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*AspenCore's 11th Design Engineer and Supplier Interface Study gathered information from engineers regarding their need for product information and other services, as well as how and when they interface with suppliers and how they see the quality and value of that interface. 1,750 U.S. engineers participated in this year's web-based survey. The results represent those surveys completed by April 2016.

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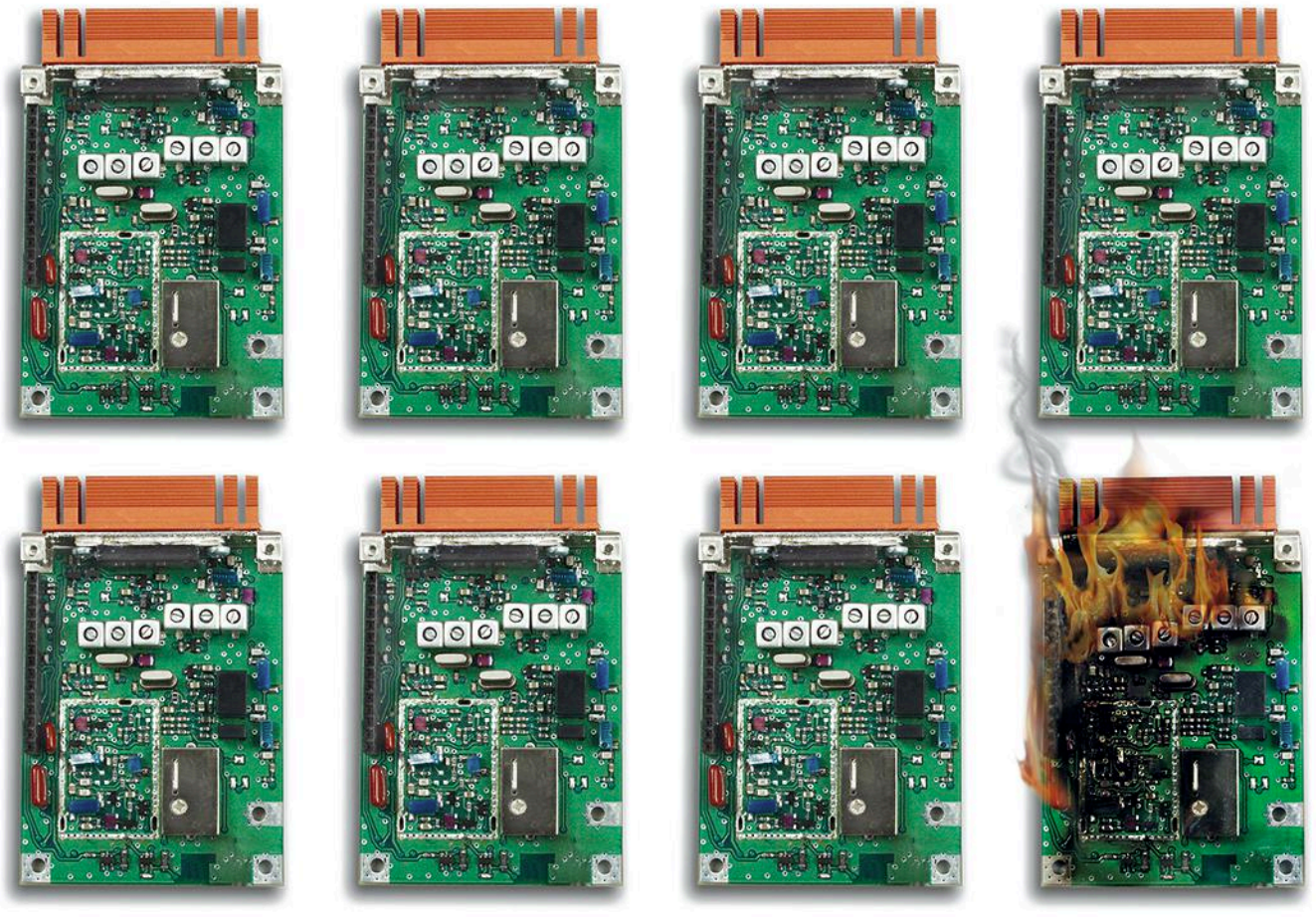

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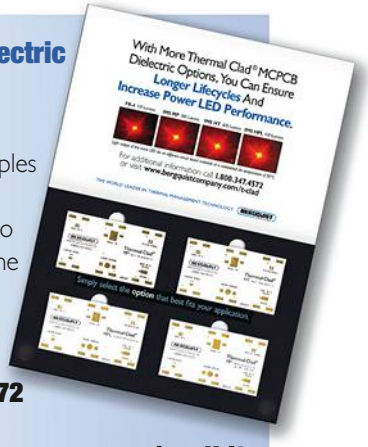

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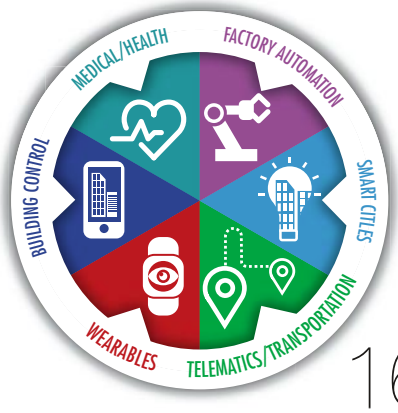

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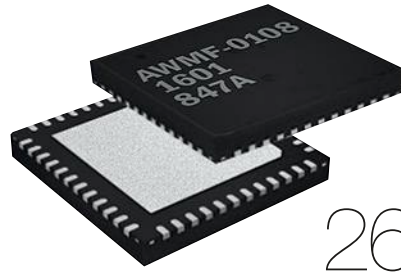

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IDEAS FOR DESIGN

COLUMNS & DEPARTMENTS

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To provide the most current, accurate, and in-depth technical coverage of the key emerging technologies that engineers need to design tomorrow's products today.

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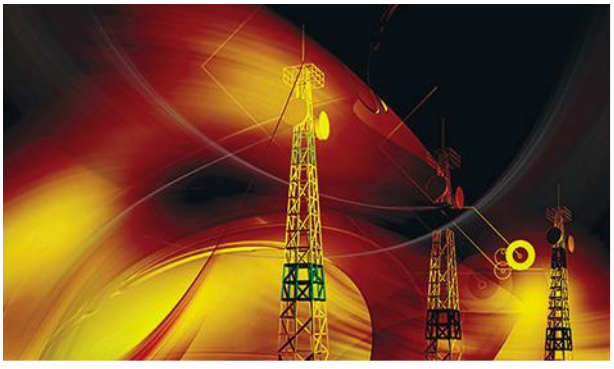

THE WIRELESS SPECTRUM CONUNDRUM

http://electronicdesign.com/communications/wireless-spectrum-conundrum

Spectrum is everything when it comes to choosing or designing wireless equipment. Knowledge of the electromagnetic (EM) spectrum is essential for all engineers working with wireless equipment and systems. It affects what you can transmit as well as how and where, determining everything from rates and range to capabilities and cost. *(Image courtesy of Thinkstock)*

GETTING ACQUAINTED WITH NB-IoT

http://electronicdesign.com/blog/getting-acquainted-nb-iot

Have you heard of this? With so much hype and coverage of the Internet of Things (IoT), it's understandable that you may have missed mention of yet another wireless technology for enabling IoT applications. NB-IoT is one of a group of relatively new LTE standards published by the Third Generation Partnership Project (3GPP), the organization that develops and standardizes our cell phone systems. *(Image courtesy of Thinkstock)*

IoT FOR THE CONSUMER

http://electronicdesign.com/iot/iot-consumer

The Internet of Things (IoT) covers a lot of ground, and much of it is in the consumer space. There has been a flood of products and the numbers continue to rise. Many have a limited market, but the number has risen into the billions: Gartner estimates 6.4 billion in 2016.

GALLERY: MAKING THE ROUNDS AT ELECTRONICA 2016

http://electronicdesign.com/test-measurement/gallery-making-rounds-electronica-2016

We've gathered what we saw on the floor of this year's electronica trade show in Munich, Germany. Some of the biggest companies at the event were talking up the Internet of Things, showing how sensors and processors can transform everything from factories to cars.

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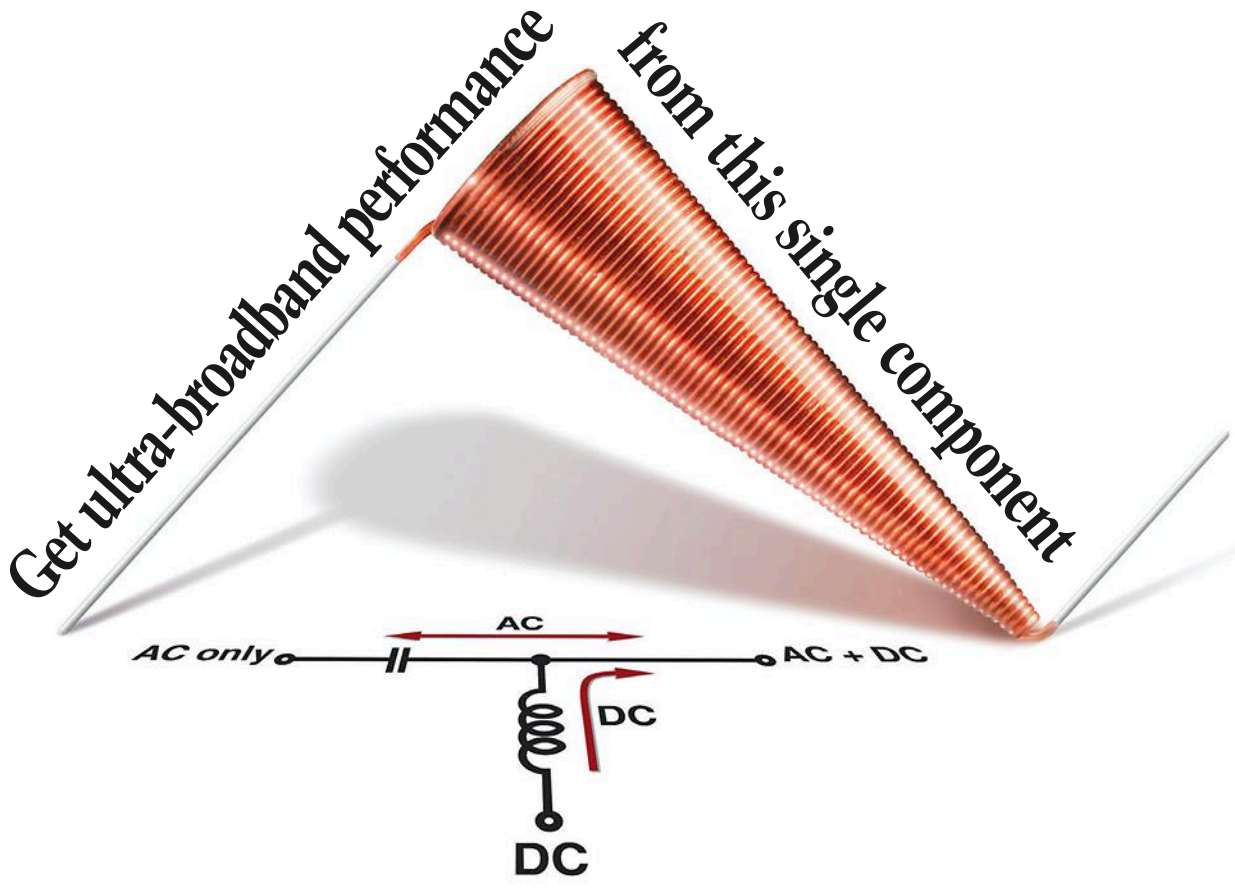

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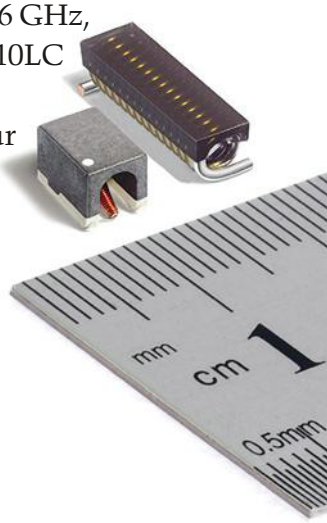

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CHANGING WAYS to Deliver Safety and Security

Vendors are changing the way they deliver safety and security support, to reduce development costs and time to market.

The rise of the Internet of Things (IoT) and Industrial IoT (IIoT) is not the only reason for increased demand for safety- and security-related solutions. Many existing standards—such as DO-254 and DO-178 for avionics and Automotive Safety Integrity Levels (ASIL) risk classifications, defined by the ISO 26262—are just some of the more demanding domain-specific specifications. There are also standards for railway (CENELEC 50126/128/129) and general applications (IEC-61508).

Each standard has its own range of safety specifications, like Design Assurance Level (DAL) DO-254 and DO-178. DAL A is designed to prevent catastrophic failures, while at the other end DAL F indicates that a failure will have no significant effect on the system. ASIL-A is comparable to DAL D; ASIL-D is comparable to DAL A or DAL B.

Most high-reliability RTOS vendors provide certification, such as Green Hills Software's INTEGRITY-178 tuMP Multicore RTOS that meets DO-178B Level A certification requirements. Lynx Software provides certification artifacts for its LynxSecure separation kernel hypervisor.

Tools can also be certified. For instance, Cadence's latest toolset is available with Tool Confidence Level 1 (TCL1) documentation. This addresses more than 30 tools that are ISO 26262-compliant. Adacore's QNAP is a certified code generator that turns Simulink models into qualifiable Ada or MISRA C code *(see "Generate Qualifiable and Tunable Code Using Model-Based Tools" on electronicdesign.com)*. Normally generated code would have to be qualified, whereas the original model would be qualified.

Even chip-level designs need to be addressed. ARM has delivered safety documentation for automotive ADAS applications for Cortex platforms *(see "Safety Document Package Targets ADAS" on electronicdesign.com)*.

Further up the food chain are certified COTS boards, such as Curtiss-Wright's boards that are certified to DAL C or DAL A for avionics applications. Generating certification artifacts is costly in time and effort, so not all boards in their repertoire are designed to meet the strictest specification.

All of these can save significant time and effort in certifying hardware and software for safety- and security-critical applications. Devices without proper certification will not be usable in many automotive, avionics, medical, and transportation applications. ed

Most high-reliability RTOS vendors provide certification, such as Green Hills Software's INTEGRITY-178 tuMP Multicore RTOS that meets DO-178B Level A certification requirements. Here, the Green Hills Software system is being used by ASELSAN in the Turkish T-70 Helicopter Program.

News

BIOSENSOR STARTUP

Aims to Untangle Hospital Patients

Surendar Magar still wonders about what to call the business he started in 2008. The chief executive of biosensor startup HMicro, he said in a recent interview that while the company is trying to change how hospitals gather data from patients, he still does what he has always done: make chips.

Magar's biography is dyed in semiconductors. After finishing a doctorate in digital signal processing, he joined Texas Instruments and helped develop the TMS320 microprocessor released in 1983. He later started the Wi-Fi chipmaker Athena Semiconductors, which he sold to Broadcom in 2005. HMicro has also devised its own unique chips, but it is difficult to leave healthcare out of the equation.

"It's probably a hybrid," Magar says about the business. The company's first product, a wireless chip that measures a patient's vital signs and relays that information to a smartphone or dongle plugged into a patient monitor. HMicro will not supply chips directly to hospitals, he said, but to equipment makers that can build wearable sensors around them.

The Fremont, Calif., chipmaker has raised around $30 million in funding since 2008. Last month, it revealed its first chip, HC1100, which has already entered "high-volume production," the company said in a statement. But it has not yet announced any OEM partners.

Lying at the heart of its first product is the company's unique chip design, which it started laying out with STMicroelectronics in 2011. The WiPoint architecture includes an array of sensors for monitoring heart rate and respiration, and three different radios so that the chip is never interrupted while streaming data. Squeezed onto the same chip are the power management, processor, and circuits for connecting motion and audio sensors.

The goal of the WiPoint chip is to replace the billions of sensors that hospitals purchase every year, so that doctors can constantly monitor patients without wiring them down to hospital beds. Patients can leave the hospital wearing the device and simply throw it out once the coin-cell battery runs out of juice.

Magar suggested that part of the reason that hospitals have been slow to employ wireless monitoring is the lack of hardware. The market for consumer fitness trackers from companies like Fitbit and Jawbone has vacuumed attention from medical-grade devices that monitor health and medical conditions, he said.

"In general, the medical world is in the stone ages," Magar says. "And if you really want semiconductors to revolutionize something, you need a very high volume application."

As the dimensions and cost of semiconductors have shrunk, other companies have taken that view. Vital Connect, which was founded by former Marvell Semiconductor engineers, created a custom chip for wireless patches that monitor vital signs. MC10, a healthcare startup based in Boston, makes wireless biosensors for medical research that stretch and conform to the human body.

General Electric and Phillips—two of the largest makers of patient monitors in hospitals—are also testing patches to remotely analyze sweat and check vitals. In 2012, they were among the most vocal supporters of a Federal Communications Commission ruling that opened 40 MHz of spectrum for medical body area networks, or MBANs.

And government regulators have not turned a blind eye. In 2013, the Food and Drug Administration passed guidelines for wireless hospital devices, advising companies to build secure wireless products that can't be cross-contaminated with Wi-Fi networks used by consumers.

Magar was guided by similar concerns: "In an emergency room, there may be 50 patients wearing the patches," he says. "They are continually transmitting to a patient monitor, so how do you connect 50 channels in a room without missing a beat?"

Hmicro's engineers were able to merge three different radios into a single WiPoint chip, so that the device always had an open passage for transmitting data. It operates primarily over Wi-Fi, but uses the medical band and ultra-wideband channels as backups.

The chipmaker also created an optimized version of Wi-Fi that consumes fewer than 10 milliamps of power from the coin-cell battery. The company decided against using Bluetooth—like Vital Connect, for instance—because it was not efficient enough for constantly streaming data.

One lingering question for the company is how the price will compare to wired sensors. Doug Linquest, HMicro's chief marketing officer, said in an interview that the chips would be slightly more expensive, but that they would become cost-competitive after increasing production. He added that the chips could further cut costs related to disinfecting reusable wires.

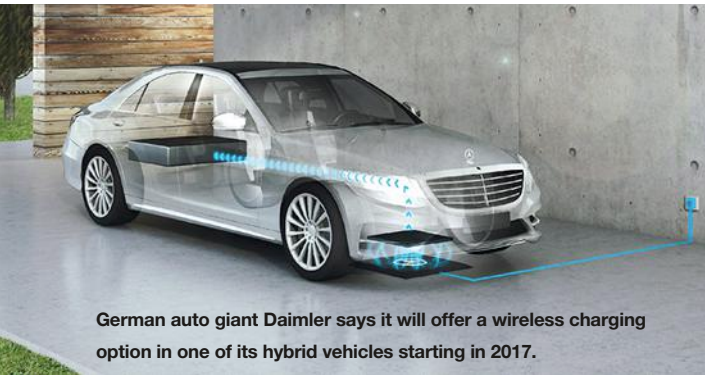
Magar suggested that the benefits of wireless monitoring would outweigh pricing concerns. And he fell back on a familiar chip industry metaphor to explain why: "It's a little

like what Wi-Fi did for Ethernet cables. It got rid of the wires and we were able to create an entirely new infrastructure." ■

MERCEDES-BENZ SAYS HYBRID VEHICLE
Will Have Wireless Charging in 2017

CHARGING AN ELECTRIC VEHICLE without cords has seemed like an afterthought to making better batteries or finding ways to charge cars faster. But some automakers are starting to embrace the technology in an attempt to make charging more convenient. Now, Mercedes-Benz wants to be first to sell cars with the feature.

Daimler, the German auto giant that builds Mercedes, recently said that it would offer a wireless charging option in one of its hybrid vehicles starting in 2017. Drivers will be able to stop their cars over a charging pad, which will start refilling the car's battery automatically, without cords or physical contact.



German auto giant Daimler says it will offer a wireless charging option in one of its hybrid vehicles starting in 2017.

If the company follows through on its plans, the 2018 Mercedes S550e hybrid will have the first known wireless charging system installed at the factory, and it will mark an early step toward spreading the technology to electric vehicles.

Wireless charging has been disappointing for years, overshadowed by the lower costs and faster charging times of electrical connectors. One of the earliest standards for charging electric vehicles without cables, Magne Charge, was scuttled in 2001 when California regulators ruled in favor of the J1772 standard, which is still widely used in charging stations.

Inside the new wireless charging system is technology from Qualcomm. The wireless chipmaker's Halo technology uses resonant magnetic induction, which transmits power between copper coils resonating at the same electromagnetic frequency. The companies said that the system will deliver 3.6 kilowatts.

Mercedes is also working on wireless charging alongside machine vision and wireless networking at its research lab in Sunnyvale, Calif. The new wireless charging system fits the blueprint that Mercedes has written for electric vehicles. At the Paris Auto Show this month, the company introduced an electric vehicle concept called Generation EQ, which will combine autonomous driving, wireless charging, and the ability to swap information with other cars on the road.

(continued on page 14)

NVIDIA LICENSES SECURITY
Hardware to Defend Against Car Hackers

NVIDIA IS FORTIFYING its graphics chips against hackers, making it harder to exploit idiosyncrasies in hardware and break into devices ranging from smartphones, security cameras, and cars.

The company said this week that it had licensed technology to thwart digital attacks starting in computer circuits. During these types of attacks, hackers watch tiny variations in power consumption to help them guess at cryptographic keys, which grant access to important layers of software.

Nvidia licensed the technology from Rambus, a Sunnyvale, Calif. memory chipmaker that also provides cybersecurity tools. Some of its most popular products are designed to prevent hackers and counterfeiters from breaking into smart cards. The company has also signed licensing deals with Boeing and Xilinx.

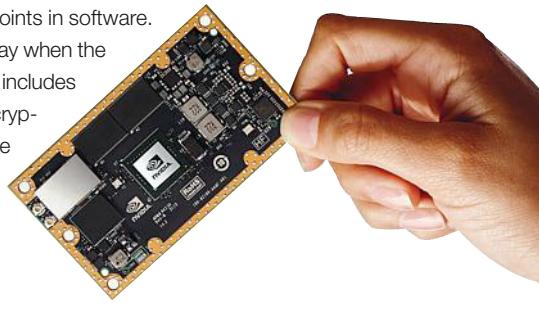
The security deal is one of many announcements that stand out against the recent attack on Dyn DNS, a New Hampshire-based firm that controls some of the infrastructure of the internet. The hackers hijacked millions of connected cameras and other cheap devices in order to cripple websites in large parts of the United States.

Nvidia is not focused on the same types of devices, but the chipmaker is betting its graphics chips will become indispensable for systems holding sensitive data. It is aiming to supply chips for virtual reality headsets, surveillance cameras, and corporate servers. It is also developing chips for autonomous cars, which are raising alarm among security experts concerned about cars being hijacked and driven off the road.

The technology built by Rambus is designed to hedge against an attack known as differential power analysis. Like rapping your knuckles on a wall to find hollow spots, hackers watch a chip's power consumption for clues about how to get inside. Similar attacks target electromagnetic noise.

The silver lining is that hackers need to have the device in their hands, measuring the power signals coming off the chip. That contrasts with more familiar flavors of hacking in which intruders search for weak points in software.

Nvidia did not say when the technology, which includes a combination of cryptographic hardware and software, might be used in its products. ■



An array of sensors inside a jet engine. Data converters, like those built by Analog Devices, turn physical signals from sensors, like movement and pressure, into digital data. Linear Technology's power management chips help to conserve the electricity required for that process. *(Image courtesy of Matt Gibson, Flickr)*

INTEL TRIES GOING INCOGNITO with New Atom Chips

FOR THE LAST quarter century, Intel's brand has morphed into a household name. But in recent years, the chipmaker has increasingly bent toward a future in which its computer chips are largely anonymous.

The Santa Clara-based company has sold vast quantities of server chips to Silicon Valley neighbors like Google and Facebook. It has tuned its computers to make them useful in cars, drones, and factories. Intel has also acquired machine vision startups like Movidius, whose chips silently watch their surroundings from inside security cameras.

Intel continued on that route Tuesday when it announced its latest Atom chip, which will provide almost twice the performance than a previous generation of chips for industrial computers, automotive displays, and cameras.

INTEL E3900 CHIP SPECS

	Number of CPU/GPU Cores	CPU TFM Frequency	Estimated CPU DMIPS Target	Estimated Graphics GFLOPS Target	Target TDP	Ambient Temperature Range
Intel Atom x5- E3930 processor	2/12	1.8 GHz	18972	106	6.5	–40 to 85°C
Intel Atom x5- E3940 processor	4/12	1.8 GHz	37944	115	9.5	–40 to 85°C
Intel Atom x7- E3950 processor	4/18	2.0 GHz	42160	187	12	–40 to 85°C

The new chip, E3900, is the chipmaker's latest venture into the kinds of power-sipping chips that dominated smartphones and could breathe life into the Internet of Things. The chip also shoulders Intel into an embedded market with competition ranging from entrenched chipmakers like Marvell to newcomers like Qualcomm, which recently tweaked its popular Snapdragon processors for robotics and smart watches.

(Image courtesy of Intel)

Ken Caviasca, a vice president of Intel's Internet of Things Group, said in a brief interview that the new chip would stand out by providing more computing power to individual sensors. That enables cameras, for example, to get started on tricky tasks like identifying objects in pictures before shifting more complicated work to the cloud.

"There are significant downsides to sending data to a server for analysis, such as loss due to video compression and time in travel," he elaborated on Intel's blog. By sending fewer tasks to the cloud, cameras can more quickly identify defects in products rolling on an assembly line, and cars can stitch together multiple cameras in real-time to help drivers squeeze into parking spaces.

The improvements in the E3900 chip can be traced to its infinitesimal circuitry. In contrast to the earlier E3800 line, which was released in 2013 with transistors measuring 22 nanometers, the new chip is based on Intel's Goldmont architecture, which uses silicon wires only 14 nanometers long.

The new Atom chip is devised with up to four computing cores and Intel's latest generation of graphics. It supports tougher security, enhanced I/O capabilities, and a broader range of operating systems, including machine vision software. The power consumption comes in between 6.5 and 12 watts, with an ambient temperature range of -40 to 85°C.

The fate of Intel's Atom brand was uncertain only several months ago. In April, Intel revealed that it had discontinued its line of smartphone processors and several reports prematurely declared that its Atom products would be canceled. But instead that decision cleaned the slate for Atom, which Intel refocused on growing markets for industrial computers and cameras.

The E3900 delivers almost three times the graphics capabilities of Intel's previous embedded chips. It contains four image processing units, allowing it to prepare sharper and more colorful images for machine vision algorithms. Itseez, a machine vision start-up that was recently acquired by Intel, is working on specialized software for the E3900, said Caviasca.

The hardware also includes what Intel calls time-coordinated computing, which synchronizes the clocks across an entire network of connected devices. It achieves timing accuracy within a microsecond for automotive cameras and the programmable logic controllers used in factory equipment.

On Tuesday, Intel also announced the A3900 chip, which is designed for digital gauges and dashboard displays in cars. It will be available in the first half of 2017, the company said, with an extended temperature range to 110°C.

The timing of the announcement, which came at the Internet of Things Solutions World Congress in Barcelona, Spain, is also significant. It coincides with the first day of ARM TechCon, an annual conference in Santa Clara for chips based on ARM blueprints, whose success in smartphones has made them an Internet of Things darling.

But Intel has defended the early success of its IoT business. The company said that samples of the new Atom chip have already lured partnerships with auto part makers like Delphi and China's FAW, and security camera companies like Hikvision. Almost 30 customers are already using the E3900, it said. ■

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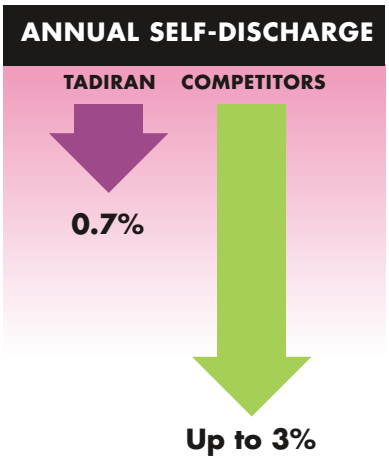

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MERCEDES-BENZ *(continued from page 11)*

"You cannot call a car autonomous if it cannot fuel [or] recharge itself," said Anthony Thomson, Qualcomm's vice president of business development and marketing, in a statement. The company says that charging coils could be built into highways, intersections, and parking lots so that electric vehicles could be continuously refueled.

Over the last year, Qualcomm has tested a 7.7-kilowatt Halo system in a hybrid vehicle that emergency responders drove to accidents during the Formula E electric racing series. Several automotive suppliers, including Switzerland's Brusa Elektronik, and Lear Corporation, have licensed its charging technology. The chipmaker is also helping to draft a wireless charging standard for the automotive industry.

That effort pushed forward earlier this year when Society of Automotive Engineers released guidelines for the first wireless charging standard, which was approved in May and operates over the 85 kHz spectrum, known as TIR J2954.

At a recent technology conference in Logan, Utah, the chairman of the society's wireless power transfer committee, Jesse Schneider, said that the standard was necessary in order to ensure that wireless charging pads from different manufacturers could work with other cars.

The new standard makes charging automatic and "extends the range for vehicle customer only by parking in the right spot," Schneider said in a statement.

While Qualcomm's technology is a starting point, it's not ready for electric vehicles. Qualcomm's system is only 90% efficient, and the company has said it is not powerful enough to charge an electric vehicle in "a reasonable amount of time." For an electric vehicle with a 30 kilowatt battery, a charger "needs double or even triple the charging power," the company said. ■

TINY ENERGY HARVESTERS Give Power to Space Exploration

BEFORE NUCLEAR WAR wiped out civilization in the video game series "Fallout," American roads purred with cars powered by nuclear generators. Such technology might seem dangerous—or explosive—but the National Aeronautics and Space Administration has equipped satellites and probes with nuclear batteries since 1961.

Now researchers from the Jet Propulsion Laboratory in Pasadena, Calif., are trying to upgrade these power systems to be more efficient, cheaper, and longer-lasting.

(Image courtesy of the Jet Propulsion Laboratory)

With more efficient power systems, the space agency could design cheaper probes using less radioactive material, allowing scientists to send probes deeper into space and to the fringes of the solar system. It could also let rovers explore planets and asteroids longer than they could before without having to rely on solar panels.

"This is particularly important for the outer planets, where the intensity of sunlight is only a few percent as strong as it is in Earth orbit," said Jean-Pierre Fleurial, the laboratory's supervisor for thermal energy conversion research, in a statement.

But Fluerial and his research team have not been trying to design new power systems from scratch. Instead, they looked at reinventing the radioactive thermoelectric generators that are already used in probes and satellites drifting out to the edges of the solar system.

These generators, which convert heat from decaying plutonium into electricity, are embedded inside the Voyager probes that launched in 1977 and have traveled more than 10 billion miles. The systems were also added to the Mars Curiosity rover and the New Horizons probe, which hurled around Pluto in 2015.

NASA is aiming for the new system, known as the Enhanced Multi-Mission Radioisotope Thermoelectric Generator, or eMMRTG, to complete its final design review before the end of the decade.

The researchers said that the new system will supply 25% more power and twice the lifespan of the generators embedded inside Curiosity. "Having a more efficient thermoelectric system means we'd need to use less plutonium," says Sabah Bux, a thermoelectric material scientist at NASA, in a statement. "We could go farther, for longer and do more."

The researchers worked on making new types of thermocouples, the devices that actually generate an electric current from the temperature difference in its circuits. While earlier devices were based on alloys of a material called telluride, the new design uses circuitry based on crystalline materials.

They are called skutterudites and have the unique ability to conduct electricity like metal and insulate heat like glass. As a result, the new devices can generate electricity with smaller variations in temperature, making them more efficient.

Like previous thermoelectric generators, the skutterudite components will be placed around a central can-like structure, which contains the plutonium. "Only minimal changes to the existing MMRTG design are needed to get these results," Fleurial says.

Last year, NASA licensed its skutterudite patents to Evident Thermoelectrics, an energy harvesting startup based in Troy, N.Y. Shortly after, the company released the first products based on the material, saying that the thermocouples could be used to soak up waste heat in industrial processing or to power wireless sensors. ■

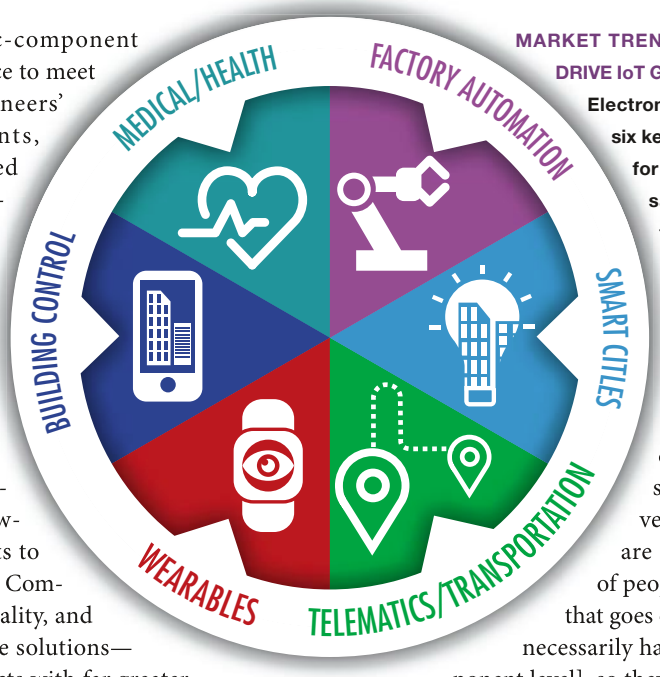
Special Report

VICTORIA KICKHAM | Contributing Editor

Size, Speed and Efficiency Drive Component Trends

Sensor fusion, ready-made solutions, and "small power" are among the top electronic components trends on suppliers' radars as they aim to keep up with IoT design needs.

As electronic-component suppliers race to meet design engineers' requirements, their eyes and ears are tuned into a handful of trends dominating the industry—especially the Internet of Things (IoT). OEMs, startups, and makers are placing new demands on manufacturers and distributors of the products and solutions essential to meet today's IoT designs, driven largely by the competitive marketplace and a growing need to get new products to market even faster these days. Compact design, greater functionality, and the trend toward ready-made solutions—including board-level products with far greater functionality than ever before—are hallmarks of the changing electronic components landscape, distributors say.



MARKET TRENDS: INDUSTRIAL, WEARABLES DRIVE IoT GROWTH

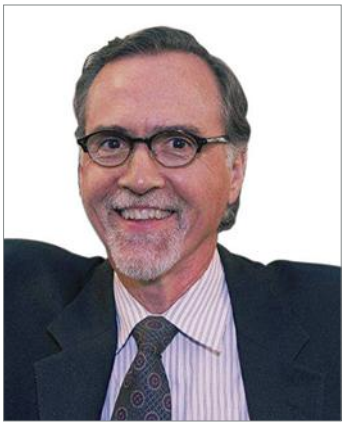
Electronic-component suppliers point to six key markets that are driving demand for Internet of Things projects. They say these end-markets are seeing the most demand for low-power components of all types, more advanced sensors, and ready-made solutions that speed time-to-market.

Randall Restle, vice president of applications engineering for Digi-Key Electronics, points to advances in sensors and transducers as well as the proliferation of more advanced board-level products as cases in point. He agrees that the IoT is driving these trends, and that keeping up with the newest offerings is one of the greatest challenges facing electronic-components suppliers today.

"I have never seen more sensors and transducers coming to market. The IoT, it seems, is spawning a resurgence in sensor development, in particular" says Restle, a 40-year industry veteran. "Board-level products are another [growth area]. A lot of people want to design something that goes on the internet, but they don't necessarily have the expertise [at the component level], so they are looking for as much of a finished solution as possible. We have brought on more board-level and modular-level suppliers than ever before.

"If there's a challenge in all this, it's keeping up with all the innovation in the industry."

This fall, *Electronic Design* asked experts from five of the industry's largest electronic-components distribution companies to weigh in on the hottest trends that they are seeing in the components market. Five rose to the top of the list: low power; wireless; sensor fusion technology; "edge" computing; and board-level solutions. Here's a look at what distributor executives had to say about each category.



> "If there's a challenge in all this, it's keeping up with all the innovation in the industry." —Randall Restle, vice president of applications engineering, Digi-Key Electronics

"SMALL POWER" RULES

Industry watchers continue to point to demand for low-power solutions, an issue that cuts across all component categories. Restle's colleague Jeremey Purcell, portfolio manager for design tools at Digi-Key, takes the issue to another level, pointing to a need for "small power" as designers seek ways to pack more technology into smaller products—particularly in the wearables market.

"It's not so much low power, but small power," says Purcell. "We get a lot of questions about how we can shrink power, because they are packing [so much] into a small space."

Restle adds that the trend is affecting all facets of the supplier landscape, creating greater power-saving options for designers.

"Everyone seems to be concerned today with low power," he says, noting an oscillator supplier Digi-Key works with that is developing low-power devices. "I don't think of that kind of device as being low power, but everyone is thinking of this issue. They're thinking about battery power, portability. And it's driving a lot of their internal development process."

Eric Williams, vice president of IoT for Avnet, adds that cost goes hand-in-hand with low power when it comes to demand for IoT solutions. He points to data communications and demand for low-power wide-area-network (WAN) offerings as one example of where the technology is headed.

"Cellular operators have the main advantage of coverage, but services are expensive and the radios are expensive (and costly to certify), and not nearly as power-efficient. For applications that require low power and low data rate, the low-power WAN offerings solve these problems," explains Williams. "That creates pressure on the mobile network operators (MNOs) to create new technology and services to fill the gap. Narrowband IoT (NB-IoT) is one such example. In addition, they will also work with the module vendors to significantly reduce the cost of radios and certification."

"I think you're really going to see a lot of work [in this area]," adds Williams. "Certainly, cost and low power consumption is key."

WIRELESS ON THE RISE

Although wired products are still in demand for IoT design—especially in industrial settings—Restle adds that "fundamentally, the rage seems to be on wireless products." Raymond Yin, director of technical content at Mouser Electronics agrees, pointing to low-power, long-range wireless technology as a key growth area. Wireless modules that leverage the technology are a particular boon to engineers designing new IoT solutions, he adds.

"Some of these new wireless modules are incredibly easy to deal with," says Yin. "It really minimizes the effort of the design engineer when you can design in a wireless link."

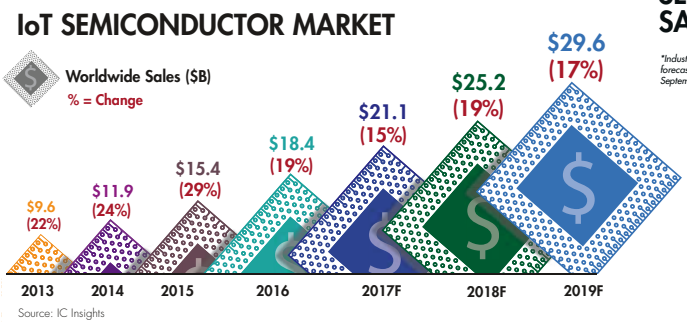
TTI Inc.'s Brian Wellhouse, supplier marketing manager for sensors, suggests Bluetooth and wireless networks as among the most cutting-edge developments in component technology today. As a passives supplier, TTI is focused on adding sensor technology to its product lineup as a way to serve the IoT market.

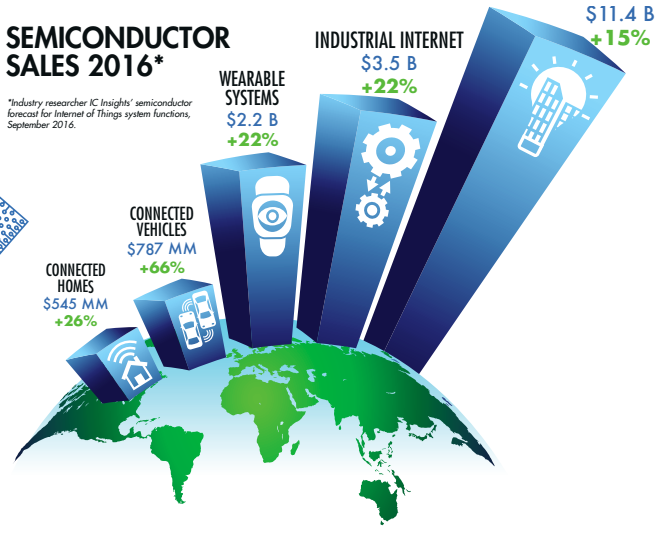
Wellhouse says one of the most prevalent customer trends he sees in both of these areas involves adding networking and data to existing devices or creating new sensor networks. He points to advances in pressure-transducer technology that can accommodate wireless modules, allowing for remote monitoring of systems. Heating, ventilating, and air-conditioning systems are a case in point. By removing additional components and cabling, data can be transmitted wirelessly to a data-acquisition system. As one example, incorporating connectors with Bluetooth technology eliminates the need to source the cable that would typically transmit data from the system.

Yin explains that, in addition to ease of use and convenience, such transformations give customers greater access to data. This can lead to improved performance in the application they are working on as well as in larger, system-wide operations.

"Once you're able to hook some sort of node or sensor up to the Internet and monitor it remotely and act on that data, it's incredibly powerful," he says. "And it's really not that difficult to do anymore."

> "Some of these new wireless modules are incredibly easy to deal with. It really minimizes the effort of the design engineer when you can design in a wireless link." —Raymond Yin, director of technical content, Mouser Electronics





IoT CHIP SALES TO RISE 19% IN 2016

Sales of semiconductors for Internet of Things projects are expected to rise nearly 20% this year—to $18.4 billion—driven by growth in connected vehicles, homes, wearables, industrial markets, and smart-city applications, according to market researcher IC Insights. This matches what many suppliers are seeing, too. Executives from five of the industry's largest electronic-components distributors have identified industrial automation, building control, smart cities, wearables, medical/health markets, and transportation as areas where they see the most demand for IoT-related electronic components.

SENSORS GET COMPLEX

Wellhouse names combination sensors—or "sensor fusion"—as another important industry trend. Customers now demand a wider range of functions out of their sensors. One example, he says, is a sensor used to gauge only temperature that can now sense humidity output as well—at a good price point. Street lighting is another example. Customers are adding sensors to lighting that not only measure energy use, but count cars and gather other traffic flow information. The drive is toward fewer components that gather more data.

He also echoes comments about today's resurgence in sensor development, adding that one of the greatest challenges faced by TTI is in educating customers on the wide range of solutions available to achieve a particular result. He says as many as four to five different technologies can do the same thing, at widely varying price ranges.

"Much of our work has been educating engineers on different technologies and solutions based on the sensing need they have for the application," explains Wellhouse. "We're supporting design and making sure engineers are aware that there are multiple solutions for a single problem."

Aiden Mitchell, vice president of IoT sales for Arrow Electronics, agrees and emphasizes growing demand for sensing at the "edge"—that is, embedding more and more sensors at the device level. This underscores the growing importance of data, says Mitchell, noting that ubiquitous sensing is giving customers the real-time execution they need to generate new and better information to improve operations.

"In components, the biggest opportunity is at the edge. On the sensor side, we're seeing sensor unit growth and low-power wireless as the two fastest growing technology areas. That growth is only matched by embedded computer solutions—board-level and box-level solutions," he says. "More and more, the value is shifting to the data. Companies run on data either because that's what's going to drive their efficiency, or maybe because it's going to drive their new revenue model. Either way, it's all about the data."

> "Much of our work has been educating engineers on different technologies and solutions based on the sensing need they have for the application." —Brian Wellhouse, supplier marketing manager for sensors, TTI Inc.

EDGE COMPUTING TAKES HOLD

Like the IoT itself, trends surrounding IoT component technology are also connected. Mitchell's point about putting more sensing technologies at the "edge" of a process is part of a separate trend toward "edge computing." It's something both Arrow and Avnet say is beginning to drive growth in the segment and has considerable long-term potential.

> "In components, the biggest opportunity is at the edge." —Aiden Mitchell, Arrow Electronics

Essentially, edge computing pushes computing technology away from centralized networks and toward the source of data by using a variety of devices—laptops, tablets, cell phones, and sensors, to name some. Avnet's Eric Williams describes it as "pushing the processing mode out to the edge." And he says it's all about data and efficiency.

"Edge computing allows you to manage some portion of the workload so you don't have to stream that information back up to the cloud 24/7," Williams explains. "Suppliers and customers are looking for edge-based solutions—to create processing at the edge."

Once again, lighting is a prime example. In the case of street lighting, an edge-based solution tracks information at the lighting source and sends back only necessary data, such as the need for service when a certain lumen level has been reached. The end result is more focused data generation that enables organizations—businesses, municipalities, and others—to make better decisions.

"Components and hardware are still vital, but it's all about what you need [in order] to generate data," adds Mitchell. "It's about sensing embedded in that edge device. Then it's about the mobilized, embedded compute options … All of this allows you to predict a lot more accurately what's going to occur."

KITS/BOARD-LEVEL SOLUTIONS IN DEMAND

Many of today's components trends can be wrapped into a single package, leading to growing demand for development boards, modules, and other ready-made solutions. The trend speeds time-to-market for many customers and allows others—"makers" and "maker professionals" in particular—a faster, easier way to solve a problem.

"We're seeing a lot more of this activity because it speeds up the time from idea to prototype," says Digi-Key's Purcell. "It also helps the makers or 'maker pros' who have an idea, are trying to fix a specific problem, and are almost there. It gives them a boost, as well."

Restle emphasizes the potential of the maker-pro market.

"These are entrepreneurs who are looking for ready-made solutions. And some of them will be tomorrow's big [customers]," he says.

Component manufacturers are rising to the call for more of these products, adds Avnet's Williams, pointing to manufacturer-distributor collaboration to create boards and kits.

"You're seeing our suppliers looking at opportunities to take their solutions and then create development boards," he says. "It isn't just chip level. It's [taking] their solution and creating a development board product that can bring that solution to life and make it easier for the customer.

"That's why you're seeing a lot of development around use cases, starter kits [and the like]. It's critical that we embed our suppliers' technology into those starter kits. There is a proliferation of starter kits in the market to ease the initial experience for the customer."

> "Edge computing allows you to manage some portion of the workload so you don't have to stream that information back up to the cloud 24/7." —Eric Williams, vice president of IoT, Avnet Inc.

MORE ROOM FOR GROWTH

Distributors agree the sky's the limit when it comes to the potential of the IoT, pointing to industrial applications, smart cities, building automation, and the wearables market—especially as it relates to medical and health industries—as some of today's hottest technology areas. Mitchell adds that Arrow has seen growth in telematics and transportation as well, and looks forward to growth areas such as smart agriculture, where customers are searching out monitoring and detection solutions to tackle a wide range of problems.

These suggestions mesh with recent industry data predicting sales growth in semiconductors for IoT-related systems. Industry researcher IC Insights said this fall that IoT semiconductor sales will rise 19% this year to $18.4 billion. Connected cars, homes, wearables, industrial applications, and smart cities will drive that growth.

"It's a really fun and interesting time in the industry," says Mitchell. "There are still challenges in many other markets. But one thing is for sure: we're seeing IoT really drive growth."

WILLIAM WONG | Embedded/Systems/Software Editor

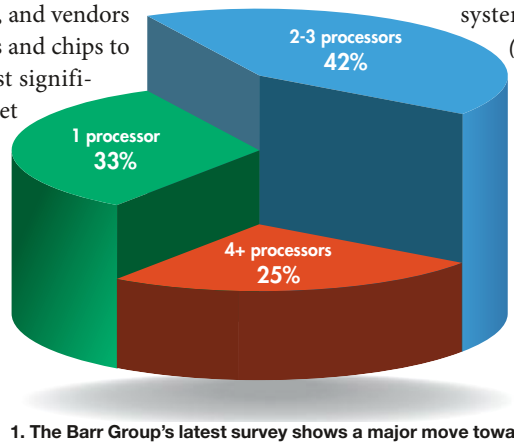
Innovations and Options Abound in 2016

The year's most interesting technologies and products include a flood of IoT development options, improvements in storage technology, and the march toward more cores even in low-end embedded applications.

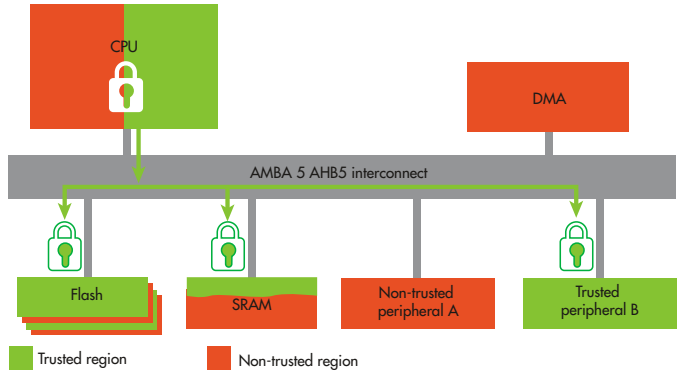
Overall, 2016 has been an amazing year, from a variety of viewpoints. Significant consolidation has occurred in all areas, from Silicon Labs buying Micrium for its µC/OS RTOS family to Mercury Systems acquiring Creative Electronic Systems. There were major purchases in the semiconductor space as well. Analog Devices picked up Linear Technology *(see "Why Did Linear Technology Sell Itself to Analog Devices?" on electronicdesign.com)*, while Broadcom became part of Cypress Semiconductor *(see "Cypress Acquires Broadcom's Internet of Things Business, Loses Long-Time Chief Executive" on electronicdesign.com)*. Of course, there was also Qualcomm's acquisition of NXP, which had recently absorbed Freescale *(see "Qualcomm Buys NXP for $47 Billion, Turning Eyes to Internet of Things" on electronicdesign.com)*. Softbank's purchase of ARM will have major implications in this space, too.

PROCESSOR TECHNOLOGY

The Barr Group's latest survey shows a major movement toward multicore solutions *(Fig. 1)*, and vendors are churning out new architectures and chips to meet the demand. One of the most significant announcements for the Internet of Things (IoT) space was ARM's new Cortex-M23 and -M33 series based on the ARMv8-M architecture *(see "Cortex-M23 and M33 Incorporate Latest TrustZone Features" on electronicdesign.com)*. The architecture includes ARM TrustZone support for hardware isolation of code, data, and peripherals *(Fig. 2)*. Chips based on the new architecture will be available next year, providing a more secure programming platform for embedded applications.



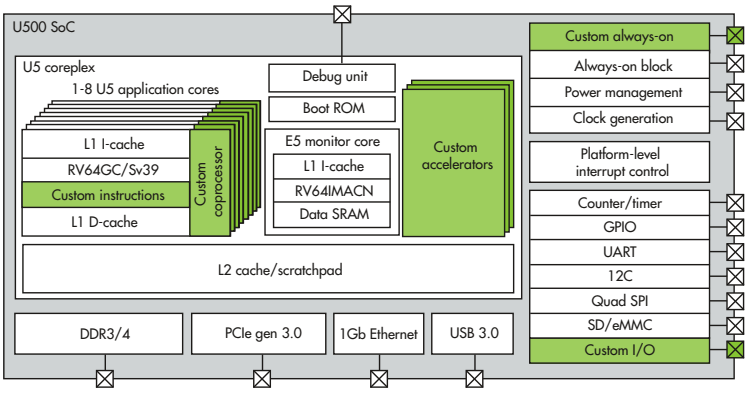
1. The Barr Group's latest survey shows a major move toward multicore solutions.



2. The ARMv8-M architecture includes TrustZone support for hardware isolation of code, data, and peripherals.

The other ARM platform of note is the Cortex-R52 that targets safety critical applications such as automotive driver assistance systems (ADAS) and even self-driving cars *(see "Multicore Separation Architecture Reduces Safety Software Complexity" on electronicdesign.com)*. It is designed to meet IEC 61508 SIL 3 and ISO 26262 ASIL D requirements. The primary feature of this multicore platform is the hardware that implements the software separation scheme similar to virtual-machine support found in ARM application processors.

The Cortex-R52 is different because it has a memory protection unit (MPU)—as opposed to a virtual memory management unit



3. SiFive's Freedom cores are based on the open RISC-V architecture.

(MMU)—because it has a single address space. It just provides protected partitions so that tasks can be isolated. This allows the use of a sandbox hypervisor, and the system can provide deterministic performance necessary for safety critical applications.

Imagination Technologies' 64-bit I6400 Warrior core is designed to be part of a heterogeneous cluster *(see "Easing Design of Heterogeneous Clusters" on electroncdesign.com).* A cluster of eight cores is a building block for larger systems that can have up to 64 clusters, and which can handle 1,536 simultaneous threads and support 128 I/O control units (IOCUs). Imagination Technologies' PowerVR GPUs can also be part of the mix. The system supports the OmniShield IO virtualization technology, which allows secure virtual domain to include a mix of hardware cores. ADAS is just one application area for this type of system.

RISC-V (risk-five) is a compact instruction set architecture (ISA) that can address a range of systems, including 16-, 32-, 64-, and 128-bit platforms. The ISA supports a mix of hardware functions like floating point and SIMD. The small instruction set makes it possible to define additional instructions, suiting it for embedded applications.

SiFive's Freedom family is an open-source chip platform based on RISC-V. Freedom U500 *(Fig. 3)* and Freedom E300 work with both FPGA or ASIC implementations. The Freedom U500 can run Linux and is designed for TSMC's 28-nm technology. The Freedom E300 microcontroller is designed for low-power IoT applications and uses TSMC's 180-nm technology. SiFive's platform includes a board support package and development boards in addition to the base silicon.

Microsemi is making RISC-V available on its SmartFusion 2 SoC FPGAs. There is no charge for using RISC-V, unlike the ARM Cortex-M1 that is also available for the SmartFusion 2 chips. Designs can be moved from an FPGA to a custom chip without incurring additional license fees.

RISC-V is supported by a range of open-source development tools, including GCC and LLVM compilers. The implementations that support Linux can take advantage of the Yocto configuration tools.

SUPERCOMPUTING TECHNOLOGY

Intel's Xeon still dominates the high-end enterprise environments, but it is finally getting more competition from 64-bit ARM platforms like Cavium's ThunderX2 *(see "54 Core SoC Targets Public and Private Cloud Servers" on electronicdesign.com)*. Configuration support up to 100-Gb Ethernet and the Cavium Coherent Processor Interconnect (CCPI) provide cache-coherent operation in a dual-socket configuration. AMD's Opteron-A and Applied Micro's X-Gene server chips fit in this space. Standard Linux distributions are available for these platforms.

Applications that incorporate deep learning, or deep neural nets (DNNs), are becoming more common *(see "GPUs and Deep Learning" on electronicdesign.com)*. Systems are being designed to handle these applications using approaches that range from many core solutions to GPGPUs.

Intel's Knights Landing Xeon Phi *(see "Integrated Fabric is Key to Many Core Platforms" on electronicdesign.com)* is a multicore solution that has built-in support for Intel's OmniPath fabric. The OmniPath fabric allows for the creation of very large supercomputer clusters with thousands of cores. Unlike earlier Xeon Phis, the latest can act as a host; therefore, a cluster can consist solely of Xeon Phi chips.

Nvidia's Tesla P100 GPGPU *(Fig. 4)* is designed to tackle DNN, among other applications *(see "GPU Targets Deep Learning Applications" on electronicdesign.com)*. It can deliver 21 TFLOPS of 16-bit floating point that is ideal for DNN applications. It is built using CoWoS (chip-on wafer-on-substrate) with HBM2 (high-bandwidth memory version 2) technology. Four high-speed NVLinks can connect multiple chips into a single node without additional logic. The P100 can run the Cuda DNN (cuDNN) runtime that targets DNN frameworks like TensorFlow, an open-source software library for numerical computation.

4. Nvidia's Tesla P100 GPGPU is built using chip-on wafer-on substrate technology to deliver 21 TFLOPS of 16-bit floating-point computing ideal for DNN applications.

EMBEDDING FPGA TECHNOLOGY

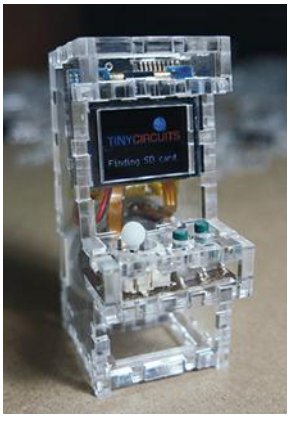
Flex Logix *(see "Q&A: Embedded FPGA Facilitates Reconfigurable SoC/MCU RTL Blocks" on electronicdesign.com)* and Menta *(see "Q&A: Embedding FPGAs into Custom SoC Designs" on electronicdesign.com)* are delivering embedded FPGA (eFPGA) technology. An eFPGA allows an ASIC to provide fixed custom hardware, as well as configurable custom hardware.

The eFPGA block works like a conventional FPGA, except that it is embedded in a chip with other logic. It allows compa-

5. Scope AR's augmented-reality software can utilize devices like tablets and smartphones to add information to a scene captured by the device's camera.

6. Hexiwear is a module that can fit into a wristband so that a user can take advantage of its portability and a heart rate monitor.

7. Tiny Circuit's Tiny Arcade is based on a postage-stamp-sized Arduino-compatible board with additional Tiny Circuit boards tacked on, including an OLED display.



nies to provide a chip with a configurable interface as well as reconfigurable hardware acceleration. The approach can help future-proof a design, and and be used to prevent third parties from copying a chip's functionality.

THE VIRTUAL EXPERIENCE

Augmented reality (AR), mixed reality (MR), and virtual reality (VR) were hot topics this year, led by a number of wearable glasses (like Microsoft's HoloLens) that provide an immersive environment. While VR and MR require this immersive approach, AR does not. AR can utilize devices like smartphones and cameras that are equipped with cameras.

Scope AR's WorkLink *(Fig. 5)* is one platform that fits the bill *(see "Putting Augmented Reality to Work" on electronicdesign.com)*. The software is able to recognize objects in view of the camera and overlay additional information. It can be used for applications such as training and maintenance. WorkLink supports glasses as well as smartphones and tablets. The Remote AR package allows a remote person to see and interact with the person running WorkLink.

Virtual experiences are no longer limited to sight and sound. Now touch can be part of the mix using Ultrahaptics' latest technology *(see "Ultrasonics Brings Haptics to Augmented and Virtual Reality" on electronicdesign.com)*. The system uses an array of tiny ultrasonic speakers combined with a 3D camera to deliver focused vibrations to a person's skin, such as the palm of their hand. It provides feedback without the need to actually touch a surface. The technology can simulate many different types of textures and effects and combine them with AR or VR interaction.

MyScript's Nebo is not an AR or VR application, but it is changing how we interact with devices *(see "The Pen Is Finally Mightier than the Word Processor" on electronicdesign.com)*. Nebo is actually a pen-based editing tool that runs on smartphones and tablets. It provides word-processing-style editing capabilities using a stylus so that handwritten notes can be turned into editable content. The key is portable data storage akin to the ubiquitous DOC file, but with script annotations and information. Like AR and VR, this is something that you really need to see to appreciate how effective it can be and how different it is from conventional stylus interactions with a computer.

GETTING STARTED WITH IoT AND PCB TECHNOLOGY

I have written and tested a wide range of platforms for IoT applications. No single one addresses everyone's needs, but I wanted to mention two that impressed me. The first is NXP's Hexiwear *(see "Module Targets Rapid IoT Development" on electronicdesign.com)*. Hexiwear *(Fig. 6)* is a hexagonal module with a touch interface and display that can also be mounted in a wrist strap to take advantage of the built-in heart-rate monitor (HRM). The HRM is an LED/sensor combination on the back of the module. It has Bluetooth Low Energy and 802.15.4 connectivity.

The other platform is TinyCircuits' array of postage stamp-sized boards that can be stacked to form some impressively tiny systems. These boards include a Tinyscreen OLED TinyShield and the Tinyduino processor board that is comparable to an Arduino Uno board. You can even get a Tiny Arcade *(Fig.7)* that is built from the boards. The Tiny Arcade uses the processor and OLED screen. It adds audio output via a built-in speaker, a rechargeable battery, and a tiny joystick and buttons.

I did want to mention NanoDimension's DragonFly 2020 *(see "Q&A: A Behind-the-Scenes Look at the DragonFly 2020 3D Printer" on electronicdesign.com)*. This 3D printer creates printed circuit boards (PCBs) using inkjet deposition. The multilayer boards are comparable in size and electrical performance to conventional PCBs, except that the DragonFly uses nanoparticle inks.

That's it for now—let's see what 2017 has in store! ed

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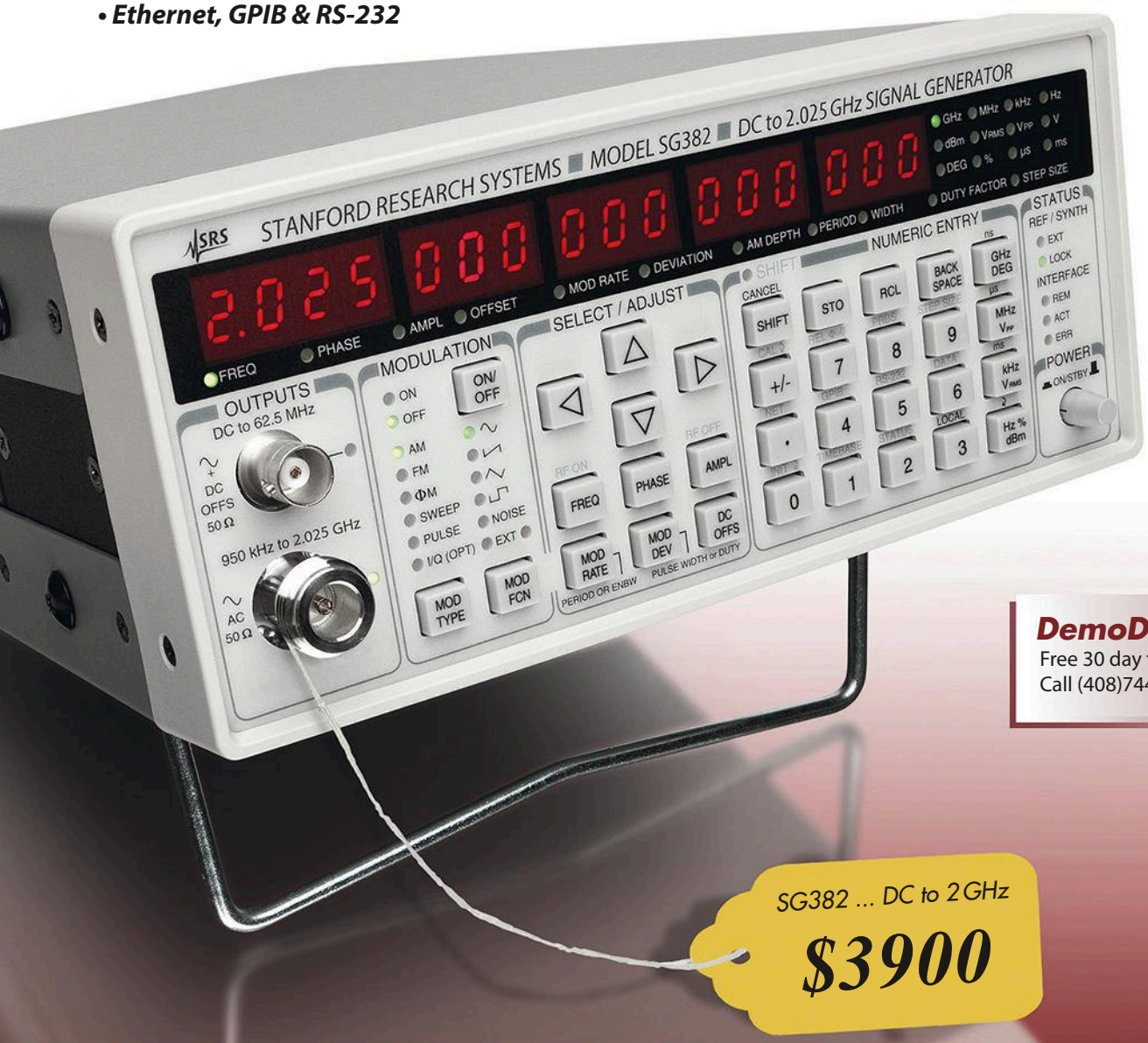

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Power

MARIA GUERRA | Technical Editor

Fast Charger for Mobiles Optimizes Power Usage

Compliancy with USB Power Delivery and Type-C gives this new reference design a universal edge, opening up fast charging to an array of consumer devices.

The DER-533 reference design is capable of 5-V/3-A and 9-V/2.2-A power delivery over a standard 3-A USB Type-C cable. *(Courtesy of Power Integrations)*

Many power-IC announcements are made through the course of a year, which makes it very difficult to narrow a choice of "best" down to just one product. Nonetheless, the "fast charger" reference design developed jointly by Power Integrations and Cypress Semiconductor stood out in 2016. The technology has started to find its way into smartphones, and will no doubt see greater use in the near future.

It's not the first fast-charger reference design developed by Power Integrations. The company previously introduced a reference design for a Qualcomm Quick Charge 2.0-enabled power supply, called the DER-381. It detects commands from a Quick Charge 2.0-enabled device using the TOPSwitch-JX switcher, CHY100D interface ICs, and an optocoupler feedback. The DER-381 can adjust the output voltage of the ac-dc wall charger to deliver increased power to the device's battery through a standard USB cable.

The new reference design, called the DER-533 *(see figure)*, is a USB-PD (USB Power Delivery) compliant ac-dc power converter also targeted at chargers for smart mobile devices. The DER-533 combines the EZ-PD CCG2 USB Type-C port controller from Cypress with Power Integrations' InnoSwitch-CP off-line constant-voltage/constant-current (CV/CC) flyback switcher IC and Fluxlink technology. Fluxlink technology, already integrated in the InnoSwitch-CP family for some time, is a safety-isolated communication technology that eliminates the need for an optocoupler, which would otherwise cause restrictions on control-loop bandwidth and speed.

The EZ-PD CCG2 device on the power-adapter (PA) board supports USB Type-C and Power Delivery (PD) 2.0. It includes a 48-MHz ARM Cortex-M0 processor with 32-kB flash and 4-kB SRAM to enable firmware upgrades during product development. In addition, Power Integrations' InnoSwitch-CP ac-dc controller handles ac-dc power conversion, overcurrent protection (OCP), and overvoltage protection (OVP). The controller supports a universal ac input supply, and manages the signaling between the device and power-conversion IC.

The DER-533 implements Profile 2 of the USB-PD standard, and is capable of 5-V/3-A and 9-V/2.2-A power delivery over a standard 3-A USB Type-C cable. According to the firms, constant power output from the switcher allows battery-operated devices to efficiently draw up to the maximum power of the charger at any selected output voltage, optimizing charge time and cost.

The reference design's compliance with USB-PD is a key benefit, since the new power-delivery protocol is universal and thus can charge a wide range of consumer electronics products. Also, the new reversible Type-C connector could become the most widely adopted standard, because it can deliver up to 100 W and supports Display Port and Thunderbolt. The overall goal with the DER-533 is that it leads to lower charging costs and helps speed time to market for designers.

Operating Modes Add Flexibility to Temperature-Sensor IC

Linear Technology enhanced its temperature sensor with multiple operating modes and by streamlining its analog inputs.

After careful consideration, the latest digital temperature-measurement system from Linear Technology Corp. (LTC), the LTC2986/LTC2986-1 *(see figure)*, stood out as the best in analog for 2016. The LTC2986 temperature sensor is built on the LTC2983 and LTC2984—two successful temperature-measurement systems that had won awards in the past. The chip just keeps getting better with the addition of more features, including three new operating modes.

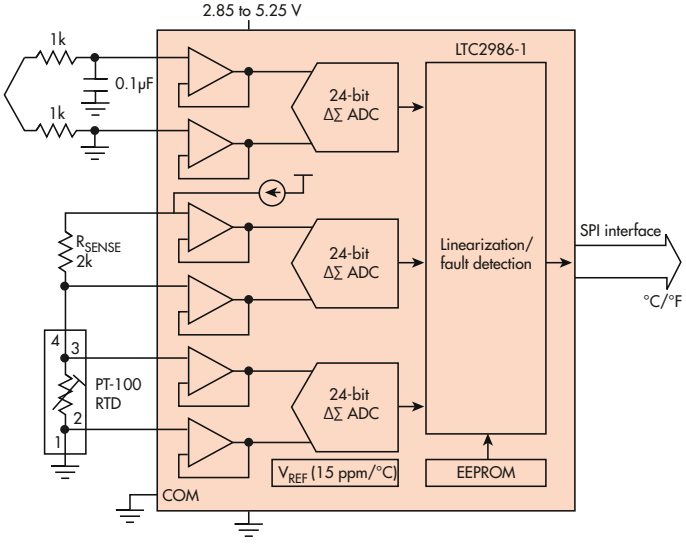
The LTC2986-1 is the EEPROM version of the LTC2986. On-chip EEPROM stores user-configuration data and custom sensor coefficients, eliminating IC or sensor programming by a host processor.

LTC claims the 10-channel LTC2986 IC can measure temperatures with 0.1°C accuracy and 0.001°C resolution. To ensure resistive measurements are accurate, current reversal eliminates thermocouple effects in the resistive sensor.

The LTC2986 can interface with different types of temperature sensors, including type B, E, J, K, N, S, R, and T thermocouples; 2-, 3-, or 4-wire resistance temperature detectors (RTDs); 2.25- to 30-kΩ thermistors; and temperature-sensing diodes. The IC includes all active circuitry, switches, measurement algorithms, and mathematical conversions to determine the temperature for each sensor type. For example, in the case of thermocouples, the IC has high-order polynomial equations built in for all types of thermocouples to convert the voltage output from the sensors into a temperature result.

The new operating modes provide better support for external overvoltage-protection resistors that are shared between multiple sensor types, powered temperature sensors with analog outputs, and non-temperature-related sensors like pressure and other voltage-output sensors.

The company offers several tools to design engineers who would like to start new projects using the new temperature-measurement-system IC. For instance, the DC2531 demo manual is a starter kit for demonstrating the LTC2986's performance. Also, sensor demonstration boards are available for universal temperature measurement, thermocouple, dedicated RTD, and dedicated thermistors. ed



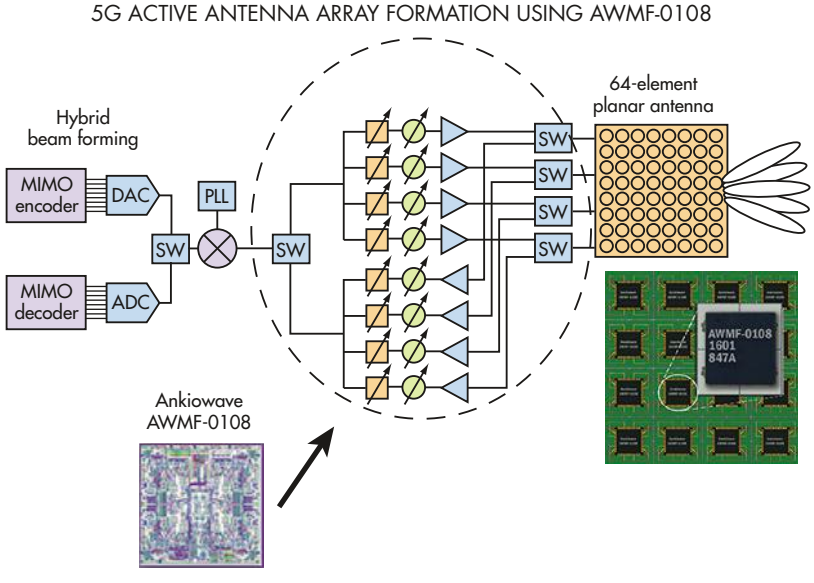
The LTC2986 Multi-Sensor Digital Temperature Measurement System features 10 flexible inputs that make it possible to interchange sensors.

LOU FRENZEL | Contributing Editor

Ka-band Transceiver Implements MIMO and Beamforming for 5G

My choice for the best communications product this year is Anokiwave's AWMF-0108 Ka-band 5G transceiver. This new IC promises to speed up and simplify the design of Fifth-Generation (5G) cell site equipment.

Even though the cellular system is still under development, great progress is being made. Field trials are being conducted and some standards are still being debated and evaluated. In addition, 5G spectrum allocations are ongoing. While full deployment is not expected until 2020, some systems will go live before that.



1. This block diagram shows the position of the AWMF-0108 in a typical 5G MIMO system. The IC contents within the circle are the phase and gain control blocks plus amplification and RX/Tx switching.

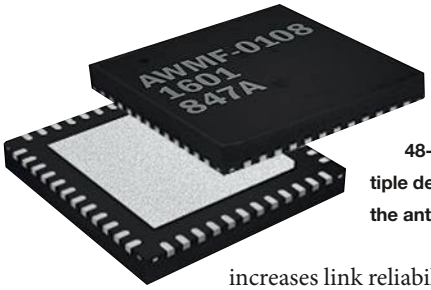
TECHNOLOGY ADVANCES PUSH 5G DEVELOPMENT

There are several drivers for 5G development. These include the desired capacity expansion of cellular service, a shortage of LTE spectrum, and the demand for higher data rates to support greater video use. Other drivers are a desire to implement a wireless broadband system and a way to support the billions of new Internet-of-Things (IoT) devices that are expected to come online in the coming years.

Here is a summary of what we know about 5G at this time:

- The 5G system will be a network of small cells. These will be mounted on walls, lampposts, and small masts, as well as indoors. Range will be a maximum of 100 to 200 meters.
- Modulation will be some form of OFDM for downstream and a single carrier variant for uplink.
- Access will be TDD.
- Use of millimeter wave (30 to 300 GHz range) spectrum to achieve needed bandwidth.
- Data rates will approach 1 Gb/s with typical averages much less than 500 Mb/s.
- Target latency < 1 ms.
- Massive MIMO. Multi-user MIMO. Antenna arrays from 16 to 1,024 elements for high gain and directivity.
- Active beam steering phased-array antennas.

The real secret to making 5G work is the use of MIMO and phased-array beam steering. Beam steering focuses the beam to produce boosted transmitter power and higher receiver gain and sensitivity. It also



2. The AWMF-0108 is housed in a 6 mm × 6 mm 48-pin PQFN package. Multiple devices will be mounted on the antenna itself.

increases link reliability and minimizes interference with nearby cells. The real challenge of 5G design is implementing the MIMO and beam steering. The new Anokiwave chip solves this problem.

THE 5G IC SOLUTION

The AWMF-0108 is the first commercially available Ka-band quad core IC transceiver for 5G communications. It is designed for fixed and mobile access networking equipment. The AWMF-0108 operates in the 27.5-30 GHz frequency range, one of the new bands recently allocated by the FCC for 5G. This new IC supports four Transmit/Receive (Tx/Rx) radiating elements and includes all necessary beam steering controls for 5-bit phase and gain control. The device operates in half duplex, enabling a single antenna to support both Tx and Rx operation. Anokiwave's patent-pending IP blocks enable low-cost hybrid beam forming for multi-antenna arrays with high energy efficiency.

Additional features of the AWMF-0108 include gain compensation over temperature, temperature reporting, Tx power telemetry, and fast beam switching using eight on-chip beam weight storage registers.

Figure 1 shows a simplified diagram of the AWMF-0108 within the dashed circle. Note the 64-element phased-array antenna—32 elements each for Tx and Rx. Multiple chips are used to build antennas with a total number of elements divisible by four. Inside the chip are the variable 5-bit phase and gain control blocks. Phase LSB is 11.25 deg. with an error of 5 deg. The gain LSB is 1 dB with an error of 0.5 dB over a full 31-dB range. Overall gain is 24 dB. Transmit output power is 9 dBm.

The AWMF-0108 is a highly integrated half-duplex transmit-receive silicon IC in a commercial 48-pin QFN-style surface mount plastic package with dimensions of 6 mm × 6 mm × 0.9 mm *(Fig. 2)*. It easily fits within the typical 5.3-mm lattice spacing at 28 GHz.

Anokiwave offers design and evaluation kits to customers for early access to the technology. The kits include boards with the Ka-band IC, USB-SPI Interface module with drivers, and all required cables. Pilot production deliveries were available in June with full production quantities available in Q4 of 2016.

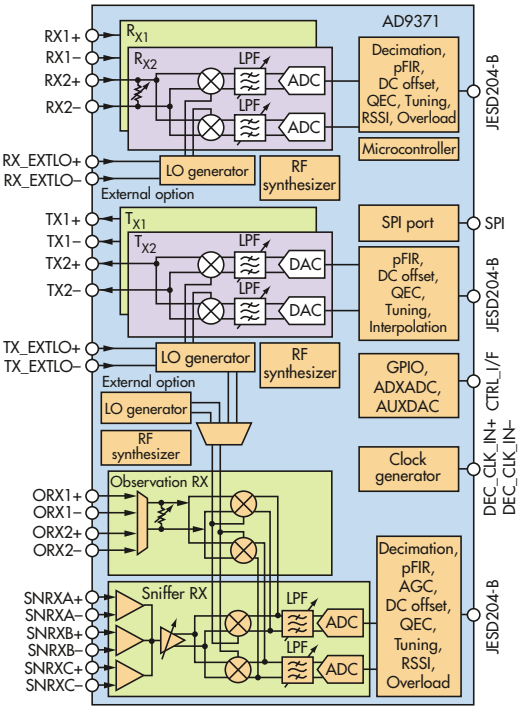
MARIA GUERRA | Technical Editor

Are IC Transceivers Ready to Support 5G Wireless Networks?

RF transceivers will be key to handling the massive amount of data and video that will be generated by the estimated 50 billion connected devices by 2020.

The evolution of transceiver technology permitted the integration of multiple wideband transmitters and receivers on a single chip. The resulting solutions provide a reduction in SWaP (Size, Weight and Power) without decreasing performance. Such an approach has allowed some transceiver ICs to promise early 5G support.

One attribute that can allow a product to target 5G is wideband operation. For example, the latest addition to ADI's new wideband Radio Verse Family is the AD9371. This wideband transceiver solution boasts two independent transmitter paths and two independent receiver paths, with a RF tuning range from 300 MHz to 6 GHz (*see figure*).



ADI's AD9371 wideband transceiver solution boasts two independent transmitter paths and two independent receiver paths, with an RF tuning range from 300 MHz to 6 GHz.

The AD9371 uses a typical wireless radio transmitter in a direct-conversion, Zero Intermediate Frequency (IF) architecture. Here, input RF signals to the receiver are mixed with LO signals at the same frequency to produce a signal at the baseband (Zero IF receiver). The AD9371 provides all the digital processing, mixed-signal, and RF blocks to implement such a conversion.

Thanks to its programmability, the AD9371 allows the two receivers channels and two transmitter channels to support both Frequency Division Duplex Systems and Time Division Duplex Systems.

The IC's power consumption depends on the exact configurations, including bandwidth and features enabled, it typically consumes approximately 5W.

The chip, which is manufactured in 65-micron CMOS, comes in a 12 × 12 mm, 196-ball CSP-BGA package. Because of its reduced component count, it targets applications ranging from light pole installations to office walls, basestations, military satellite communication (satcom) systems, unmanned aerial vehicles (UAVs), and more.

THE 5G PATH

Meanwhile, another transceiver is taking a different path to 5G by operating on the new spectrum bands recently allocated by the Federal Communications Commission (FCC) for development of 5G cellular networks. Specifically, the AWMF-0108 from Anokiwave is targeting 5G communications antenna array applications with a silicon quad-core IC. This Ka-Band transceiver IC covers 27.5 GHz to 30 GHz and supports four radiating elements. The AWMF-0108 is a half-duplex transceiver that enables a single antenna to support both Tx and Rx operation, Tx power telemetry, and fast-beam switching using eight on-chip beam weight storage registers.

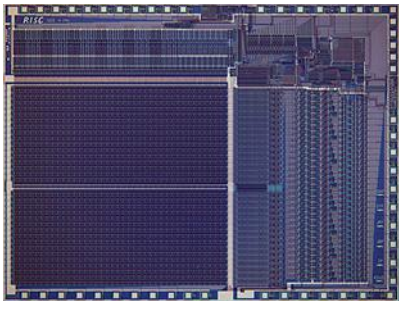
As future wireless networks start handling higher frequency bands, the demand for multi-mode/multi-band functionality increases, as well as the demand for supporting multiple standards. Future transceivers are adapting to these demands in the race to provide more support to 5G wireless networks.

WILLIAM WONG | Technical Editor

RISC-V (Five) is Alive!

RISC-V (RISC five) is a compact, open- source, instruction-set architecture (ISA) that is ideal for embedded applications.

RISC-V (RISC five) is a compact, open- source, instruction-set architecture (ISA) that is ideal for embedded applications, including low-power platforms for the Internet of Things (IoT). It was originally developed at the Computer Science Division of the EECS Department at the University of California, Berkeley *(see figure)* and it has its own foundation to foster its use and adoption.



The RISC-V was developed at Computer Science Division of the EECS Department at the University of California, Berkeley. This die shot is of the original RICV-I chip.

RISC-V is a true reduced instruction-set computing (RISC) platform using an explicit load/store architecture. The ISA uses 32-bit instructions and it does not have condition codes, using register-based comparison branching instructions instead. It is based around a register file with 32 registers, although register 0 contains a value of zero. The system can be configured with 16-, 32-, 64-, and 129-bit registers. There is no hardware stack. The jump and link (JAL) instruction copies the program counter to a register. A software stack is generally implemented when needed. The advantage is that different stack implementations are possible.

The RISC-V implementation designations include a number of instruction extensions denoted by letters.

- I – base integer configuration
- E – embedded version with only 16 register file
- A – atomic, real-time instructions
- C – compact 16-bit instruction set for embedded applications
- M – integer multiplication and division
- F – single precision floating point
- D – double precision floating point
- Q – quad precision floating point
- G – general, includes IAFDP

There are additional extensions for features like SIMD support. A typical embedded instantiation would be designated RV32EC (RISC-V, 32- bit, 16 register file, compact instruction set). High- end implementations of RISC-V can run operating systems such as Linux.

RISC-V is ideal for embedded applications. The base system has less than 50 instructions. This enables additional instructions to be added even when features like floating point are included. RISC-V is supported by compiler technologies like GCC and LLVM that can handle additional instructions. Low- power IoT applications can benefit from this approach by implementing some functions in hardware.

RISC-V started as an academic exercise, but has moved into the commercial space courtesy of companies like SiFive. SiFive's Freedom series are actual RISC-V core implementations. The Freedom U500 platform is a RV64GC implementation, while the Freedom E500 is a RV32IMC/RV32EMC implementation. The U500 is available through TSMC using its 28-nm technology. It includes support for multicore implementations with cache coherency and support for high-speed peripherals, including PCIe 3.0, USB3.0, Gigatbit Ethernet, and DDR3/4 memory controllers. The E500 uses 180-nm technology support on-chip flash memory, OTP, and SRAM.

Those not wanting to dive into a custom chip can take advantage of Microsemi's SmartFusion 2 FPGAs that support RISC-V. Microsemi supports a range of RISC-V implementations up to the 128-bit RV128I. Microsemi's FPGAs support ARM's Cortex-M1 but this would need to be licensed if a design were to move from FPGA to a custom ASIC. That would not be the case with RISC-V. Microsemi includes a complete development platform with its Libero FGPA IDE and the Eclipse-based SoftConsole software IDE. The system includes graphical configuration tools.

RISC-V's simplicity can also be advantageous in safety and security applications that require certification. Of course, ARM already does this for some of its platforms *(see "Safety Document Package Targets ADAS" on electronicdesign.com)*.

By the way, this article title is a revamped version of a quote from the movie, *Short Circuit*. Number 5 is the robotic central character.

YONG-SEOG KIM | President, Society for Information Display, *www.sid.org*

What's the Difference Between TV Display Technologies?

Ongoing innovation in the display space is creating opportunities for new TV technologies that may actually stick around.

The current state of the market for TV displays is a mixed bag. On one hand, each visit to the TV department at an electronics store reveals that the selection of available screens is literally bigger than before—more than two-thirds of TV screens now on the market exceed 40 inches in size. At the same time, however, unit growth is sluggish at best, and average selling prices (ASPs) are falling. Consumers are a bit more wary about making a new purchase these days, perhaps in response to having been burned by investing in next-big-things that flamed out.

Of course, it takes a lot of trial-and-error for new technology to take hold, and ongoing innovation has yielded some promising offerings that are already vying, or soon will be, for space in consumers' living rooms. To get some insight into the state of the market and the potential impact of these display technologies, we tapped several industry experts, each of whom also made a case for his company's individual approach:

- OLEDs—Dr. Mike Hack, vice president, Universal Display Corp.
- Eric Li, CEO and president, SiliconCore Technology
- Jeff Yurek, corporate marketing director, Nanosys, Inc.

This is an exciting time for the display market. Those of us involved with the Society for Information Display have the privilege of regularly getting early peeks at new display technologies—and since we don't play favorites, we support and encourage them all. Another way to glimpse emerging developments in this industry is to attend Display Week, SID's annual symposium and tradeshow, where more display innovations are introduced than at any other conference in the world. If this sounds like it's right up your alley, next year's event will be held May 21-26 in Los Angeles. We look forward to seeing you there!

1. A flexible display that can be rolled up into a pen is one example of a unique product enabled by OLED technology. *(Courtesy of Universal Display Corp.)*

DR. MIKE HACK: THE CASE FOR OLEDS

What is UDC's business focus on OLED, and how does it differ from other OLED competitors?

UDC's focus is on the emissive layer of the OLED device *(Fig. 1)*. We have developed and commercialized proprietary phosphorescent OLED materials and technologies that enable OLED TVs to be high performing, very power efficient, and have good lifetimes. Other commercial emissive layer systems are based on conventional fluorescent OLEDs, which have only about one-quarter the efficiency of UDC's UniversalPHOLED technology. Virtually all commercial OLED displays use UDC's materials and technologies.

What is UDC's approach to improve OLED technology for the home-theater market, while staving off alternative display technologies?

Our strategy is to deliver the best performance at a cost-competitive price. We are constantly developing new materials, with improved performance such as color and efficiency, and all at increased lifetimes. We collaborate closely with our customers to understand their future requirements and design next-generation materials.

What are the benefits of OLED vs. QD LCD and direct-view display technologies?

Quantum-dot LCDs are simply LCDs with an improved color gamut. We believe that OLED technology enables display makers to create differentiated, high-performing, energy-efficient, innovative products. With the numerous benefits of OLED—from its fast response times and extremely high contrast ratios, to its slim, lightweight form factor and ability to be manufactured on plastic (which will usher in new design possibilities for the display industry), to high power efficiency—we believe OLEDs are the best display technology.

There are cost concerns with OLED production. What is UDC doing to address this?

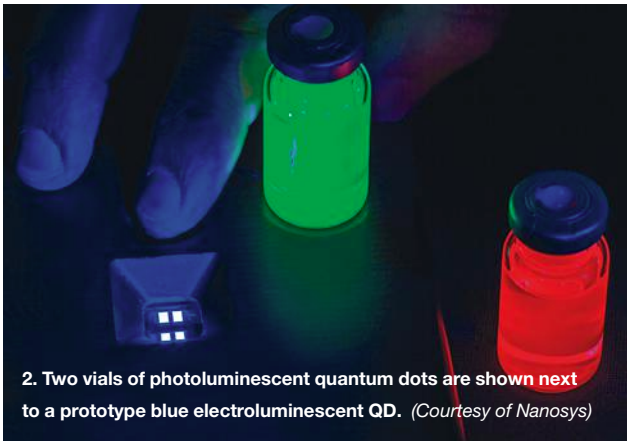
Our strategy is to partner non-exclusively with all major display and lighting manufacturers so as to provide them with the best OLED technology to meet their needs. OLED production costs will reduce with volume; thus, encouraging multiple manufacturers to participate in this business will lead to lower pricing.

JEFF YUREK: THE CASE FOR QUANTUM DOTS

What are the benefits of QD-LCD compared to OLED or other emerging display technologies?

Quantum dots *(Fig. 2)* improve the power efficiency, brightness, and color performance of LED LCD displays. This enables LCD to compete with and actually surpass OLED displays in a number of ways, with the key advantages being peak luminance, color accuracy and reliability.

Quantum dots are today's most efficient light-emitting material. This means they emit more light for less power. In the market today, we're seeing QD TVs producing more than 1,400 nits of peak luminance, which is more than double a typical OLED set. Far from being simply brighter, this extra luminance means QD TVs can more faithfully reproduce HDR content, which can contain values up to 10,000 nits. Consumers strongly prefer TVs with higher peak luminance for viewing in a typical living-room environment.



2. Two vials of photoluminescent quantum dots are shown next to a prototype blue electroluminescent QD. *(Courtesy of Nanosys)*

In terms of color accuracy, quantum dots create a pure red-green-blue (RGB) spectrum with colors that are precisely tuned to meet the color gamut required by UHD TV. Today's OLED TVs, on the other hand, rely on a two-color white backlight system, which can result in much less precise color reproduction. Quantum dots are also extremely rugged and can outlast a typical TV's lifetime. They don't exhibit the kind of burn-in reliability issues that other emerging technologies suffer from. In fact, one of our partners just announced a 10-year "no burn-in" warranty for a QD TV to highlight this benefit.

Nanosys has succeeded in lessening the use of cadmium in the manufacturing process. What will be the next steps/areas of focus for improving QD technology quality and safety?

A key focus is working on packaging the materials—these improvements will enable us to package quantum dots in unique new ways, lowering costs and improving the profits of display makers. We are also working on emissive QD displays that are sometimes called QLEDs. We see this approach as the future of QD for displays.

Samsung and TCL are both using your technology. What other TV makers are you working with? What is your projection for when we will see a significant portion of advanced TVs utilizing quantum dots?

I believe we have already reached the inflection point, where we will start seeing quantum dots in a significant portion of the TV market. As an example, Samsung has said that they expect to ship 5 million premium QD TVs in 2016.

Our technology is currently found in TV products from three of the top four TV makers. Brands using our technology include Samsung SUHD, Vizio, TCL, Hisense, and Sharp. We have already delivered more than five tons of quantum-dot materials to customers, and we are able to deliver enough material for more than 18 million 60-in.-class TVs per year.

ERIC LI: THE CASE FOR SOLID-STATE DISPLAYS

How does your technology differ from LCD, quantum dot, and OLED display technologies?

With our LED solutions *(Fig. 3)*, the display shows everything that the camera sees, offering crystal-clear images and superior uniformity so that all kinds of content can be reproduced with extreme accuracy. SiliconCore SSD is the new term we've given to our technology, replacing "Direct View" to differentiate it from other companies' solutions, particularly those based in China. In our vision of the future of LED technology, there is no surface-mounted device (SMD), no bulky electronics behind the display, and no energy wasted in heat generation—all of which are issues, to varying degrees, with other display technologies.

Our new technology combines our proprietary Common Cathode LED driver and LED Link Protocol (LLP) with chip-on-board (CoB) technology. All three combine to make a unique solution; no bulky FPGA in the middle of the screen is what makes it truly scalable. SiliconCore SSD is the only technology that can be characterized per pixel accurately, driven by precision current. Unlike with LCD, there are no dead pixels, and the cost is lower than OLED.

In terms of comparison to other technologies, my understanding is that quantum-dot LCDs run hot due to high power consumption, whereas our SSD technology is the most efficient in terms of converting electricity to light since it's based on fundamentally superior material. Our Common Cathode technology supplies separate, dedicated power-supply voltages to the red, green, and blue LEDs, allowing our solution to equalize the brightness efficiency of the red, green, and blue diodes and thus dramatically reduce the power dissipation of the LED display system.

What are the advantages of SiliconCore SSDs for consumers?

In today's typical LED display system, you have many elements, such as the control board, interface, Ethernet transponders, lots of memory, and an FPGA. It's bulky, expensive, and very large, compared to the tiny chip you can create using SiliconCore technology. We created an IC solution for LED. The first generation is 30X smaller and 30X faster due to a massive bandwidth improvement, and reduces the form factor dramatically.

LED has intrinsic properties related to speed and power efficiency. That's the key reason we're focusing on LED—high efficiency means high dynamic rate and low power consumption. LED has physical properties that no other device can compete with, so we started there, but are making it more attractive to the consumer. As I mentioned earlier, the SSD technology builds on the proven capabilities of our Common Cathode driver to create a display that has the highest possible brightness and dynamic range, is highly durable and reliable, and is thinner and less bulky than previous LED solutions. It's a bit like a super-strength LED, without the manufacturing and cost issues associated with OLED.

What will be required to make these displays competitive for the TV market?

One key is using CoB—it makes the display far more rugged as, unlike with SMD, it can't be damaged by touching, it's water resistant, and it's nearly impervious to breakage or short-circuiting because the quality is far better. Cost will matter, but it's secondary to reliability, quality, and performance. If you can achieve those parameters and make the product very attractive, people will be willing to buy. There are always ways to bring down costs once you've proven a technology's capabilities. ED

3. Solid-state LED displays can be customized to fit specially designed spaces, like this Orchid 1.9-mm display created for Dolby Laboratories' San Francisco headquarters lobby. *(Courtesy of SiliconCore Technology)*

LINEAR TECHNOLOGY

DESIGN NOTES

Low EMI LED Driver Features 2A, 40V, Integrated, Synchronous Switches for Automotive Lighting

Design Note 557

Keith Szolusha

Introduction

The breadth of LED applications has grown to encompass everything from general lighting to automotive, industrial and test equipment, sign boards and safety instruments. Feature requirements for LED drivers have become more extensive. The latest LED solutions require drivers that are compact, efficient, low noise, and have high dimming ratios and advanced fault protection. The LT3922 meets these demands.

The LT3922 synchronous LED driver with integrated 2A, 40V switches can be configured as a boost, buck or boost-buck LED driver. Its high efficiency integrated switches fit into a tiny 4mm × 5mm QFN package. This device integrates Linear's most advanced switching technologies, condensing high power capability into tight spaces while controlling the edge rates and mitigating unwanted EMI. The LT3922 features controlled switching edges that do not ring—offering just the right balance of high efficiency and low noise. They can be run at up to 2.5MHz for compact solutions.

The tiny LT3922 LED driver features low EMI, high efficiency and fault protection required in automotive environments. It can handle 36V automotive transients and 3V cold crank. Its Silent Switcher® architecture, spread spectrum frequency modulation (SSFM) and controlled switching edges make it ideal for powering LEDs with low EMI. Its flexible topology is useful in daytime running lights, signal lights, taillights, and headlight segments as well as dashboard and heads-up displays with high dimming ratios. Built-in fault protection reduces the number of extra components required to protect against short and open LEDs.

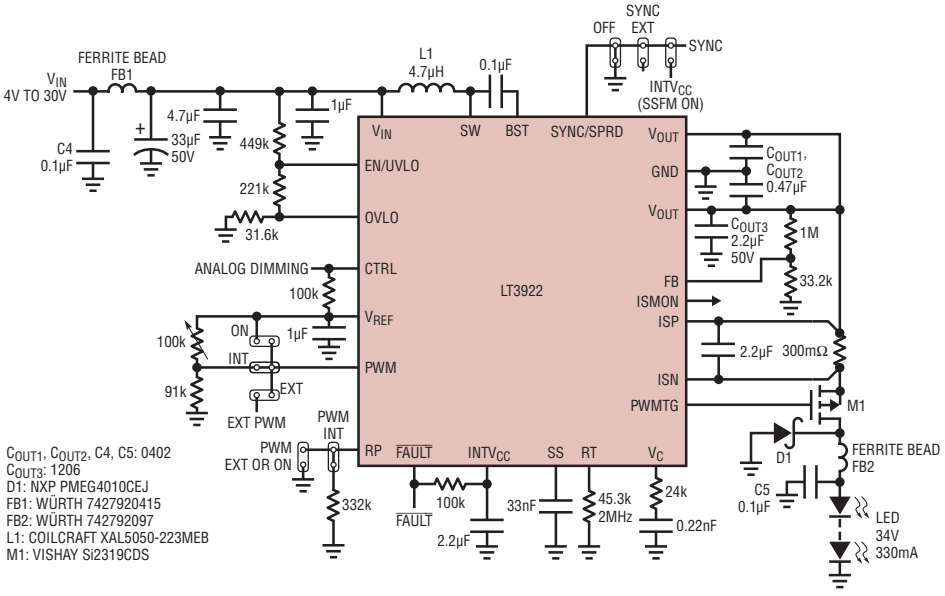


Figure 1. 2MHz Automotive Boost LED Driver Features Low EMI and Internally Generated PWM Dimming Has 91% Efficiency and Passes CISPR 25 Class 5 EMI

Built-In Features Enable Low EMI

The LT3922 includes a number of features that allow it to easily achieve low EMI. First, it incorporates Linear's patented Silent Switcher architecture, where internal synchronous switches minimize hot-switching-loop size and controlled switching edges that do not ring. Its pinout enables placement of small, high frequency capacitors near the two V_{OUT} pins to minimize hot-loop size and EMI. The switching edge rate is controlled by the IC, eliminating high frequency ringing that is common to converters without this feature, reducing high frequency EMI without degrading power or efficiency.

SSFM in the LT3922 spreads the resistor-set switching frequency up and down from 100% to 125% of its value. This decreases both peak and average EMI in the converter at low and high frequencies.

Boost, Buck and Boost-Buck

Since LEDs are light sources driven by controlled current, either or both of LED$^+$ and LED$^-$ can be attached to non-ground potentials. This opens options for LED driver topologies, including boost-buck (step-up and step-down) and buck mode (step-down). The high side PWMTG driver and low EMI switches can be configured as boost, buck, or boost-buck LED drivers while retaining use of all of the IC's desirable features—low EMI, SSFM and internal PWM dimming.

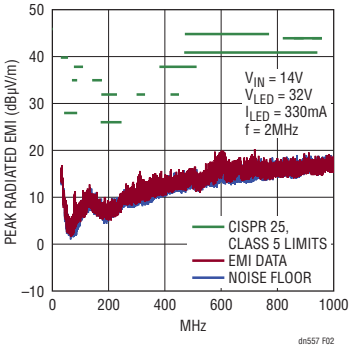


Figure 2. LT3922 Boost Passes CISPR 25 Class 5 Radiated and Conducted EMI

The LT3922 can power LEDs up to 34V as a boost converter. For automotive applications it can be configured as a highest efficiency 400kHz converter or a smallest size 2MHz converter with up to 5000:1 PWM dimming range.

The LT3922 boost-buck topology in Figure 3 supports an input voltage range extending above and below the LED string voltage. This patented low EMI topology features a boost-type low ripple input inductor and a buck-type low ripple output-facing inductor. A 4V to 18V input can drive an LED string voltage between 3V and 16V.

Conclusion

The LT3922 synchronous LED driver meets the many demands of automotive and industrial LED drivers.

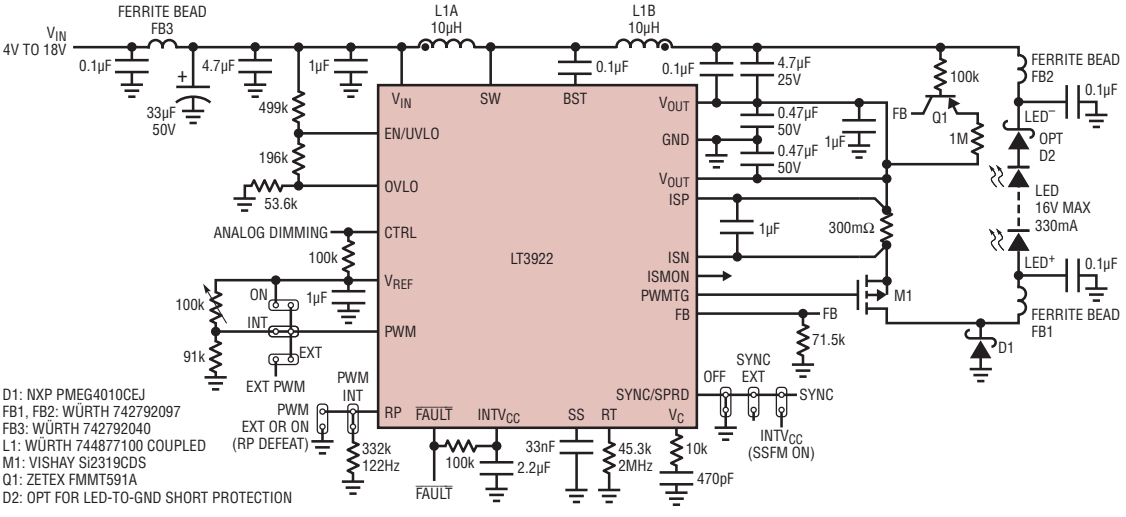


Figure 3. 2MHz Boost-Buck LED Driver with Low Input and Output Ripple. Passes CISPR 25 Class 5 EMI

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DR. MICHAEL HACK is Vice President of Business Development at Universal Display Corp. He is responsible for developing and commercializing advanced high-efficiency next-generation OLED products, with a special focus on flexible display applications and solid-state lighting. Prior to joining UDC in 1999, he was associated with dpiX, a Xerox Company, where he was responsible for manufacturing flat-panel displays and digital medical-imaging products based on amorphous silicon TFT technology. Dr. Hack received his PhD from Cambridge University, England in 1981, and in 2007, Dr. Hack was elected a Fellow of the Society for Information Display. In 2014, Dr. Hack was nominated to serve on the board of the U.S. OLED Lighting Coalition to promote the advancement and commercialization of OLED lighting.

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JEFF YUREK is the Communications Manager at Nanosys. He does a mix of product marketing, investor relations, and marketing communications for the company. As Nanosys' resident color expert, Jeff also manages the "dot color" blog and shares his insights on color quality and display technology. Jeff received a BS from the Berklee College of Music and an MBA from Suffolk University's Sawyer School of Management.

ideas for design

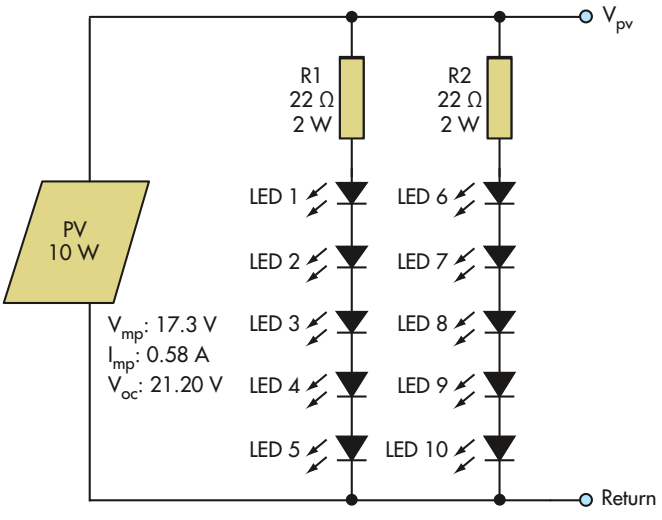
Solar "Day Lamp" Also Powers FM Receiver

By POONAM DESHPANDE, New Horizon College of Engineering, Bangalore, India

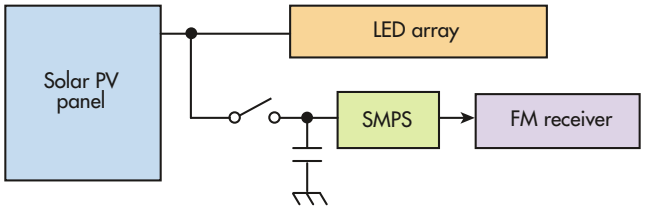
A SOLAR-POWERED, DAYTIME-ONLY LAMP without a battery for energy storage may seem to be a marginally useful device, but many areas in homes and offices are relatively dark, even during the daytime. This "day lamp" provides light throughout the day from a nearby solar panel, and supplies regulated auxiliary power of 0.5 W for a small load (such as an FM receiver) at very small incremental cost.

The solar day lamp *(Fig. 1)* uses a photovoltaic (PV) panel with a 10-W rating. The voltage at maximum power (V_{MP}) is 17.3 V, and two identical arrays of LEDs are connected in parallel to the output of this panel. Each array consists of five white LEDs (LEDs 1-5 and LEDs 6-10) rated at 1 W each, and has series resistance of 22 Ω and power rating of 2 W (R1 and R2) to control the current into its LED string.

The output of the PV panel is connected through a switch to a switched-mode power supply (SMPS), which provides the regulated power *(Fig. 2)*. The bulk capacitor at the SMPS input reduces variations in LED light that would occur due to changing levels of audio output at the FM receiver as load.

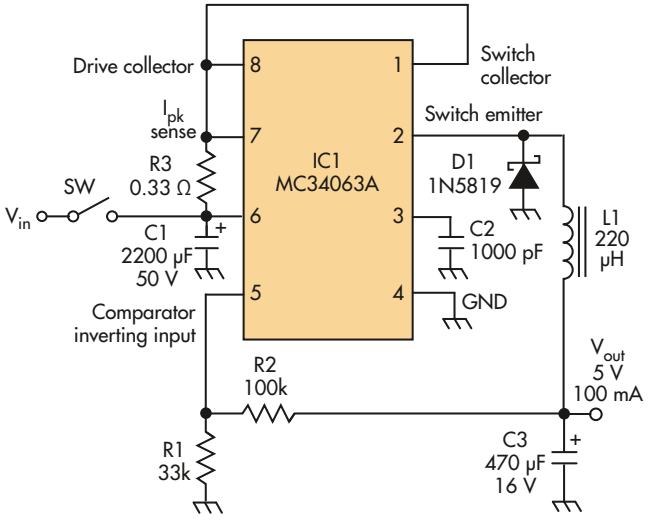


1. The solar day-lamp schematic shows two identical strings of LEDs, each fed by a basic current source using a current-defining resistor.

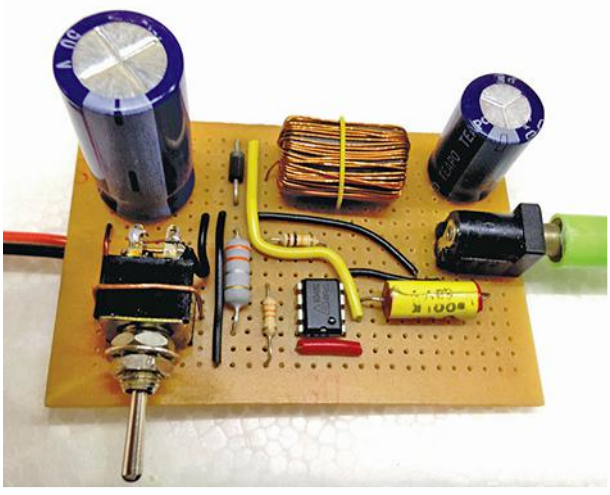


2. Here's a block diagram of the day lamp with a small, regulated switched-mode power supply for powering auxiliary loads such as a small FM receiver.

There are several low-cost switch-mode ICs, and three widely available ICs with identical switching frequency, output voltage, L-C values, and load resistance were bench-evaluated for this application: the LM3524, MC34063, and LM2575. The converter implementation based on the MC34063 produced the least amount of drop in PV voltage (V_{PV}) under identical conditions, due to its lower quiescent current and the lower saturation voltage of switching device. Thus, it was selected.



3. The circuit diagram of the dc-dc converter for the FM receiver (5 V/100 mA) includes a "home-made" 220-μH inductor.



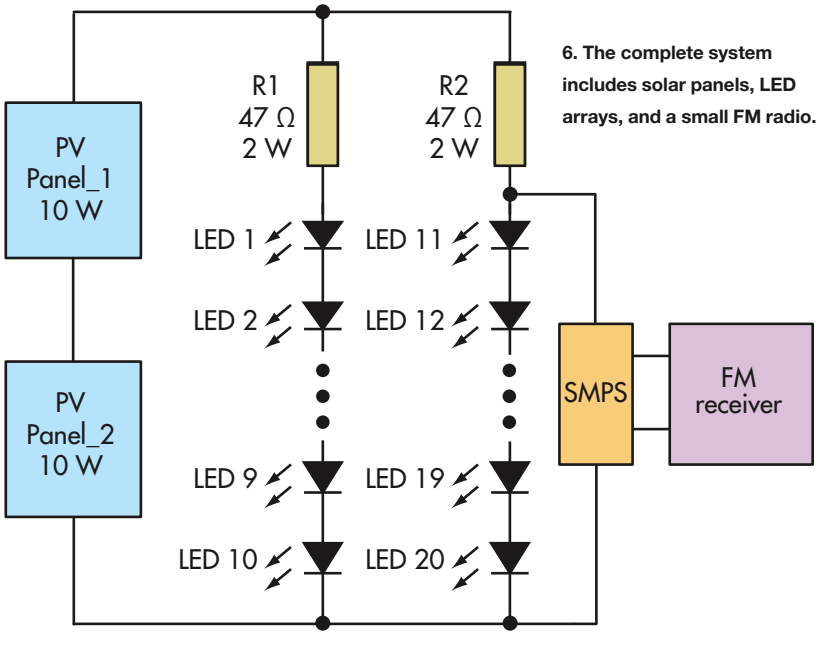
4. The actual assembled circuit of the dc-dc converter shows basic construction on perforated phenolic board and point-to-point wiring.

5. The day lamp can also use two PV panels, but the topology must be adjusted to avoid excessive voltage on the regulator.

The input supply voltage (V_{IN}) is connected to pin 6 through ON/OFF switch SW in the dc-dc converter using the MC34063 *(Fig. 3)*. Bulk capacitor C1 (2200 µF) is connected after the switch to minimize the voltage variations caused by changes in light intensity. Capacitor C2 (1000 pF) at pin 5 sets the switching frequency to 33 kHz.

The output is filtered by L1 and C3. The 220-µH inductor is made by winding 48 turns on a toroidal core (suitable cores with a diameter of about 10 mm and length of 20 mm can be salvaged from old computer cables). Resistors R1 and R2 were selected to provide 5 V at output, and the output voltage can be changed by changing the value of R1. For an output of 6 V, R1 should be 27 kΩ; for 4.5 V, R1 will be about 39 kΩ. The assembled circuit is shown in *Figure 4*, and *Figure 5* shows the complete system.

It's possible to design a day lamp with two PV panels connected in series to capture more light *(Fig. 6)*. In this case, however, the maximum PV voltage can exceed 40 V while the MC34063 is rated up to a maximum voltage of 40 V. To overcome this problem, the dc-dc converter is connected across one of the two LED arrays, instead of directly connecting to PV output. Each LED array contains 10 LEDs and the maximum forward voltage of each LED will not exceed 3.5 V; thus, the voltage across 10 LEDs will not exceed 35 V.



6. The complete system includes solar panels, LED arrays, and a small FM radio.

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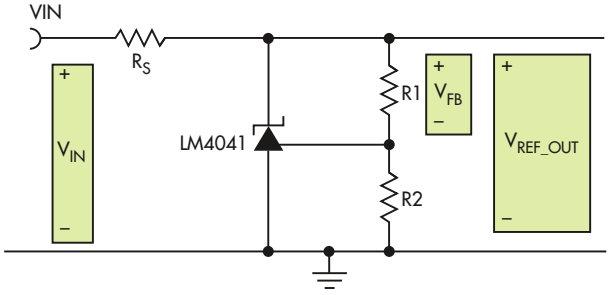
1. Simple Solar Day Lamp Which Lasts for 15 Years (http://www.instructables.com/id/Simple-Solar-Day-Lamp-which-lasts-for-15-years/)
2. High Power Solar Day Lamp (http://www.instructables.com/id/High-Power-Solar-Day-Lamp/)

POONAM DESHPANDE is a 4th-semester computer-science student at New Horizon College of Engineering, Bangalore, India.

Circuit Enhancement Enables Digital Setting of Voltage Reference

CHRISTOPHER DEAN | Applications Engineer, Texas Instruments

ADJUSTABLE VOLTAGE REFERENCES offer great flexibility to circuit designers because the reference isn't limited to the manufacturer's preset values. The adjustable output is typically configured with a voltage divider from the output to the feedback pin *(Fig. 1)*. To regulate the output, the circuit compares the voltage at the feedback pin to an internal reference (shown in this article as V_{REF_INT}), typically 1.2 V. The device adjusts the output until V_{FB} and V_{REF_INT} match.



1. In a typical adjustable voltage reference, a voltage divider between the output and feedback pin is used to enable setting of the output value.

Some adjustable shunt references, such as the LM4041-N, maintain V_{FB} across R1; some maintain V_{FB} across R2, such as the TLV431. This circuit enhancement shows one possible method of changing the resistor divider and in turn changing the reference voltage with digital signals. It uses the LM4041-N, but the concepts apply equally to other adjustable shunt references by switching R1 and R2 in the equations.

The method involves replacing the two fixed resistors with a single digital potentiometer. *Fig. 2* demonstrates the concept, where the feedback pin is connected to the wiper of the potentiometer and the high side and low side are connected to V_{REF} and GND, respectively. *Fig. 3* shows the circuit redrawn, with the TPL0102 digital potentiometer as the voltage divider.

To configure a digital potentiometer to act as a voltage divider, connect a voltage across the high and low pins of the internal resistor and connect the output to the wiper pin. The wiper position affects the ratio of the resistance between the wiper and the high and low pins, and its position is controlled digitally by sending a code word to the device. The TPL0102 uses an I^2C interface, while other potentiometers are available with a serial peripheral interface (SPI) or parallel interfaces.

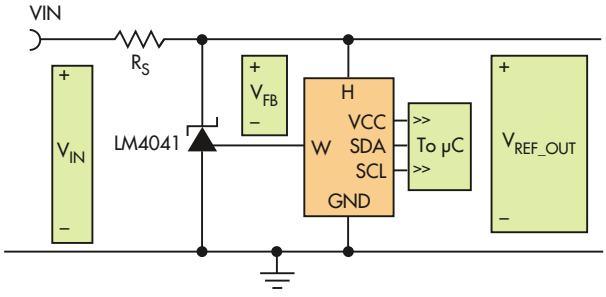
Since the ratio of the resistances sets the output voltage, the absolute values of the divider resistors are not critical. This allows you to easily replace the resistor divider with a digital potentiometer, with this relationship between the adjusted output, V_{REF_OUT}, and the resistance ratio:

$$V_{REF\_OUT} = V_{REF\_INT} \times ((R2/R1) + 1) \quad (1)$$

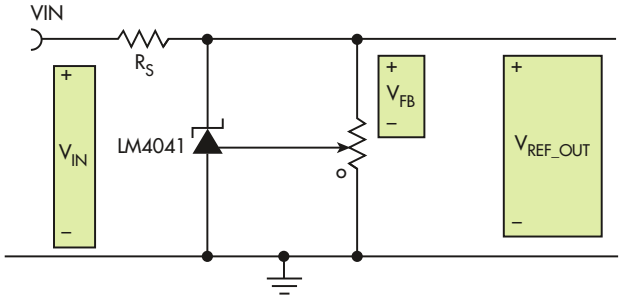
This is an important consideration, as the absolute resistance value of digital potentiometers can vary significantly, but the ratio of the resistances is very accurate. For example, to generate a 3.3-V reference voltage, the required resistance ratio of R2-to-R1 is 1.66.

The potentiometer datasheet provides the formulas to calculate the output of the voltage divider for a given code, shown in Equations 2 and 3. V_{HW} is the voltage from the high pin (H) to the wiper (W), while V_{WL} is the voltage from the wiper (W) to the low pin (L):

$$V_{HW} = V_H \times (1 - Code/N_{TAPS}) \quad (2)$$



2. By substituting a digital potentiometer for the two fixed resistors, a structure is established for digitally setting the output voltage.



3. With the digital potentiometer in place, the wiper position affects the critical resistance ratio while its position is digitally controllable.

$$V_{WL} = V_H \times (Code/N_{TAPS}) \quad (3)$$

V_{FB} is across R1, so we use Equation 2, which calculates the voltage between the high pin and the wiper pin. The wiper is connected to the feedback pin of the device, and V_{FB} is forced to V_{REF_INT}. Equation 4 shows the formula solved for the digital code required for V_{REF_OUT}:

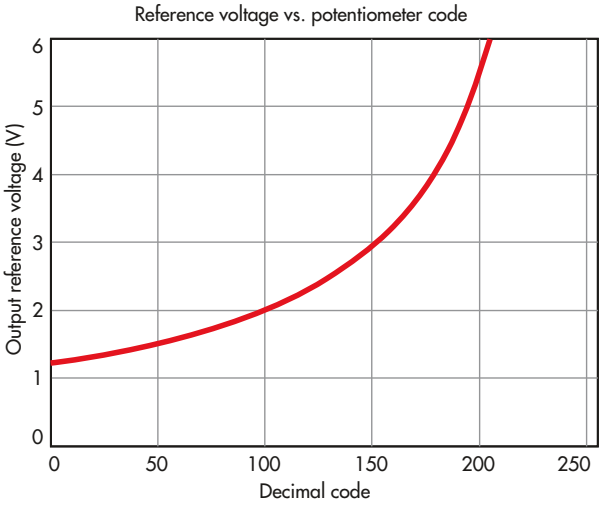
$$Code = N_{TAPS} \times (1 - V_{REF\_INT}/V_{REF\_OUT}) \quad (4)$$

Continuing with this example in Equation 5, where N_{TAPS} is 256, V_{REF_INT} is 1.24 V, and V_{REF_OUT} is 3.3 V, you need to write decimal code 160, which yields resistance values of 37.50 kΩ for R1 and 62.50 kΩ for R2. More importantly, the ratio of these two resistances is 1.66, which is also calculated using Equation 1:

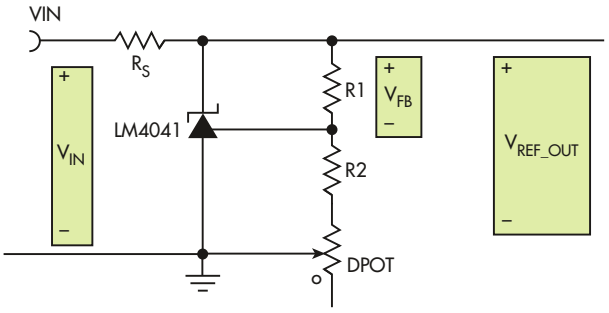
$$Code = 256 \times (1 - 1.24\ V/3.3\ V) = 160 \quad (5)$$

To change the reference voltage, simply write an I²C-bus transaction to move the wiper position accordingly. As a result, the voltage at the feedback pin changes and adjusts V_{REF_OUT}. You can also use the potentiometer to digitally "tune" the reference voltage. A greater number of taps in the potentiometer yields finer resolution in the resistance ratio, and therefore finer resolution in the output-reference voltage.

A limitation of using a digital potentiometer in this application is the voltage limit of the digital potentiometer IC, which typically cannot exceed 5.5 V. Therefore, it's important to confirm that the resistance ratio does not get set to a condition that would present a V_{REF_OUT} greater than 5.5 V. For a 256-tap digital potentiometer and a shunt reference with an internal reference of 1.24 V, the decimal code should not exceed 200. *Fig. 4* shows the effect of the input code on the reference voltage for a 256-tap potentiometer and a 1.24-V-referenced device.



4. The relationship between digital code and reference voltage is not linear, but can easily be calculated as needed, or determined in advance and stored.



5. Configuring the potentiometer as a rheostat avoids the need for an extra resistance in parallel. However, it now makes the circuit behavior dependent on an absolute resistance value rather than precisely known resistance ratios.

You should enable and configure the potentiometer before powering the shunt reference to ensure that the resistor divider is correctly in place. If that's not possible, add a large resistance in parallel with the resistor that's not acting as the drop for V_{FB}. That would be 1 MΩ from the feedback pin to ground (across R2) for the LM4041, or 1 MΩ from the feedback pin to the output (across R1) for the TLV431.

To avoid an extra parallel resistance, configure the device with fixed R1 and R2 resistors and a digital potentiometer in series with one of them. You would then have to configure the potentiometer as a rheostat *(Fig. 5)*. This configuration depends on the absolute resistance of the digital potentiometer, which is not as accurate as when using it as a ratiometric voltage divider—it requires feedback to the microcontroller for final digital-code selection. Technical references 1 through 3 provide additional information on voltage references, their topologies, and their operation *(see the online version of the article at www.electronicdesign.com for links to the references, listed below)*.

REFERENCES

1. "Voltage Reference Selection Basics" provides a detailed explanation of voltage-reference selection with respect to analog-to-digital converter (ADC) resolution.
2. "Shunt vs. series: How to select a voltage reference topology" provides guidance on this basic decision between the most-common reference topologies.
3. "Understanding Voltage References" discusses the applications of both shunt and series references and when to use them.

CHRISTOPHER DEAN is an Applications Engineer at Texas Instruments, currently working on automation and validation of dc-dc converters. Chris also supports voltage references and has written multiple articles on selecting a voltage reference, and different ways they can be used.

FPGA Kit Detects USB Type-C Configuration Channel Signals

RAJARAM REGUPATHY | Engineer

ADOPTION OF USB TYPE-C connector technology, along with the new USB Power Delivery (USB PD) specification, has been significant and swift. Many leading companies now support the new technology, and it's already available on existing microcontrollers or with FPGAs for early adopters.

USB PD uses USB Type-C port's Configuration Channel (CC) signal line as a medium of transport for its power negotiations and alternate modes. The USB PD physical layer uses biphase mark coding (BMC) to transfer data over this CC signal line. The challenge is to decode the USB PD BMC data in a FPGA setup.

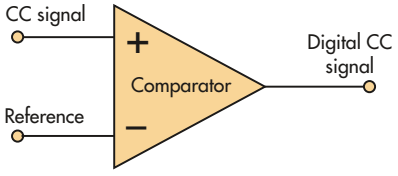
The USB Power Delivery physical layer employs the BMC scheme in its physical layer to transmit USB PD messages, with dc-coupled baseband signaling on the CC line to transmit data (Ref. 1, chapter 5). In BMC coding *(Fig. 1)*, there's a transition every bit-unit time and a second transition in the middle when a 1 is transmitted.

The voltage swing of this BMC signal on the CC line is defined as "vSwing" in the range of ≈0 V to ≈1.1 V by the USB PD specification. The specification also defines the center or midpoint voltage of the pulse as close to half of "vSwing." Thus, a comparator and a reference voltage that indicates the midpoint is required to convert this BMC signal from the analog domain to the digital domain *(Fig. 2)*.

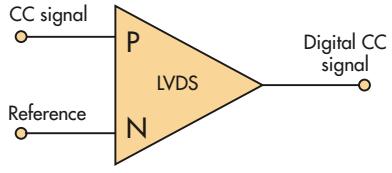
The circuit converts a given BMC signal over the CC signal line to a 0 or 1 that's readable by "soft logics," which can then collate these bits to form the actual USB PD packet that's received. A majority of the FPGA families have low-voltage differential-signaling (LVDS) I/O as an option in their configurable I/O options.

Therefore, the comparator required for USB PD BMC signaling can be created on a FPGA's LVDS I/O by feeding a fixed reference voltage *(Fig. 3)*. Since CC data signals swing between 0 and 1.1 V, and for easier understanding and setup, a midpoint closer to ≈0.55 V will be used as a reference input for one of the LVDS pins.

2. To convert the BMC signal from the analog to the digital domain, a comparator can match the signal to the reference voltage at the midpoint of the voltage swing.



3. A fixed reference voltage from the FPGA's LVDS I/O pin can be used with the comparator.



STEP 1: XILINX ZYNQ DESIGN OF USB TYPE-C/USB PD BMC SIGNALING

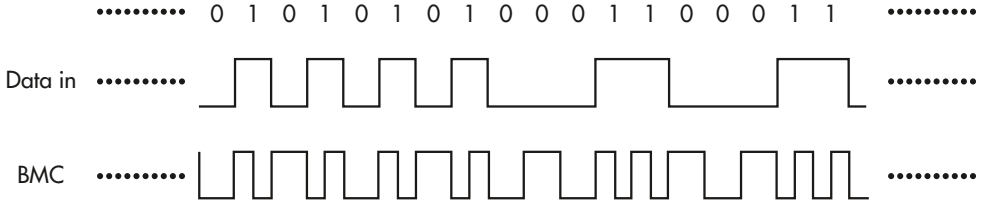
An FPGA-based system would be well-suited to explore using LVDS I/O to implement decoding of BMC signaling. The Xilinx Zynq combines programming logic and programming systems to implement and verify new technologies such as the USB Type-C/USB PD; here, we'll use the Avnet MicroZed board based on the Xilinx Zynq platform. The circuit in *Figure 4*, based on the *MicroZed Breakout Carrier Card Hardware User Guide*[2] uses Zynq's Bank 34 T10/T11 differential pair to demonstrate BMC signal decoding.

Using the Xilinx Vivado design suite,[3] the reference voltage and the BMC signal are mapped as differential signals using the "util_ds_buf" library *(Fig. 5)*. The Utility Differential Signaling Buffer generates buffers to bring off-chip differential signals into the USB Type-C IP for packetizing and processing the BMC data.

STEP 2: SETTING UP LVDS I/O PINS

After creating the design, the next step is to set up the constraints and map differential pairs pins connected to utils_ds_buf to the appropriate Zynq pins, here with differential pair LVDS_0_P (T11/T10) of Bank 34 selected *(Fig. 6)*.

1. In biphase mark coding, there's a signal transition every bit-unit time, as well as a second transition in the middle when a 1 is transmitted.



Having successfully set up necessary constraints and design in Vivado, the next step is to generate the bit stream and program on the board to see the BMC signals in digital domain. Additional debug mechanisms can be incorporated to monitor the signal received in methods that are detailed by Vivado guides.

While the CC signal can be received in a system with simple capabilities such as a comparator, there are additional functions, including connect/disconnect detection, transmit logic, and BMC eye-diagram quality, that should be implemented for a fully functional USB Type-C/USB PD system.

RAJARAM REGUPATHY holds a master's degree in software systems from the Birla Institute of Technology & Science (BITS) in Pilani, India, and has 15 years of professional experience in developing firmware and system software embedded products. He has worked on USB technology from USB 1.1 to USB Type-C for leading semiconductor companies like Oki Semiconductor, NXP, ST-Ericsson, and Cypress Semiconductor, and has written three books about USB technology. He also has experience with other connectivity technologies like smart-card protocols (ISO7816, EMV), Bluetooth, and language processing tools.

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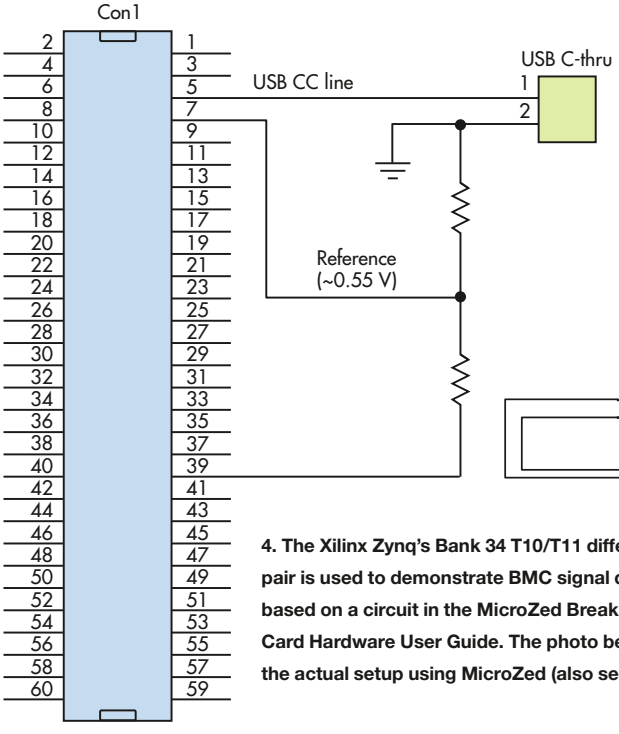
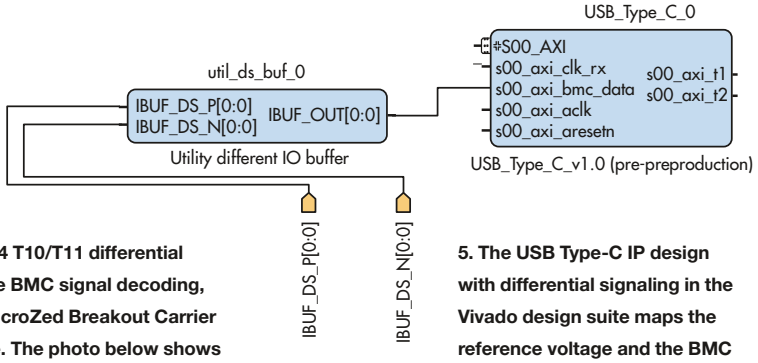
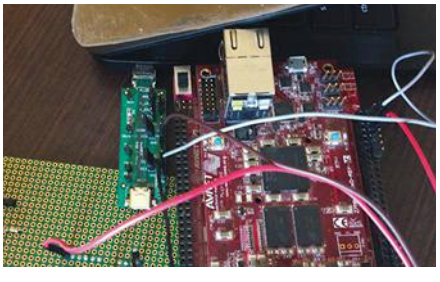
2. MicroZed Breakout Carrier Card User's Guide
3. Xilinx Vivado Design Suite
4. USB C-Thru, http://goarks.com/products/usb-c-thru-usb-type-c-paddle-card)

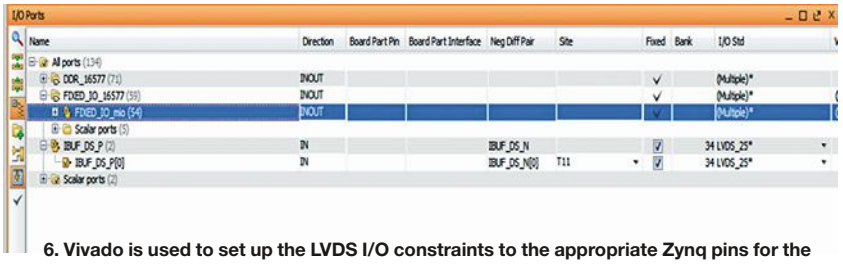


4. The Xilinx Zynq's Bank 34 T10/T11 differential pair is used to demonstrate BMC signal decoding, based on a circuit in the MicroZed Breakout Carrier Card Hardware User Guide. The photo below shows the actual setup using MicroZed (also see Ref. 4).



5. The USB Type-C IP design with differential signaling in the Vivado design suite maps the reference voltage and the BMC signal as differential signals.





6. Vivado is used to set up the LVDS I/O constraints to the appropriate Zynq pins for the CC signal and reference.

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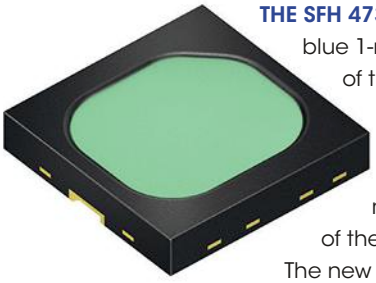

THE SFH 4735 broadband emitting infrared LED from Osram Opto Semiconductors is based on a blue 1-mm² chip in UX:3 technology and a special phosphor converter. The emission spectrum of the LED has a homogeneous spectral distribution in the infrared range, targeting the chip at near-infrared spectroscopy for analyzing food quality. The LED allows infrared spectroscopy to use the characteristic absorption behavior of certain molecular compounds—if a defined spectrum is directed at a sample, it is possible to determine the presence and quantity of certain ingredients from the wavelength distribution of the reflected light.

The new development enables this sensor technology to move into the consumer sector, for example, as an add-on for smartphones. A compact sensor, like a USB stick, could be used with an appropriate smartphone app to measure calories, freshness or nutritional content of food. Medicines can also be checked in the same way. Spectrometers are expected to be able to be integrated directly in mobile devices in the near future. The chip is mounted in the compact Oslon Black Flat package, which boasts excellent thermal resistance.

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Failsafe SPDT Switch Features Low Loss, High Linearity

THE GRF6011FAILSAFE SPDT switch from Guerrilla RF provides low loss and high linearity, combined with failsafe operation, for applications ranging from 100 MHz to 3.8 GHz, including cellular boosters, cellular infrastructure, and L-Band satcom. A key application is at the LNA in a tower-mounted amplifier, where failsafe functionality is typically implemented using mechanical relays or Schottky diode switches external to a traditional LNA device.

The SPDT switch provides failsafe operation with one RF path defaulting to a low insertion loss state, with all power removed and the other path defaulting to a high insertion loss state. Only a few external capacitors are required for dc blocking, which helps to achieve the compact application footprint. The device is operated from a supply voltage of 3 V to 5 V with the single control input from 3 V up to VDD. At 1,900 MHz, typical 3.3 V RF performance is as follows: insertion loss: <0.45 dB; IP1dB: >31 dBm; and IIP3: >50 dBm. Offered in a 1.5 × 1.5 mm DFN-6 package, the GRF6011SPDT switch is priced at $1.45 each/10,000. Samples and evaluation boards are available now.

GUERRILLA RF

guerrilla-rf.com

Intelligent Motion-Control Device Targets Consumer Market

STMICROELECTRONICS COMBINES an MCU and an analog IC in a 7 × 7 mm QFN package, boasting the flexibility and power of a MCU-based motor drive with the space-efficiency of a single IC. The STM32F0 MCU features the ARM Cortex-M0 core, which is capable of hosting motor-control algorithms such as sensored or sensorless FOC, six-step control and others. Its high performance enables fast algorithm-execution times with bandwidth and headroom to support additional functionality.

The embedded analog IC implements a three-phase, half-bridge gate driver with integrated bootstrap diodes (up to 600 mA gate-drive current). Built-in protection mechanisms include real-time programmable over-current, cross-conduction, undervoltage, and overtemperature protection. An internal 3.3 V dc-dc buck converter and 12 V LDO linear regulator provide the voltage rails to supply the MCU, the external circuitry and the gate drivers.

Target applications include manufacturing equipment, power tools, cooling fans, drones, small robots and home appliances containing high-efficiency motors. The device leverages the STM32 ODE, with software tools, firmware libraries, and middleware available on top of motion-control algorithms such as FOC and 6-step control. The STSPIN32F0 motor-control system-in-package is in production now in 7 × 7 mm QFN, priced from $1.95 each/1,000.

STMICROELECTRONICS

www.st.com

Multiphase PWM Controllers Offer Synthetic Current Control

TWELVE NEW DIGITAL MULTIPHASE PMW scontrollers from Intersil (ISL681xx and ISL691xx controllers) provide up to seven phases assignable in any combination across two outputs and combine with an ISL99227 smart power stage to offer a scalable solution from 10 A to 450 A supporting CPU core voltages, memory, and auxiliary power rails.

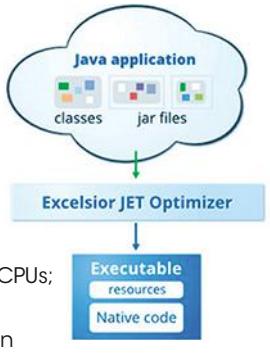
The digital multiphase family is comprised of three groups: The ISL68137and ISL68134 controllers utilize AVSBus to power and communicate with ARM-based processors in network routers, switches, servers, storage, and wireless telecom equipment; the ISL68127 and ISL68124 general-purpose controllers power network processors, FPGAs, SoCs, and graphics accelerators; and eight controllers (ISL69147/44, ISL69137/34, ISL69128/27, and ISL69125/24) add a secondary high-speed interface (SVID or SVI2) to power the latest Intel and AMD processors in cloud computing applications.

The dc/dc controllers integrate a high-performance digital engine featuring a synthetic current control architecture that tracks each phase current with zero latency, allowing the device to respond to any load transient with precise current and voltage positioning. The ISL681xx and ISL691xx multiphase controllers and ISL99227 smart-power stage (5 × 5 mm, 32-lead QFN) are available now.

INTERSIL

https://www.intersil.com

AOT Java Compiler Available for ARM Platforms



EXCELSIOR IS NOW OFFERING its first Java product to target ARM-based devices, Excelsior JET Embedded 11.3 for Linux/ARM. A complete implementation of the Java SE Embedded technology, the software package is enhanced with an AOT optimizing native code compiler that enables the circumvention of the restrictions from target hardware. The embedded software seeks to help vendors of Java-powered devices protect their intellectual property and improve the run time characteristics of their Java code.

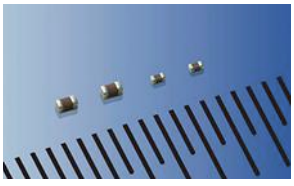
The ARM architecture flavors initially targeted by Excelsior JET Embedded are ARMv7-A with VFPv3-D16 extension or better, and 32-bit ARMv8-A. Future versions will also support 64-bit ARMv8 CPUs; support for the lower end processors will be driven by customer demand.

Excelsior JET Embedded 11.3 for Linux/ARM and Intel-based platforms is available for evaluation and purchase immediately. Pricing depends on the customer's choice of a support plan and project parameters. Excelsior is an Oracle Java Licensee, so the product includes Oracle's implementation of the Java SE Platform API, but the use of a licensed Java implementation in an embedded device requires paying per-unit royalties to Oracle.

EXCELSIOR

https://www.excelsior-usa.com/

MLCCs Offer Volumetric Efficiency Suited to Smartphones



A 4.7 µF MLCCS in a 0201 case size and a 0.47 µF MLCCs in a 01005 case size, designed by Kyocera for use in telecommunication equipment including smartphones, deliver double the capacitance of the conventional 0201 and 01005 MLCCs while maintaining the same sizes.

The MLCCs enable the reduction of the number of components equipped in a device and reduce space. Kyocera achieved the level of capacitance for these sizes of MLCCs through a stable multilayer structure made by reducing the thickness of the dielectric material using their nanomaterial technology and highly accurate processing technology.

Characteristics of both devices are X5R (EIA). The ceramic capacitorshave a 6.3 Vdc rated voltage and tolerance is M (±20%). Both the 4.7 µF in a 0201 case (0.6 × 0.3 × 0.3 mm) and the 0.47 µF in a 01005 case (0.4 × 0.2 × 0.2 mm) will be available on a sample basis in October 2016.

KYOCERA

global.kyocera.com

High-Res, Low-Power SAR ADC Shortens Test Times

ANALOG DEVICES' NEW GENERATION of high-precision SAR ADCs, the AD4003 and AD4000, enables mobile test and measurement instruments to operate for longer during field tests, while claiming improved measurement accuracy and repeatability. The new devices support development of smaller-sized instruments which can be placed closer to the sensors being measured, or allow for an increased number of data acquisition channels in the same form factor.

The 2-MSPS, 18-bit AD4003and 16-bit AD4000 SAR ADCs offer features such as high input-impedance mode and span-compression mode. The high input-impedance mode allows the use of low-power precision amplifiers to directly drive the ADC, and reduces the signal-chain power demands. Internal overvoltage protection removes the need for external protection devices, and the span compression enables the ADC driver stage to operate from the same supply rail as the ADC. This combination supports increased channel density while lowering the system-level power requirements, without compromising performance. The AD400x series includes 20-, 18-, and 16-bit SAR ADCs with speed options from 500 kSPS to 2 MSPS.

ANALOG DEVICES

www.analog.com

Cylindrical Supercapacitors Enhance Pulse Power Handling

AVX IS OFFERING TWO new families of cylindrical, electrochemical, double-layer supercapacitors, the SCC and SCM Series. SCC supercapacitors, rated for 2.7 V, deliver 1 F to 3,000 F capacitance values, 0.16 to 200 mΩ ESR at 1,000 KHz, 6 to 5,800 µA leakage, 1.2 to 5.6 Wh/kg energy density, and 50,000+ cycles lifetime performance. The SCC Series is rated for use in operating temperatures spanning –40°C to +65°C (or, with voltage de-rated to 2.3 V per cell, –40°C to +85°C).

Currently available in 5 V and 5.4 V versions, the series-connected cylindrical SCM Series modules feature 0.47 F – 7.5 F ±20% tolerance capacitance values, 4 – 300 mΩ ESR at 1,000 KHz, 2 – 1,000 µA leakage, and 1 to 5.6 Wh/kg energy density. SCM supercapacitors are rated for operating temperatures spanning –40°C to +65°C at 5.0 V – 5.4 V balanced (or, with voltage de-rated to 3.9 V – 4.6 V per cell, –40°C to +85°C balanced). The supercapacitors are packaged in plastic or shrink-wrapped cases from 14 to 24 mm with vertical or horizontal radial leads.

Designed to provide reliable hold-up, energy harvesting and instantaneous pulse power, both series can be used alone or in conjunction with primary or secondary batteries in applications such as UPS, wireless alarms, remote meters, GSM/GSR transmissions, camera flash systems and scanners.

AVX

www.avx.com

EMC Test Box Enables Shielded RF Interface Measurements

THE TS7124 EMC test box from Rohde & Schwarz enables reliable and reproducible shielded RF radio interface measurements. Key features of the test box include: >80 dB shielding effectiveness; rugged design for long life; possibility of integration into a 19-in. rack; customized configuration of integrated feedthroughs (filtered RF connectors); customized radiation patterns using the antenna ring; and antenna couplers for LTE, Wi-Fi, ISM, GSM/CDMA2000/WCDMA, WLAN, GPS, Bluetooth, WiMAX, and Zigbee. The manual version for labs and the automatic version for production environments utilize identical measurement scenarios to improve correlation between labs and factories.

The TS7124 RF test box combined with the ARTS9510 automotive radar target simulator and the NRP8S power sensor provides an optimized measurement solution for production tests on automotive radar sensors.

Additionally, Rohde & Schwarz is offering the SMW200A vector signal generator and FSW85 signal and spectrum analyzer combination to provide the T&M functionality required to test solutions for candidate waveforms, new frequency bands, etc. The FSW85 analyzes FMCW chirp signals up to 2 GHz bandwidth and covers the 24 and 79 GHz frequency bands allocated to automotive radars.

ROHDE & SCHWARZ

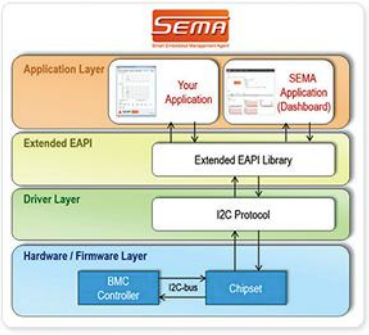
https://www.rohde-schwarz.com

Active Voltage Rail Probe and SPMI Decoder Aids PMIC

TELEDYNE LECROY IS INTRODUCING two new products, the RP4030 active voltage rail probe that measures small signal variations on a dc power/voltage rail, and an MIPI SPMI serial decoder that monitors and correlates SPMI serial bus messages with dc power/voltage rail changes. The products are targeted for testing line or battery-powered computing and embedded systems that use digital PMICs to reduce power consumption, and are specifically intended to add to the capabilities provided by Teledyne LeCroy's HDO8108 and HDO9404 high-definition oscilloscopes.

The RP4030 has ±30 V built-in offset range, 1.2x attenuation and 50 kΩ dc input impedance. A standard 914 mm SMA to MCX cable attaches to the probe, permitting connection to a 4-GHz MCX solder-in lead, 4-GHz MCX PCB-mount receptacle, or 3-GHz MCX coaxial to U.FL receptacle. The RP4030 probe is priced at $2,580. The optional RP4000-BROWSER

Intelligent Middleware Device Control Tool Upgrades Functionality



THE LATEST VERSION OF ADLINK Technology's intelligent middleware and management tool, SEMA Utilities 3.5, seeks to monitor and collect system performance and status information from devices and control system functions in a timely, flexible, and precise manner. The new version now supports the latest OSs such as Windows 10, and well as the latest x86 and ARM SoC generations. System performance and quality have also been improved, with call speed increased by 60% and added support for concurrent access of multiple processes and software applications leveraging SEMA functions in parallel.

The 3.5 version introduces an enhanced feature set and offers comprehensive hardware support at the board level. A history of last power-up sequence errors is logged, including detailed forensic information, enabling further investigation into technical issues in order to avoid unplanned system downtime. New 1-Wire support offers a serial interface that allows access to memory, security, and temperature sensor devices.

The intelligent middleware runs on many widely used embedded operating systems and supports both x86 and ARM architectures. Available now, SEMA 3.5 is provided at no-cost for use in combination with SEMA-enabled ADLINK hardware.

ADLINK

www.adlinktech.com

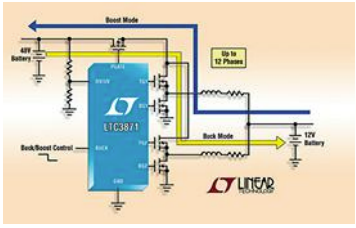
is $1,590. HDO9000 Series oscilloscopes currently support the RP4030 with software version 8.2.1.1. Support for most other Teledyne LeCroy oscilloscopes is expected in January 2017.

The SPMI decoder provides a transparent, color-coded protocol decode overlay for the acquired SPMI physical-layer waveform. It features serial pattern search of decoded data, an interactive protocol decode table, and full arbitration sequence support. Priced at $2,010, the MIPI SPMI serial decoder is multi-master/multi-slave capable and supports all sequences with pauses.

TELEDYNE LECROY

teledynelecroy.com

Automotive Buck/Boost DC/DC Controller Increases Power



DESIGNED BY LINEAR TECHNOLOGY for automotive dual battery systems, the LTC3871 (100 V / 30 V) two-phase synchronous buck or boost controller combines a secondary 48 V bus with an existing 12 V system. The 48 V rail includes a BSG or ISG, a 48 V lithium-ion, and a bidirectional dc/dc converter for delivery of up to 10 kW of available energy from the two batteries combined.

The controller operates in buck mode from the 48 V bus to the 12 V bus or in boost mode from 12 V to 48 V. Up to 12 phases can be paralleled and clocked out-of-phase to minimize I/O filtering requirements. Allowing both batteries to supply energy simultaneously, the 12 V bus will continue to power the ignition, lighting, and audio/video systems, while the 48 V bus supplies the active chassis systems, power steering, air conditioning, and turbos. The controller operates at a selectable fixed frequency between 60 and 460 kHz, and can be synchronized to an external clock over the same range.

Available in a thermally enhanced 48-lead LQFP package with prices starting at $5.40 each/1,000, the LTC3871 buck or boost controller comes in three temperature grades, –40°C to 125°C for the extended and industrial grades, and 40°C to 150°C for high-temp automotive.

LINEAR TECHNOLOGY

https://www.linear.com

IIoT Middleware Upgrade Connects to Multiple Clouds

EUROTECH IS INTRODUCING Release 4.0 of Everyware Software Framework (ESF), a commercial, enterprise-ready edition of Eclipse Kura, an open source Java/OSGi middleware for IoT multi-service gateways and smart devices. ESF boasts a secure execution environment for embedded applications and a secure, reliable and optimized communication system for data and remote device management. By supporting x.509 certificates, the middleware provides mutual authentication between devices and remote servers and IoT cloud platforms, and ensures that only properly signed and verified application code is deployed and executed on the devices.

The Java/OSGi development environment for IoT gateways facilitates application development and modularization of software components, assuring interoperability of apps and services between different devices.

The new release includes enhancements such as: the ability for a single gateway to be simultaneously connected to multiple cloud platforms, including Eurotech Everyware Cloud and other IoT platforms such as Amazon AWS, Oracle Cloud, Microsoft Azure, and IBM Watson; support for Wi-Fi Dual Mode; and support for Terminal Server/Client, allowing remote access and configuration of a gateway's serial port using a TCP connection. ESF Release 4.0 also supports the recently released ReliaGATE 20-25, an IoT gateway for industrial and lightly rugged applications.

EUROTECH

https://www.eurotech.com

RJ-45 Plug Accelerates Cat 8 Cable Adoption

A NEW RJ-45 PLUG (high-speed) electronic dc load series, the latest addition to Intepro Systems' family of power system automatic test equipment, is a stand-alone 40 W load module providing POL connections and POU for faster slew rate dc loading. The dc load offers a smart on-board load head that minimizes inductance, resistive losses, and noise.

Designed for sub-1 V testing, the device's standalone modular POU layout, along with its smart on-board load head, allows for positioning the load to DUT without requiring customization. The standard load offers four programmable modes of operation: constant current, constant resistance, constant power and constant voltage. All have a 50 MHz measurement bandwidth with a 150 MS/s, 14-bit digitizer. Measurements include voltage, current, power, noise, settling time, and overshoot/undershoot. The standard 20 V/20 A/40 W module can sink 20 A with 0.3 V applied to the load head. In constant-current mode the module achieves 40 A/µs rise time with a 20 A load for high-speed pulse loading.

Intepro Systems offers their electronic loads as stand-alone units or as complete test systems. Prices for the EL 2000 HS electronic dc loads start at $2,255, with availability at 8-12 weeks.

OCC

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BILL WONG | Embedded/Systems/Software Editor
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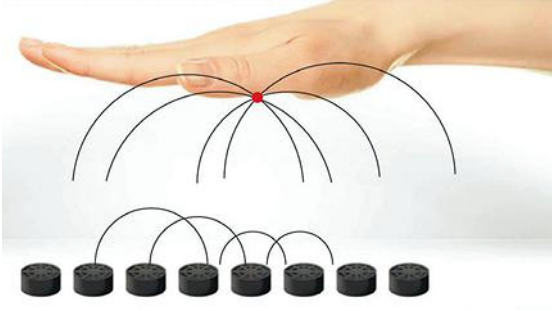
Ultrasonics Brings Haptics to Augmented and Virtual Reality

Ultrahaptics uses an array of ultrasonic speakers to deliver haptics at a distance for augmented and virtual reality feedback.

Ultrahaptics hasn't quite brought holodeck solidity to augmented or virtual reality applications, but it is a step in that direction. The company's technology employs a phased array of ultrasonic speakers to deliver sound waves that reinforce each other, so that vibrations can be induced at a fixed position away from the array *(Fig. 1)*. This is similar to how a phased-array radar system works.



1. Ultrahaptics uses a phased array of ultrasonic speakers fired at precisely selected intervals so the intersection of the waves hit the hand providing a tiny forceful vibration.

The force on the skin of a hand is minute, but it provides sufficient haptic feedback—much like the vibrations of a smartphone when pressing a button on the screen. The difference is that the smartphone is in contact with a finger, while Ultrahaptics technology operates at a distance. The current incarnation can operate up to 2 m from a hand.

2. Ultrahaptics initial array utilizes standard automotive ultrasonic speakers. The array is driven by an FPGA. A Leap Motion 3D sensor is used to determine the range to target.

There is another aspect to this technology that is not shown in the diagram; the system needs to know where the target is located. In most cases this will be a hand or head, although it will work with most body parts when not covered by clothing. The missing piece is usually a 3D imaging system, the Leap Motion sensor *(see "Consumer Electronics Take User Interfaces Beyond Your Fingertips" on electronicdesign.com)* used with the development kit *(Fig. 2)*. Ultrahaptics' technology is agnostic to the 3D imaging system.

I tried various demos recently and was suitably impressed by the feedback. For example, I could hold my hand a foot or more above an array to feel bubbles or water flowing by, and feel feedback when pressing a virtual button. The force is not sufficient to cause any significant movement or provide a solid surface (like a holodeck might), but it was more than sufficient to simulate surfaces and distinct objects.

This basic augmented reality only required the use of Ultrahaptics hardware. The hardware can also be combined with augmented or virtual reality systems. One demo had me picking up and moving small balls and blocks.

One example where the more basic approach can be effective is with automotive controls or white-good appliances. The system can easily simulate sliders, buttons, and knobs. It can even provide positioning information so a user can know by touch whether they are close to a control or control area, without looking at the area or having other visual feedback mechanisms.

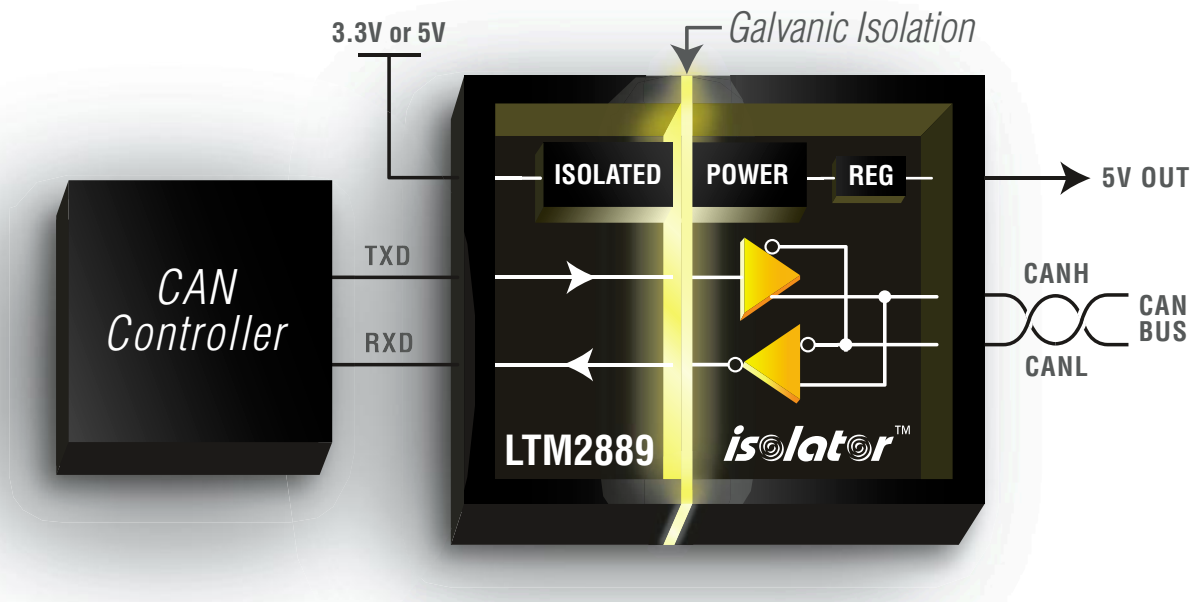
Ultrahaptics includes tools that developers can use to create different effects and touch sensations. There are other changes in the works, like a custom ultrasonic speaker that is a fraction of the size of the current automotive solution. The automotive speakers are targeted side sensors for parking and object notification versus a dense array that Ultrahaptics needs.

Long-range haptic feedback is not needed for every application, but it offers significant and unique advantages for many applications. There are many possibilities for medical applications, as well.


MPD
MPD MPD
MPD MPD MPD
MPD
SEASON'S GREETINGS
MPD batteryholders.com

Isolated CAN + Power

Rugged 4Mbps µModule CAN Transceiver Features 2500V_{RMS} Isolation and ±25kV ESD Protection

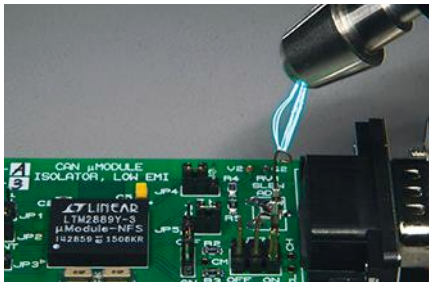


The LTM®2889 is a robust isolated CAN transceiver that breaks ground loops by isolating the logic level interface and line transceiver. An onboard DC/DC converter powers the transceiver and provides 0.75W for powering additional system circuitry. The ISO 11898-2 compliant CAN transceiver supports an extended common mode range of ±36V, is ±60V fault protected and ±25kV ESD protected, and provides uninterrupted communication during common mode transients over 30kV/µs. This ensures high system reliability under the harshest operating conditions.

Features

- Isolated 4Mbps CAN Transceiver
- 2500V_{RMS} for 1 Minute per UL1577
- Up to 150mA Isolated Power Output
- ±60V Fault Protection
- High Common Mode Transient Immunity: 30kV/µs
- ±25kV ESD Transceiver Interface
- 15mm x 11.25mm BGA Package

LTM2889 ±25kV ESD Protection



Info & Free Samples

www.linear.com/product/LTM2889

www.linear.com/products/umodule_solutions

1-800-4-LINEAR

LINEAR TECHNOLOGY