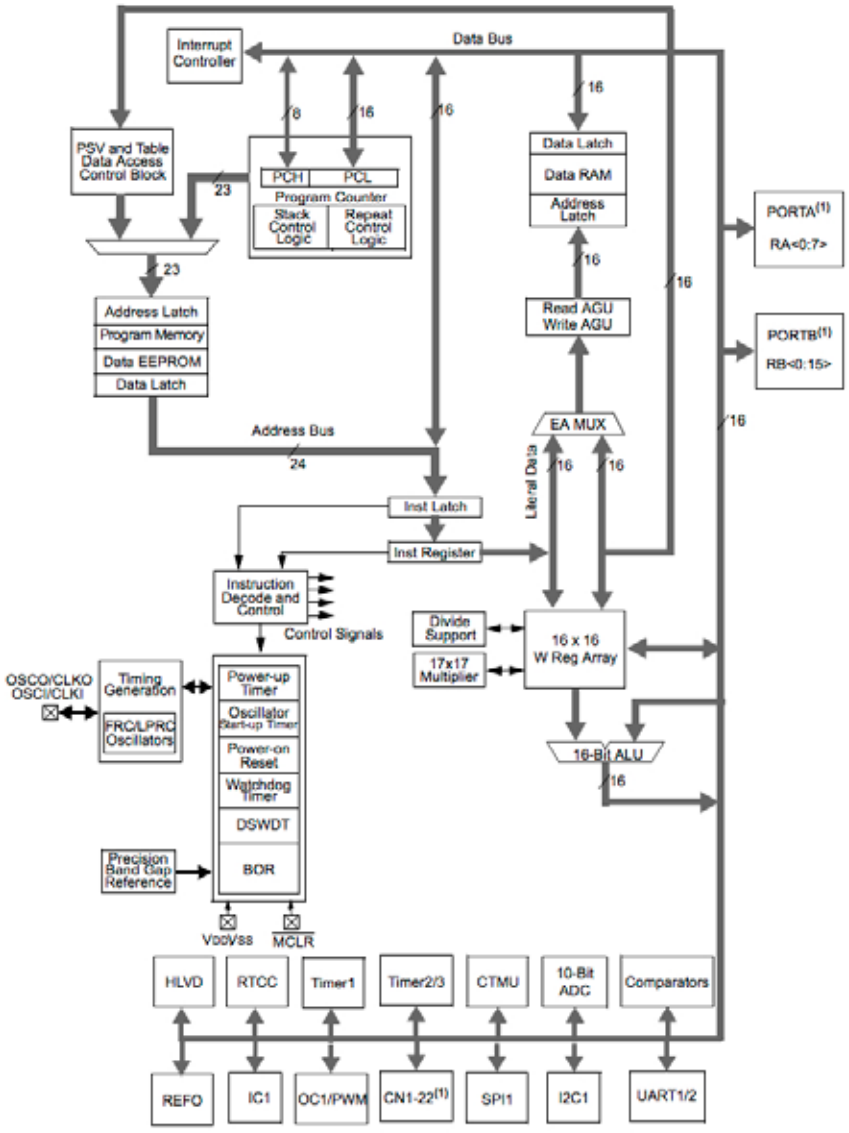


Figure 2: nRF52832 block diagram

low current. If you can use 100nF instead of 1µF you could save a lot of energy.

Low Supply Voltage

Devices will consume less power at lower voltage even if they don't consume less current. Therefore, if a microcontroller is powered by 1.8V instead of 3.3V, power consumption will be around half for the same current. Usually digital devices will also consume less current at lower voltages, so the power is further reduced. Look out for the maximum clock speed also being reduced - it is not uncommon for the maximum clock speed to be lower at lower voltages. So, while the current will be lower, it will also take twice as long to run the microcontroller's code.

For example, a Microchip nanoWatt XLP PIC24F16KA102 microcontroller running at 2MHz consumes 695µA at 3.3V, but it only requires 363µA at 1.8V, which is 70% less power - a massive saving. However, at 3.3V the microcontroller can run at a maximum speed of 32MHz, while at 1.8V the top speed is 8MHz.

Clock Speeds

Choose the clock speed to suit the application, not just the fastest possible. This probably won't be known until the code is finished. Most microcontrollers have an adjustable clock multiplier, allowing the clock speed to be changed by the application code. If the microcontroller code is the limiting factor in terms of executing the code and going back to sleep, then the fastest processor may also be the most efficient. However, if something else will actually be slowing things down and the microcontroller will be "marking time", the microcontroller could be woken by a periodic interrupt instead.

An alternative approach would be to dramatically slow down the processor when it is just "waiting" and then speed it back up when there is something to do. Ideally you would sleep instead, but clock startup times and the power wasted while waiting for the clock to stabilize can mean sleep is not the best option in some circumstances.

Clock Startup

Power is wasted while waiting for the system clock to stabilize. If code can be run while the clock is still settling then that can help, but if there is any other part of the circuitry relying on a stable, accurate clock the processor has to wait, resulting in wasted energy. Some microcontroller manufacturers' clocks are quicker to start than others.

32-bit Microcontrollers

Does every design really need a

32-bit processor? They seem to be everywhere but the work actually being done by them can be minimal. A 16-bit or 8-bit microcontroller may be more efficient in some applications. It does depend on what code is running and the efficiency of the compiler. If there is a Bluetooth or Internet interface, then more memory may be required and a 16-bit or 32-bit processor should be used. A TCP/IP stack with a web server also requires a 32-bit processor. Creative software writing can minimize the resources needed and therefore minimize power consumption.

Wider data width processors consume more power in a number of ways. Accessing 32-bit RAM and Flash memory is more power hungry than accessing 16-bit memory. Also, leakage current increases with wider memory. That points towards keeping memory size to a minimum both by efficient code structuring and writing, and also not choosing a processor with massive amounts of excess memory.

RF power

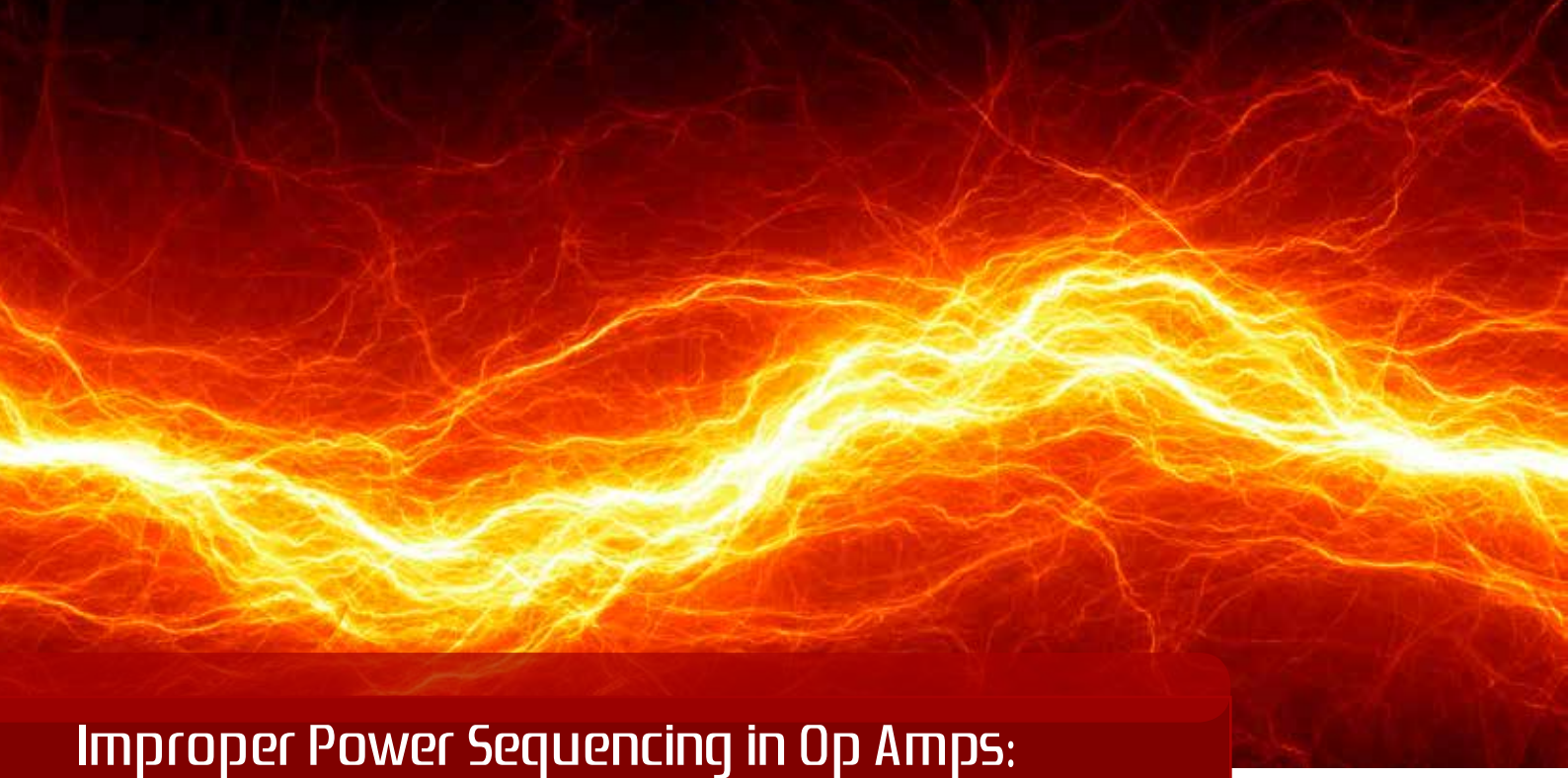
If there is a RF wireless interface, e.g. Bluetooth Smart, consider the transmitting distance. Not only are there power savings by transmitting with lower power, the receiver sections can have adjustable sensitivity and will take less power when sensitivity is set lower. For example, the Nordic Semiconductor nRF52832 has a high receiver sensitivity mode using 10.9mA but normal sensitivity only takes 6.1mA.

Custom ICs

The ultimate lower power solution might be a full custom IC design with only the required circuitry. Circuitry that never drives off-chip consumes a lot less power. However, it is the slowest and most expensive way of developing a product. It is also probably why a Frederique Constant Smartwatch battery lasts 2 to 3 years and a Fitbit Flex lasts 3 to 5 days.

Summary

There are a lot of aspects to consider when designing a low power system. It can be a good idea to create a spreadsheet with all the parts of the system listed with current consumption, required duty cycles, voltages and total power consumed. Then for each design scenario calculate the projected power consumption. The only way to find out some of the information needed is to actually build a prototype and test it.



Improper Power Sequencing in Op Amps: Analyzing the Risks

› David Guo, Analog Devices

Introduction

In systems with multiple supply voltages, operational amplifier power supplies must be established simultaneously with or before any input signals are applied. If this doesn't happen, overvoltage and latch-up conditions can occur.

However, this can sometimes be a difficult requirement to meet in realworld applications. This article takes a look at the activity of op amps in different power sequence situations (see Table 2), analyzes possible issues, and presents some suggestions.

Power Sequencing Issues Can Vary

There are a number of different scenarios where power sequencing issues may arise. For example, in one customer application, an AD8616 can be configured as a buffer, the input is 0 V before power supplies are established (Figure 1), and the negative supply is powered on before the positive supply (negative power is present and positive power is absent).

Table 1 shows the results of all AD8616 pins in such conditions. Before V+ is applied, the voltage at the V+ pin and OUT pins is negative. This may not damage the op amp, but if these signals are connected to terminals on other chips that haven't been fully powered (for example, assuming the ADC uses the same V+, and its power pin normally tolerates only –0.3 V minimum voltage), the chips may suffer damage. A similar issue will happen if V+ is powered up before V–.

Electrostatic Discharge (ESD) Diodes Within Op Amps

Electrostatic discharge can also result in an overvoltage event. Most op amps have an internal ESD diode to prevent electrostatic ESD events. ESD diodes can provide a key to analyzing activity when either V+ or V– is absent. Figure 2 is a simplified block diagram of the ADA4077/ADA4177. Table 3 shows the ADA4077-2/ADA4177-2's typical drop voltage of internal ESD diodes and back-to-back diodes. Notice that back-to-back diodes are placed between the two input terminals of the op amps to clamp the maximum differential input signal.

Also note that when DMM is used to measure D5/D6 of the ADA4077-2, it shows no diode between the two input terminals. In fact, there are two series of resistors before the back-to-back diodes to limit input current smaller than ±10 mA. The internal resistors and back-to-back diodes limit the differential input voltage to ±Vs to prevent a base-

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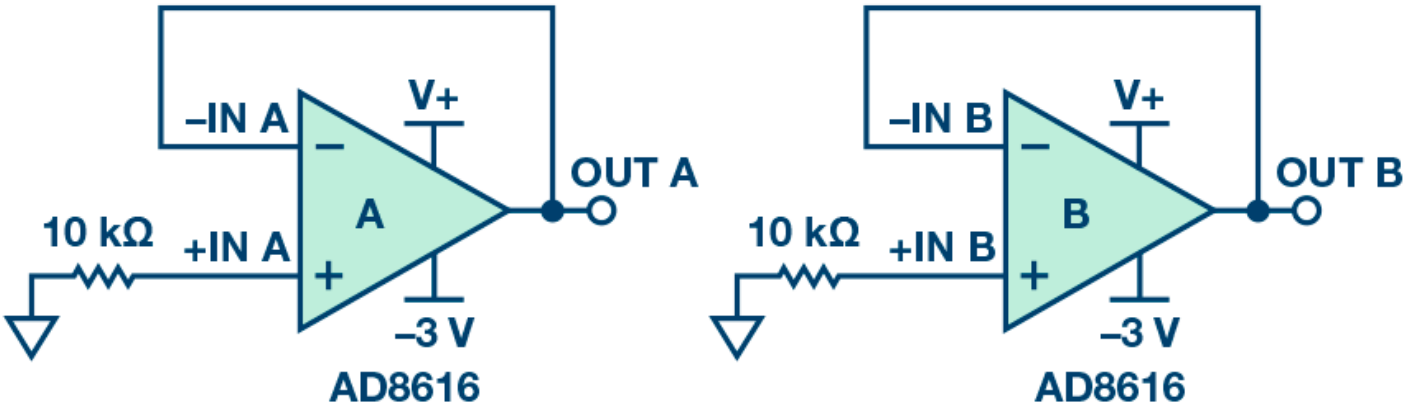

Figure 1. AD8616 test circuit with -3 V V- applied and V+ absent

Pin1: OUTA	Pin2: –INA	Pin3: +INA	Pin4: V –	Pin5: +INB	Pin6: –INB	Pin7: OUTB	Pin8: V+
–1.627	–1.627	–0.959	–3.000	–0.959	–1.627	–1.627	–1.627

Table 1. AD8616 Pins' Voltage with –3 V V– Applied and V+ Absent

	IN	V+	V–	Amplifier Power with Load	Amplifier Out with Load
Case 1	Floating Floating	Present Absent	Absent Present	No No	No No
Case 2	0 V 0 V	Present Absent	Absent Present	No No	No No
Case 3	Positive or negative Positive or negative	Present Absent	Absent Present	No No	No No
Case 4	Positive or negative Positive or negative Positive or negative Positive or negative	Present Present Absent Absent	Absent Absent Present Present	Yes No Yes No	No Yes No Yes

Table 2. Possible Situations in Power Sequencing

emitter junction breakdown.

For the ADA4177, OVP cells are integrated for robustness. They are placed before the ESD diodes and back-to-back diodes, so it's hard to measure these diodes by DMM. The output ESD diodes of ADA4177 can be measured.

Evaluation Setup

Figure 3 is used to measure the activity of the op amp. Channel A and Channel B are each configured as a buffer, and the Channel B noninverting input is connected to the GND by a 100 kΩ resistor. By making V+ absent (V– present) or V+ present (V– absent), the input and power-related variables can be measured by the ampere and voltage meters. "By analyzing these variables, we can determine the current flow path.

Case 1: Input Is Floating

Table 4 shows the results of a floating input and one absent supply. When V– is present and V+ is absent, there is a negative voltage at the V+ pin. When V+ is present and V– is absent, there is a positive voltage at the V– pin.

Testing the ADA4077-2 and ADA4177-2 reveals similar results. No large currents are observed at the input pins and power pins, and the op amp with floating input remains safe when a power rail is absent.

Case 2: Input Is Grounded

Table 5 shows the results when the

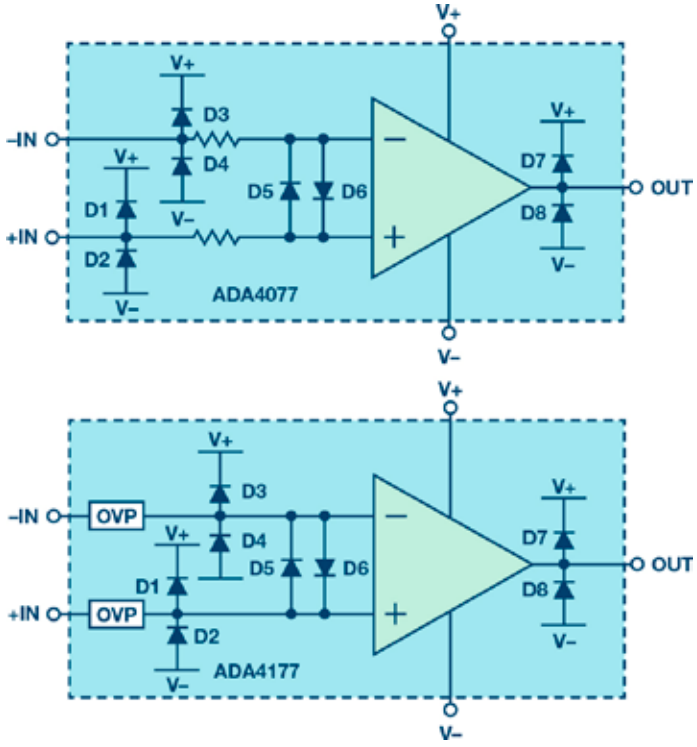

Figure 2. ADA4077/ADA4177 simplified block diagram

	ADA4077	ADA4177
D1	0.838	Unknown
D2	0.845	Unknown
D3	0.837	Unknown
D4	0.844	Unknown
D5	Unknown	Unknown
D6	Unknown	Unknown
D7	0.841	0.849
D8	0.842	0.849

Table 3. Internal Diode of an Op Amp

input is grounded. Note for IB+, a negative value means the current flow out of the +IN terminal. For IOUT, a negative value means the current flow out of the –IN terminal. Taking ADA4077-2 with V+ absent as an example, V+ is clamped to the VIN voltage by an ESD diode.

VIN is connected to V+ via an ESD clamp diode, so when VIN is 0 V, V+ is –0.846 V.

Current flow path loop: as the red path shown in Figure 4, 0.7 mA current flows from GND (+IN) to V+. 1.6 mA current flows from GND (+IN) through an internal resistor, D5 and the feedback path between –IN and OUT, then the current flow into output terminal. Finally the two currents (0.7 mA and 1.6 mA) combine to flow to –15 V, and the combined current flows back to GND (+IN).

Results are similar between the ADA4177-2 and ADA4077-2. Note that within the ADA4177-2, D1 is implemented by an emitter base of a lateral PNP transistor. The transistor routes the overvoltage current away from the V+ to the V–. The ADA4177 circuit in Figure 4 shows 9.1 mA current flow from V+ back to V– , and combined with 0.2 mA current in the feedback path, results in a 9.3 mA current flow to –15 V, then the current flows back to GND.

No large currents are observed at the input pins and power pins for either the ADA4077-2 or the

	Condition	V+	V–	ISY+ (mA)	ISY– (mA)	IB+ (mA)	IOUT (mA)	IN (V)	OUT (V)
ADA4077-2	All power	15	–15	1.02	1.01	–0.00005	0.00007	0.001	–0.008
	V+ absent	–13.1	–15	0	0.12	–0.00001	0.001	–13.73	–14.42
	V– absent	15	13.06	0.15	0	–0.00001	0.001	12.93	13.62
ADA4177-2	All power	15	–15	0.98	0.96	–0.00001	0.00002	0	0.001
	V+ absent	–14.26	–15	0	0.14	–0.00002	0.00137	–13.77	–13.78
	V– absent	15	12.96	0.14	0	–0.00001	–0.00039	12.26	12.31

Table 4. ADA4077-2/ADA4177-2 Results with Floating Input

ADA4177-2 (Table 5). These op amps can withstand any order of PU sequencings in a gain of +1 with +IN grounded.

Case 3: With Input

A positive or negative signal (+10 V or –10 V) is applied to the +IN terminal when one power is absent. Table 6 shows no large current, so these op amps can withstand any order of PU sequencings in a gain of +1 with +IN grounded for a short duration.

The current flow path analysis is similar with Case 2 (0 V input), refer to Figure 5.

Case 4: With Input and with Load at Power/ Output

In a real application, the op amp circuit may work with another circuit. For example, the op amp's output may drive a load, or the op amp's power supply may also power other circuits. This can cause a problem.

In this test, a 47 Ω resistor is connected between the output and GND or the absent power pins and GND. Table 7 shows the test results for the ADA4077. Large currents are highlighted in red. Three possible situations can pose risks, assuming V+ is absent:

Situation 1: When the input is 10 V and the load of OUT is 47 Ω, the output is 1.373 V. When there is a 23 mA current flow out of the op amp's output pin (refer to Figure 6) the current path is:

- Input signal source supply 30.2 mA current
- 24 mA current flow through D1 to V+, and 6.2 mA current flow through D5 and feedback path to OUT

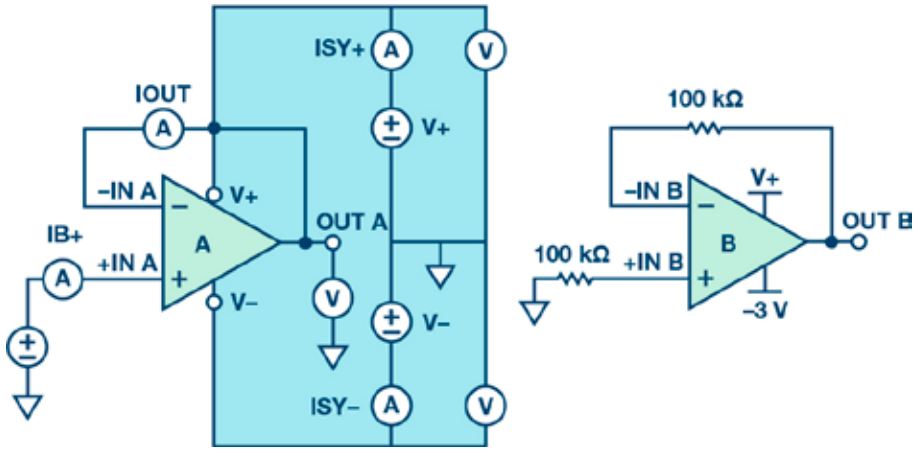

Figure 3. Setup for power sequencing test

	Condition	V+	V–	ISY+(mA)	ISY-(mA)	IB+(mA)	IOUT(mA)	IN(V)	OUT(V)
ADA4077-2	All power	15	–15	1.01	1	–0.00005	0.00001	0	-0.019
	V+ absent	–0.846	–15	0	2.30	2.300	-1.60	-0.017	–2.68
	V– absent	15	0.847	1.78	0	–1.758	1.064	0.012	2.116
ADA4177-2	All power	15	–15	0.98	0.96	–0.00001	0.00002	0	0
	V+ absent	–11.99	–15	0	9.3	9.300	–0.200	-0.068	–11.98
	V– absent	15	1.848	1.84	0	–1.823	0.067	0.013	1.851

Table 5. ADA4077-2/ADA4177-2 Results with Grounded Input

	Condition	V+	V–	ISY+ (mA)	ISY– (mA)	IB+ (mA)	IOUT (mA)	IN (V)	OUT (V)
ADA4077-2	All power	15	–15	1.03	1.01	0.00098	–0.00003	10	9.97
	V+ absent and positive input	9.14	–15	0	2.4	2.396	–1.653	9.99	7.3
	V+ absent and negative input	–10.83	–15	0	2.41	2.308	–1.651	–10.02	–12.66
	V– absent and positive input	15	10.83	1.81	0	–1.689	1.055	10.02	12.09
	V– absent and negative input	15	–9.15	1.77	0	–1.759	1.031	–9.99	–7.88
ADA4177-2	All power	15	–15	1.02	1	–0.00099	–0.00009	9.99	9.97
	V+ absent and positive input	–9.09	–15	0	8.86	8.866	–0.113	9.92	–9.06
	V+ absent and negative input	–12.33	–15	0	4.31	4.18	–0.039	–10.02	–12.32
	V– absent and positive input	15	11.42	1.33	0	–1.2	0.056	9.99	11.43
	V– absent and negative input	15	–8.33	1.51	0	–1.492	0.062	–9.97	–8.32

Table 6

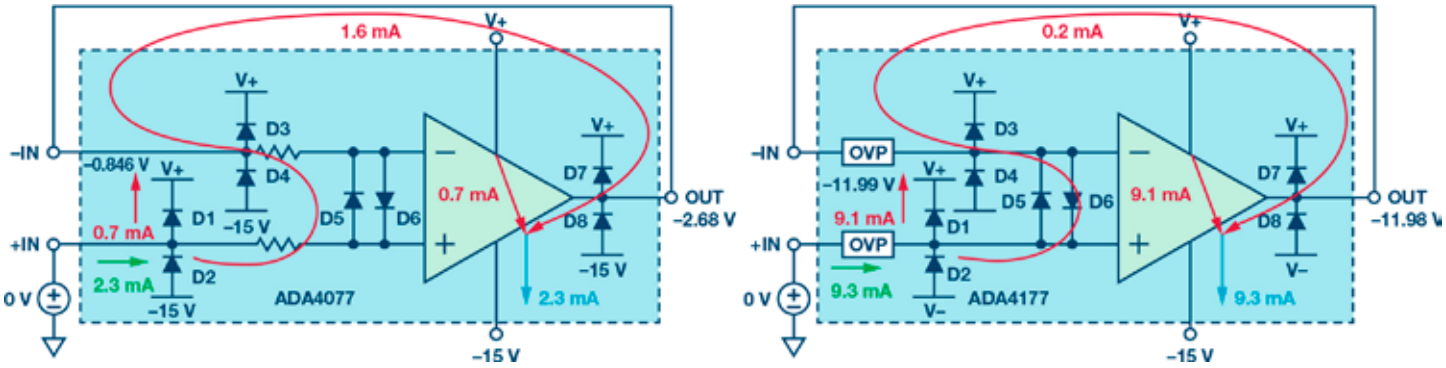

Figure 4. ADA4077/ADA4177 current path when V+ is absent (input grounded)

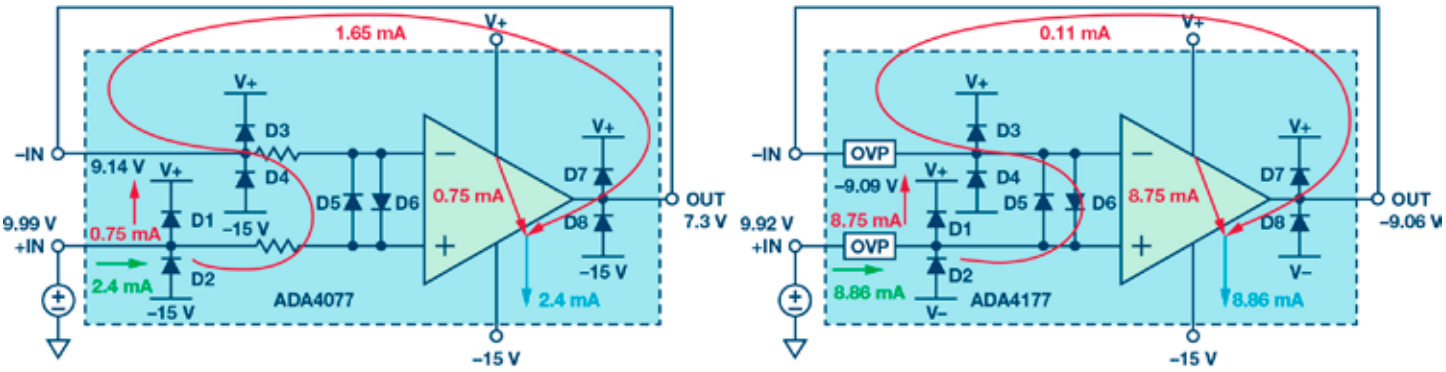

Figure 5. ADA4077/ADA4177 current path when V+ is absent (10 V input)

- 24 mA current from V+ is divided to 1 mA (to V–) and 23 mA (to OUT) 29.2 mA current flow through 47 Ω load to GND
- The current needs to be limited. By adding a 1 kΩ resistor at +IN, the input current is decreased to 6.8 mA.

Situation 2: When the input is 10 V and the load of V+ is 47 Ω, 170 mA current flows into the ADA4077-2 and flows out of V+ pin to a 47 Ω power load. 170 mA current will burn the internal diode and damage the chip. By adding a 1 kΩ resistor at +IN, the input current is decreased to 8.9 mA. Figure 7 shows the current flow path.

Situation 3: When input is negative (–10 V) and the load of OUT is 47 Ω (refer to Figure 8), there is a 48 mA current that flows through the chip. This will generate a 48 mA × (–2.5 V + 15 V) = 0.6 W power dissipation. Considering the ADA4077-2's 158° C/W θJA , the junction temperature is 94.8° higher than the ambient temperature. If there are two channels or there is a heavier load, the junction temperature may be higher than 150°, and the chip may be damaged.

Instead of adding a current-limiting resistor at the input, the resistor should be added at the output.

When V+ is present and V– is absent, the same phenomena will happen. By adding external resistors to limit the current, the circuit can be more robust.

For ADA4177-2, only Situation 3 applies. When there is a large negative input and a heavy load at the output at the same time and when V+ is absent and there is 53 mA current flow through the chip, the power dissipation may be increased and the junction temperature is increased (refer to Figure 9). By adding a 1 kΩ resistor at the output, the risk can be avoided.

Of the two op amps, the ADA4177-2 is more robust than the ADA4077-2. It is a preferred choice for applications that require both precision and robustness.

Other Op Amp Activity in Power Sequencing

Among op amps, there are varying implementations of diodes, resistors, and OVP cells. Some op amps have no internal OVP cells, some have no back-to-back diodes.

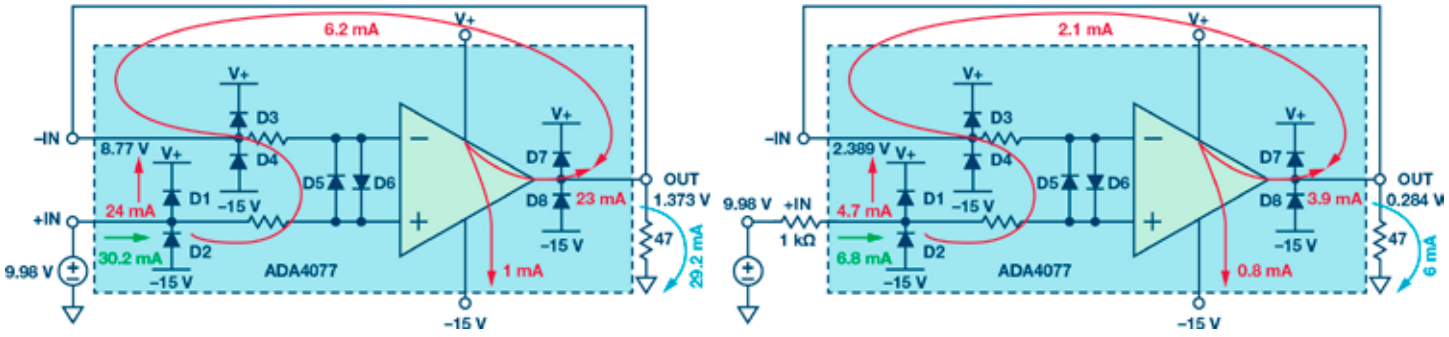

Figure 6. ADA4077 current path when V+ is absent (10 V input and 47 Ω output load)

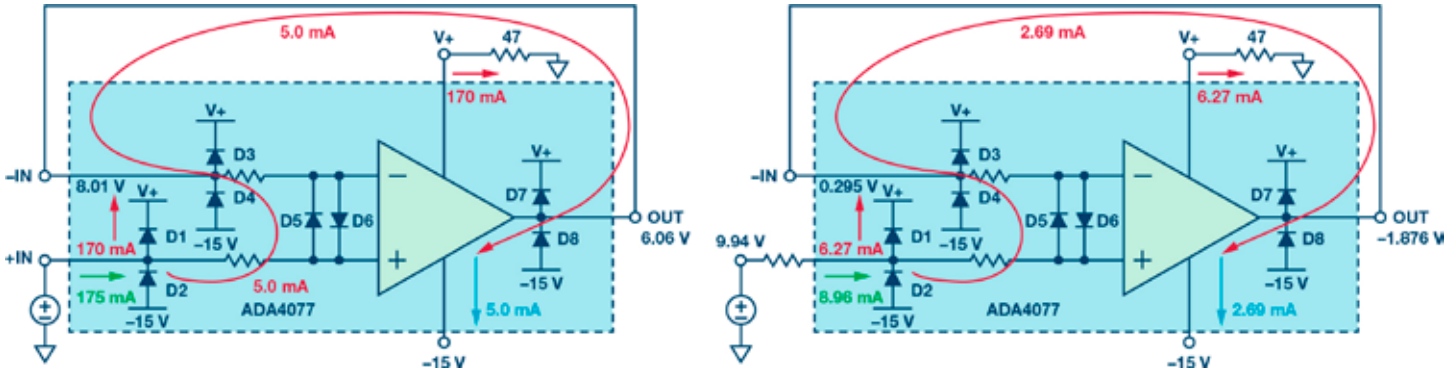

Figure 7. ADA4077 current path when V+ is absent (10 V Input and 47 Ω power load)

ADA4077-2	Condition	IN (V)	V+	V–	ISY+ (mA)	ISY– (mA)	IB+ (mA)	IOUT (mA)	OUT (V)
V+ absent	Vo or V+ no load/positive input	9.99	9.14	–15	0	2.4	2.396	–1.653	7.3
	Vo 47 Ω to GND	9.98	8.77	–15	0	1.00	30.22	–6.174	1.373
	Vo 47 Ω to GND and 1 kΩ	9.98	2.389	–15	0	0.76	6.828	–2.104	0.284
	V+ 47 Ω to GND	9.59	8.01	–15	170	5.05	175	–5.0	6.06
	V+ 47 Ω to GND and 1 kΩ	9.94	0.295	–15	6.27	2.69	8.96	–2.69	–1.876
	Vo or V+ no load/negative input	–10.02	–10.83	–15	0	2.41	2.308	–1.651	–12.66
	Vo 47 Ω to GND	–9.97	–3.226	–15	0	48.6	–4.65	4.885	–2.501
	Vo 47 Ω to GND and 1 kΩ	–10.02	–10.83	–15	0	14.30	2.284	–1.629	–0.563

Figure 5: ADRF6780 sideband suppression and carrier feedthrough nulling

A different implementation will produce different results if one power supply is absent. In addition, different op amp designs can produce different results.

For example, the ADA4084-2 has no internal current-limiting resistor or OVP cells, and it has ESD diodes connected to the power supply and back-to-back diodes. Table 9 and Figure 10 show the results when V+ is absent and there is 10 V input. The ADA4084's activity and current path are similar to those of the ADA4077-2 and ADA4177-2 (discussed previously in Case 3). However, because the ADA4084 has no internal resistor or OVP cell to limit the current, 60 mA current will flow into the chip, which may cause damage.

In system applications, different op amps, different topology (such as noninverting amplification, inverting amplification, and difference amplification), different load, and external connections can be implemented. If one power supply is absent, the risks need to be evaluated. This article can provide guidance on setting up the evaluation circuit (Figure 2), how to analyze the current path, and

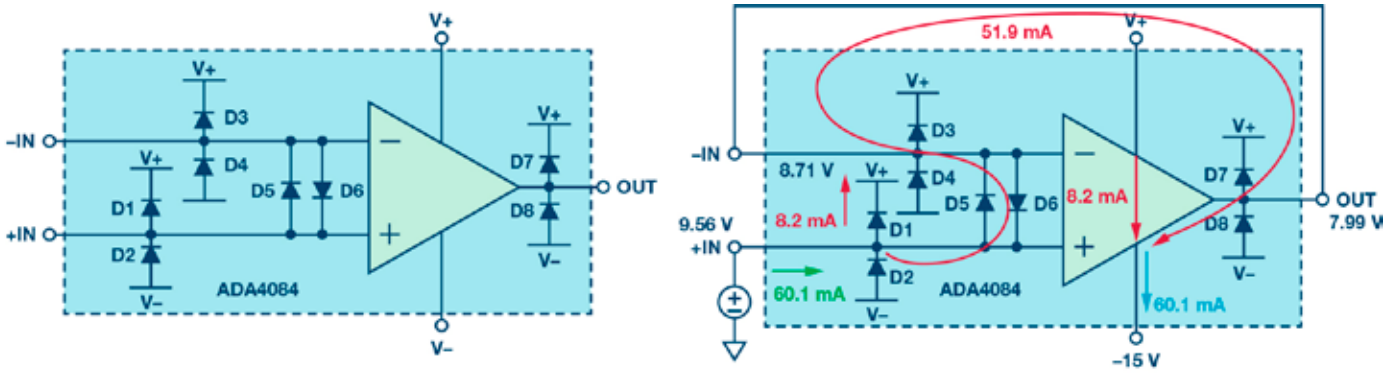

Figure 8. ADA4077 current path when V+ is absent (–10 V Input and 47 Ω output load)

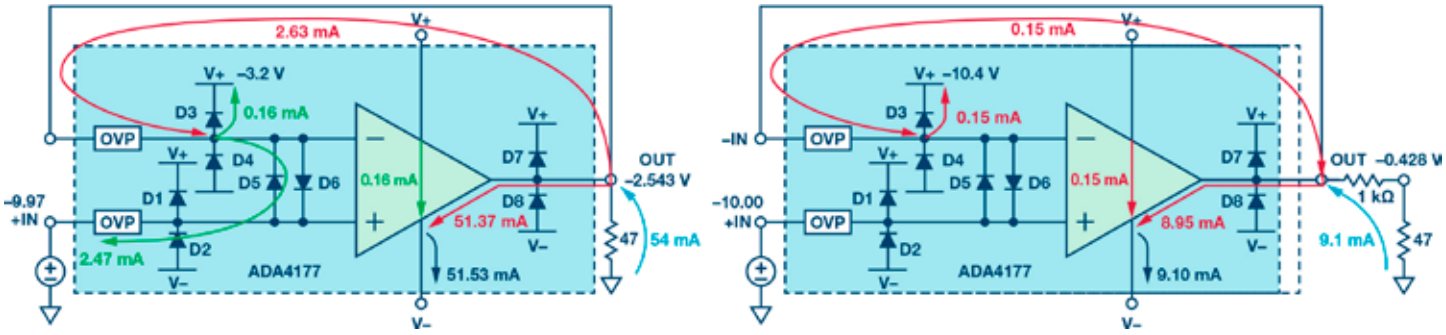

Figure 9. ADA4177 current path when V+ is absent (–10 V Input and 47 Ω output load)

evaluate the potential risks.

Summary

To avoid overvoltage or latch-up situations, operational amplifier power supplies must be established simultaneously. General guidelines are:

- During the Power On sequence, turn on the supply first, then apply a signal at the input
- During the Power Off, turn off the input signal first, then turn off the power supply

In real-world applications, these guidelines may be difficult to adhere to. This can cause problems, especially when there is an input signal, and designers need to properly evaluate the risk. An effective solution is try to limit the input current of the op amp so it is within the spec in the data sheet. Adding a current-limiting resistor at the input and output can help in applications where power can't be supplied at the same time.

We tested three ADI op amps in a power supply absent application (ADA4084-2, ADA4077-2, and ADA4177-2). When integrated with internal resistors, the ADA4077-2 proved to be very robust. The ADA4177, when integrated with an OVP circuit, delivered the best robustness. In applications where the power may be absent, and external current-limiting resistors can't be added, the ADA4177 is recommended to avoid degrading the precision.

References

- ADA4077. Analog Devices, Inc.
- ADA4177. Analog Devices, Inc.
- Arkin, Michael and Eric Modica. "Robust Amplifiers Provide Integrated Overvoltage Protection." Analog Dialogue, Volume 46, Number 1, 2012.
- Blanchard, Paul and Brian Pelletier. "Using ESD Diodes as Voltage Clamps." Analog Dialogue, Volume 49, Number 10, 2015.

For more information on the ADA4177 and ADA4077, see the product pages and data sheets here: ADA4177 and ADA4077.

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R&S Scope Rider A multitalent for debugging in the field

› Dr. Markus Herdin, Rohde & Schwarz

Portable instruments are ideal for installation, maintenance and emergency work on electrical and electronic systems. Sources of faults can be varied, ranging from problems with the power quality to faulty behavior of electronic systems in the target system. Rohde & Schwarz developed the R&S Scope Rider for such applications. The rugged handheld oscilloscope offers the performance of a lab instrument in the compact format of a handheld device.

Sleep Mode

Automation in building and production technology is progressing rapidly. Systems are controlled by bus systems, have wireless, web, and/or LAN interfaces and consist of modern electronic components. Disturbances can arise from a variety of causes. Insufficient power quality can lead to sensitive electronic devices operating unreliably. A drive's strong electromagnetic fields can affect control signals and lead to faulty behavior. The new handheld oscilloscope from Rohde & Schwarz is the all-in-one solution for such situations. It offers the operational safety to safely measure the AC supply voltage/mains voltage and simultaneously analyze sensitive signals in electronic circuits.

Safely measure power quality

If hazardous live voltages need to be measured, users have to pay special attention to the instrument's IEC 61010-1-compliant measurement category. In a CAT IV environment – upstream of the main fuse of a building's power supply – overvoltages of up to 8000 V can occur when measuring a maximum voltage of 600 V. The safety of the user is only guaranteed if the measuring instrument was developed for these overvoltages and has the corresponding certification. The R&S Scope Rider is certified for voltage measurements up to 600 V for CAT IV environments and up to 1000 V for CAT III environments. It can therefore be used for power quality monitoring at all points of the installation.

The galvanic isolation of the input channels relative to one another is also crucial. With a conventional oscilloscope, inadvertently switching the ground and signal wires leads to a short circuit with potentially devastating consequences. The isolated channels of the R&S Scope Rider prevent this problem and also allow simultaneous differential measurement. Expensive differential probes are unnecessary, for example, when measuring power electronics.

Fig. 1: Suitable for all applications – as a two-channel instrument with integrated multimeter for field use or with four input channels for analyzing electronic circuits. Source: Rohde & Schwarz

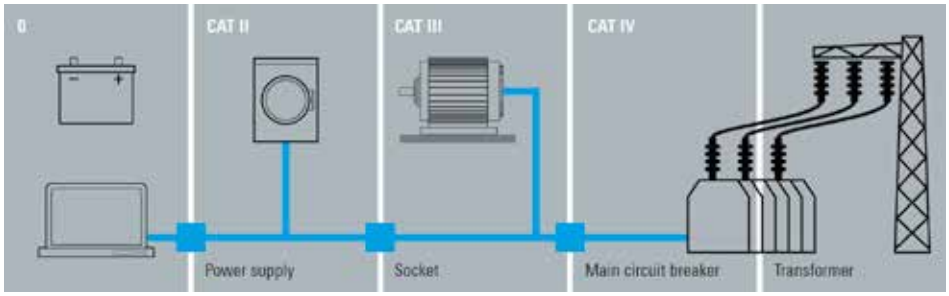

Fig. 2: To ensure the user's safety, measuring instruments need to be certified for the respective measuring environment. The R&S Scope Rider offers maximum safety and flexibility during measurements, with a certification of up to 600 V in a CAT IV environment and up to 1000 V in a CAT III environment. Source: Rohde & Schwarz

Detect sporadic network interruptions

A common problem in electrical installations are loose contacts, which leads to sporadic interruptions in the power supplies. These interruptions can be triggered by mechanical vibrations and be so brief that they are not noticeable for normal electrical loads, but nonetheless interfere with the functioning of sensitive electronic equipment.

The various trigger functions of the R&S Scope Rider allow it to specifically detect and analyze root causes. Short interruptions of the power supply, for example, can be detected easily and effectively with the pulse width trigger.

Measurements on drives and power electronics

A common application is monitoring and maintaining electrical drives and power electronics or electrical equipment in general. Thanks to the automatic measurement functions, power parameters such as apparent, active and reactive power and even the power factor can be directly and simply measured. The integrated data logger allows the user to automatically record the configured measurements for up to 23 days and analyze long term trends simply by switching to the logger mode.

Analysis of serial protocols made easy

The trigger and decode functions of the Rohde & Schwarz Scope Rider help users analyze serial protocols to check the communications between individual electronic modules. These functions can be used to analyze digital communications and to specifically trigger on specific data packets. Users can determine whether UART, CAN or LIN control commands sent are received and processed correctly by the tested module. The ability to load symbolic labels into the device and select the desired control commands via text labels makes it even easier to work with the instrument. The

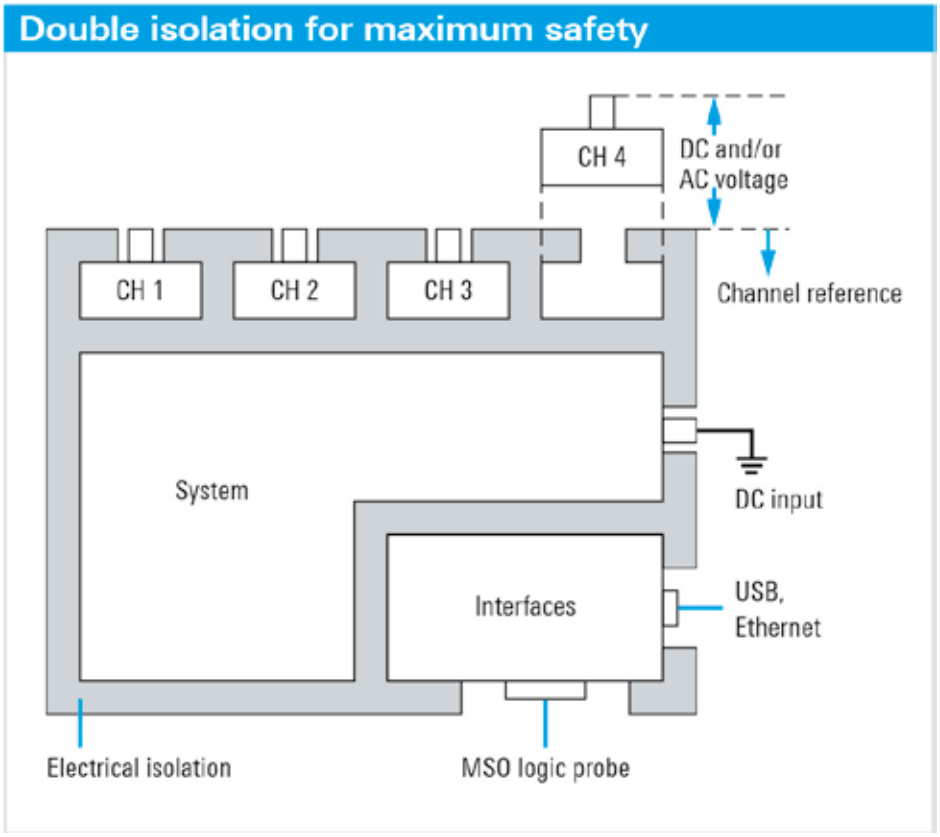

Fig. 3: The isolated input channels prevent short circuits caused by inadvertent swapping of ground and signal wires at two oscilloscope inputs. Power electronics measurements can be safely performed. Source: Rohde & Schwarz

Fig. 4: Powerful trigger functions make it possible to specifically detect power quality problems. Brief power supply interruptions due to poor contacts are quickly detected with the pulse width trigger. Source: Rohde & Schwarz

Rohde & Schwarz Scope Rider is the only handheld oscilloscope on the market with powerful triggering and decoding capabilities and symbolic labels.

Simple operation

In daily service and maintenance, it is crucial to identify and solve root causes of problems. Each additional hour of work costs money and system downtime can be costly. Equipment for service and maintenance tasks must therefore be especially easy to use since there is no time for long learning phases. This is why particular attention was given to the operating concept when developing the handheld oscilloscope. The touchscreen makes operation simple, similar to a smartphone. Deep menu levels were avoided and settings for the most important functions can be accessed directly via the keypad. The extra-large keypad layout makes the instrument easy to operate even when wearing gloves.

For especially unpleasant or dangerous measurement situations, the oscilloscope can be controlled directly from a web browser on a PC, tablet or notebook via the integrated WLAN module. The oscilloscope can then be conveniently and safely operated from afar.

Five instruments integrated into a single handheld oscilloscope

Troubleshooting in the field often requires a variety of measurement functions. This is why the R&S Scope Rider integrates four essential measuring instruments in addition to the oscilloscope function:

- Logic analyzer with eight additional digital channels
- Protocol analyzer with trigger and decoder functionality for debugging serial protocols
- Data logger for long-term

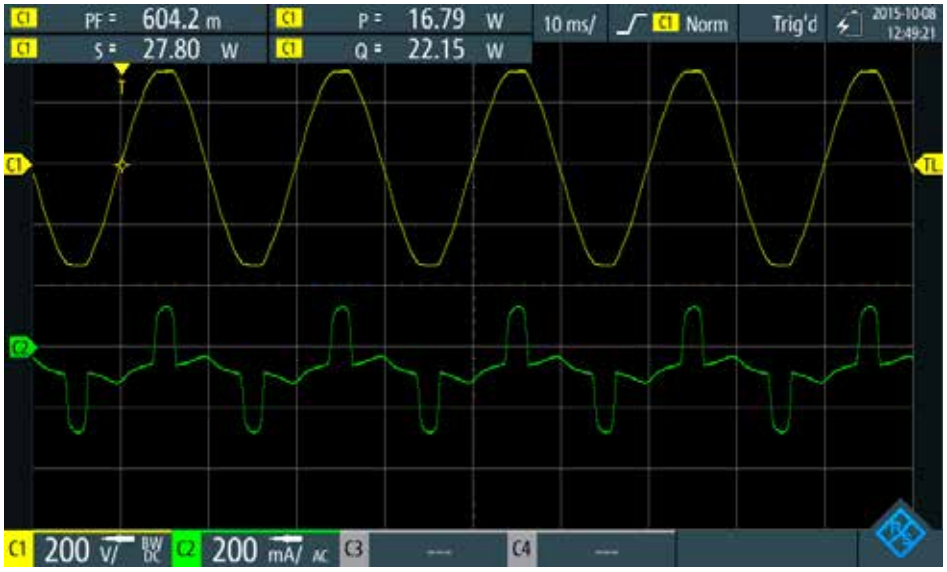

Fig. 5: Automatic measurement functions calculate apparent, active and reactive power as well as the power factor from the measured voltage (channel 1) and current (channel 2). Source: Rohde & Schwarz

Fig. 6: Decoding of and triggering on CAN protocol messages. Source: Rohde & Schwarz

monitoring

■ Digital voltmeter in the four-channel instrument or digital multimeter in the two-channel instrument

Using the blue mode key, the user can quickly switch between the different instrument modes. Instrument setups are automatically applied when switching between modes. For example, automatic measurement functions can be activated in oscilloscope mode – switching to data logger mode takes over the preset measurements and starts data acquisition.

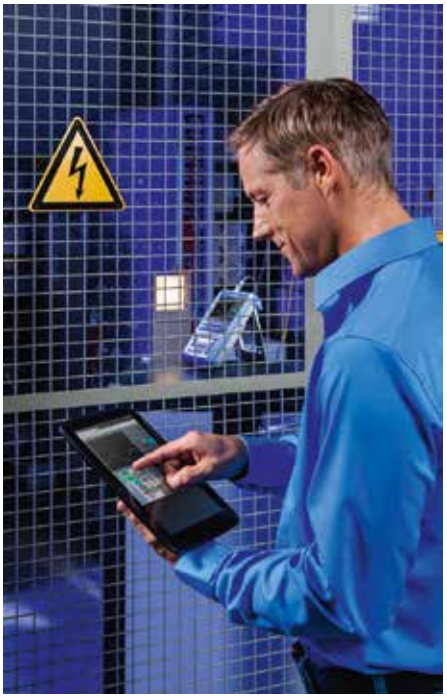

Fig. 7: In potentially dangerous applications, the R&S Scope Rider can be operated via WLAN directly from a web browser. Source: Rohde & Schwarz

Suitable for individual measurement requirements

The R&S Scope Rider is available as a two-channel or as a four-channel instrument in five bandwidths from 60 MHz to 500 MHz. All instruments can be configured as a mixed signal oscilloscope with additional digital inputs. Users can activate extra options with a keycode to obtain a measuring instrument tailored exactly to their requirements: a lab instrument with an intuitive operating concept designed for use in rugged environments. The R&S Scope Rider offers much more than other handheld instruments on the market, yet it does not cost more than a commercial handheld oscilloscope with isolated inputs.

Solving Power Capacity Challenges with Software Defined Power

› Mark Adams, CUI Inc.

Running out of power is a constant concern for the operators of data centers and similar IT and communications infrastructure. The fight for footprint optimization while boosting processing and storage capabilities is a never-ending battle. However, the inefficiencies and underutilization of current power supply infrastructures that are designed to meet peak demand can now be avoided using a combination of hardware and software to even out supply loading and optimize the available capacity. This intelligent use of available power can be realized with software tools that profile usage and recognize priority tasks. Utility power can then be supplemented with battery storage to supply peak demand using power stored during low utilization periods. Similarly, low-priority workloads can be assigned to server racks that are only powered when there is sufficient supply capacity. In this way the system can respond to peak demand while managing other tasks to spread the power load.

In much the same way that Software Defined Data Centers allow self-serviced users to deploy services and workloads in seconds, this approach to Software Defined Power® unlocks the underutilized power capacity available within existing systems. This allows a data center's server processing and storage capacity to expand without increasing power supply capacity and achieves considerable capital expenditure savings by not overprovisioning power. Furthermore, the use of battery storage to provide peak shaving and load leveling can also enable UPS functionality within a data center or server rack to protect it from power outage.

Understanding the data center 'power challenge'

The demand for Cloud data services continues apace as businesses and individual consumers become ever more reliant on remotely stored data that can be accessed over the Internet from almost anywhere. In addition, Cisco has estimated that the emergence of the Internet of Things will result in some 50 billion "things" connected to the Internet by 2020 as a myriad of sensors and controls enable smart homes, offices, factories, etc. Combined with more established applications, this is forecast to require a daily network capacity in excess of a zettabyte (1021 bytes) as early as 2018.

Servicing this demand and scaling up the capacity of networks and data centers is inevitably challenging, especially as customer requirements can turn on rapidly. While the IT

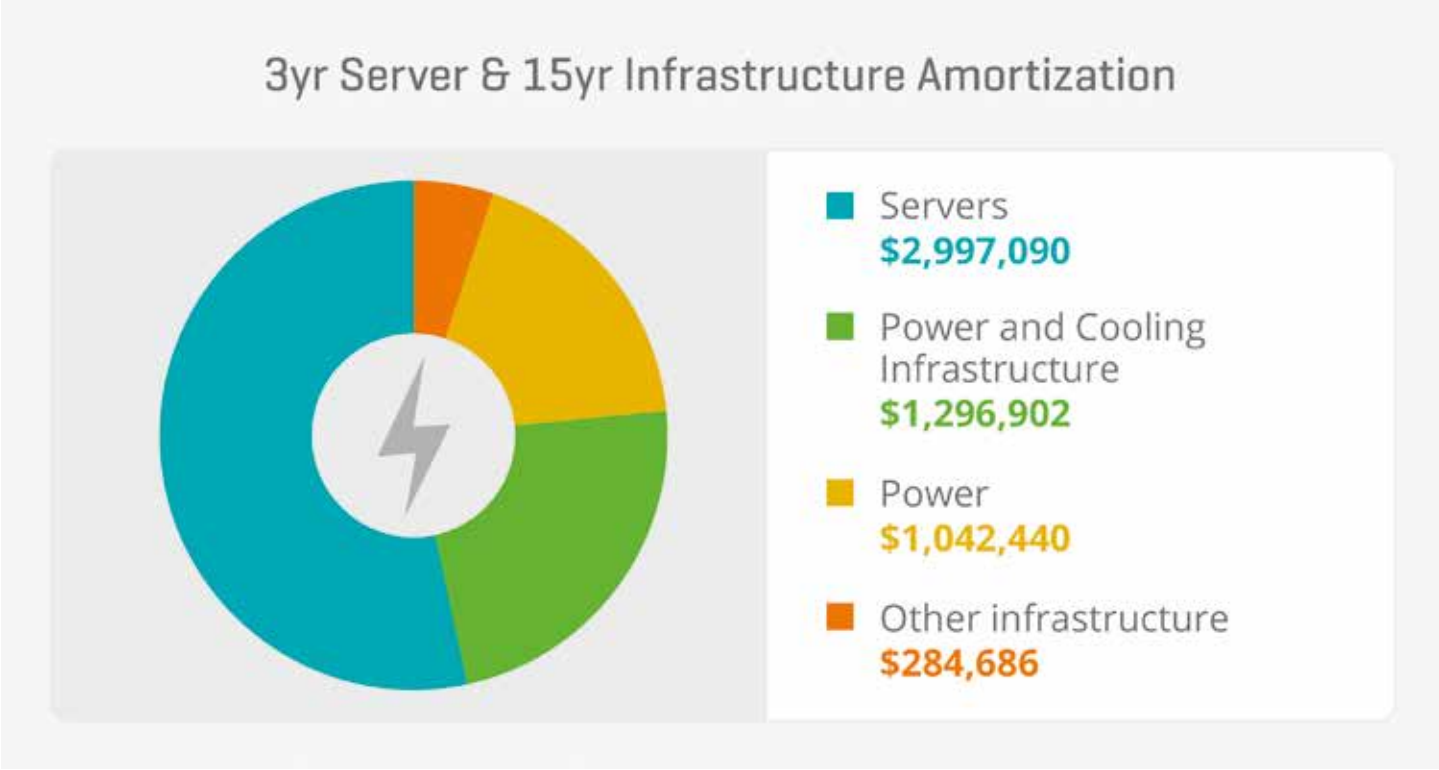

Figure 1. Data center monthly-amortized costs (source: James Hamilton's blog)

industry faces pressure to scale data centers, one of the most constrained resources is power. It is often the case that the power capacity of existing data centers is exhausted well before they run out of storage or processing capacity. The two main factors of this power capacity limitation have been the need to provide supply redundancy and the way power is partitioned within data centers, both of which take up significant space but more importantly leaving untapped power sources idle. And this is despite the fact that current server designs are far more power efficient than previous generations and have significantly lower idle power consumption.

Providing additional power capacity within a data center is also time consuming and expensive even assuming that the local utility can supply the additional load, which IDC forecasts could double from 48GW in 2015 to 96GW by 2021 for a typical data center. From a capital expenditure standpoint, as shown in figure 1, the power and cooling infrastructure cost of a data center is second only to the cost of its servers.

The nature of Cloud services also means that demand can fluctuate dramatically with a significant difference between the peak and average power consumed by a server rack. Consequently, providing enough power to meet peak-load requirements will clearly result in underutilization of the installed power capacity at other times. Also, lightly loaded power supplies will always be less efficient than those operating under full-load conditions. Clearly any measure that can even out power loading and free up surplus supply capacity has to be welcome in enabling data center operators to service additional customer demand without having to install extra power capacity.

With regard to efficiency considerations, servers and server racks use distributed power architectures where the conversion of power from ac to dc is undertaken at various levels. For example, a rack may be powered by a front-end ac-dc supply that provides an initial 48 Vdc power rail. Then, at the individual server or board level, an intermediate bus converter (IBC) would typically drop this down to 12 Vdc leaving the final conversion, to the lower voltages required by CPUs and other devices, to the actual point-of-load (POL). This distribution of power at higher voltages helps efficiency by minimizing down-conversion losses and also avoiding the resistive power losses in cables and circuit board traces, which are proportional

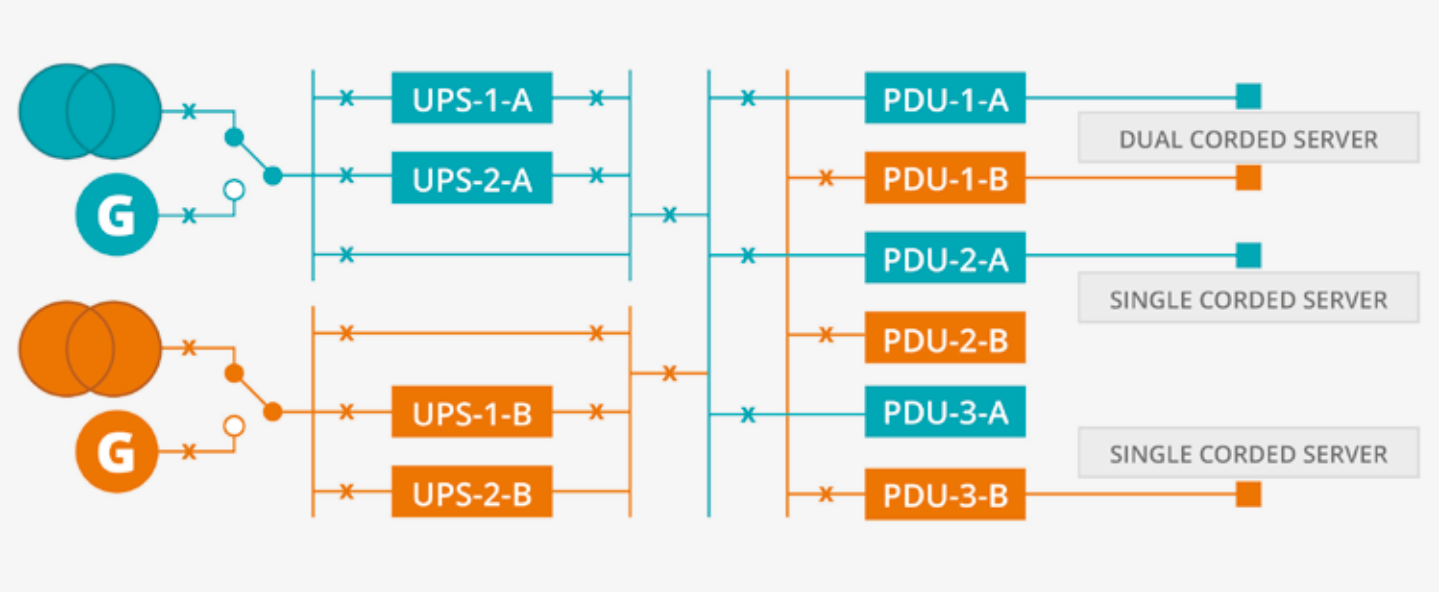

Figure 2. A 2N 100% redundancy power architecture for a tier 3/4 data center

to current and distance.

The more recent migration to digitally controllable power supplies has allowed the introduction of Software Defined Power® techniques that can monitor and control the loading of all the power supplies. This allows intermediate and final load voltages to be varied so that the various supply stages can always operate as efficiently as possible. Nevertheless, further improvements in hardware performance are reaching their limits and other solutions are needed.

The problem with existing data center power provisioning

Traditional data center power supply architectures are designed to provide high availability using supply redundancy to cope with mission critical processing workloads. This is illustrated by figure 2, which shows a 2N configuration that provides the 100% redundancy requirements expected of a tier 3 or tier 4 data center. As can be seen, for a dual-corded server this provides independent power routing from separate utility supplies or backup generators with the additional protection of intermediate redundant uninterruptable power supplies. Even single-corded servers have the security of a backup generator and uninterruptible power supplies (UPS).

However, implicit in this approach is the usually false assumption that all the servers are handling mission critical tasks and that the loading on each (and hence the power demand) is equal. In reality up to 30% of the servers could be handling development or test workloads meaning that half the power provisioned for them is not really required i.e. 15% of the total data center power capacity is blocked from use elsewhere.

The other issue is that, conventionally, supply capacity is designed to provide sufficient power for peak CPU utilization. The variability in server power consumption that this results in can be simply modeled by the following linear equation:

$P_{server}=P_{idle}+u(P_{full}- P_{idle})$

where Pidle is the server power consumed when idle and u is the CPU utilization.

With new technology delivering lower idle consumption the difference between idle and full power becomes ever more significant. This spread becomes larger still at the rack level, making power capacity planning based on an assumed CPU utilization figure very challenging. Furthermore, the type of workload exacerbates the variability in power consumption. For example, Google found that the ratio between average power and observed peak power for servers handling web mail was 89.9% while web search activity resulted in a much lower ratio of 72.7%. So provisioning data center power capacity based on the web search ratio could result in underutilization by up to 17%.

Unfortunately, it does not end there. The fear is that actual peaks might exceed those that have been modeled, potentially overloading

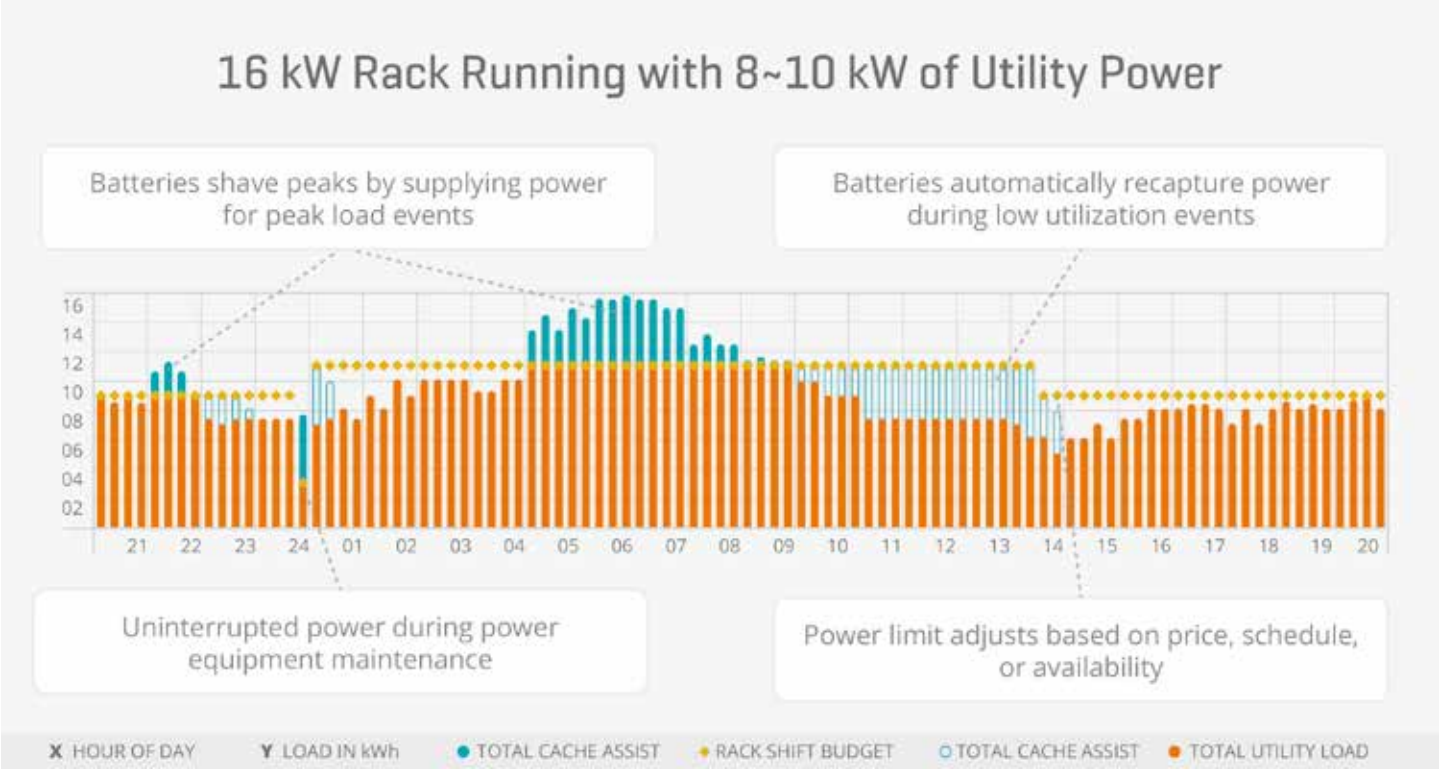

Figure 3. By profiling power demand and employing battery storage it is possible to manage peak demand using power stored during low utilization periods

Figure 4. CUI's rack-mount ICE hardware for intelligent power switching and battery storage

the supply system and causing power outages. This leads planners to add additional capacity to provide a safety buffer. Consequently it is not surprising to find that the average utilization in data centers worldwide is less than 40% purely by taking account of peak demand modeling plus the additional buffering - this figure drops further when redundancy provisions are also included.

Unlocking underutilized power supply capacity

The peak versus average-power consumption issue discussed above clearly locks up considerable power capacity. Where peaks occur at predictable times and have a relatively long duration, data centers typically use local power generating facilities to supplement their utility supply, akin to how power utilities ramp up and down their generating capacity throughout the day to meet expected demand from consumers and business.

Unfortunately, the use of generating sets does not address the problem of peaks arising from more dynamic CPU utilization that is characterized by a higher peak to average power ratio, which is of shorter duration and occurs with a higher frequency. For this the solution is to provide battery power storage. The principle here is simple, the batteries supply power when demand peaks and are recharged during periods of lower utilization. This approach, referred to as peak shaving, is illustrated by figure 3, which shows how a server rack that would normally require 16kW of power can operate with 8-10kW of utility power. Indeed, if utility power is constrained, the

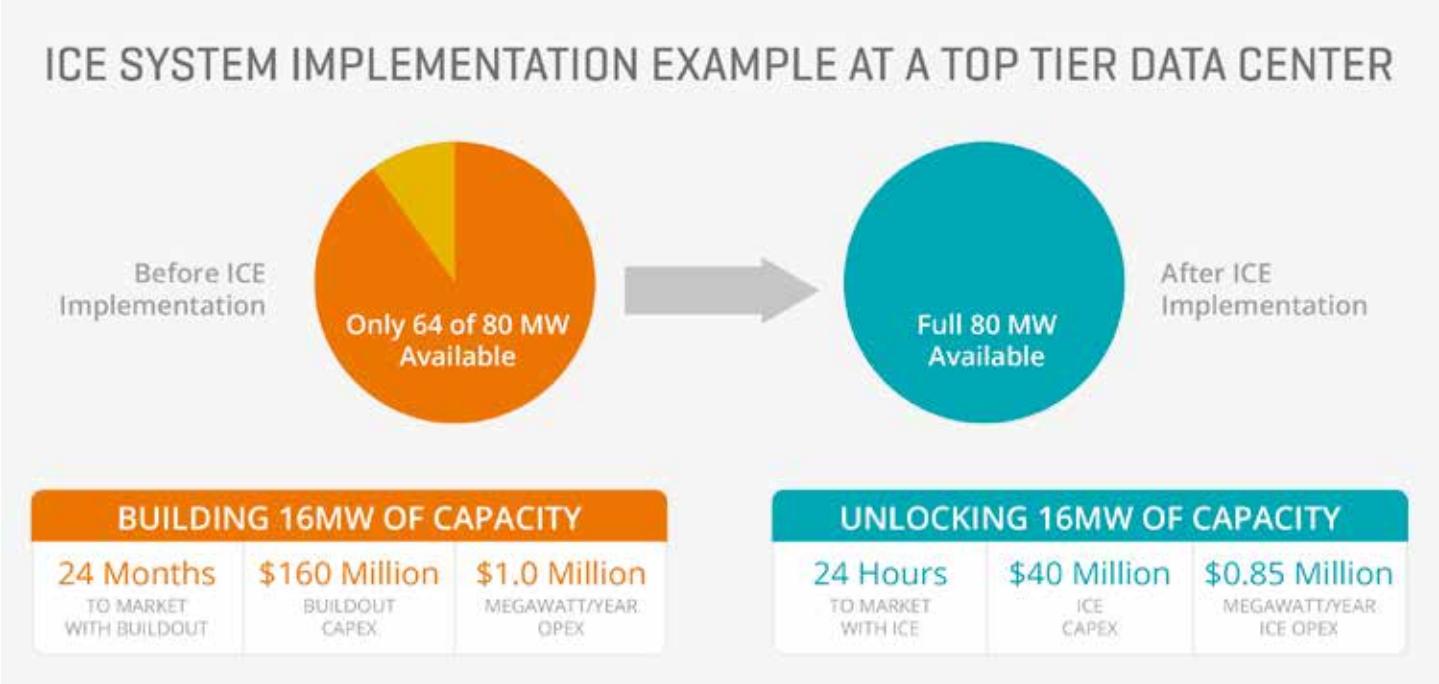

Figure 5. The value proposition from installing ICE to unlock unused power capacity

power step from 8kW to 10kW could be taken care of with locally generated power, holding the utility supply to a constant 8kW.

Optimization through dynamic redundancy

The false assumption, mentioned earlier, that all servers in tier 3/4 data centers are handling mission critical workloads can be mitigated by assigning non-critical tasks to specific low-priority server racks. This allows additional server capacity to be installed in the data center up to a limit defined by the maximum non-critical load. So, for example, in a full data center where the maximum server rack load of 400kW for all racks nominally requires dual 400kW supplies to provide 100% redundancy, it could be possible to provide additional low-priority server racks to service perhaps 100kW of non-critical workload. Then in the event that one of the 400kW supplies fails, power is cut to the low-priority server racks to ensure that the mission-critical racks receive full power from the alternate 400kW supply.

Using intelligent load management in this way can free up redundant supply capacity, which has no value-add, to provide a significant increase in a data center's workload capacity - in this instance adding 25% without the need for provisioning more power. Once again, a combined software and hardware solution can provide this dynamic management of power, monitoring and detecting a supply disruption and immediately switching the alternative supply to ensure continued operation of the mission-critical server racks.

The Intelligent Control of Energy (ICE®) solution

CUI has partnered with Virtual Power Systems to introduce the concept of peak shaving in a novel Software Defined Power® solution for IT systems. The Intelligent Control of Energy (ICE®) system uses a combination of hardware and software to maximize capacity utilization and optimize performance. The hardware comprises various modules, including rack-mount battery storage and switching units, which can be placed at the various power control points in the data center to support software decisions on power sourcing. The ICE software consists of an operating system that collects telemetry data from ICE and other infrastructure hardware to enable real-time control using power optimization algorithms.

To illustrate the system's benefits, figure 5 highlights an ICE system trial at a top-tier data center. The trial has shown the potential to unlock 16MW of power from an installed capacity of 80MW. Furthermore, the capital expenditure in adding ICE is not only a quarter of the cost that would have been

incurred in installing an additional 16MW of supply capacity but the time taken was a fraction and the ongoing operating expenditure is reduced.

Conclusion

Expanding the capacity of data centers to address the increasing demand for Cloud computing and data storage can often be constrained by available power. Sometimes this can even be a limitation of the utility supply in a particular location but, even if it isn't, the ability to add more server racks may be restricted by the existing power and cooling infrastructure. Provisioning additional power capacity is costly, second only in cost to adding servers, so any means to improve the utilization of existing power sources has to be welcome.

Through its Intelligent Control of Energy (ICE®) solution, Virtual Power Systems, partnered with CUI, provides a complete power management capability for data centers and similar network and IT infrastructure applications. It maximizes capacity utilization through peak shaving and releases redundant capacity from systems that aren't totally mission-critical. Importantly its power switching and Li-ion battery storage modules can be readily deployed in both existing and new data center installations with a dramatic reduction in total cost of ownership, up to 50%.

For more information on the ICE® Platform, visit our site

Mark Adams – Senior Vice President, CUI Inc.

Mark Adams has over 25 years of industry experience and has been instrumental in reorganizing CUI's sales structure and moving the company into advanced power products. Before joining CUI in 2009 Mark was a Sales Director at Zilker Labs for the 3 years leading up to their acquisition by Intersil, during which time Mark secured numerous design wins with some of the largest communication OEMs in the world. Prior to that Mark's sales experience includes 7 years working in distribution with Future Electronics and a further 7 years as a manufacturer representative primarily supporting Xilinx FPGAs. Mark attended Central Washington University where he studied Business Marketing, received his commission from Army ROTC and served in the Army National Guard for 13 years. As Senior Vice President at CUI, Mark is involved in business development and strategic customer engagement.

Discrete vs. Integrated Solutions for Sensor Conditioning

› Debbie Brandenburg, Exar

Our world is filled with intelligent (smart) products and technology to make our lives more efficient, convenient, connected and informed. We come into contact with these smart devices every day. More and more cities are employing smart traffic lights that adjust to real-time traffic conditions. Smart street lights and office lighting dim or turn off when no one is around to conserve energy. High efficiency top load washers determine the water level for each load based on the weight of clothing in each load. New smart automobiles respond to adverse conditions and feature parking assist. Cell phones respond not only to your touch but also the force of your touch. Many of these systems incorporate multiple analog sensors that are used to detect pressure, temperature, force, position, light, flow, sound, speed, heat, etc.

Between the analog sensor and digital signal processing lies an important electronic interface that conditions the electrical signal to ensure it lies within the range of the downstream ADC (analog-to-digital converter). This signal conditioning or sensor interface block is highlighted in Figure 1. Analog sensors produce an electrical signal that is usually very small and surrounded by noise. In many cases, no two sensors are alike, each sensor carries its own unique noise signature, introduces its own offset into the signal path and requires a different gain to meet the requirements of the downstream ADC. Calibrating the system, differentiating signal from noise and amplifying it are crucial to end system performance.

Today's system designer is faced with choosing between developing a discrete sensor conditioning function or making use of a more integrated sensor interface analog front end (AFE). Unfortunately, there is never a clear choice for all applications. Footprint, ease-of-use, flexibility, performance, price, and functionality are all things to consider. This article will describe some benefits and short-comings of each.

Footprint Comparison

If real-estate is a concern, then a more integrated solution is usually more desirable. Take for example a system that uses 16 Hall Effect sensors to monitor current in a solar panel application. The XR10910, a 16:1 sensor interface AFE has a 6mm x 6mm footprint

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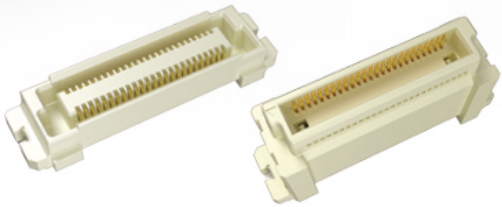

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and integrates a 16:1 differential multiplexor, a programmable gain instrumentation amplifier (PGA), a 10-bit offset correction DAC (digital-to-analog converter) and an LDO (Low-dropout regulator). As shown in Figure 2.

The XR10910 AFE allows each Hall Effect Sensor to have a unique amplification and offset correction path. This function can be handled discretely but with approximately two times the footprint and four times the power consumption, refer to the example shown in the table below. There are many ways to implement a discrete solution for this function, the below table takes only one into account. In most cases, an AFE will have a total footprint advantage over its discrete counterpart.

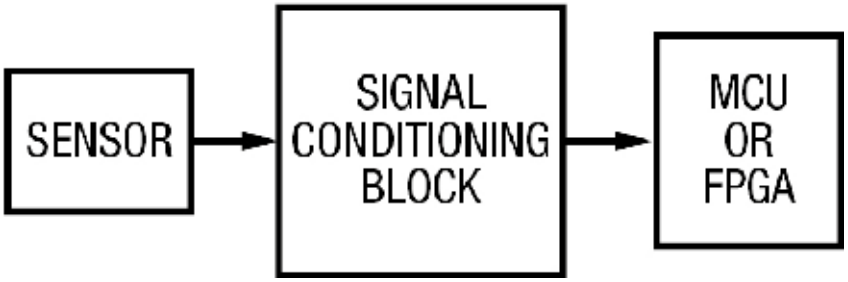

Figure 1: The Signal Conditioning Block conditions analog sensor signals for use by downstream MCUs or FPGAs with integrated ADCs

Performance Comparison

When it comes to performance, the end application plays a crucial role when deciding between a discrete and a more integrated solution. There are literally thousands of precision amplifiers on the market with varying price/performance tradeoffs. And only a handful of integrated AFEs. When manufacturers develop an AFE, they typically have set applications in mind which dictate the overall performance specifications of the device. The XR10910 mentioned above offers 1mV maximum offset voltage, 2µVpp noise, and a gain range of 2V/V to 760V/V. Although this may be adequate for some applications it most

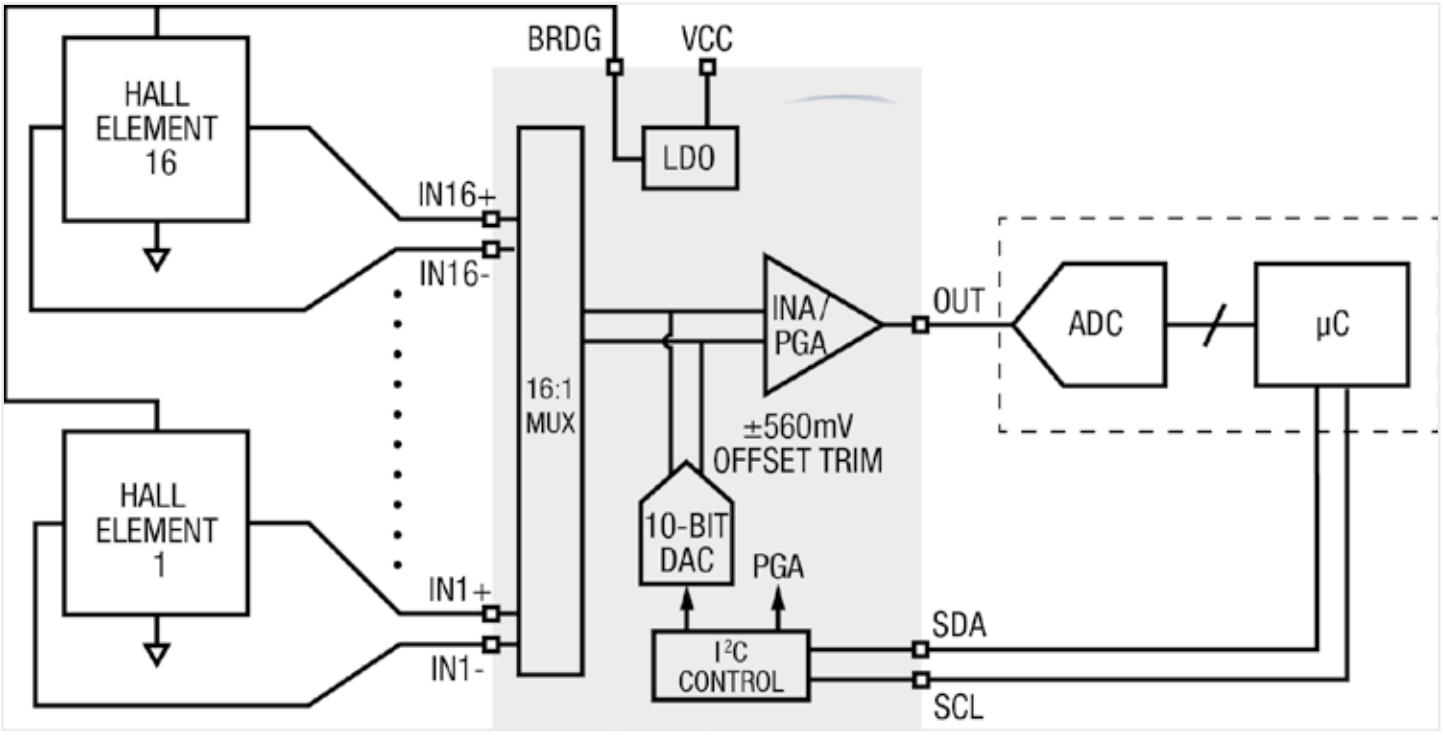

Figure 2: XR10910 as Hall Effect Sensor Interface AFE

Function	Integrated AFE (XR10910)		Discrete Solution	
	Footprint	Power Consumption	Footprint	Power Consumption
16:1 differential mux	6mm x 6mm (QFN)	0.5mA	~ 7mm x 7mm (16:1 diff MUX in LFCSP)	~0.01mA
Digitally controlled PGA			~ 4mm x 3.75mm (Digitally program-mable amp in LFCSP)	~1.8mA
Offset correction			~2mm x 2mm (10-bit DAC in SC70) + ~2mm x 2mm (amp in SC70)	~0.08mA + ~0.1mA
LDO to power sensors			~2mm x 2mm (LDO in LFCSP)	~0.09mA
Total	**36mm^2**	**0.5mA**	**76mm2**	**2.08mA**

certainly will not fit every sensor interface requirement out there. If performance is the designers' top priority and you cannot find an AFE on the market designed specifically for your application, then a discrete solution will usually be the preferred method because the designer can hand-pick the components to best fit his/her needs. Ultimately fine tuning the sensor conditioning block.

Comparing AFEs

AFEs on the market today offer different levels of integration. Some include an ADC or processing power, while others like the XR10910 do not. Most sensor interface AFEs on the market are very application specific, thus their performance feature set and functional blocks are extremely useful when used in the target application. For example, there are several AFEs on the market today that were designed for medical instrumentation applications and integrate 16-bit or 24-bit delta-sigma ADCs, PGAs and a host of features designed to reduce size, power, and time to market if you happen to be designing an ECG (electrocardiogram) or other medical diagnostic equipment. But if you are a designer with the challenge of conditioning multiple Hall Effect sensors, as described above, this highly integrated AFE is not the answer. Something with less integration and more flexibility is needed.

Conclusion

Sensor interface AFEs tend to offer faster time to market, higher ease of use, smaller footprint and in many cases lower power. But many are extremely specialized for certain applications and are not able to support multiple sensors or multiple types of sensors. Discrete solutions tend to be more flexible and can be fine-tuned to each specific application, but they require analog design prowess, more real-estate, more power, and tend to lack many automated features like auto calibration to correct for sensor drift.

The XR10910 feature set truly unique in the market, filling the gap between less feature rich discrete solutions and single-chip sensor interface AFEs that include processing power. Consuming only 457µA supply current and only 36mm2 of real-estate, the XR10910 offers the industry's smallest, lowest power interface for 16 analog sensors. The XR10910 will be the first in a growing family of easy-to-use sensor interface products from Exar. Smaller channel count versions are on the horizon as well as versions that offer digital outputs.

Sensors enable the smart products and technology we use every day. Sensor conditioning products like the XR10910 will continue to play a key role in how these sensors interface with our ever growing digital world. Designers will continue to weigh the benefits of integrated AFEs versus discrete solutions and semiconductor manufacturers will continue to expand the AFEs offered in an effort to supply AFEs to a broader market space.

Interplay Between Chip and Digital Technologies Crucial for the Internet of Things

› Rudi Cartuyvels & Danny Goderis, IMEC

There is still a great deal more innovation required in hardware if the intuitive Internet of Things is to be achieved. This includes advanced sensor modules and wireless communication chips that enable sensors to talk both with each other and with their environment. But if we want to see a reliable, secure and efficient IoT, we will also have to make a lot more effort in terms of digital technologies and software. Rudi Cartuyvels, Executive Vice President Smart Electronics at imec, and Danny Goderis, Executive Vice President Smart Applications at imec and the former CEO of iMinds, explain the main developments in their fields and give us a taster of what the interaction between microchip and digital technology can create.

Enabling the wireless connectivity of sensors

A functional Internet of Things is inextricably linked with reliable wireless communication that enables the various sensors, equipment and machines to 'talk' both with each other and with the cloud. Rudi Cartuyvels: "For that to happen you need wireless communication chips for the IoT's sensor networks. The sensors in these networks will be powered by batteries and that's an area that poses an enormous challenge for us: at the moment we only have very low power available to supply the communication chips. In addition to that, the wireless communication chips have to be capable of transmitting data over a relatively long distance (we're talking about kilometers here). They also need to comply with the communication standards proposed for the IoT, just as for Wi-Fi and Bluetooth Low Energy." Imec and Holst Centre have built up many years of experience in designing ultralow-power communication chips. Rudi Cartuyvels: "We again had excellent results in 2016, such as at the ISSCC conference. Our achievements included developing a transceiver that is optimized for IoT applications and which is in line with the low-power, long-distance Wi-Fi protocol IEEE802.11ah. We are also working on solutions that meet the Bluetooth Low Energy standard for IoT applications, as well as looking at combined solutions that incorporate Bluetooth and Wi-Fi on the same chip."

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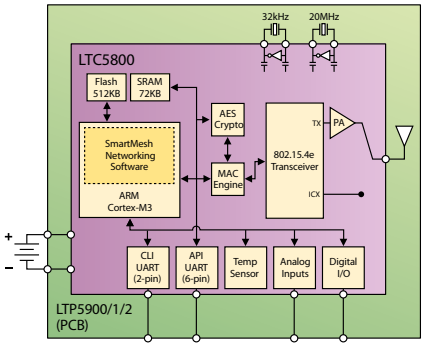

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LINEAR TECHNOLOGY | ARROW

One obvious solution would be to use the cellular phone network that is available everywhere. Rudi Cartuyvels: "At the moment we are not yet able to use this technology in sensors because it uses too much power. However, we are working on solutions that comply with the narrowband IoT standard and which ultimately will enable sensors to communicate over long distances via the cellular network."

Sending large volumes of data wirelessly

Data speeds ranging from kilobits to megabits per second are sufficient for sensor networks. But what happens if large volumes of data have to be sent wirelessly and at high speed? Researchers of imec - UGent - IBCN (a former iMinds research group) are working on ultrahigh-speed wireless connectivity that uses ATTO technology. Danny Goderis: "ATTO technology is a development from wireless 'small cells' technology in which large numbers of antennas each cover a limited area (or cell) to make fast wireless broadband connections possible. Professor Demeester's team aims to check whether this technology can be used to provide each object in large groups of moving objects with a superfast mobile connection of 100Gbits per second and as little signal delay as possible." Professor Demeester was awarded an ERC grant for this work in 2016. He will use the funds to develop the technology further over the coming years. Initially, the technology will be used in production environments to enable flexible swarms of intelligent robots to work in harmony with humans. Danny Goderis: "But we also hope to lay the foundations for a whole series of other mobile applications that need high levels of fast calculating power. And I see ATTO as an enabler for the 'mass customization of products', a trend that I believe in strongly. Mass customization, as opposed to mass production, will enable customers to adapt products to their own requirements. Intelligent robots that can be reconfigured quickly – and preferably wirelessly – will be needed to do this."

An alternative way to transport huge amounts of data makes use of millimeter wave technology. Rudi Cartuyvels: "We will need to be able to send large amounts of data from the sensor networks to the cloud, at very high speeds and wirelessly. We are looking at wireless solutions that will reach speeds of up to 20Gbits per second, using millimeter wave technology in 60GHz. We use beamforming for this, which enables directional signal transmission between a transmitter and a receiver, at very high speed. In 2016 at ISSCC we worked with the Vrije Universiteit Brussel and Holst Centre to present a low-power demonstration chip in 28nm CMOS technology for 60GHz communication. We were able to achieve data speeds of almost 5Gbits per second over a distance of 1 meter. At the imec campus, we demonstrated data rates of 1.5Gbits per second over 100m distance. We are currently working on solutions that will enable even higher data speeds and a longer range."

Testbed

Ultimately, the technologies used for the IoT (such as sensor platforms and wireless communication technologies) must also be linked with each other and be rolled out to scale in a genuine test environment. Rudi Cartuyvels: "At imec we have a great deal of expertise in developing integrated wireless sensor modules, for example for measuring ambient gases, fluids or body parameters. But it is also very important to know how these technologies behave in 'real life'. As a result, working with the former iMinds (now merged with imec) is very important. They have a lot of experience in setting up testbeds that enable technologies to be validated." The flagship project is the City of Things in Antwerp, Belgium, in which researchers will roll out a hundred gateways and a multitude of sensors in a city infrastructure by the end of 2017. "But the software is also important," says Rudi Cartuyvels. "In the end, we also need to have a software platform capable of controlling and managing the hardware components. One of the challenges here is the heterogeneity of the network: a lot of different technologies will have to work together as part of the same network." Here again our expertise in digital technologies will come into its own. Danny Goderis: "In the Internet of Things there will be far more 'any-to-any' connectivity than in a conventional network. To be able to run and manage that network, you need sophisticated tools. Our researchers are developing these operations management (or OM) systems. We are working on a plug-and-play design that will give us a simple way of plugging in sensors and wireless interfaces so that they can then be programmed, upgraded, monitored or managed.

We produced a prototype for this in 2016."

Safety first

One of the major challenges facing the IoT is protecting the data that will be collected by all of these sensors in our home, on our body or in our car. Rudi Cartuyvels: "In the future, data security will become extremely important. Furthermore, standards will have to be created that people will have to comply with before a device can be connected with a networked environment. Data protection will be a combination of both software and hardware security." However, security at a sensor or chip level is not so straightforward in view of their limited calculating power and battery content. Danny Goderis: "There are already methods in place today, such as complex cryptographic algorithms, for protecting devices against hackers. But these forms of security require a great deal of calculating power and energy. At imec - KU Leuven - COSIC (a former iMinds research group) new ways of securing microchips are being investigated. In 2016 Ingrid Verbauwhede was awarded a European ERC Advanced Grant that she will use over the coming five years to develop new protective mechanisms for making electronics more resistant to abuse. " This is another fine example of what the interplay between hardware and software can create...".

Authors:

Rudi Cartuyvels

Danny Goderis

Rudi Cartuyvels is Executive Vice President Smart Electronics at imec. He is passionate about delivering industry-relevant innovations in electronic microsystems and nanosystems, enabling novel applications in the field of IoT, healthcare and energy markets. Imec's Smart Electronics delivers innovative electronic system platforms to imec's global partner network, enabling sensing and wireless connectivity for smart cities and vehicles, wearable electronics for health and lifestyle, microfluidic and electro-optical components for medical diagnostics, thin-film electronics for flexible displays and smart tags, photovoltaic energy generation for smart buildings, solid state batteries and GaN-on-Si power electronics. Rudi Cartuyvels holds a Master Degree in Electrical Engineering from the KU Leuven, Belgium. He started his career at imec in 1990 in advanced CMOS technologies. He was appointed Director of Interconnect Technologies in 2001 and has held several management roles in semiconductor technology development and smart electronic systems. He was appointed Executive Vice President in 2016 and directs imec's R&D in Smart Electronics.

Danny Goderis is Executive Vice President Smart Applications at imec and was formerly CEO of iMinds. Before he joined iMinds in 2012, Danny Goderis worked in research, venturing and strategic marketing. He ran Bell Labs in the Benelux, which is the Research and Venturing organization of Alcatel-Lucent (one of iMinds' strategic partners). The areas of research there included fixed access (DSL, fiber optics), home networking, (3D) video research, ICT Web 2.0 & telecoms applications and cloud computing. Before joining Alcatel-Lucent, Danny worked with a number of Belgian universities in a range of doctoral and post-doctoral positions. He received his doctorate in Science and a Master's in Physics from KU Leuven and is the author of more than 50 publications. Danny also has a Master's in Business and Marketing Management.

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Contactless Connectivity Unshackles Robotic Systems

› Benjamin Mang & Rich Miron, Digi-Key Technical Content

Industrial manufacturing and production may be the first to benefit from a new way of thinking about connections.

Post burn-in, connectors are a major point of failure of an electronic system due to mechanical and environmental stresses, and in some cases, poor design. This becomes increasingly significant as electronics, particularly robotics, permeate industrial and manufacturing applications where maximum flexibility must be combined with minimum downtime.

To meet and overcome these dual challenges, designers need to understand the function and failure modes of connectors and match the right connector to the application. Factors to be considered include environmental, functional, and mechanical stress requirements. All conditions and usage models need to be considered before making a final connector choice.

While it's important to understand the fundamentals to ensure longevity, it's just as important to look for and review the latest advances in connector technology to help achieve the optimum balance of performance, reliability, flexibility and cost.

What exactly is a connector?

This question can be answered in two ways, functionally and structurally. Functionally, a connector provides a separable connection between two elements of an electronic system without unacceptable signal distortion or power loss. There are two important parts to this definition, the "separable connection" and the "unacceptable" performance. Both depend on the connector application and its electrical and environmental requirements.

The separable connection is the reason for using a connector in the first place, to provide easy repair, upgrading, maintenance or interconnectability. Requirements on the separable interface include mating-force limitations and meeting a specified number of mating cycles.

"Unacceptable" performance includes a large range of characteristics, but this discussion will concentrate on the limitations the connector introduces into the electronic system. The traditional approach is to use a standard, full-contact wired power and signal connector. There are many advantages and disadvantages to this

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	APC	Crush resistant armored cable construction for production floors where heavy machinery is used	DC-18	N
	ULC	Ultra-flexible construction, highly popular for lab and production test where tight bends are needed	DC-18	SMA
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Data Link	Pro	Challenges
Capacitive coupling	Low EMI. Also suitable for ring structures	Requires significant plate area, challenging for tiny rotating couplers, sensitive to changes of material/ fluids
RF, 60 GHz (OOK, ASK, QAM)	Large bandwidth (>1Gbps), low latency (nanoseconds)	Should generate a circular polarized wave to support rotation
RF, 2.4/5 GHz (e.g. GFSK, MSK, ASK)	Easy near field antenna design (simple loop), RF solutions widely available	No high bandwidth without OFDM, but that increases latency
RF, sub GHz (e.g. FSK)	Easy near field antenna design (simple loop), RF solutions widely available	Low bandwidth (sub Mbps)
Via ICPT power link	No separate antenna needed	Low bandwidth (10-100kbps)
Optical	Very high bandwidth possible (>10Gbps)	Sensitive to dust and dirt, precision optics & lenses needed

Figure 1. There are numerous options for a contactless data link, including 2.45-GHz RF, but power links are for now best achieved using inductively coupled power transfer

approach.

As mentioned, a separable connection provides a separate connection between two elements of an electronic system without unacceptable degradation of performance. The separable connection and unacceptable performance depend on the connector application and its electrical and environmental application. Factors to consider when choosing a connector include:

- **Power distribution:** Joule heating, which is proportional to the connector resistance, can result in increases in the connector operating temperature, a major factor in connector degradation. Both magnitude and stability of contact resistance are critical for power connectivity. Arcing is also significant in power applications, especially where there are hazardous gas environments.
- **Signal distribution:** Signal distribution requirements center around maintaining the integrity of the signal waveform. For high-data-rate systems, this may involve controlled-impedance connector designs and careful attention to signal-to-noise ratios. The magnitude of the required connector resistance is strongly dependent upon the devices in the circuitry the connector must interconnect. For many devices, high connector resistance - hundreds of milliohms - can be tolerated.
- **Environmental considerations:** Harsh environments, such as deep ocean or vibration sensitive surroundings, may constrain the traditional connector application and design. There may also be harsh and safety-critical applications, such as gaseous environments, which limit the application of contact technology.
- **Corrosion:** Corrosion occurs in many forms and can be classified by the cause of the chemical deterioration of a metal. The most common form of corrosion is rust or ferric oxide. Galvanic corrosion, or dissimilar metal corrosion, occurs when two different metals are located together in a corrosive electrolyte.
- **Movement:** Cabled solutions are generally constrained in their movements. Wear and tear on cables coupled to motor-driven, rotating subsystems, such as robotic arms, can lead to downtime, severely affecting productivity. A classic example is a robotic arm, which may have to move along multiple axii.

Traditionally, rotation with reliable connectivity is achieved using slip rings that are connected to stationary rings via brushes. Cables are used to position these copper rings in close proximity to enable physical contact with carbon brushes.

- **Mating cycles:** The connector may be designed to meet specified mating frequency and cycles from a few hundred to thousands. Cycle-life requirements affect the design and materials used in manufacturing the connector.
- **Other factors:** Cost, size, efficiency and the ability to transmit over certain distances may also be

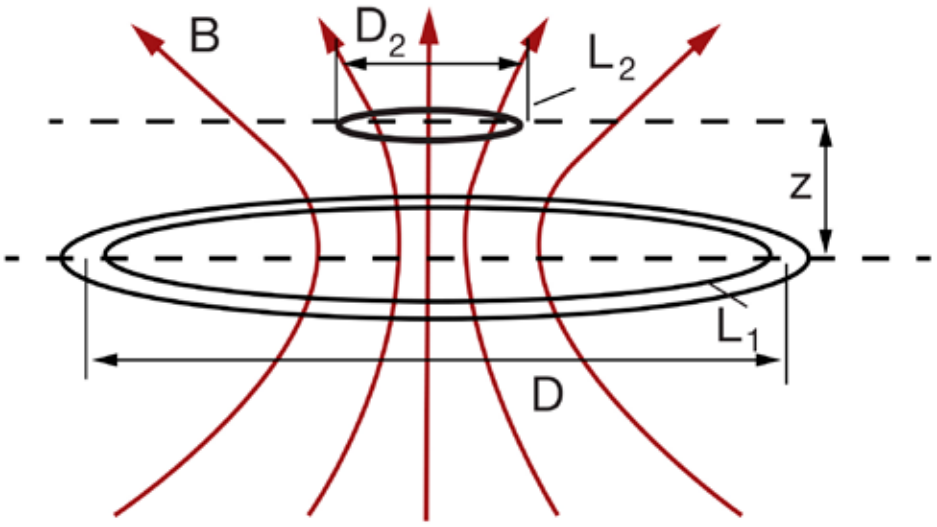

Figure 2. In inductive coupling, the coupling is determined by the distance (z) and the ratio of D2/D, while the efficiency of power transfer between transmitting coil L1 and receiver coil L2 depends on the coupling (k) between the inductors and their Q factor

design criteria that need to be considered for each application.

The ability to transmit over "certain distances" as mentioned above is particularly interesting. There are instances where power and data need to be transferred wirelessly across small distances, such as through a wall or other material. Also, more connector freedom may be needed without mechanical wear and tear, or the environment may be too hazardous to introduce any possibility of arcing.

It's at this point that advances in contactless connectivity need to be considered.

Contactless connectivity

"Contactless connectivity requires both contactless power and contactless data technology which can easily connect over a short distance without physical contact" [TE Connectivity (TE)].

There are many benefits to be accrued from contactless over traditional connectors which should be considered when deciding how to meet the design specification most effectively. These include:

- **Improved reliability:** Delivers robust power and data without wires or physical contact. Also, the connectors are hermetically sealed ensuring environmental integrity.
- **Greater flexibility:** There is an unlimited range of motion, allowing 360° movement, tilt, angle and misalignment.
- **Unlimited mating cycles:** There are unlimited mating cycles in wet and dusty environments. This is particularly suitable where slip rings or spring cables reach their limit.
- **Connection through walls or materials:** Contactless technology allows connection through walls or materials, which is not possible with traditional connectors.
- **Improved safety:** There is no arcing, which is a major plus in hazardous environments such as gas-filled chambers.
- **Cost savings:** There is no wear and tear thus improving the uptime and reducing maintenance.

However, a truly contactless connector must be able to transmit both data and power. For power, there are few options. Capacitive power transfer (CPT) has the advantage of being able to penetrate (floating) metal and has low EMI, but it suffers from low power density and short range. Some generalized comparisons of various wireless options, using pros and cons, are shown for easy reference (Figure 1.)

For contactless power transfer, an inductively coupled power transfer (ICPT) option proves to have more pros than cons. It is has high power density at reasonable distance, is well known with widely available product and technology solutions, and high efficiency is possible. The downside is that it cannot penetrate metal.

For data transmission, there are a number of options. Capacitive coupling's low EMI is also an advantage for data transfer, but such coupling requires significant surface-plate area, which can be challenging for tiny, rotating couplers. Inductive coupling for data suffers from low bit rates. Other options include RF at 60 GHz, 2.45 or 5 GHz, sub-GHz, and ICPT, as well as optical links. Each has pros and cons, as shown in Figure 1.

The 2.45-GHz industrial, scientific, medical (ISM) band is also unlicensed, with global acceptance and wide usage, most notably as "wireless Ethernet" under the moniker of Wi-Fi.

In the final analysis, it turns out that a hybrid architecture, RF for data and inductive coupling for power, is the best approach for contactless connectivity.

Defining induction

Inductive power transfer has been with us for quite some time, but for the sake of clarity a quick run

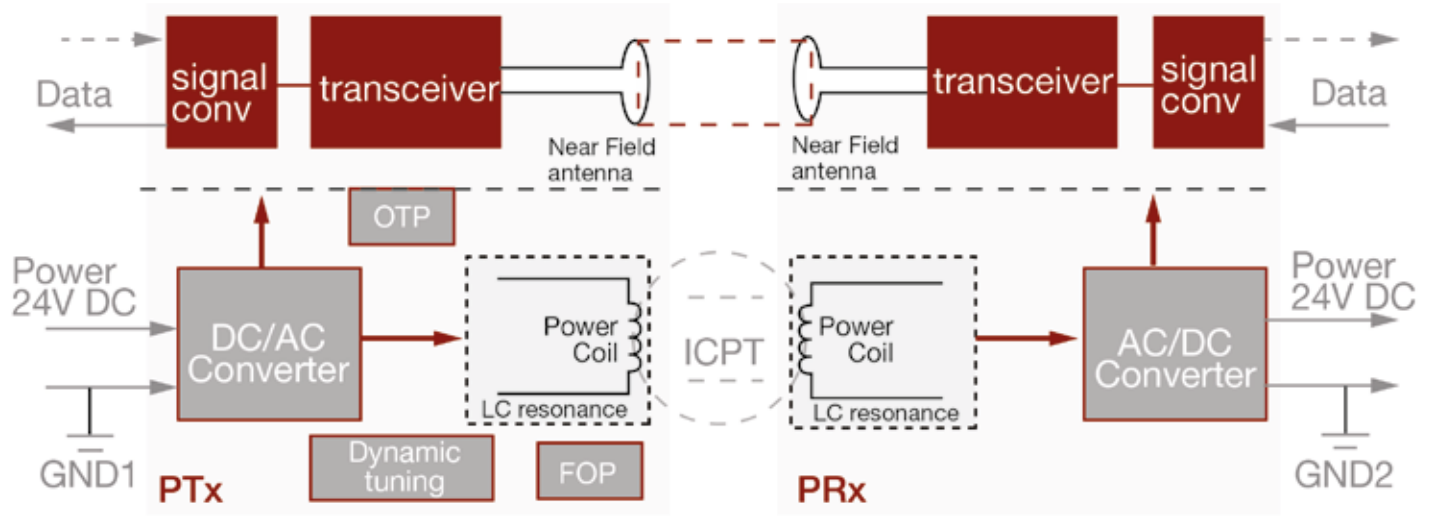

Figure 3. A complete contactless connectivity design integrates ICPT for power transfer and 2.45GHz wireless for data transmission, all within an M30-type form factor. [Image courtesy of TE Connectivity]

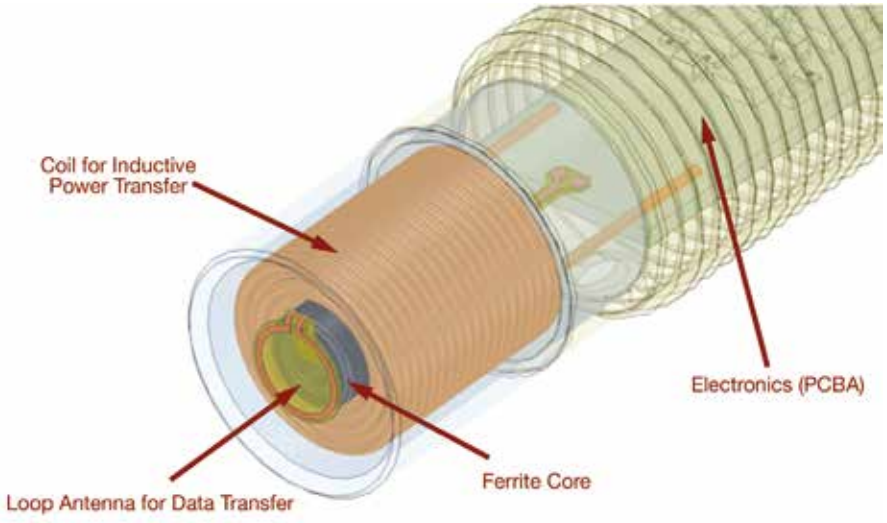

Figure 4. Implemented in an M30-type connector, the near-field loop antenna design for a contactless connectivity-based data link is symmetrical to allow for rotation. [Image courtesy of TE Connectivity]

through of how it works is useful in understanding its utility as a wireless power-transfer mechanism.

Faraday's law of induction states that the induced electromotive force in any closed circuit is equal to the rate of change of the magnetic flux enclosed by the circuit, or mathematically as:

$$\varepsilon = \frac{d\Phi_B}{dt}$$

Where ε is the electromotive force (EMF) and ΦB is the magnetic flux.

The basic principle of an inductively coupled power-transfer system is shown (Figure 2). It consists of a transmitter coil L1 and a receiver coil L2. Both coils form a system of magnetically coupled inductors. An alternating current in the transmitter coil generates a magnetic field, which induces a voltage in the receiver coil. The efficiency of the power transfer depends on the coupling (k) between the inductors and their quality, defined as their Q factor.

The coupling is determined by the distance between the inductors (z) and the ratio of D2/D. The shape of the coils and the angle between them further determines the effective coupling.

The performance of a wireless power link can be improved using resonant inductive coupling. Resonance of a circuit involving capacitors and inductors occurs because the collapsing magnetic field of the inductor generates an electric current in its windings that charges the capacitor, and then the discharging capacitor provides an electric current that builds the

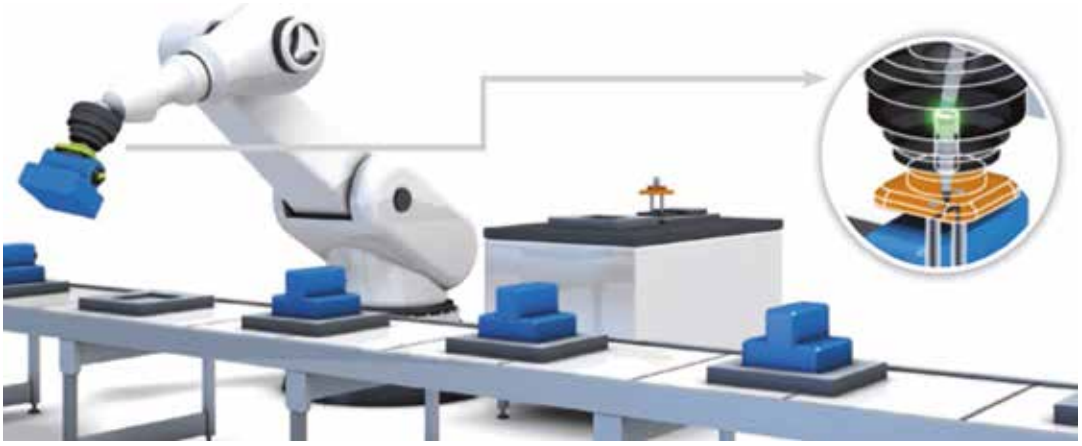

Figure 5. A contactless connectivity option implemented on a robotic arm allows 360 degrees of freedom with no brush wear typical of current slip-ring designs. Integrated sensors also enable "gentle touch" sensitivity. [Image courtesy of TE Connectivity]

magnetic field in the inductor. This process is repeated continually.

At resonance, the series impedance of the two elements is at a minimum and the parallel impedance is at maximum. Resonance is used for tuning and filtering, because it occurs at a particular frequency for given values of inductance and capacitance.

To cancel the influence of the inductive reactance and the capacitive reactance they should have equal magnitude, $\omega L = 1/\omega C$, so:

$$\omega = \frac{1}{\sqrt{LC}}$$

Where L is the inductance in Henrys, C is the capacitance in Farads , and $\omega = 2\pi f$, in which f is the resonance frequency in Hertz. In low-power systems and for high power efficiency, higher k and Q are required.

Applications of inductive coupling

Taking inductive coupling a step further, the idea of using it to transmit power wirelessly has been around since the mid 19th century. Nikola Tesla initially experimented successfully with the lighting of gas-discharge lamps wirelessly over a distance of approximately 15 feet. This sparked interest in wireless power transfer technology and applications involving microwaves, lasers, and solar cells capable of transmitting power from space.

Closer to home, modern power mats used to charge mobile devices use resonant inductive coupling, but use a "handshake" between the charging surface and the device, and then energy is transferred to the device. It is an intelligent system and will only send power to identified devices and only at a rate determined by the charging profile of the device's battery.

Inductive power transfer is also the operating principle behind passive RFID tags, toothbrushes, and contactless smart cards.

Integrating wireless power and data

The principle challenges with a contactless connector are integrating the power coils and near-field antenna into a very small form factor that is relatively easy to manufacture. This requires knowledge of mechanical design and power electronics, as well as magnetics, RF circuit design and antennas.

The power-transmit portion takes the 24-V DC supply, puts it through a circuit protection section, followed by a DC-DC converter and a DC-AC converter. The converter output feeds the transmit primary coil, which has a capacitor in parallel as part of a resonant tank that allows it handle variable loads and distance. The receiver side also contains a resonant tank. The received power is rectified, put through a DC-DC converter to deliver 24 V DC to the point of load.

The inductive power link itself has an efficiency of approximately 95%, while the output power is always 12 W. The overall system efficiency depends on the data link and includes the losses on the board, e.g. through the DC-DC conversion.

Using this circuit and techniques, an M30-diameter implementation can provide 12 Watts of output power. The effective power over distance is 7 mm (Z) distance for M30. In addition, the coupling is tolerant of misalignment up to 5 mm.

For contactless data transmission, the data is sent separately through a signal converter to a 2.45-GHz transceiver and out to a near-field antenna (Figure 3). On the receive side, the process is reversed.

The first variant is designed for sensor applications and supports up to eight PNP channels, unidirectionally from receiver to transmitter, with a switching frequency of 500 Hz (maximum). Development of higher data rates is on going, with a goal of supporting industrial Ethernet at 100 Mbits/s.

The data connection happens upon physical connection, and is by necessity dynamic, occurring without user interaction. The range is short, up to a couple of millimeters, which is good for security and RF emissions purposes. The connector can accommodate up to eight digital PNP channels, with the current variant.

To enhance reliability, the data link uses redundancy in the 2.4-GHz channel, has minimal far-field interference and the antenna design is symmetrical to allow for rotation (Figure 4). It's also tolerant of misalignment, rotation and tilt.

The full system efficiency, meaning the efficiency of the power and data link together, is ~ >75% (output power of receiver end/input power to the transmitter). Of course, this depends on the load, the distance and other factors, but it also includes the losses through the data link and PC-board assemblies.

In rugged or dangerous environments, connectors are hermetically sealed to IP67, even if they are not connected with each other.

Unleash the robots

The challenge of integrating contactless data and power translates to relatively high cost, so the target applications are those where the capabilities of classic connectors have reached their limit in terms of mating cycles or environmental conditions, or where the application requires complex harness construction, and especially for new applications, such as connecting through walls and materials, or connections on the fly.

One such application is robotic systems, which are being increasingly adapted to manufacturing and production processes that require greater complexity and precision. Given the rigors of the environment and the cost of downtime, maximizing reliability through dependable connectivity can pay dividends in the long term.

In a typical robotic application, cables limit the range of motion and the constant movement and friction of the mechanical parts also creates wear and tear. Robots also need to move rotationally to perform complex tasks. Traditionally, rotation is enabled with rotating connectors, spring cables, or slip rings, the latter of which are mechanically connected to stationary rings via brushes. Cables are used to position these copper rings in close proximity to enable physical contact with the carbon or metal brushes. The brushes then transfer the electrical current to the ring, creating rotation.

This constant friction creates wear and tear on the moving contacts, slip rings and brushes, which must be replaced frequently. This results in increased downtime and reduced productivity.

With contactless connectors, the deterioration of moving components is no longer a limiting factor (Figure 5.)

Issues typically affecting connectivity in harsh environments, such as water, dust or vibrations, no longer impact the reliable delivery of power, data and signals. Contactless connectivity can replace complex and expensive harness constructions and slip rings, enabling connectivity where you could not connect before. The ability to integrate sensors within the robotic graspers or "fingertips" for force feedback to the system also enables "gentle touch" sensitivity for delicate items.

Data to date shows that the total cost of ownership (TCO) using contactless connectors versus traditional solutions is positive within the first few months through increased efficiency, reduced downtime, maintenance savings and increased output.

It may be the case that contactless connectivity will provide designers with an entirely new way of thinking about mechanically designed machines.

References:

Connector Design/Materials and Connector Reliability
Robert S Mroczkowski

Definition and Benefits of Contactless Connectivity

For factory and industrial environments where dust, liquids, and gases combine with friction, power and robotic system wear and tear through multiple axii of rotation, designers need a new approach to connectivity. This new approach needs to be able to overcome these many environmental and operational challenges to secure, reliable, flexible, and robust connectivity - for both power and data.

The solution lies in a new interconnection system, based

Figure 2: Free from the strictures of contact, contactless interconnects provide greatly improved flexibility and reliability, while magnetic coupling protects against explosions in gaseous or otherwise flammable environments

on both contactless power and contactless data technology, which can easily connect (and disconnect) over a short distance without using any mechanical contact, demonstrated in the ARISO connectors from TE Connectivity.

To date, contactless, or wireless, data has come in many forms, from cellular to Wi-Fi, Bluetooth and ZigBee; however, for low-data-rate sensor data, these interfaces have a lot of packet-processing and network-interface and mesh networking overhead. This costs the designer, both in terms of real estate and power consumption, as well as direct component costs.

For its part, wireless power has undergone a revolution of late, thanks to the efforts of groups such as the Wireless Power Consortium, pushing Qi, as well as the now merged Alliance For Wireless Power and Power Matters Alliance. These have developed standards for the transmission of power levels of up to 5 W, with a usable range of up to 30 mm, to charge mobile devices, particularly handsets. The standards use variations of inductive and resonant power at various frequencies to achieve this, but all require a relatively large footprint, while also being relatively costly.

The trick is to find the sweet spot in terms of data rates, cost and power consumption for wireless data, and in terms of range and cost for wireless power, such that both interfaces can fit within the confines of a typical M30- or M12-type sensor head.

Thanks to the work that been done to date in terms of RF function integration to lower cost, as well as increases in the efficiency of wireless power transmission, this sweet spot is attainable by matching the wireless data and power transmission circuits to the application's low power and short range requirements.

For data, the 2.45-GHz unlicensed band was chosen as it can be implemented using a near-field antenna design with a simple loop

For power, the principle challenges are integrating the power coils and near-field antenna into a very small form factor that is relatively easy to manufacture. This requires knowledge of mechanical design and power electronics, as well as magnetics, RF circuit design and antennas.

With both the data and power transmission now integrated into a single connector head, the options and application dynamics change, dramatically. Flexibility jumps to a higher level, with 360° rotation without cable, connector, or harness wear and tear. This freedom of movement also allows for connector tilt, angle or misalignment, while the rotational freedom enables faster maintenance-free rotation as well as faster return to starting points, as the rotating heads don't have to rotate back through 180° offset, but instead can keep going to 360°.

Contactless connectors are vibration resistant and are hermetically sealed against harsh environments and have unlimited mating cycles, despite wet & dusty environments. The magnetic coupling is particularly attractive in gaseous applications or where flammable liquids or material are present.

Other advantages include easy on-the-fly connection without the traditional mechanical limitations, design flexibility and cost savings by enabling the transfer of power and signal through fluids and walls, as well as improved reliability for reduced maintenance & lower total cost of ownership.

For more information about the ARSIO range of products from TE, please visit the company's site.

ARISO and TE Connectivity are trademarks.

Augmenting Touchless Gesture Recognition with Haptic Feedback

› Vicky Messer, Ultrahaptics

Touchless gesture recognition is widely acknowledged as the next frontier in the development of human machine interfaces and the technology is now beginning to move beyond computer and gaming markets to include consumer and domestic appliances as well as automotive dashboards. However, it is commonly found that touchless controls can lack the precision and tactile feedback that is so valuable to humans to confirm they are properly controlling the system. Vicky Messer, Technical Marketing Manager at Ultrahaptics looks at the market and advocates touchless or mid-air haptic feedback as the next key step for the development of the technology.

Ever since the development of the trackball in the 1940s and the consumer release of the computer mouse in the 1980s, engineers have sought to push the limitations of computer-human interaction in an attempt to achieve a more intuitive and natural user experience. An obvious avenue to explore has been the gestures used in face-to-face communications, and the market has come a long way especially when considering developments in sophisticated audio and visual capabilities. The importance of the human sense of touch has also been championed with haptic feedback added to many consumer devices. Traditionally, however, the two markets have been distinct entities. According to market analyst firm GIA, the global market for gesture recognition will exceed $12.7 billion in 2020, driven by expanding applications in gaming, healthcare, automation, consumer electronics and automotive sectors. Consumer electronics (including gaming) currently accounts for approximately 99% of the gesture recognition market. A second report predicts the market for both gesture recognition and touchless sensing technologies will have a CAGR of 28% over the next few years and is predicted to be worth $24 billion worldwide by 2020.

Touching and Touchless

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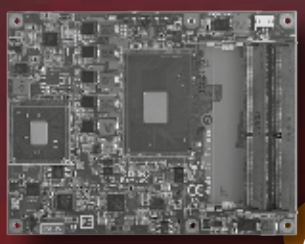

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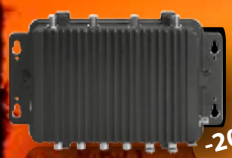

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Touchless haptic hob control

Touchless haptic feedback evaluation kit from Ultrahaptics

gestures is, of course, now commonplace: the ability to swipe, pinch, push virtual buttons and type on touchscreens is provided by almost every type of electronic equipment. However, almost all require the physical touching of controls or surfaces. Clearly, this has limitations such as wear and tear of electrical switches and vulnerability to contamination – the classic example being spilt coffee on a computer keyboard. Some less obvious examples include the possibility of cross-infection from medical equipment controls or public toilets, or possible injury from hot or cold surfaces or sharp or electrically charged objects.

Touchless haptic hob control

Controlling equipment via human gestures without touching has become a growing area of interest to major technology companies over the past few years. The enormous global gaming market in particular has driven demand for the detection of body movements at a distance. However, a fundamental weakness of touchless controls is that they do not offer the desired level of precision and tactile feedback necessary to provide the best user experience. Users will prefer to feel a control or different textures and surfaces, and ideally also have audible confirmation. Effective simulation of tactile feedback – haptics – is therefore being seen as the key to unlocking the potential of touchless gesture recognition.

Tactile Feedback

The accuracy and usefulness of human gesture recognition is advancing rapidly and will continue to do so for decades to come. The issues associated with image-based systems are a focus of development efforts, including adaptability to varying lighting conditions and backgrounds and managing unwanted objects in the field of view. However, only seeing and hearing limits human perception and the ability to effectively control computers, which can be a significant problem particularly in safety critical applications. Simply recognising human gestures does not necessarily provide the tactile feedback experienced from physical controls such as switches and dials. For example, even with the use of predictive text, there is the need for the user to check the screen to ensure the correct key has been pressed when using the virtual keyboard of a tablet, phone or touchscreen. Adding the third sense of touch provides feedback that a key, button or switch has been activated correctly and substantially enhances perception and control. Tactile feedback is even more important in some other applications such as vibrating the steering wheel to simulate the effect of driving over a rumble strip, which warns a distracted driver that their vehicle is drifting from its road lane. In a number of scenarios, tactile feedback will be an absolute necessity for the public acceptance of touchless gesture recognition.

Haptics

Haptic feedback is the sensation of touch and is already well known in computer gaming to provide a more immersive environment, and especially in various applications such as aircraft control where user attention is critical. Even flat-panel

touchscreens can use programmed interference patterns between several tiny vibrators around the edge of the glass display to produce haptic feedback at the fingertips and simulate different surface textures.

Many new consumer products now feature haptic feedback - for example, major smart phone makers are now implementing vibrational haptic feedback in some of their latest models - generating a great deal of interest for numerous other applications worldwide. A number of standard APIs (Application Programming Interfaces) are now available for research in the field of haptics, and several of these are being used to produce tactile sensations in simulations and training for remote and keyhole surgery such as laparoscopy and other medical applications.

Although tactile feedback provides a much more complete user experience - it closes the loop to provide helpful non-visual cues - almost all these approaches are limited by the need to be in physical contact with the haptic system. Therefore, they cannot be used in applications based on touchless gesture recognition at a distance.

Evaluation Kit

Providing touchless haptic feedback has been impossible until very recently. Ultrahaptics has developed a range of focussed ultrasound techniques to augment recognition and control systems for hand gestures with touchless or mid-air haptic feedback. The company's haptics evaluation kit – the only solution for touchless gesture recognition on the market today – includes a 'leap motion' camera and gesture recognition system and is allowing developers to experiment and generate novel haptic sensations in touchless gesture control interfaces for a range of devices including computers, consumer electronics, domestic appliances and automotive dashboards.

Summary

Recognising human gestures and using them to control computers and equipment is well proven given the existing market of billions of smart consumer device and other electronic equipment. The advantages of not touching equipment are valuable, if not vital, in many use cases. Touchless gesture recognition has therefore become a well-established market sector and an area of academic and intense commercial research by major global corporations.

There is little doubt that many challenges still remain in perfecting the user experience, including maximizing the range and field of view, and particularly in the accuracy of detection – not only of position and movement – but perhaps more importantly in the correct understanding of a user's intention. In addition to incremental improvements from enhanced software algorithms, plus more accurate lower-cost and lower-power camera and sensor hardware, tactile feedback adds another new dimension to the accuracy of touchless gesture recognition in interpreting a user's commands and confirming the correct action.

1. Global Industry Analysts Inc. – Gesture Recognition, June 2015
2. Markets and Markets – Gesture Recognition & Touchless Sensing Market, June 2015

Vicky Messer, Technical Marketing Manager Ultrahaptics

A commuter's dream: Entrepreneurs race to develop flying car

Even before George Jetson entranced kids with his cartoon flying car, people dreamed of soaring above traffic congestion. Inventors and entrepreneurs have long tried and failed to make the dream a reality, but that may be changing.

Nearly a dozen companies around the globe, including some with deep pockets such as European aircraft maker Airbus, are competing to be the first to develop a new kind of aircraft that will enable commuters to glide above crowded roadways. A few of the aircraft under development are cars with wings that unfold for flight, but most aren't cars at all. Typically they take off and land vertically like helicopters. Rather than a single, large main rotor, they have multiple small rotors. Each rotor is operated by a battery-powered electric motor instead of a conventional aircraft piston engine.

It's no sure bet that flying-car dreams will turn into reality. There are many obstacles, including convincing regulators that the aircraft are safe, figuring out how to handle thousands of new low-flying aircraft over cities without collisions and developing batteries that will keep them aloft long enough to be useful.

But entrepreneurs are moving forward. They see a vast potential market for "air taxis" and personally owned small aircraft to transport people from the fringes of metropolitan areas to city centers as urban areas grow more congested and people spend more time stuck in traffic. They envision tens of thousands of one or two-person flying taxis delivering passengers to the rooftops of office buildings in city centers and other landing pads during rush hours.

"In as little as 10 years, products could be on the market that revolutionize urban travel for millions of people," said Zach Lovering, the leader of Airbus' project to develop an autonomous flying taxi called the Vahana. The name means the mount or vehicle of a Hindu deity.

Uber released a 98-page report in October making the business case for air taxis, which the company sees as the future of on-demand transportation. Uber doesn't have any plans to develop a flying car itself, but the online transportation network is advising several companies that have aircraft in the works.

"The role we want to play is as a catalyst for the entire industry," said Nikhil Goel, an Uber project manager for advanced programs.

Some of the aircraft are drones that will be preprogrammed for each flight and monitored or operated from the ground or a command center. Others are designed for human pilots.

It's unclear yet how much the aircraft will cost, although prices are likely to vary significantly. Some of the aircraft are designed to be individually owned, while others are envisioned more for commercial use. Designers hope that if demand is high, prices can be kept affordable through economies of mass production.

Several recent developments could make these aircraft possible. Advances in computing power mean the rotors on multi-copter drones can be adjusted many times per second, making the aircraft easy to control. Drones have also benefited from advances in battery and electric motor technology. Some companies, like Chinese dronemaker EHang, are scaling-up drones so that they can carry people.

Another aircraft under development, Santa Cruz, California-based Joby Aviation's S2, looks more like a conventional plane except that there are 12 tiltrotors spread along the wings and tail. And some, like the Vahana, a cockpit mounted on a sled and flanked by propellers in front and back, don't really look like any aircraft in the skies today.

"In terms of what you can make fly in a reliable manner, the solution speed gateway that (computer) chips have gone through recently have literally opened the door to a whole new world of flying machine possibilities," said Charles Eastlake, an Embry-Riddle Aeronautical University professor emeritus of aerospace engineering.

But he also cautioned: "My best engineering guess is that people actually using autonomous air taxis in the next 10 or 15 years is possible, but definitely not certain. The challenges are big."

Key for many of the designs will be the development of longer-lasting lightweight batteries. Currently available batteries could probably keep an air taxi aloft about 15 to 30 minutes before it would have to land, experts said. Depending on how fast the aircraft flies, that probably isn't quite enough to transport passengers between nearby cities or across metropolitan areas, experts said.

Another hurdle will be winning Federal Aviation Administration certification for any radical new kind of aircraft when approval of even small changes in aviation technology can take years.

The FAA said in a statement that it is taking a "flexible, open-minded, and risk-based approach" to flying cars. FAA officials have discussed with several manufacturers the certification of aircraft that will be flown with a pilot in the beginning, and later converted to an autonomous passenger aircraft.

While further research is needed to ensure that autonomous aircraft are safe, "we believe automation technology already being prototyped in low-risk unmanned aircraft missions, when fully mature, could have a positive effect" on aviation safety," the agency said.

Reducing noise is another challenge since air taxis will be taking off and landing in densely populated areas. So is creating enough landing pads to handle lots of aircraft at the same time. A new air traffic control system would also likely be needed.

"It's pretty clear that the existing air traffic control system won't scale to the kind of density at low altitudes that people are talking about," said John Hansman, a Massachusetts Institute of Technology professor who chairs the FAA's research and engineering advisory committee.

NASA is developing an air traffic control system for small drones that perhaps could be expanded to include flying cars.

"There's no question we can build the vehicle," Hansman said. "The big challenge is whether we can build a vehicle that would be allowed to operate in the places where people want to use it."

Cypress Offers Enhanced Security, Reliability and Performance for Automotive, Industrial and IoT Applications with New FL-L NOR Flash Memories

New 64Mb and 128Mb Quad SPI Devices Join 256Mb Density Devices in 3.0V Family with 4KB Uniform Sector Size, AEC-Q100 Qualification and Deep Power-down Mode

Cypress Semiconductor Corp. (Nasdaq: CY), a global leader in embedded systems solutions, introduced 64Mb and 128Mb densities to its family of NOR Flash memories with a Quad Serial Peripheral Interface (Quad SPI). The new FL-L NOR Flash devices provide the utmost reliability and security for high-performance embedded systems that store critical data and operate at extended temperatures. The FL-L devices also offer low power consumption and AEC-Q100 automotive-grade qualification with high read bandwidth and fast program time at an extended temperature range. Using small, uniform 4KB physical memory sectors allows the devices to optimally store program code and parametric data. The devices are ideal for high-performance applications, such as Advanced Driver Assistance Systems (ADAS), automotive instrument clusters and infotainment systems, industrial control and smart factory equipment, networking equipment, IoT applications, video game consoles and set-top boxes.

"Our FL-L Quad SPI NOR Flash family offers the highest reliability and enhanced security, along with the bandwidth and small form factor that high-performance applications require," said Rainer Hoehler, Vice President of the Flash Business Unit at Cypress. "Expanding this family fits in with our strategy to offer high-performance memories that combine with Cypress' MCU, analog and connectivity solutions to offer complete embedded system-level solutions for our fast-growing target markets."

High-performance system designs require high read bandwidth for program execution, small, low-pin-count packages, and fast program and erase times. Cypress' 128Mb and 256Mb FL-L Quad SPI NOR Flash devices are each capable of 133-MHz Single Data Rate (SDR) and 66-MHz Double Data Rate (DDR) for bandwidth of 67 Mbps, and the 64Mb devices leverage a 54-MHz DDR mode to deliver read bandwidth of 54 Mbps, enabling fast program execution for high-performance systems. The memories provide low standby current and a deep-power-down mode that extends battery life for battery powered applications. The family offers AEC-Q100 automotive qualification and supports an extended temperature range of -40°C to +125°C. The 128Mb and 256Mb devices can increase customers' manufacturing throughput with a fast 0.30-ms program time per 256 bytes, and they offer a 50-ms erase time that enables new data to be written quickly. The devices are available in industry-standard packages including the USON (4mm x 4mm) package that saves board space and simplifies layout. More information on the family is available at http://www.cypress.com/NOR-FLASH-FL-L.

3MHz Chopper Op Amps from STMicroelectronics Feature Rail-to-Rail Input and Output in Tiny Footprint

The TSZ182 dual precision op amp from STMicroelectronics combines low and extremely temperature-stable input-offset voltage with the added advantages of a 3MHz gain-bandwidth, rail-to-rail inputs and outputs, and ultra-small 2mm x 2mm DFN8 or Mini-SO8 package options.

Complementing ST's popular conventional op amps, the chopper-stabilized TSZ182 enables superior precision in instruments like body-signal monitors, blood-glucose meters, industrial sensors, factory automation, and low-side current sensing.

The offset voltage of 25µV at 25°C enables high measurement resolution and accuracy without external trimming components, saving board space and the need for adjustments during production. Moreover, offset drift less than 100nV/°C maintains accuracy over a wide temperature range and saves periodic auto-recalibration thereby simplifying design and enhancing convenience for end users.

Operating from a 2.2V-5.5V supply and providing rail-to-rail inputs and outputs – a competitive advantage over some other precision op amps – the TSZ182 maximizes utilization of available dynamic range. The gain-bandwidth of 3MHz ensures consistent frequency response over a wide range, and the maximum operating current of just 1mA at 5V helps maximize runtime of battery-powered devices.

The extended operating-temperature range of -40°C to 125°C enables use in harsh outdoor or industrial environments. Automotive-qualified variants (TSZ182IYST)

will also be available next month for precision sensor-signal conditioning in equipment ranging from simple wiper modules or climate controls to autonomous-driving systems.

The TSZ182 is in production now in the Mini-SO8 or DFN8 2mm x 2mm package, priced from $0.97 for orders of 1000 units.

For further information please visit www.st.com/tsz182-pr

Ricoh launches 4A PWM step-down DCDC converter for industrial, automotive and consumer applications

Ricoh Europe (Netherlands) B.V. Semiconductor Support Centre has launched the new 4A synchronous buck DC/DC converter RP510 with an input voltage range up to 5.5V and an optional fixed or adjustable output voltage range from 0.8V to 3.3V. The DC/DC converter supports Power Supplies or Point of Load converters for Microprocessors, FPGAs or DSPs.

Point of Load power supplies solve the challenge of high peak current demands and low noise margins, required by high-performance processors, by placing individual power supply regulators close to their point of use.

The device features a range of protection circuits contributing to the safe operation of the application. A Power-Good (PG) output provides a fault signal to the system when the device is not ready for regular operation or when any of the protection circuits or states are active. An Under Voltage Lock Out (UVLO) function disables the chip below a minimum input voltage level.

The Thermal Shutdown function protects the device during an overload condition and disables it when exceeding a temperature threshold.

The Output Over Voltage Detection (OVD) and Under Voltage Detection (UVD) indicate a fault signal when the output voltage is 20% above or below the regular setting value.

With the Over Current protection option, the designer can either select from a latched mode or fold-back version, depending on the application requirements. Latched over current protection shuts down the chip after detecting an excessive high load for a specified time and requires a reboot of the power supply to resume to normal operation after removing the excessive load. The fold-back protection circuit is triggered in a similar way but reduces the switching frequency in order to lower the excessive load current, the circuit will be released automatically after removing the excessive load.

The adjustable Soft Start Time provides a smooth output voltage ramp up, by using an external capacitor. The oscillator frequency is internally fixed at 2.3MHz and the RP510 requires a small inductor of 1mH. RP510 is available in a compact 3 x 3mm DFN3030-12 package, convenient to be used on high density boards.

Intersil Battery Charger Extends Backup Battery Life of Automotive eCall Systems

Intersil Corporation (NASDAQ: ISIL), a leading provider of innovative power management and precision analog solutions today announced the ISL78693, a 3.6V single-cell battery charger that extends the life of Lithium Iron Phosphate (LiFePO4) batteries used in automotive emergency call (eCall) systems. The ISL78693 battery charger offers up to 4x lower leakage current (3uA) than competitive chargers, allowing the eCall backup battery to remain charged for a longer period of time. See a demonstration of the ISL78693 in Intersil's booth #E30-11 at the Automotive World conference, January 18-20 in

Tokyo, Japan.

Automakers worldwide are installing eCall in their Vehicle to Infrastructure (V2I) systems. In the event of a crash, the eCall system automatically broadcasts its location via GPS and contacts the nearest 24-hour emergency call center for help. Thus, V2I eCall systems must be capable of operating reliably and autonomously from the backup battery at a moment's notice, even if the vehicle is involved in an accident minutes after being parked for several months.

The ISL78693 battery charger is designed to support emerging worldwide eCall systems such as Japan's D-Call Net trial, which saves additional life-saving seconds by automatically transmitting vehicle data to an emergency call center that assesses collision severity and dispatches ground or air-ambulance help. Europe's eCall initiative also brings immediate assistance to motorists involved in a collision, and both ERA-GLONASS in Russia and OnStar® in the United States provide safety and ambulance call services.

The ISL78693's battery temperature monitoring and low 3.6V output voltage helps safeguard and extend the life of popular LiFePO4 batteries. The ISL78693 offers a much simpler and easier to use solution than the competition, requiring only five external passive components to program the full charging platform. The ISL78693's tiny 3mm x 3mm DFN package easily fits on space-constrained PCBs, creating a very robust, small footprint design. It also offers a unique charge current thermal foldback feature that prevents overheating by automatically reducing the battery charging current to enhance reliability.

"Carmakers want an automotive-qualified battery charger that prevents rapid discharging of the backup battery during a traffic accident or when the vehicle is parked for an extended period of time," said Philip Chesley, senior vice president of Precision Products at Intersil. "The ISL78693 leverages Intersil's innovative power management technology to deliver a solution that provides the industry's lowest leakage current and a charging profile optimized for eCall applications."

Features and Specifications:

Complete charger for single-cell Lithium chemistry batteries

Reverse battery leakage of 700nA (typ) and 3uA (max) over -40°C to +85°C increases duration the backup battery remains charged when Vin supply is off

Up to 1A programmable charging current, allows trade-off of battery charging time against heat dissipation and expected battery lifetime

Guaranteed operation down to 2.65V after start-up, preventing shut off during cold-crank start

1% initial voltage accuracy provides precise control of charging level to extend operating lifetime of battery

Integrated power transistor and current sensor

10% trickle charge preconditions fully drained battery until it reaches 2.6V minimum charge level

NTC thermistor input protects battery by monitoring temperature and shuts off charger when battery is outside the specified charging temperature

Accepts Constant Current/Constant Voltage (CC/CV) types of voltage adapters or USB power

AEC-Q100 Grade-3 qualified

The 3.6V ISL78693 is pin-compatible with the 4.1V ISL78692 Li-ion battery charger. Either charger can be combined with the ISL78268 55V synchronous buck controller, ISL78201 2.5A synchronous buck/boost regulator, ISL78206 2.5A synchronous buck regulator, and ISL78233 3A synchronous buck regulator to provide a full power supply solution from 12V lead acid battery to eCall battery.

Pricing and Availability

The ISL78693 battery charger is available now in a 10-pin, 3mm x 3mm DFN package and is priced at $0.99 USD in 1k quantities. An ISL78693EVAL1Z evaluation board is also available for $56 USD. For more information, please visit: www.intersil.com/products/isl78693.

Highly Integrated Capacitive-Digital Converter Delivers Superior Gesture Sensing and Enhanced Touch Performance to Automotive and Industrial Systems

ON Semiconductor (Nasdaq: ON), driving energy efficient innovations, has introduced a new touch/proximity sensing solution that combines industry-leading performance, cost-effectiveness and convenience in a single chip. The LC717A30UJ high dynamic range capacitance-to-digital converter uses mutual capacitance to detect changes in capacitance down to femtofarad (fF) levels. Parasitic capacitance cancellation raises the detector sensitivity, while its built-in noise rejection mechanism combats the effects of electromagnetic interference (EMI).

The eight capacitance-sensing input channels make the LC717A30UJ highly optimized for use in systems where an array of switches is required. The device includes an integrated multiplexer for input channel selection, analog-to-digital converter, dual-stage amplifier that determines capacitance changes plus outputs analog amplitude values, system clock, power-on reset circuit, and all the necessary control logic to create a total solution. Both I2C and SPI interfaces are selectable based on the system application needs.

As the device's sensitivity has a range of 150 millimeters (mm) – beyond the scope of any competing device on the market – its higher sensitivity enables gesture motions as well as offering conventional touch functionality, thereby enhancing users' control options to address a wide range of application scenarios. In addition, it is capable of operating with an airgap between the sensor/PCB and the protective cover – so engineers can eliminate the inclusion of a light guide from the assembly and reduce overall complexity. This device also includes an integrated automatic calibration function which optimizes and self-calibrates total capacitance according to electrode, line capacitance, and surrounding environment, thus significantly accelerating system development cycle time as well as robustness in the field.

The LC717A30UJ delivers rapid responsiveness, with a measurement time of 16 milliseconds (ms) for its 8 sensing channels and runs off a +2.6 volt (V) to +5.5 V supply with a low-power standby mode of one microampere (µA). The high degree of integration means that minimal external components are required, thereby further reducing the bill of materials. To support the needs of automotive applications such as vehicle entry systems and dashboard controls, the device is AEC-Q100 compliant. With its high integration level and wide dynamic range, it can also be employed in a range of touch or gesture human interfaces in industrial and consumer end products such as induction cookers, refrigerators, home entertainment systems, building automation equipment, industrial equipment, and lighting controls.

"As we all know, touch technology has witnessed widespread uptake within the consumer electronics sector over the course of the last decade. Now there are an ever-increasing number of opportunities for its utilization in various non consumer sectors," said Ikuya Kawasaki, General Manager of the Intelligent Power Solutions Group at ON Semiconductor. "This new device possesses the key attributes needed to address these demands, by providing a robust, simple to deploy solution that successfully combines low price and superior performance."

Packaging and Pricing The LC717A30UJ is offered in a SSOP-30 package and priced at $1.05 per unit in 10,000 unit quantities. The LC717A30UJGEVK capacitance touch sensor operation evaluation boards are available to evaluate the operation of various switch patterns. For more detailed product information, read the LC717A30UJ blog or visit the website.

Renesas Electronics Unveils Automotive Radar Solution to Bolster ADAS and Autonomous Driving Vehicles

Renesas Electronics Corporation (TSE: 6723), a premier supplier of advanced semiconductor solutions, today announced its first RH850-based, 32-bit, automotive radar microcontroller (MCU) series, the RH850/V1R,

that will deliver the high performance and features required for enabling future advanced driver assistance systems (ADAS) and autonomous driving vehicles. The RH850/V1R-M, the first product from the RH850/V1R Series, includes a digital signal processor (DSP, Note 1) and high speed serial interfaces and is specifically designed for middle- to long-range radars.

Software and tools including evaluation boards will also become available to enable the system developers to start their development immediately with the RH850/V1R-M solution.

With the expansion of ADAS and autonomous driving, sensors are fast becoming a key technology. Currently vehicles are being equipped with a broad spectrum of sensors such as cameras, lidar and ultrasonic sensors. In particular, radar sensors are required for ADAS applications, including advanced emergency braking and adaptive cruise control, because, unlike other sensors, radar sensors are not negatively affected by external environmental limitations which includes adverse weather conditions, such as rain, fog or whether the sun is shining or not.

Additionally, high precision sensing becomes critical in realizing future autonomous driving to meet the increasing requirements of range resolution, separation of objects and precision in measurement of velocity. This requires increased numbers of antennas and boosting of the signal processing performance.

To address these needs, Renesas launched the new RH850/V1R-M MCU specifically designed for radar applications in ADAS. The new MCU includes optimized, programmable digital signal processing, a dual core at 320 megahertz (MHz) with industry-leading high speed flash of 2 megabyte (MB), a 2 MB internal RAM, while meeting the industry's highest temperature requirements.

NXP Presents the World's First One-Chip Solution for All Global In-Car Infotainment and Broadcast Standards

Software-defined, multi-standard device for global digital and analog broadcast standards AM/FM, DAB(+), DRM(+) and HD

Ultra-compact single chip integrating six ICs into one: radio and audio as one combined high-performance system solution

Seamless integration with NXP's latest automotive multimedia processor families and next-generation NXP smart Class D Amplifier

LAS VEGAS, Jan. 04, 2017 (GLOBE NEWSWIRE) — At CES® 2017, NXP Semiconductors N.V. (NASDAQ:NXPI), the global leader in automotive and in-car infotainment semiconductor solutions, announced the SAF4000 – the world's first fully integrated software defined radio solution capable of covering all global broadcast audio standards, including AM/FM, DAB+, DRM(+) and HD. The new IC represents a breakthrough in simplifying the development of high-performance infotainment platforms as it replaces today's multi-chip solutions with a single ultra-compact RFCMOS device.

The SAF4000 is software-defined, thus simplifying the logistics for car OEMs: a single hardware device covers all regional broadcast requirements via an end-of-line firmware update, saving cost and complexity for multiple hardware and software offerings across the globe. In combination with NXP's newly announced i.MX 8 applications processor and the new TDF8534 smart Class D amplifier, NXP is now able to offer a complete high-performance, easy-to-use car infotainment platform with integrated audio in the market.

Car infotainment is a true differentiator for carmakers and the competitive automotive marketplace. The integration provided by the SAF4000 reduces complexity and system costs while delivering a 60% power and space savings for great design flexibility.

Quotes:

"The step from multi-chip discrete to a one-chip RFCMOS solution is a true quantum leap for the industry," said Torsten Lehmann, senior vice president and general manager of Car Infotainment and Driver Assistance at NXP. "One-chip means a significantly smaller hardware

footprint, easier development and simple worldwide integration with the ability to receive multiple different digital, as well as analog radio standards and to switch between them via software. Centralized infotainment head units, distributed radio/audio systems, as well as smart antenna solutions are perfectly supported by this new one-chip family."

Availability:

Engineering samples are available for our lead customers.

Resources:

New NXP Radio IC SAF4000

Quick Facts:

NXP radio designs are in 19 of the top 20 tier-1 automotive offerings delivering more than 500 million car radios in the past 10 years. NXP continues to offer world class integration of RFCMOS and SDR (Software-Defined Radio).

NXP has delivered 400 million car amplifiers in the past 10 years. The new TDF8534 is the market's first full digital amplifier. It has the smallest footprint available for five channels.

i.MX multimedia processors have been deployed in over 65 million vehicles. i.MX 8 is a highly scalable, powerful application processor family designed to advance the multimedia experience in future connected cars. Samples are available. Customers using i.MX 8 + SAF4000 will benefit from a full NXP solution with reference design and software enablement. For further information see www.nxp.com/iMX8.

Infineon enables compact and cost-effective LED front light applications with LITIX™ LED driver family

LEDs in automotive front lighting enable energy savings, new light designs and applications such as matrix beam and laser high-beam. Supporting the progress in automotive lighting Infineon Technologies AG (FSE: IFX / OTCQX: IFNNY) launched high-power LED drivers specifically designed for automotive front lights. The drivers are available within the new LITIX Power Flex series and the LITIX Power series. They address flexible DC/DC driver solutions supporting LED systems of up to 50 W and even above. Application setups can vary: many medium-power LEDs with string voltages of up to 55 V or few LEDs with high currents of up to 3 A and more.

Both LED drivers, the LITIX Power Flex TLD5541-1QV and the LITIX Power TLD5190QV, are well-suited for high-power and high-current LED applications. These include for example front lighting, laser and LED headlamps. They also suit high-efficiency supplies for LED applications working on battery voltage. Furthermore, they allow cost-optimized full-LED front light applications for cars and even motorcycles with their space limitations in the handlebar's headlamp.

Maximum LED system efficiency with LITIX Power Flex TLD5541-1QV

The TLD5541-1QV is a first available member of the new multi-topology DC/DC controller family LITIX Power Flex. The synchronous H-bridge DC/DC controller is ideal for driving all high-power LED configurations with maximum system efficiency of well above 92 percent. This results in higher reliability and improved thermal behavior and reduced PCB size. Thanks to its optimized spread spectrum switching frequency, the TLD5541-1QV helps reduce EMC emissions to fulfill challenging EMC requirements like CISPR 25 class 5.

The TLD5541-1QV features seamless buck-boost regulation and fast dynamic load jump behavior. Therefore, it enables cost-optimized LED headlamps with complete protection and diagnosis features. Just one TLD5541-1QV can drive two and more separately switched LED loads in one string, with up to 55 V string voltage. The LED current accuracy is specified with +/- 3 percent.

The TLD5541-1QV with built-in protection features and SPI interface offers both analog and digital (PWM)

dimming. The switching frequency is adjustable in the range of 200 kHz to 700 kHz. The adjustable soft start feature limits the current peak as well as voltage overshoots at start-up.

LED system cost reduction with LITIX Power TLD5190QV

The LITIX Power family of DC/DC converters and controllers targets medium-power to high-power applications. These comprise LED daytime running lights and LED low-beam and high-beam. The new family member TLD5190QV is a synchronous H-bridge DC/DC controller with similar features as the TLD5541-1QV. Without SPI interface it particularly suits LED control electronics where no microcontroller is needed, while it is easy to implement. The device also offers integrated protection functions, both analog and digital (PWM) dimming and an adjustable switching frequency in the range of 200 kHz to 700 kHz.

Availability and packaging

The synchronous H-bridge DC/DC controllers TLD5541-1QV TLD5190QV are already in volume production and available in VQFN-48 packages. Both LED drivers are suitable for use in harsh automotive environments and specified according to AEC-Q100. Infineon supports the design-in with demo boards, data sheets and PSpice simulation models.

Further information on the complete LITIX portfolio is available at www.infineon.com/LITIX

60V I²C Battery Monitor Measures State of Charge Parameters with 1% Accuracy

ON Semiconductor (Nasdaq: ON), driving energy efficient innovations, has utilized its strength and depth in a broad range of semiconductor disciplines – including analog, power management, sensor interface and signal conditioning – to introduce a comprehensive development resource for the wearable electronics sector. The newWearable Development Kit (WDK1.0) combines a wide array of highly optimized components, with the objective of assisting OEMs in bringing differentiated products to market. Using it can significantly accelerate design cycles for wearable electronics while mitigating heavy engineering costs.

"Despite the growing interest in wearable electronics, to date there is simply not a solution on the market that provides the scope needed by OEMs to help them develop feature rich designs that will attract strong consumer uptake," states AJ ElJallad, senior manager, corporate strategy and business development at ON Semiconductor. "The WDK1.0 is a multi-faceted design asset that will allow wearable technology projects to be expedited – shortening time to market and curbing the associated investment in engineering by leveraging the extent of ON Semiconductor's product portfolio."

For this new offering, a high efficiency programmable NCP6915 Power Management IC provides 5 LDOs and 1 DC-DC to support power requirement for the smartwatch and for additional development requirements. An NCP1855 battery charger IC, plus an LC709203F fuel gauge and a 10 watt (W) rated SCY1751 wireless charging front-end controller (supporting AirFuel compatible magnetic resonance charging) have also been incorporated. The kit's sensor capabilities stem from the MEMS-based FIS1100 inertial measurement unit (IMU), with 3□axis gyroscope and 3□axis accelerometer operation enabling accurate multi-dimensional motion tracking. There is also an embedded temperature sensor included and an LC898301 driver IC for initiating haptic feedback.

Critical to the WDK1.0 is its wireless connectivity, which is addressed via an ultra-lower power nRF52832 multi-protocol system-on-chip (SoC) from Nordic Semiconductor. This features a 32-bit ARM® Cortex™ processor core and a 2.4GHz transceiver – offering support for Bluetooth Low Energy (BLE) and other relevant wireless technologies. The kit is complemented by a SmartApp which can be downloaded directly from Android PlayStore and Apple AppStore. Using this, various pieces of information can be transposed, such as the steps taken, calories burnt, distance covered and activity period, as well as human machine interface aspects like screen brightness adjustment, clock face control, alarm settings and establishing fitness goals. An

Eclipse-based IDE accompanies the kit. This presents engineering teams with all the resources they need to rapidly create and subsequently debug code necessary for designs. A highly intuitive Project Wizard further facilitates the development process, by giving engineers access to numerous useful wearable-related project examples.

The WDK1.0 solution also has a 1.44-inch format, 128 x 128 pixel TFT display into which a capacitive touch screen is integrated. A 26□pin expansion port complements all the other elements in the kit. Through this there is ample provision for further additions to the system design, such as supplementary microcontroller, signal processing or GPS functionality, the inclusion of more sensors or the specifying of different display. Hardware schematics and Cadence EDA design files are also made available. Read the WDK 1.0 blog and visit the website for more detailed information.

In addition to the WDK 1.0, ON Semiconductor will be demonstrating its latest solutions for Automotive, Internet of Things (IoT), Virtual Reality, and Wearable applications including CES Innovation Award Honorees at CES 2017 in Las Vegas from January 5 – 8. To schedule a private tour of the company's demo room please contact your ON Semiconductor sales representative.

STMicroelectronics Boosts Feature Integration, Efficiency, and Flexibility of Next-Generation Intelligent Power Modules up to 100W

STMicroelectronics has extended its SLLIMM™ nano series of Intelligent Power Modules (IPMs) for motor drives with more package options that help minimize overall size and complexity, extra integrated features, and greater efficiency leveraging the latest-generation 500V MOSFETs.

With a current rating of 1A or 2A, the new IPMs target applications up to 100 Watts, such as refrigerator compressors, washing-machine or dishwasher motors, draining and recirculation pumps, fans, and other drives running at less than 20kHz in hard-switching circuitries. Operation up to 150°C allows use in harsh environments.

The modules integrate a three-phase MOSFET bridge and gate-driver HVICs, with value-added features including an unassigned op-amp and comparator for functions such as over-current protection and current sensing. Additional built-in safety features include interlocking to prevent shoot-through currents from damaging MOSFETs of the bridge, a fault-status output, shutdown input, and smart-shutdown capability. An optional built-in thermistor helps simplify over-temperature protection.

In addition to the zig-zag lead option, the new series is also available in a line-lead package. These give designers extra flexibility to simplify the board layout and minimize controller size in mechatronic assemblies and other space-constrained applications.

The high thermal performance of the packages, combined with the superior efficiency of ST's latest 500V MOSFETs, enhances designers' freedom to minimize heatsink size or create heatsink-free solutions for lower-power applications. The low MOSFET on-resistance of 3.6Ω and 1.7Ω, in 2A and 1A variants, respectively, combines with low switching losses to ensure high overall energy efficiency. The MOSFETs have separate open-emitter connections to module pins, which simplifies use of three-shunt current sensing for field-oriented motor control (FOC) or single-shunt sensing for trapezoidal control. The modules also integrate the bootstrap diodes needed to control the high-side MOSFET gates, further minimizing demand for external components.

The STIPN1M50T-H, STIPN1M50-H, STIPN2M50T-H (L), and STIPN2M50-H are in production now, priced from $4.50 in the Dual Inline Package for orders of 1000 pieces.

Fourth-Generation 600 V E Series Power MOSFET Lowers Conduction and Switching Losses, Increases Efficiency

Vishay Intertechnology, Inc. (NYSE: VSH) today introduced the first device in its fourth generation of 600 V E Series power MOSFETs. Providing high efficiency for telecom, industrial, and enterprise power supply applications, the Vishay Siliconix n-channel SiHP065N60E slashes on-resistance by 30 % compared to previous 600 V E Series MOSFETs, while delivering 44 % lower gate charge. This results in the industry's lowest gate charge times on-resistance, a key figure of merit (FOM) for 600 V MOSFETs used in power conversion applications.

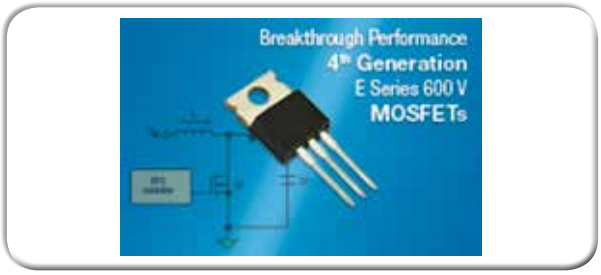
"We are committed to providing our customers with a broad line of MOSFET technologies that support all stages of the power conversion process, from high-voltage inputs to the low-voltage outputs required by the latest electronic systems," said David Grey, senior director of market development for Vishay. "With the SiHP065N60E and the upcoming fourth-generation 600 V E Series family, we are addressing the need for efficiency and power density improvements in the first stages of the power system architecture — power factor correction and subsequent high-voltage DC/DC converter blocks."

Built on Vishay's latest energy-efficient E Series superjunction technology, the SiHP065N60E features low maximum on-resistance of 0.065 Ω at 10 V, and ultra-low gate charge down to 49 nC. The device's FOM of 2.8 Ω*nC is 25 % lower than the closest competing MOSFET in the same class. For improved switching performance, the SiHP065N60E provides low effective output capacitances Co(er)and Co(tr) of 93 pf and 593 pF, respectively. These values translate into reduced conduction and switching losses to save energy in power factor correction and hard-switched DC/DC converter topologies for telecom, industrial, and enterprise power systems.

Offered in the TO-220AB package, the device released today is RoHS-compliant, halogen-free, and designed to withstand overvoltage transients in the avalanche mode with guaranteed limits through 100 % UIS testing.

Samples of the SiHP065N60E are available now. Production quantities will be available in January 2017, with lead times of 10 weeks.

Vishay Intertechnology, Inc., a Fortune 1000 Company listed on the NYSE (VSH), is one of the world's largest manufacturers of discrete semiconductors (diodes, MOSFETs, and infrared optoelectronics) and passive electronic components (resistors, inductors, and capacitors). These components are used in virtually all types of electronic devices and equipment, in the industrial, computing, automotive, consumer, telecommunications, military, aerospace, power supplies, and medical markets. Vishay's product innovations, successful acquisition strategy, and "one-stop shop" service have made it a global industry leader. Vishay can be found on the Internet at www.vishay.com.



0.33-inch full-HD DLP® Pico™ chipset from Texas Instruments is industry's smallest 1080p display solution with unmatched brightness capabilities

As brands and developers have been eagerly awaiting a solution that will allow them to create smaller form factor products integrating 1080p projection displays, Texas Instruments (TI) (NASDAQ: TXN) today announced its DLP Pico 0.33-inch full-HD chipset. Consisting of the DLP3310 digital micromirror device (DMD) and DLPC3437 controller, this is the industry's smallest 1080p display chip solution with the highest brightness capabilities in the 0.3-inch imager class. This latest DLP offering continues TI's commitment to enabling smaller form factors, superior image quality and high system efficiency for customers designing and integrating pico displays. For more information, visit www.ti.com/dlp3310.

With the 0.33-inch chipset, developers can create a myriad of compact, portable display applications, such as mobile smart TVs, battery-operated pico projectors, smart home projection displays, signage and industrial solutions.

Key features and benefits of the 0.33-inch full-HD chipset:

Small form factor 1080p: The fast switching speed of the DMD enables each mirror to display two distinct and unique pixels on screen during every frame. This DLP solution delivers 1080p resolution to the screen along with the industry's highest brightness capability for its size class, enabling a powerful new combination for developers

of compact display products.
Crisp images and video: Proven DLP technology delivers high color fidelity (up to 16M colors) for vibrant, beautiful images.
Power efficiency: This latest DLP chipset offers efficiency to meet the growing demand of battery powered devices adding display capability
TI collaborates with the most extensive ecosystem of pico optical engine manufacturers in the industry. This offers developers a path to production-ready optical engines, which helps reduce design time and gets customers' innovative products to market faster. Manufacturers planning to offer an optical module utilizing DLP3310 include Shenzhen Anhua Optoelectronics Technology Co. Ltd, Coretronic Corporation, DigitalOptics Co. Ltd, Ongine Technology, Young Optics, Inc. and others.
Availability
The 0.33-inch full-HD chipset and the associated components1 will be available in 2H17. For more information, or to sign up for DLP3310 notifications visit www.ti.com/dlp3310.
Find out more
DLP3310 DMD datasheet
DLPC3437 ASIC datasheet
Online training
Getting started with DLP Pico technology
Enlightened blog
Watch our video

ADL Embedded Solutions Inc. Announces New 75mm x 75mm Intel E3800-series Edge-Connect SBC – ADLE3800SEC

ADL Embedded Solutions Inc., a leading provider of high-performance embedded solutions, has announced today its compact ADLE3800SEC SBC with Edge-Connect. This ultra-compact 75mm x 75mm form factor is a full-featured, standalone SBC for rugged, embedded applications. The Edge-Connect architecture allows for added I/O expansion and connectors in a variety of baseboard/breakout board configurations (flat, vertical, odd-shapes, etc.) for rugged, portable/mobile applications such as unmanned systems, robotics, remote datalogging, wearable computing or portable medical devices.
At 75mm x 75mm the ADLE3800SEC is ideal for rugged, extended temperature intelligent systems with stringent size, weight, and power (SWAP) requirements. It boasts a wide thermal junction temperature (Tj) range (-40C to +85C), wide input voltage (20-30VDC), DisplayPort, USB2.0, USB3.0, and two GLAN ports with support for DirectX 11, Open GL 4.0, and full HD video playback.
"This rugged, ultra-compact SBC really seems to resonate with embedded engineers in a variety of markets. The early interest has been very positive with applications ranging from hand-held ground-penetrating radar applications to mobile location/navigation for port-of-entry systems, ATMs, toll road and border surveillance cameras and traffic management systems," Martin Kristof, Managing Director of ADL Embedded Solutions GmbH.

congatec now entirely supports the Windows 10 IoT editions congatec's latest OS implementation further simplifies development of IoT-connected devices

congatec – a leading technology company for embedded computer modules, single board computers and embedded design and manufacturing services – has announced its comprehensive support of the IoT editions of Windows 10. These full versions of Windows 10 are characterized by their extended security functions and lockdown options for IoT-connected appliances. congatec has integrated these innovative features on all its current boards with Intel Atom, Celeron, Pentium,

Core and Xeon processors as well as AMD Embedded R and G Series processors. Customers benefit from an overall simplified development of IoT connected devices. Target markets include industrial automation and production, retail and outdoor advertising, the healthcare and transportation segments, plus a host of additional industries.

"Our customers who are using Windows 10 platforms want to develop innovative IoT applications and generate comprehensive business intelligence. They need highly unified, consistent and completely trustworthy OS support to cover all the embedded devices, tablets, smartphones and IT systems that are to be deployed. Supporting Windows 10 IoT is a very crucial milestone for us as part of an array of measures on our IoT roadmap which aims to simplify the integration and use of IoT connected embedded computer technology," Martin Danzer, Director Product Management at congatec, explains.

Main new features of congatec boards running Windows 10 IoT Enterprise

The Windows 10 IoT Enterprise as well as IoT Core editions, which congatec and Microsoft will support for at least 5 years for mainstream appliances and 5 additional years for customers with extended support, offer a range of security technologies such as Secure Boot, BitLocker, Device Guard and Credential Guard, to ensure that appliances are comprehensively protected for the entire operation time from power-on to power off. Whether just a particular app has to be launched or access to non-authorized USB peripherals has to be locked down, Windows 10 IoT provides the necessary functions for any specific device environment.

Additionally, Windows activation – which is otherwise obligatory – can be switched off to enable booting in locked network environments. Customers also benefit from the integrated interoperability for IoT-typical heterogeneous device environments, which apart from embedded appliances also integrate smartphones, PCs and laptops as well as edge, fog and cloud servers. That simplifies the development of universal apps and additionally the security and management of IoT applications. It also means that developers can completely focus on their tasks and core competences.

The new Windows 10 IoT Board Support Packages are now available in the download area of the corresponding congatec single board computers and modules: http://www.congatec.com/en/products.html

Reflective optical sensor provides robust reliability and versatility along with market leading ambient light immunity

TT Electronics, a global provider of engineered electronics for performance critical applications, today introduced its Photologic® V OPB9000 reflective optical sensor for industrial and medical applications. The sensor provides dependable edge and presence detection of reflective media under a wide range of ambient light conditions.

The OPB9000, under the OPTEK brand, is suitable for a variety of applications including: industrial printing, dispensing, manufacturing automation, safety and security devices, portable lab/medical equipment.

"In designing and developing the OPB9000, TT Electronics built upon its Photologic® design heritage with over 35 years' experience and 10M+ units sold globally," commented David Kertes, Vice President of Global Sales and Marketing, TT Electronics. "We addressed a number of real world challenges that affect sensor design and their ability to perform to the highest level with this product."

The OPB9000 is a reflective, CMOS logic output sensor with programmable sensitivity, output polarity, and drain select. Unparalleled 25+ kilolux ambient light immunity along with a wide operating temperature range sets the OPB9000 apart from the competition. The self-calibration feature avoids the need for constant recalibration as the LED ages, saving valuable time and effort. Temperature compensation and automatic gain control features enable it to reliably function in the most demanding and dynamic environmental conditions where consistent performance from sensor

devices is critical. The industry leading response time of 6µs ensures high-speed detection for time-critical applications.

Designs using standard analogue circuits can be extremely complex, with additional external components which add space and cost. The OPB9000 is designed to eliminate circuit complexity and reduces board space requirements by up to 80% with its fully integrated analogue front end and digital interface. It combines an infrared emitter and integrated logic sensor in a miniature 4.0 mm x 2.2 mm x 1.5 mm surface-mount package.

For further information visit http://www.ttelectronics.com/optoelectronics/ir-sensors/photologic-reflective-object-sensors

TI technology extends flight time and battery life of quadcopters and industrial drones

Texas Instruments (TI) (NASDAQ: TXN) today introduced two circuit-based subsystem reference designs that will help manufacturers add flight time and extend battery life to quadcopters and other non-military consumer and industrial drones used to deliver packages, provide surveillance or communicate and assist at long distances.

"Flight time continues to be a top design challenge for recreational quadcopters and professional drones, especially those being used by companies for beyond visual line-of-sight operation. Delivery companies want drones with enhanced battery life, and are testing delivery of parcels with drones to see how far they can go," said Stelios Kotakis, senior analyst of data transmission & managed services with IHS Markit. According to a recent IHS Markit study*, almost 50 percent of drones in the market have an estimated battery life of less than 30 minutes, 35 percent can fly between 31 and 60 minutes and the remaining 15 percent and less can fly more than an hour – all under ideal flying conditions without additional payload.

Breakthrough battery management design

TI's 2S1P Battery Management System (BMS) reference design transforms a drone's battery pack into a smart diagnostic black box recorder that accurately monitors remaining capacity and protects the Li-Ion battery throughout its entire lifetime. Designers can use the drone BMS reference design to add gauging, protection, balancing and charging capabilities to any existing drone design and improve flight time. Leveraging the bq4050 multi-cell Li-Ion gas (fuel) gauge to accurately measure remaining capacity over the entire life of the battery, the design also features the bq24600 battery charge controller and a high-efficiency DC/DC converter to achieve high-efficiency power conversion efficiency.

High-speed performance for efficient motors

Another barrier to increased flight time has been the inefficiency of turning a drone's propellers. TI's new reference design for drone electronic speed controllers (ESCs) will help manufacturers create drones with longer flight times and more smooth and stable performance. The Sensorless High-Speed Field Oriented Control Reference Design for Drone Electronic Speed Control helps electronic speed controllers achieve the highest possible efficiency with performance for speeds more than 12,000 rpm (> 1.2kHz electrical) including fast-speed reversal capability for more stable roll movement. The design features TI's InstaSPIN-FOC™ C2000™ solution, including an F28027F microcontroller for precise motor control and FAST™ field observer proprietary software algorithm that estimates the rotor flux, angle, speed and torque. Motor parameter information is used to tune the current control bandwidth. Unlike other techniques, the FAST sensorless observer algorithm is completely self-tuning, requiring no adjustments for proper operation and propeller control. The design also includes a 60-V LMR16006 SIMPLE SWITCHER® DC/DC converter with ultra-low quiescent current to efficiently manage a drone's lithium polymer (LiPo) batteries.

Find out more about TI and drone subsystem design

capabilities:
Get more information on TI's analog and embedded processors for drone subsystem design.
Download reference designs from the TI's reference design library.

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ams launches world's first digital multispectral sensor-on-chip leveraging breakthrough wafer-level filter technology AS7262 and AS7263 six-channel digital multispectral sensor ICs bring the lab to the sample to enable a revolution in consumer and industrial spectral analysis applications

ams AG (SIX: AMS), a leading provider of high performance sensor solutions and analog ICs, today launched the world's first series of cost-effective multispectral sensor-on-chip solutions, opening the way for a new generation of spectral analyzers for consumer and industrial applications.
Offered in a small 4.5 x 4.4mm land grid array package, the ultra-low power AS7262 visible range sensor and AS7263 NIR sensor each provide six calibrated spectral channels. Because of their attractive price point, the new multispectral sensors open the door to testing and use in a very wide range of consumer and real-world field applications. Key solution spaces include material and product authentication, product quality and integrity as well as material content analysis in the near-infrared (NIR) and visible spectrums.
"In much the same way that intense sensor integration into our smartphones and tablets has created a tidal wave of new mobile applications, the launch of the AS7262 and AS7263, enabling chip-scale spectral analysis, heralds a similar revolution that will open the door wide for spectral sensing innovation for both industrial and consumer applications", commented Jean Francois Durix,
Marketing Director for Emerging Sensor Systems at ams. "The dramatic reduction in the size and cost of spectral analysis enabled by our new spectral sensing solutions brings the lab to the sample for an incredible variety of applications from food safety and product authentication, to routine
testing that can better protect both our health and our environment."
The multispectral sensors employ a new fabrication technique which enables nano-optical interference filters to be deposited directly on the CMOS silicon die with extreme precision. This interference filter technology used for the sensors offers extremely precise and reproduceable filter characteristics which are stable over both time and temperature and are much smaller and more cost-effective than the components typically used in today's spectral analysis instruments.
The AS7262 six-channel visible light sensor with integrated intelligence provides a calibrated digital output over an I2C or UART interface. It measures light intensity at six wavelengths in the visible light spectrum: 450nm, 500nm, 550nm, 570nm, 600nm and 650nm. The AS7263 operates in the NIR spectrum detecting 610nm, 680nm, 730nm, 760nm, 810nm and 860nm infrared signatures. Both devices include an electronic shutter with LED drive circuitry, which means that device de-signers can accurately control the light source and the spectral sensing functions with a single chip.
The small size of the new multispectral sensors combined with their low power consumption enable measurement equipment OEMs to develop new product types that take advantage of these unique attributes. For instance, bulky laboratory-grade analysis equipment can now be replaced by conve-nient handheld form factors. In factories, samples which today have to be removed from the production line and taken to a laboratory for chemical analysis or quality testing will be tested in-line by new small, robust spectral analyzers based on the multispectral sensors.
The AS7262 and AS7263 are in volume production now. Unit pricing is $4.00 in order quantities of 1,000.
For more technical information and sample requests, go

to www.ams.com/spectral-sensing/AS7262 and www.ams.com/spectral-sensing/AS7263.

Harwin increases design choices and production flexibility with extensions to 1.27mm, 2mm and 2.54mm pitch connector ranges

Harwin has extended the number of models available in its highly successful Industry Standard Connector ranges, including Harwin's Archer M50 (1.27mm pitch), M22 (2mm pitch) and M20 (2.54mm pitch) interconnects. The range extensions bring greatly increased choice to design engineers, with the extended product offerings adding new orientations, different connector pin counts and soldering methods. Harwin expanded its choice of connection systems to suit an increased variety of PCB layouts and offer customers more flexibility. Additionally, all of the new surface mount connectors are available supplied in Tape & Reel packaging, for use with automated pick and place assembly.

SMT and Throughboard additions

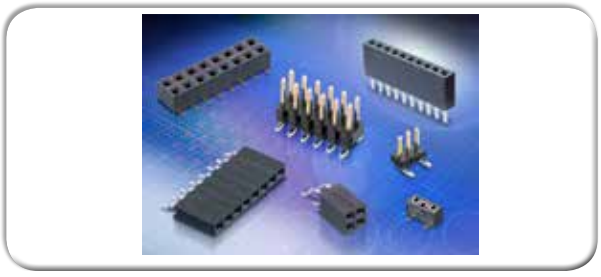
Harwin's Archer M50 connectors, based on 1.27mm pitch, now include a complete range of single-row pin headers and sockets, both available in through-board and surface mount options. The M22, 2mm pitch Industry Standard range has been extended with the addition of single and double row SMT horizontal sockets, plus a double row vertical SMT pin header with location legs for precise board placement. Harwin's extended M20, 2.54mm pitch Industry Standard Connector range has seen the addition of single and double row SMT horizontal sockets, a double row vertical SMT pin header with location pegs, plus a low-profile dual-entry vertical SMT socket.

Variety of Applications

There are applications across many markets for the new model variants, including: industrial drives, transformers and control systems; test & measurement equipment; navigation systems and marine displays; IoT applications such as smart meters, sensors and tracking. LED light strips also benefit from the increased design and production flexibility of these new Harwin interconnects.

Industry Standard

All Harwin's Industry Standard Connectors conform to current conventions for pin header and socket systems, backed by Harwin's renowned reputation, ensuring confidence in quality, confidence in supply (all ranges are stocked throughout the Harwin global network) and full technical support, including fast turnaround of samples on request.



COM modules with 7th generation Intel Core processors

The new Kaby Lake processors are manufactured in 14 nm technology, as the former 6th generation Intel® Core™ processors, and have a similar architecture but are optimised for higher performance at the same level of power dissipation. The MSC C6C-KLU and MSC C6B-KLH module families are partly available with Intel® Celeron® and Xeon® processors as well. Designed and manufactured by MSC Technologies (an Avnet Company) in Germany, these COM Express™ modules offer at least a 7-year lifecycle from the date of introduction.

The powerful MSC C6C-KLU COM Express™ modules in the Compact form factor of 95 mm x 95 mm have a typical power consumption between 17W and 19W and are suited for compact high-end embedded systems. The operating temperature ranges from 0° to 60°C. Avnet Embedded offers four variants with the dual-core processors Intel® Core™ i7-7600U, i5-7300U, i3-7100U, and Intel® Celeron® 3965U. The on-chip Intel® HD Graphics Gen. 9 supports DirectX® 12, OpenGL 4.4., and OpenCL 2x. Hardware-based graphics acceleration and video encoding/decoding complete the feature list. Three independent displays with up to 4k x 2k resolution can be connected. The modules can be equipped

with up to 32GB DDR4 memory in two SO-DIMM sockets. An integrated Trusted Platform Module (TPM) and an optional Secure Boot BIOS ensure additional security features. The wide range of modern interfaces includes USB 3.0/2.0 ports, PCI Express™, SATA, and the display interfaces DisplayPort, DVI/HDMI and LVDS or embedded DisplayPort (eDP).

With the MSC C6B-KLH Type 6 COM Express™ module family in the basic form factor of 125 x 95 mm, Avnet Embedded rounds off the top end of its product portfolio. The powerful boards are offered with numerous processor variants: Intel® Core™ i7-7820EQ, i5-7440EQ, i5-7442EQ, i3-7100E, i3-7102E with four or two CPU cores or with quad-core Intel® Xeon® E3-1505Mv6 and E3-1505Lv6. The typical power consumption is between 35W and 55W depending on the module type. The high-end processor boards operate between 0°

700 V CoolMOS™ P7 family from Infineon for quasi resonant flyback topologies

Infineon Technologies AG (FSE: IFX / OTCQX: IFNNY) developed the new 700 V CoolMOS™ P7 family to serve today's and tomorrow's trends in quasi resonant flyback topologies. These new MOSFETs offer unmatched performance improvements compared to currently used superjunction technologies. Soft switching topologies like smart phone and tablet chargers but also notebook adapters profit from this advantage. Additionally, the new CoolMOS supports fast switching and high power density designs for TV adapters, lighting, Audio, and Aux power. The new family conveys an improved form factor for very slim designs.

Compared to competitor parts the new 700 V CoolMOSP7 technology delivers reduced switching losses (E OSS) from 27 up to 50 percent. In a flyback based charger application the technology leads to up to 3.9 percent higher efficiency. Furthermore, the device temperature is reduced by up to 16 K. In comparison to the previous 650 V C6 technology it offers a 2.4 percent gain in efficiency and 12 K lower device temperature.

The integrated Zener diode ensures an increased ESD ruggedness of up to HBM Class 2 level. Customers profit from an improved assembly yield which leads to less production related failures and finally saves manufacturing costs. Additionally, the 700 V CoolMOS P7 shows low losses due to its very low RDS (on)*Q g and RDS (on)*E OSS. Compared to C6 technology as well as to some competitor devices, the new family features an additional extra 50 V blocking voltage. Keeping the ease-of-use in mind, the technology has been developed with a V GSth of 3 V and a very narrow tolerance of ±0.5 V. This makes the new P7 family very easy to design-in and enables the usage of lower gate source voltage, which makes it easier to drive and leads to less idle losses. Especially in price sensitive segments, the new 700 V CoolMOS P7 offers an attractive price performance ratio that helps customers in taking further advantages in competitiveness.

Availability

The 700 V CoolMOS P7 family is available with the most relevant R DS(on) package combinations including 360 mΩ up to 1400 mΩ in IPAK SL, DPAK and TO-220FP. The R DS(on) range of this superjunction technology will be complemented with additional variants and combined with new package innovations from Infineon soon. More information is available at www.infineon.com/700V-p7.

EU industrial leadership gets boost through launch of three advanced pilot lines in photonics

Three major Pilot Lines, which help SMEs take photonics technologies from lab into market, have been launched today by the Photonics Public Private Partnership (PPP). The Pilot Lines mean that thousands of high tech SMEs in Europe – who often lack access to advanced, cost-intensive

infrastructures and expertise needed to manufacture new and innovative products – will be able to take their good ideas, scale-them up and validate them with the first customers for commercial production. The Pilot Lines will focus on health applications, flexible organic light-emitting diodes and sensors for the detection of chemicals in gas and liquids. The European Commission has invested €35 million in these projects to boost Europe's industrial competitiveness. This is part of the Commission's €700 million investment in the Photonics Public Private Partnership over the seven years of Horizon 2020, the Framework Programme for Research and Innovation.

"With these Pilot Lines Europe will position itself at the forefront of innovation in photonics. Our companies, and in particular the manufacturing sector, will have access to support for innovation and the facilities needed to get ahead in global markets. Photonics is a crucial component for the successful digitalisation of European industry and the economy" said European Commissioner for Digital Economy and Society Günther H. Oettinger.

The Photonics PPP was launched in December 2013 by the European Commission in order to reinforce European leadership in Photonics, one of the key enabling technologies (KETs). Photonics are driving innovation in many areas, from communications to advanced energy efficient lighting, and from early detection of diseases to safety and security.

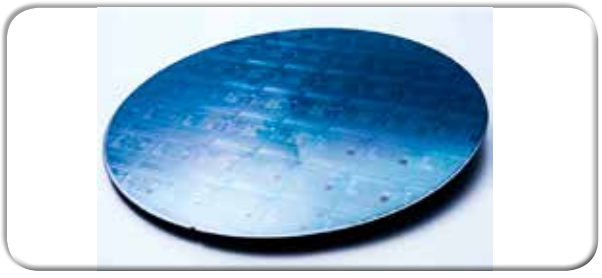
The Photonics PPP links up the European industry (large players and SMEs), researchers, academia and the European Commission to cooperate in research and innovation in the Photonics domain and define strategic roadmaps in sectors which can shape the future digital economy of the EU and revolutionise the industrial landscape. The Photonics PPP is characterised by having a strong impact in cross-cutting areas: that is why Photonics can drive the transformation of EU into a digital society and strengthen Europe's Digital Single Market.

The three manufacturing Pilot Lines are PIX4LIFE, MIRPHAB and PI-SCALE.

PIX4Life (http://pix4life.eu) is a pilot for a state-of-the-art photonics platform for health applications. Recently, a promising Silicon Nitride Photonic Integrated Circuit technology was researched to make compact, low cost detection and imaging systems in the visible range and the TriPleXTM and BioPIX platforms were developed. PIX4Life will scale up these platforms in order to bring Silicon Nitride based systems towards commercial production and industrial take up. This will open a multibillion market of products including biosensors, cytometers, DNA sequencers, gas sensors, microscopes, medical imagers and more. The PIX4Life pilot line will drive European leadership in health applications by making this technology accessible to industrial and academic customers together with the necessary design, packaging and test services. The project brings together 15 leading organisations from 7 European countries and is coordinated by IMEC, Belgium.

PI-SCALE (www.pi-scale.eu) is a pilot line providing open access services to a wide range of external users in order to accelerate the commercial adoption of flexible Organic Light-Emitting Diodes (OLEDs). These large area, energy efficient light sources are ultra-thin, flexible, lightweight films which can be made or cut to any shape or size allowing new opportunities to create high value-added products in many different application areas, such as architectural lighting, automotive, aerospace, consumer electronics and the built environment. PI-SCALE will offer world class capability in pilot production services for customised flexible OLEDs. It will enable companies to quickly and cost effectively test and scale up their flexible OLED lighting concepts and turn them into market ready products. PI-SCALE brings together 14 expert partners, from 5 European countries and is coordinated by Holst Centre, the Netherlands.

MIRPHAB (http://www.mirphab.eu/) is a pilot line for prototyping and production of innovative sources and sensors in the Mid-IR range, for the detection of chemicals in gas and liquids. MIRPHAB platform is based on miniaturized laser systems and will allow the manufacturing of compact, low cost and low power consumption sensing devices which can be used for safety, security and environmental applications. The industry partners involved in MIRPHAB are committed to deploy new products swiftly in the market and achieve prompt take up in the environmental and chemical sensing areas. The project brings together 18 leading organisations from 9 European countries and is coordinated by CEA-Leti, France.



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