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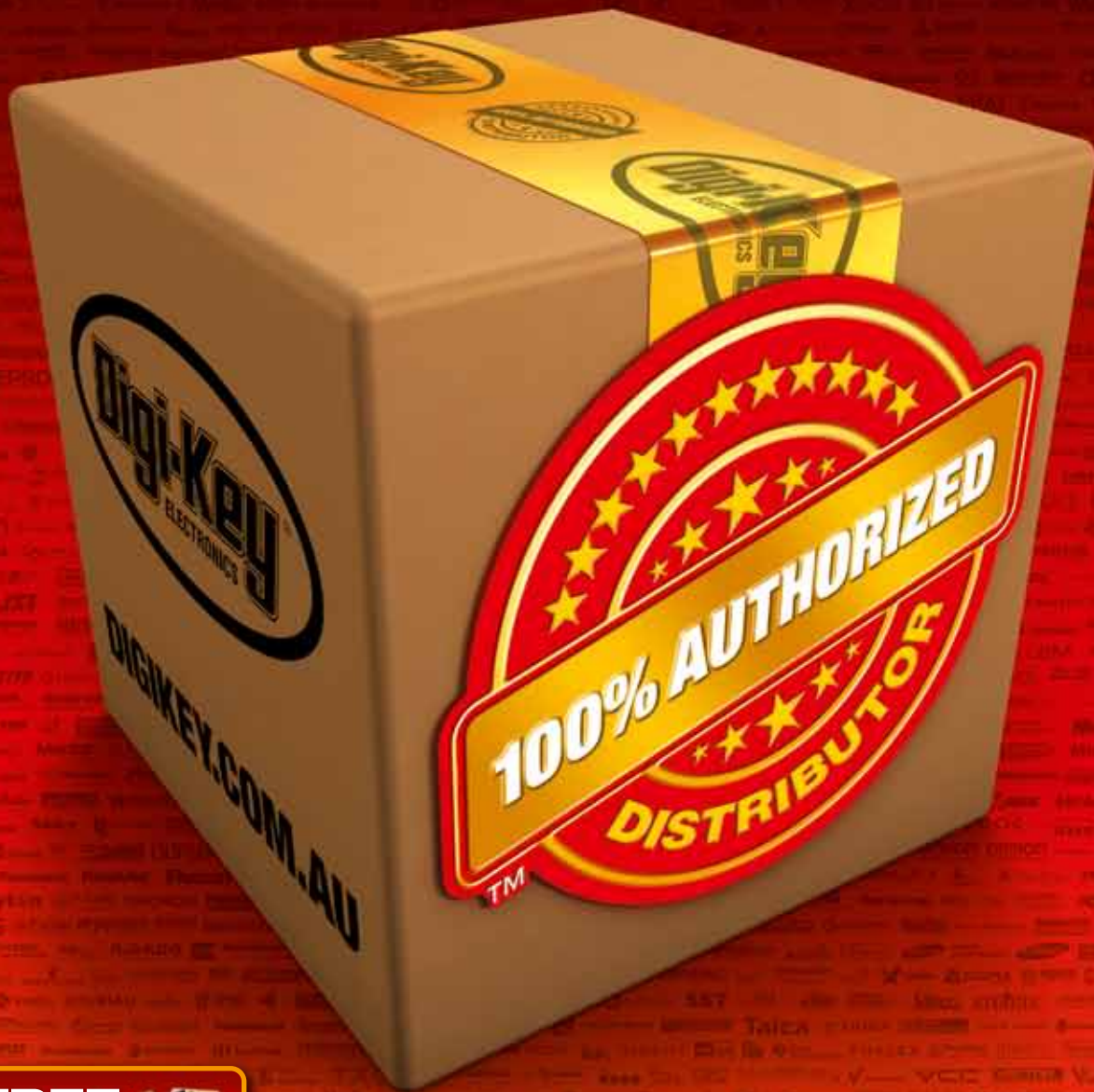
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COVER STORY



An ultrafast acquisition rate of 1 million waveforms per second, real-time compensation of transmission losses (de-embedding) between the signal source and oscilloscope, and silent operation even at full load — these are just some of the benefits of the high-performance R&S RTP oscilloscope family.

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The R&S RTP was designed to be the world's first oscilloscope to compensate the impairment of the signal contacting in real time while maintaining the high acquisition rate. Hardware-based compensation filters are configured using user-applied S-parameters. It is even possible to trigger on de-embedded signals.

The oscilloscope combines multiple instrument capabilities for time-correlated debugging in one box. Additional integrated test resources such as MSO or multiple 18-bit high-precision voltage and current channels for power measurements make the R&S RTP a powerful debugging tool. With all this in a compact instrument format, plus silent operation, the oscilloscope is a good fit for any lab.



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POWERING THE FUTURE OF SMART HOMES

When sci-fi cartoon *The Jetsons* first hit screens in 1962, it was preposterous that we'd be waited on by robot maids or be able to video call one another. Michele Windsor, Global Marketing Manager at home automation battery manufacturer Ultralife Corporation, explores the future of smart homes and explains why reliable power will be the responsibility of sensor designers.

The home automation market is one of the most interesting sectors of recent years. While still early in its adoption phase, it has the potential to become one of the global economy's most valuable technology segments. Who wouldn't want to invest in technology that provides everything from security to comfort, all while putting the user in control? This is a view shared by market research analysts.

"While it's still early days for the smart home market — and the wider consumer IoT ecosystem in general — we expect to see considerable growth over the next few years, especially as consumers become more aware of and increasingly interact with smart assistant platforms like Amazon's Alexa and Google Assistant," said Adam Wright, Senior Research Analyst for International Data Corporation's Consumer IoT Program.

As with any new technology, adoption is slow but steady. According to a 2017 connected home report from Gartner, only 10% of households in the US, UK and Australia have purchased smart home devices. However, another survey, conducted by McKinsey, found that the US market is growing at a 31% compound annual growth rate (CAGR) with a total of 29 million smart homes in 2017.

The McKinsey research is particularly interesting, as it highlights some of the reasons that consumers choose to invest in smart home technology. Consumers are currently buying smart technology to solve daily problems. This often means standalone products rather than entire Internet of Things (IoT) platforms. We expect this will change over time, as smart technology businesses begin offering better value propositions to customers.

Building confidence

We can break the most popular smart device types into three functions: convenience, entertainment and security. Devices that serve these purposes often prove to be the most popular, as they fulfil a fundamental purpose for the consumer.

For example, products such as Amazon's Alexa intelligent home assistant and Philips' Hue smart lighting systems are two of the most popular smart home technologies — and both serve convenience. Likewise, smart doorbells fitted with surveillance technology like those provided by Nest or Ring fulfil security purposes.

While few would argue that convenience is as important as security, consumers will still expect the same level of reliability and consistency for both devices. This is because value is



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the main deciding factor when investing in the technology, so consistency helps to justify cost. If original equipment manufacturers (OEMs) in the smart home industry can prove their products are consistently effective, they will build consumer trust in their technology.

With any technology in its infancy, there are a range of technical difficulties that can impact a device's performance. For example, there was an infamous series of incidents in early 2018 that saw Amazon's Alexa laughing spontaneously without being activated. While these bugs will be addressed on an ongoing basis, there is another problem that smart home device manufacturers must consider: power.

Smart technology can be powered in several ways. Some devices, such as smart lighting, can be wired into the house and powered from the electrical network. However, many devices run on batteries, as do many sensors in smart security systems.

As devices evolve and sensor technology allows for smaller footprints, these battery types change. At Ultralife, we've researched the market and found that many first-generation battery-powered sensors use CR123A batteries. This makes sense, as these batteries are lightweight, compact and have high voltage capacities.

Battery specification

It's important that design engineers note that not all CR123A batteries are made equal. Selecting one that has a high voltage capacity

“

BESIDES HIGH ENERGY CAPACITY, ENGINEERS SHOULD LOOK FOR BATTERIES WITH MINIMAL SELF-DISCHARGE AND A GENTLE VOLTAGE CURVE OVER THEIR LIFESPAN.

and longevity allows the device manufacturer to provide more value to customers, because it offsets the inconvenience of needing to replace batteries throughout a system that is designed to maximise convenience for the user.

Design engineers should specify CR123A batteries with very specific characteristics to make the most of their product. Besides high energy capacity, engineers should look for batteries with minimal self-discharge and a gentle voltage curve over their lifespan.

The steady voltage curve is particularly important, because it directly affects the performance of the overall sensor. The voltage curve indicates how the current draw of the battery changes over time, with a gentle curve meaning that the battery's performance is consistent until the energy is depleted. This is a common characteristic in CR123A batteries with a lithium chemistry, such as Ultralife's lithium manganese dioxide battery for smart sensors.

Ensuring a steady voltage curve is one example of why battery selection is essential. Other chemistries, such as alkaline batteries, have steep voltage drops that mean

they aren't ideal for applications like sensors that require a steady draw of power. These drops cause erratic performance, which could potentially compromise a smart security system — particularly for systems that will be regularly attempting to connect to wireless networks.

Although it will be the user that will ultimately be responsible for ongoing battery replacements, we've found that many customers follow OEM recommendations on battery choice. This means that if a sensor OEM packages an alkaline battery with its sensors, the user will often choose alkaline instead of lithium, leading to a less effective performance that reflects negatively on the overall system.

If we are to truly achieve the smart homes of the future that shows like *The Jetsons* tempted us with, we must ensure our devices are designed to last at component level. Design engineers must take responsibility for initial battery selection and set customers on the right path to a smarter future.

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HYBRID ENERGY STORAGE SYSTEM COULD CHARGE EVs IN SECONDS

Chemists from the University of Glasgow have developed an energy storage system based on a nanomolecule that can store electric power or hydrogen gas, resulting in a hybrid system that can be used as a flow battery or for hydrogen storage.

The nanoscale battery molecule is designed to store energy, releasing the power on demand. When a concentrated liquid containing the nanomolecule is made, the amount of energy it can store increases by almost 10 times. The energy can be released as either electricity or hydrogen gas, meaning that the system could be used flexibly in situations that might need either fuel or electric power.

One potential benefit of this system is that electric cars could be charged in seconds, as the material is a pumpable liquid. This could mean that the battery of an electric vehicle could be 'recharged' in roughly the same length of time as petrol cars can be filled up. The old battery liquid would be removed at the same time and recharged ready to be used again.

Writing in the journal *Nature Chemistry*, the scientists say their research will help pave the way for the development of new energy storage systems that could be used in electric cars, for the storage of renewable energy and to develop electric-to-gas energy systems for when a fuel is required.

"For future renewables to be effective, high-capacity and flexible energy storage systems are needed to smooth out the peaks and troughs in supply," said Professor Leroy Cronin, the University of Glasgow's Regius Chair of Chemistry. "Our approach will provide a new route to do this electrochemically and could even have application in electric cars where batteries can still take hours to recharge and have limited capacity.

"Moreover, the very high energy density of our material could increase the range of electric cars, and also increase the resilience of energy storage systems to keep the lights on at times of peak demand."

SUPERCOMPUTER HACKING HALTED BY NEW ALGORITHM

IT experts at Monash University have devised what is claimed to be the world's leading post-quantum secure privacy-preserving algorithm — so powerful it can thwart attacks from supercomputers of the future.

Announced at the 23rd Australasian Conference on Information Security and Privacy, the Lattice-Based One Time Ring Signature's (L2RS) enhanced security and privacy-preserving features enable large transactions and transfer of data without risk of being hacked by quantum computers and privacy revoked by unauthorised users.

According to Dr Joseph Liu, Director of the Blockchain Research Lab at Monash, data security will become essential as quantum computing gets closer to being able to unravel the technology that underpins the security of blockchains — a milestone estimated to reach the world within the next 10 years. He and his fellow IT experts consider L2RS as a significant leap forward in maintaining data security, user privacy and integrity for blockchain technology as the race to build powerful quantum computers gains momentum.

"The L2RS deploys cryptographical techniques to protect the privacy of users," said Dr Liu. "It allows any user to hide his identity among a group of users. The transaction amount will be hidden as well. No-one knows how much money has been transferred in each transaction.

"It is also post-quantum secure. That is, even in the existence of the future powerful quantum computer — which can easily break the current security algorithms such as RSA — Hcash is still secure and user privacy remains preserved."

Dr Liu said blockchain has legitimate potential to change the world to create new foundations for economic and social systems, and a working quantum computer could, in theory, break today's cryptography. "Therefore, Hcash has a significant advantage over other cryptocurrency exchanges even after the practical rise of quantum computers," he said.

The launch of L2RS is part of a research partnership between Monash University, Collinstar Capital and Hong Kong Polytechnic University to advance Hcash as a virtual cryptocurrency exchange far superior to Bitcoin.



Joseph Liu.

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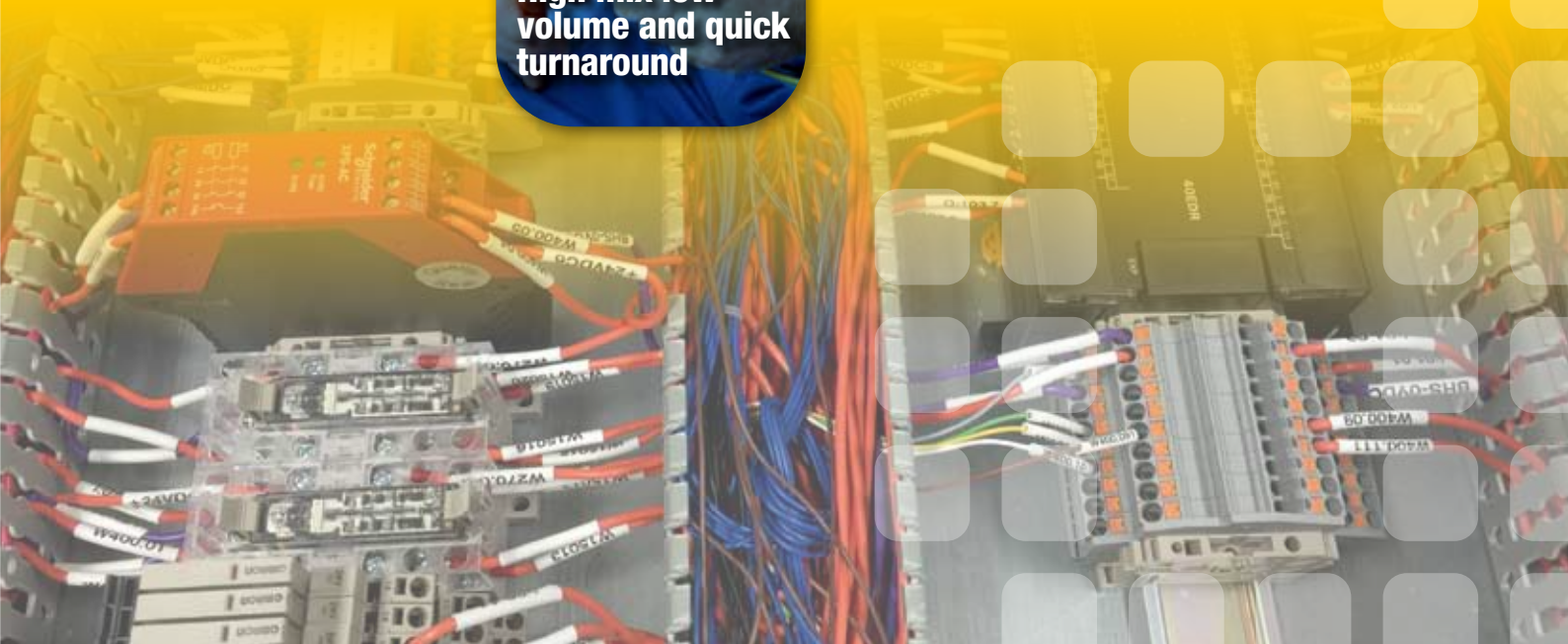
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QUANTUM BATTERIES COULD ENABLE INSTANTANEOUS CHARGING

The University of Adelaide's newest Ramsay Fellow, Dr James Quach, will harness the properties of quantum mechanics with the aim of building the world's first quantum battery — a battery with the potential for instantaneous charging.

Dr Quach, who is an expert in quantum physics, has joined the University of Adelaide's School of Physical Sciences for four years under a Ramsay Fellowship, originally established in 2008 to reduce the brain drain from our shores and advance scientific research. He will be working within the Precision Measurement Group at the Institute for Photonics and Advanced Sensing (IPAS).

Dr Quach says that unlike ordinary batteries, which take the same amount of time to charge no matter how many you have, the theory is that quantum batteries would charge faster the more you have of them.

"If one quantum battery takes one hour to charge, then two would take 30 minutes, three would take 20 minutes, and so on. If you had 10,000 batteries, they would all charge in less than a second," he said.

This is possible thanks to a feature of quantum mechanics known as entanglement — a feature that violates the conventional laws of physics.

"When two objects are entangled it means that their individual properties are always shared — they somehow lose their sense of individuality," Dr Quach explained.

"It's because of entanglement that it becomes possible to speed up the battery charging process."

The idea for a quantum battery was first discussed in a 2013 research paper, but Dr Quach says he will "take the theory from the blackboard to the lab".

"Entanglement is incredibly delicate, it requires very specific conditions — low temperatures and an isolated system — and when those conditions change the entanglement disappears," he said.

"With the support of the academic community in Adelaide, interstate and globally, I aim to extend the theory of the quantum battery, construct a lab conducive to the conditions needed for entanglement and then build the first quantum battery."

Once built, the quantum battery could replace conventional batteries used in small electronic devices such as a watch, phone, iPad or computer, or any other product that relies on stored energy. Eventually it is hoped larger quantum batteries could provide opportunities for the renewable energy sector.

"The long-term aim is to scale up, to build bigger batteries which will support renewable energy technologies by making it possible for continuous energy supply no matter the weather conditions — rain, hail or shine," Dr Quach said.

AUSTRALIA'S FIRST COMPUTER BACK ON DISPLAY

The world's longest surviving first-generation computer has found a new home at Melbourne's Scienceworks museum.

Half the size of a shipping container and about a millionth of the speed, computing power and volume of a smartphone, the Commonwealth Scientific and Industrial Research Organisation Automatic Computer (CSIRAC) was at the cutting edge of the new field of computing when it was built in 1949. It was Australia's first stored-memory computer and the fourth in the world to ever be built.

Originally engineered at CSIRO in Sydney, CSIRAC was moved to the University of Melbourne in 1955. After taking a year to reassemble, it was ceremoniously switched on in 1956.

For the next eight years, CSIRAC provided a highly sought after computing service for science and industry, with people often waiting weeks to gain access. Operating for approximately 30,000 hours and tackling around 700 projects, it was used to play the first electronic music, make weather forecasts, calculate mortgages and even play some of the first computer games.

Dr Peter Thorne, former Head of the Department of Computer Science at the University of Melbourne, worked with CSIRAC as weekend computer technician in the early 1960s. He said that to the Australian ICT sector, CSIRAC is a symbol of our nation's sustained excellence in information and communications technology, from the very beginning of the computer age.

CSIRAC has been in Museums Victoria's collection since 1964 and was on display at the Melbourne Museum from 2000 until 2017. It has now been relocated to the Think Ahead exhibition at Scienceworks, where it will be on permanent display.



Image courtesy of Museums Victoria.

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SIX EXPECTATIONS FOR IoT PLATFORMS IN 2018

Joseph Zulick*

From increased value provided by edge computing to security improvements with blockchain integration, IoT platforms across the board are starting to get interesting.

The intelligent digital mesh is evolving and enterprises today are paying attention to the disruption and impact on business operations now and soon on the horizon. In this article, we look at new trends for IoT platforms in 2018 and what to expect as the year continues.

1. Pushing it to the edge

The evolution of computing and cost efficiency has made commercial devices capable of running full-on operating systems and complex algorithms, right in the office. IoT platforms in 2018 are continuing to push for the fastest connectivity and that's of course where the concept of edge computing comes in; where workload is processed on the edge of the network where the IoT connects the cloud with the physical world.

A key part of this sequence is the fast and effective integration between IoT and the cloud, locating many of the processes on board the devices themselves and connecting them with the cloud for the most essential functions — 'Elementary, my dear Watson'. As machine learning algorithms evolve and advance, so

does the potential for edge devices to take over a growing percentage of computing data, combined with its ability to increase local privacy by not exporting sensitive data to the cloud plus reducing latency from data requirements. In 2018 we will continue to see an increased momentum of companies adding business solutions requiring local, secure data analysis, and edge computing will be a key focus of that implementation, with the benefits of the cloud for increased security, easy scalability, design configuration, simple deployment and management options.

2. Blockchain getting hotter

While BitCoin, LiteCoin and Ethereum have had their best climb and largest drop, before going back to a slow climb again in 2018, it is also likely to be the year that this technology enters widespread adoption through increased usage cases in IoT. As more and more devices are continually added to the IoT network, blockchain adoption promises to take security for users and companies to better levels as the year progresses. The fact is that every system of connected IoT devices can use blockchain to safely and reliably



organise, store and share transactions of data. Over this year, this technology is expected to play a key role in the number of industries that manage physical objects moving across the planet, which could benefit from the many advantages of blockchain script, shifting focus towards large-scale deployments requiring reliability, stability and ease of integration with existing technology infrastructures. New pilot projects of positive use studies are emerging and blockchain technologies with IoT is a natural evolution that will drive adoption, making it one of the most significant trends for IoT software in 2018.

3. Beyond blockchain

Of course, as more devices are connected and as IoT expands, security challenges will increase as well. There will be more IoT-related risks both on devices and on the cloud network as hackers work to extract sensitive data by compromising systems, presenting new levels of concern and challenges to overcome in security design on the global infrastructure and for IoT platforms.

4. Expanding platform offerings

Designers building IoT into objects and experiences need functionality for remote product management, monitoring and control, and it's the same for IoT business operators; they need data management platforms that integrate their diverse set of IoT-enabled business functions into easy-to-use business data they can leverage for managing the business, not manually sorting through a sea of bits of information. For functionality, they will increasingly choose IoT platforms that include built-in applications that are tailored for their needs.

Edge processing naturally leads to consolidation. As more companies push processing and data analysis to the edge of the network in order to improve security, reduce network latency and cut cloud costs, it will become increasingly attractive for an IoT platform to offer additional services to distinguish itself from other enterprise offerings. The ensuing pressure of supporting both edge and core with a cost-effective model will force all but the largest and most innovative IoT platform providers out of the market over the next few years or to focus their offering on niche applications.

5. Commercialise IoT data

Recent European guidelines recognise what 45% of data and analytics decision-makers at US enterprises are saying about commercialising data — they're already doing it. In France, 35% of companies are doing it; in Germany, that number is 38%. Seeing the opportunity to level the playing field, the European Commission will issue guidelines this year to encourage the use of advanced data mining technology to boost the data economy with the advancement of IoT.

6. IIoT platforms leaving IaaS market

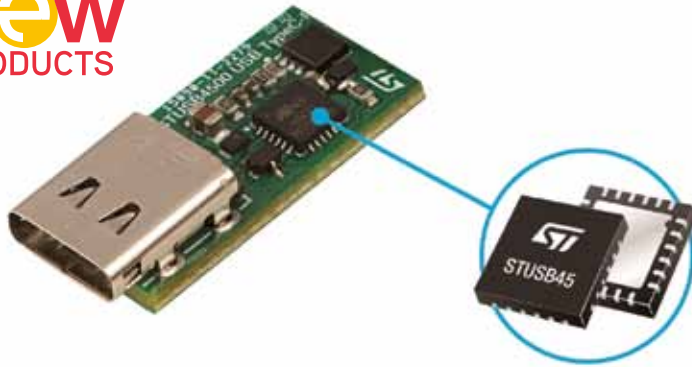
A part of ongoing consolidation and offering built-in applications for customers is that the major IIoT platforms have transferred at least some of their industry-based or IoT-specific functions available through hyperscale cloud providers like AWS, IBM and Microsoft. As these massive clouds extend their global reach, get clearance for compliance in a strict regulatory environment and solidify their own IoT capabilities, this trend will continue to unfold.

Conclusion

IoT platforms have an exciting year ahead for them as they adapt to the evolving environment of edge computing, blockchain and niche application support. The intelligent digital mesh is increasing in complexity and the security demands at all levels of the network are here to make the year even more interesting for software designers and platform engineers alike.

**Joseph Zulick is a writer and manager at MRO Electric and Supply.*

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STANDALONE USB TYPE-C POWER DELIVERY CONTROLLER

STMicroelectronics' STUSB4500 standalone USB Type-C and power delivery controller extends the convenience and environmental benefits that come with powering and charging from a standardised USB-C outlet to a wide variety of consumer, industrial and medical products. Optimised for sink-only applications powered through a USB-C cable, the product is a certified standalone USB PD controller that can be easily customised by the user to suit the application.

Based on default power profiles (PDO) loaded in an internal non-volatile memory, the IC implements proprietary algorithms to negotiate a power delivery contract with a source without any internal support (auto-run mode), making it suitable for automatic high-power-profile charging especially from a dead-battery power state. An application processor can then optionally and dynamically change product power profiles to force another negotiation.

The controller supports multiple options to manage multiple input power paths and irrelevant power sources. With this device onboard, numerous types of portable equipment from 15 to 100 W can replace a product-specific charger with a standard USB Type-C connection. These include toys, power tools, vacuum cleaners, office equipment, lighting products, smart speakers, medical devices and others. Equipment normally AC-powered through a captive mains cable, such as small kitchen appliances, can also become DC-powered to simplify product design, reduce size and weight, and allow the option of cordless battery-powered operation.

Saving individual dedicated chargers and power supplies by migrating to USB power delivery controlled by the device is said to enhance convenience and portability, and mitigate the environmental burden imposed by waste electrical equipment discarded with each product-upgrade cycle. More flexible charging options including fast-charging or charging multicell batteries above 5 V are also possible.

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LITHIUM COIN CELL BATTERY HOLDERS

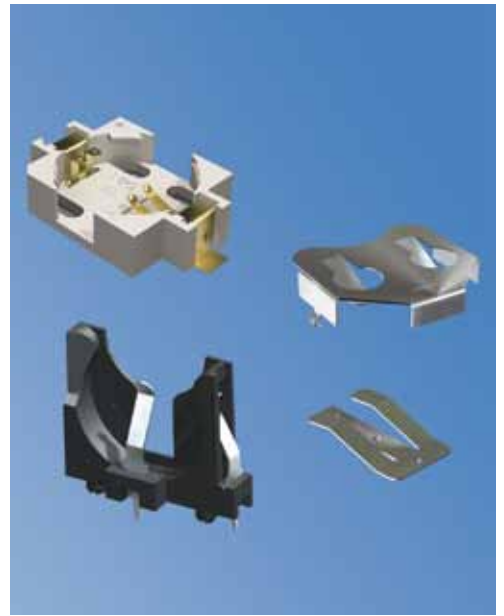
Keystone Electronics' lithium coin cell battery holders, in thru-hole mount (THM) and surface mount (SMT) varieties, are available for 12, 16, 20, 23, 24 and 30 mm-diameter cells.

The holders are manufactured from UL rated 94V-0 materials. Contacts are made of high-quality spring steel to ensure correct connections and allow contact resistance. Each contact is clearly marked with its polarity to assist proper battery insertion.

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Laser welding of the motor flange is used to affix a customer-specific drive pinion to the shaft, providing strong power transmission coupling in these miniature sizes. The company provide its customers with complete drawings and models for appraisal before samples are manufactured, even for non-standard DC motor and gearhead assemblies.

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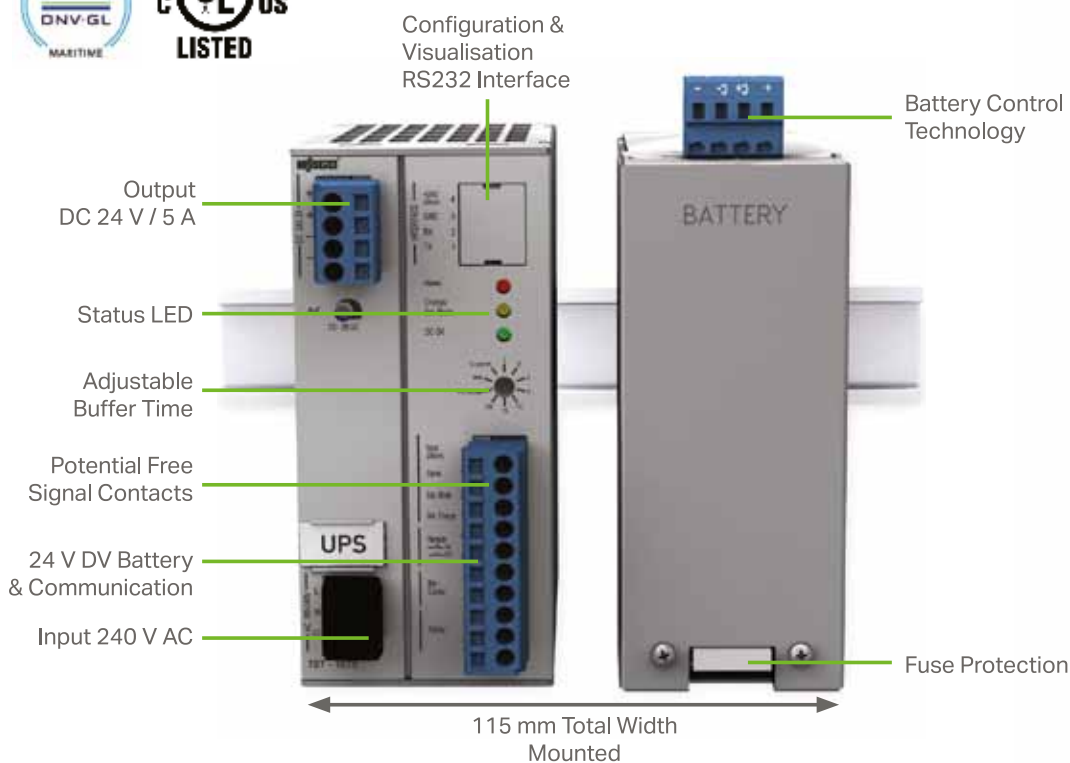
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16-CHANNEL ANALOG INPUT MODULE

ICP DAS's M-2018-16 is an analog input module that includes 16 differential analog input channels. The voltage input range can be from ± 15 mV to ± 2.5 V; the current input range can be either +4 to +20 mA, 0 to +20 mA or ± 20 mA; and types J, K, T, E, R, S, B, N, C, L, M, L DIN43710 thermocouple can be used for the thermocouple input.

Overvoltage protection of up to 120 VDC is provided. The module also features per-channel open wire detection for the thermocouple input types and provides 4 kV ESD protection as well as 3000 VDC intra-module isolation, even for applications that are subject to high vibration and shock.

Other features include: adjustable CJC offset; open thermocouple detection; dual watchdog; and a wide operating temperature range of -25 to $+75^{\circ}\text{C}$. The product is suitable for applications in building, factory and machine automation; remote maintenance; and diagnosis or testing equipment.

ICP Electronics Australia Pty Ltd
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19" RACK ENCLOSURES

METCASE has created a 19" mini-rack version of its TECHNOMET tabletop instrument enclosures.

The new TECHNOMET cases are designed for mounting standard 19" subracks, chassis and front panels. Applications will include test and measurement equipment, networking and communications devices, sound and studio systems, laboratory instruments, industrial computers and control systems.

The elegant and ultramodern enclosures combine die-cast aluminium front and rear bezels, a folded case body and chassis, and four snap-on cover trims to create a flush-fitting cohesive design with no visible fixing screws.

Standard 19" panel mounts with caged nut apertures for fixing the equipment are included in the front and rear bezels. There are three standard case sizes — 3U, 4U and 6U — all with a depth of 400 mm. Custom depths can be supplied on request.

The rear and base panels are ventilated to aid cooling. Inside there are two subrack/chassis support rails. All case panels are fitted with M4 threaded pillars for earth connections. ABS side handles are recessed for easy portability. Moulded ABS non-slip feet are also included.

Accessories include 1U to 6U (unvented and vented) 19" front panels and M6 caged nuts and fixing screws.

METCASE can supply TECHNOMET 19" enclosures fully customised. Services include: custom front panels; CNC punching, folding, milling, drilling and tapping; fixings and inserts; painting and finishing; digital printing of legends and logos.

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Its small size of 11.5 x 9 x 17.5 mm makes the K78xx-2000R3 series a small and efficient regulator suitable for use in industrial control, medical, mining, railway and/or in any application requiring a 2 A regulator in 3.3, 5, 9, 12 or 15 V.

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A HISTORY OF INDUSTRIAL ROBOTS

Alex Misiti for Mouser Electronics

Driven by advances in software, sensors and electronics, the market for industrial robots has greatly evolved over the past half century. In today's industrial workspaces, the evolution continues with collaborative robots — or cobots — working side by side with humans.

In recent decades, as automation has emerged as the central competitive factor in manufacturing operations across the globe, the use of industrial robots has grown substantially. To provide perspective on this growth, consider the fact that in 1970 the total number of industrial robots in use in the US was 200. By 1980, that number had risen to 4000; by 2015, it was 1.6 million. This growth is expected to accelerate even further in the coming years, as another 1.4 million industrial robots are expected to enter service by 2019, according to a report from the International Federation of Robotics.

Industrial robotic beginnings

Industrial robots are often discussed in the context of 21st-century innovations. However, their roots date back much further to the 1950s, when George Devol developed the first industrial robot — a two-ton device that autonomously transferred objects from one place to another with hydraulic actuators. Since that time, as sensors, electronics and computer software have advanced, the capabilities of industrial robots have greatly expanded to include complex tasks such as welding, painting, assembly, packaging, palletising, inspecting and testing — all accomplished with speed, precision and repeatability.

Robots were first used commercially on assembly lines in the early 1960s. Most featured hydraulic or pneumatic arms and were primarily used for heavy lifting. Although the devices were primitive and sensorless, and featured limited programmability, they proved to be an invaluable tool for increasing production in manufacturing facilities and set the stage for what would be a prolonged period of robotics development.

Throughout the late 1960s and early 1970s, as the need for automation of manpower-intensive tasks in manufacturing increased, the focus of industrial robotics shifted away from heavy lifting to materials handling and precision work. This gave birth to the development of smaller electric robots with advanced controls, microprocessors, miniaturised motors, gyros and servos, which made them ideal for lighter assembly tasks, such as bolt and nut tightening.

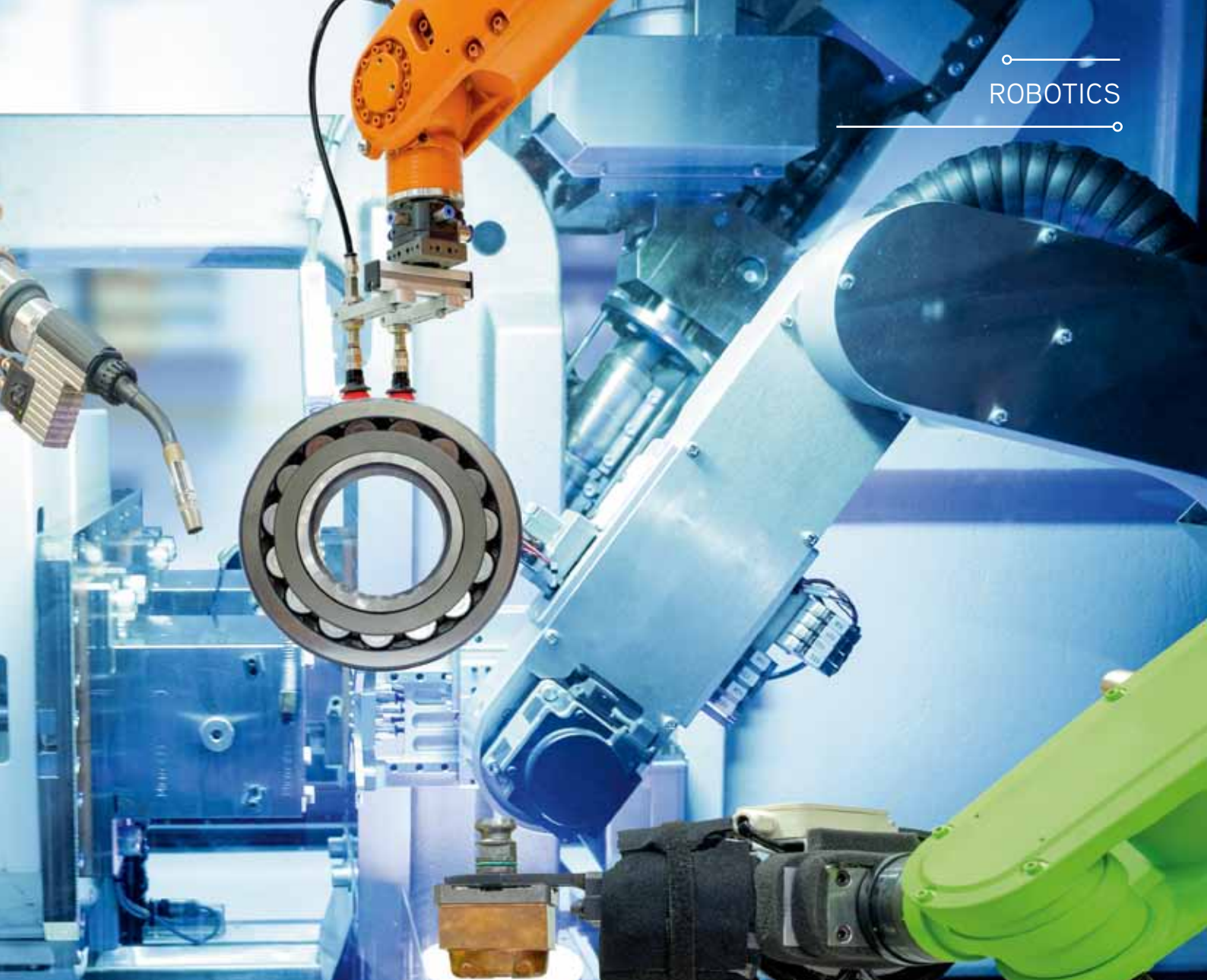
By the late 1970s, the capabilities of robots expanded even further to include tasks such as material transferring, painting and arc welding. They also began taking over dangerous tasks in manufacturing facilities. In steel mills, for instance, robots were used to move parts and materials in high-temperature environments

that were inhospitable for humans. This significantly improved facility safety and drove increased workforce productivity by freeing up skilled labourers to direct their focus to more important manufacturing operations.

Robotic technology in the 1980s: foundation for the future

The mid 1980s started to see increased interest and excitement in robotics. In seeing robots as the 'machines of the future', engineers began pushing the frontier forward to support industrial development and achieve greater manufacturing competitiveness. It was during this period that the foundation of the present-day industrial robot was laid, as they began incorporating advanced sensors and rudimentary machine vision systems.

The emergence of these technologies, coupled with a substantial reduction in costs of computer hardware like microprocessors, resulted in a step change of advancement in industrial robotic capabilities. Using precision force sensors and lasers, industrial robots were given the ability to detect and follow manufacturing components along assembly lines. These lasers and sensors provided the robots with a human-like sense of sight and touch and revolutionised their interactions with the industrial environment. As a result, robots were transformed from simple mechanical devices that were programmed to perform repetitive tasks to more elaborate machines that possessed what many categorised as 'limited intelligence'.



Industrial robots of today and tomorrow

Since the early 2000s, developments in industrial robotics have largely been driven by advancements in software. Emerging fields, such as machine learning (ML) and artificial intelligence (AI), are now pushing forward the frontier of what robots can do — giving them the ability to learn, improve and make decisions without direction or guidance from humans.

Most industrial robots in use today are equipped with a multitude of advanced sensors that gather immense amounts of data. When integrated with advanced analytics and ML software, the robots can interpret this data and use it to adapt, alter mechanical motions and better complete the task at hand. This quest to provide robots with ‘real intelligence’ is now the primary focus of robotics engineers.

In the coming years, as industrial robots become smarter, they will be able to take on more complex tasks and execute them with an efficiency that far exceeds human capabilities. They will also be able to safely work alongside humans in the manufacturing environment. This is something that is already occurring today with the emergence of collaborative robots, or cobots.

Cobots are a relatively new type of robot designed to safely operate in close proximity or even in direct contact with humans. They utilise advanced technology, including force-limited joints and computer vision to detect the presence of humans in their environment. Cobots are often much smaller and lighter than

traditional industrial robots, easily moveable and trainable to perform specific tasks.

Together, humans and cobots offer a unique level of skill that neither can offer on their own, which results in manufacturing products far better and faster than would be if either were working without the other. Cobots generally serve one specific purpose when employed to perform a job. For example, a cobot may provide the force required to move an object, while a human provides guidance on where to place it. In recent years, the use of collaborative robots in industries like manufacturing, construction and health care has grown rapidly. By 2020, the cobot market is expected to reach \$1 billion — with an estimated 40,000 machines in operation across the globe, according to ABI Research.

Conclusion

Industrial robots have come a long way from the hydraulic arms and bolt turners of the 1950s and 1960s. Today, these smart mechanical devices can work safely alongside humans to perform a wide array of complex tasks, such as painting, welding, complex product assembly and even surgery. In the coming years, as automation continues to drive competition among manufacturers across the globe, the robotics market will continue to expand, and the role robots play to help drive efficiency and throughput within industrial environments will grow in importance.

Mouser Electronics
www.mouser.com

SCALABLE DIGITAL CONTROLLERS

Renesas Electronics has announced two PMBus-compliant, fully digital DC/DC controllers that provide single output point-of-load (POL) conversions for FPGAs, DSPs, ASICs, network processors and general-purpose system rails.

The ISL68300 with integrated MOSFET drivers and ISL68301 with PWM output are said to simplify designing power supplies for data centre, wired and wireless communications, and factory automation equipment. The ISL68300 can drive discrete external MOSFETs directly, while the ISL68301 pairs with Renesas's smart power stages or DrMOS power stages to create a complete voltage regulator solution.

The digital controllers feature a high-speed current share bus that parallels up to eight controllers in an eight-phase 240 A+ current share configuration. Both implement the company's digital ChargeMode control modulation, which responds to load transients in a single switching cycle and provides an inherently stable control loop without requiring external compensation. This modulation architecture significantly reduces output capacitor requirements and minimises V_{out} undershoot and overshoot.

Engineers can use the PowerNavigator GUI with the controllers to simplify power supply set-up, sequencing, configuration and monitoring, including all device parameters and telemetry. Full schematic designs are completed in minutes, and the GUI with PMBus makes it easy to control the entire design and change features without soldering components or rework.

Renesas Electronics
www.renesas.com



SIGNAL ANALYSER SUPPORTING 5G NR ANALYSIS

Anritsu has announced that the MS269xA series signal analysers now support measurements of RF Tx characteristics of 5G mobile communications base stations and terminals.

When enabled with 5G measurement software and NR TDD sub-6 GHz options, the signal analyser supports easy and consistent 5G signal analysis, including Tx power, frequency error, EVM, etc, of 5G NR TDD sub-6 GHz signals expected to be adopted by the 5G standard. 3GPP-compliant sub-6 GHz uplink and downlink signals are supported when specifying one component carrier (1CC) up to a bandwidth of 100 MHz.

Key features include EVM measurements of <0.5% using wide-dynamic-range performance and a built-in, one-button Auto-Range function for optimised EVM measurements.

With good level accuracy and dynamic range, the MS269xA series is a suitable solution for signal analysis. Additional options such as the built-in vector signal generator not only help improve the quality of wireless equipment but are also designed to cut the cost of sub-6 GHz measurements.

Anritsu Pty Ltd
www.anritsu.com



BULB REPLACEMENT LED

The Marl Bulb Replacement range has been designed to provide 'fit and forget' solutions to both new equipment and retrofit applications requiring replacements of the filament bulb.

The 236 Series is available with single-chip, flat-topped LEDs to provide high-intensity, effective illumination. Suitable applications include illuminated push-button switches and lamp holders.

The series offers a direct replacement for the T1¾ Midget Flange SX6s bulb, featuring a surface mount LED and bipolar termination. With high-intensity, single-chip LED technology, it is available in a range of colour and voltage options, with voltage ranges to suit both AC and DC operation.

Aerospace & Defence Products
www.aerospacedefenceproducts.com.au



EDGE PLATING ON PCBs: A SHORT GUIDE

A plated through-hole (PTH) is a common feature in multilayered printed circuit boards. Fabricators drill holes through the stack and electroplate the walls with a layer of copper connecting two pads, one on the top-most layer and the other on the bottom-most layer of the board.

The two pads may further connect to other copper traces or planes on the two layers and, if necessary, to traces or planes on some inner layers as well. PCB manufacturers can extend this technique to edge plating, connecting the top and bottom planes of a PCB by electroplating around its external edges.

The process

Edge plating requires precision handling of the boards, while fabricators face several challenges — chiefly around preparing the edges for plating and creating a lifetime adhesion for the plated material. This requires a controlled process during circuit board fabrication to limit any potential hazard for PTH and edge plating. The most significant concern is the creation of burrs, which leads to discontinuities in PTH walls and limits the life of adhesion of the edge plating.

Applications

Several industries require edge-plated boards, especially in applications that require better support for connections such as for boards that slide into metal casings. Edge plating has other uses as well as it improves the current-carrying capabilities of the board, provides edge connection and protection, and offers the possibility of edge soldering to improve fabrication.

Although edge plating on printed circuit boards is a simple addition in most cases, fabricators need specialised equipment and trained personnel for the process. Designers must take care that internal power planes do not come up to the edge, and fabricators must make sure there is a gap before they take up edge plating. Designers must make sure there is a band of copper on both edges of the top and bottom side, as the plating will connect to these copper bands.

Limitations

As fabricators need to hold the board within the production panel during processing, they will not be able to plate round the complete length of the edge; therefore, some gaps are necessary for placing rout tabs. Manufacturing a board with edge plating requires routing the board profile at the place the edge plating is required before starting the process of through-hole plating. That precludes V-cut scoring on boards that need to undergo edge plating.

Working towards success

Designers must confirm with their fabricators the possibility of manufacturing PCBs with edge plating and the extent to which the fabricator can edge plate the PCB. Designers should indicate clearly in a mechanical layer where they need the edge plating and the type of surface finish they need on it. Most fabricators prefer a selective chemical nickel-gold as the only surface finish suitable for round edge plating.

Additional function

Edge plating is the copper plating connecting the top to the bottom surface of a PCB, running along at least one of its perimeter edges. This has an additional function, that of preventing electromagnetic emissions from radiating or leaking out the edges of a backplane — it is a practical solution and a cost-effective one.

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PCB Global has experienced many PCB designs that have required edge plating. For technical details on the edge plating process and specifications, feel free to contact our sales team and we will be able to assist accordingly.

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MOLECULAR ELECTRONICS ON THE HORIZON

We may not be able to cram any more processing power into silicon-based computer chips, but we can make electronic devices 10 times smaller and use molecules to build electronic circuits instead.

That's according to an international research team led by IBM Research – Zurich, who have developed a new technique to fabricate microelectronic devices by electrically contacting molecules at two well-defined termini.

As the miniaturisation of silicon technology continues, devices which offer more than the on/off functionality of a transistor become more attractive. Molecular electronics, which aims to use molecules to build electronic devices, offer exactly this advantage, allowing a chemical tailoring of the device response. This is useful not only for emerging computing paradigms such as neuromorphic computing, but also for highly specific sensors based on molecular recognition or quantum effects.

Molecular devices are a reality in the laboratory, but the step towards first commercial applications has been severely hampered by technological difficulties. Scientists simply haven't been able to make a stable device platform for molecules to sit inside which could reliably connect with the molecules, exploit their ability to respond to a current or be easily mass-produced.

Now, the IBM Research team has developed a proof-of-concept device which they say addresses all these issues. Writing in the journal *Nature*, the researchers explained how they addressed previous limitations using a technique that allows molecules to be compartmentalised into dielectric pores and electrically contacted.

A type of sandwich construction was used in which a layer of molecules was brought into contact with metallic electrodes from above and below. The lower electrode consisted of a layer of platinum lithographically patterned onto a conventional silicon wafer, which was coated with a non-conducting material. Tiny pores of arbitrary diameters were then etched into this dielectric layer to expose a defined area of the bottom electrode.

The researchers then took advantage of the ability of certain molecules to self-assemble onto surfaces. When placing the wafer in a solution of molecules, these molecules self-assembled on the open platinum areas. The resulting monolayer of upright, regularly

spaced molecules was electrically connected to the bottom electrode by the covalent anchoring groups.

To perform the crucial step of creating a top-contact without destroying the molecular layer, a film of metallic nanoparticles was deposited directly onto the molecules. This layer allowed a bulk electrode to be added using conventional methods, creating thousands of stable metal-molecule-metal junctions without compromising the properties of the molecules.

The new technique thus resolves the problems that previously hampered the creation of electrical contacts to molecules, including high contact resistances or short circuits by filaments penetrating the film. Building blocks fabricated by this inexpensive and mass-production-compatible method can be operated under ambient conditions and provide long-term stability.

The researchers demonstrated their approach using alkane-dithiol molecules made up of carbon, hydrogen and sulfur; their next goal will be to test the platform with different molecules that have different functions to see if they can make it work. If successful, their technique could lead to molecular compounds being integrated into solid-state devices that could be scaled down to the size of a single molecule, including new electronic devices and instruments in the fields of sensor technology.

"Imagine a miniaturised transistor made up of several single molecules," said Koushik Venkatesan, an associate professor at Macquarie University and co-author on the study.

"That's the promise of molecular electronics — devices that are smaller, faster, have more memory and are cheaper to make."

Koushik is confident that the team's research will open up the bottleneck for molecular-based technology to move forward, claiming, "The electronic buildings blocks of the future will be molecules."

"Molecular electronics hasn't previously lived up to expectations, but we've seen a renaissance of the field in the last five to six years," he said.

"The device platform is the missing link. We hope work like ours will accelerate this type of technology."



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Vicor has introduced 25 products to its growing family of DC-DC converter modules (DCMs) with tight output voltage regulation of $\pm 1\%$. With power densities of 63 W/cm^3 , the series allows engineers to drive loads requiring tight regulation with minimal additional circuitry or downstream components.

The DCM ChiP (converter housed in package) is a DC-DC converter module that operates from an unregulated, wide range input to generate an isolated, regulated DC output. With its high-frequency zero-voltage switching (ZVS) topology, the converter consistently delivers high efficiency across its entire input voltage range.

The modules are used broadly across defence and industrial applications that require tight output voltage regulation. These applications include UAV, ground vehicle, radar, transportation and industrial controls. The devices are available in M-grade, which can perform at temperatures as low as -55°C .

Vicor Corporation

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EXAIR's 1/8 NPT Small External Mix Spray Nozzles atomise fluids at up to 94.6 L/h . The nozzles are suitable where a high volume of liquid is needed and can be used on liquids with a viscosity up to 800 cP .

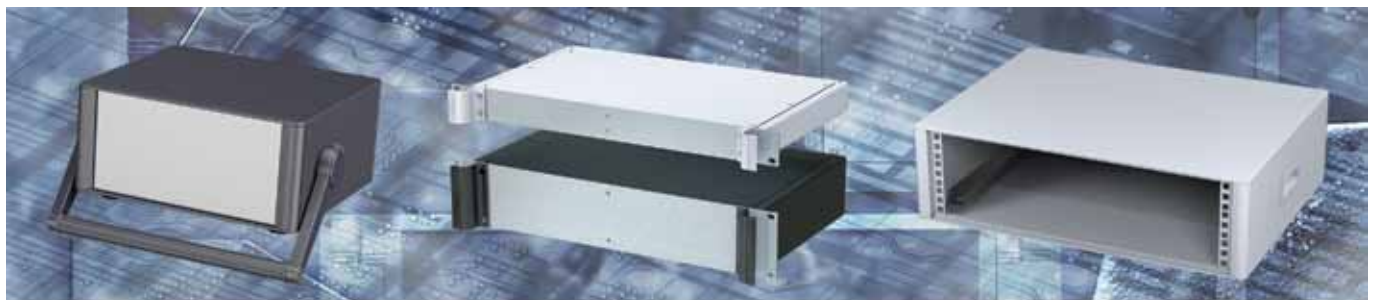
The nozzles are available in a narrow-angle flat fan pattern and are suitable when a thick liquid needs heavy application over a narrow band. They combine liquid and compressed air to create a coating of liquid that can be easily adjusted to meet the needs of the user's application.

With the external mix atomising nozzles, the user can coat, cool, treat and paint a variety of products. Used with water or coolant, atomising nozzles are an efficient way to evenly cool hot items in automated processes. Since they are external mix, airflow and liquid flow can be controlled independently, which provides a precise liquid flow.

The stainless steel construction of the atomising nozzles adds to their durability and corrosion resistance. They are also available in 1/4 and 1/2 NPT in a variety of flow patterns and liquid rates to meet the user's needs. Internal mix and siphon-fed atomising nozzles are offered too, as well as no-drip versions. All models are adjustable and CE compliant.

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SOLAR TESTER

The HT I-Ve Solar Tester is designed to measure the efficiency of single-phase photovoltaic systems and verify the I-V curve of a module or a string. It is available to rent from TechRentals.

For measuring I-V curve, the Solar Tester manages an internal database of modules (which can be updated at any time by the user) to compare the measured data with the rated values, thus allowing the immediate evaluation whether the string or the module fulfils the efficiency parameters declared by the manufacturer.

Measurement of short-circuit current Voc/Isc and open-circuit voltage can be performed with ease using the HT Solar Tester. Data from the instrument can be downloaded onto a smartphone or tablet via Wi-Fi for easy viewing of results.

The HT Solar Tester also features the HTCloud database, which allows the user to share results and measurements with colleagues. Additional features include an online FAQ and troubleshooting assistant, power measurement of modules and strings, and a large LCD 128 x 128 backlit display for easy operation in bright conditions.

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The N9311X-100 close field probe set contains four different H-field near field probes that cover frequencies from 30 MHz to 3 GHz. Near-field probes are useful in the

early R&D stage to evaluate or troubleshoot EMI emissions and avoid rework later.

The user can choose the best probe shape to move and rotate over the DUT's surface to locate the maximum power readout. They can identify emissions from chipset pins, PCB traces, power and signal cables, or metal closures. They can also capture and display the truest spectrum and power of the EMI emission sources.

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MULTIPROTOCOL SYSTEM-ON-CHIP

The nRF52840 is a multiprotocol system-on-chip (SoC) from Nordic Semiconductor. Based on the nRF52 Series architecture and compatible with the existing nRF52, nRF51 and nRF24 Series products, the ultralow power SoC offers simultaneous Bluetooth 5 and Thread support, with Zigbee support coming soon.

The product builds on the architecture of the nRF52 Series of SoCs to support complex Bluetooth Low Energy and other low-power wireless applications. It employs a 64 MHz, 32-bit Arm Cortex-M4F processor, plus a CPU with 1 MB of flash and 256 KB of RAM, a floating-point unit and digital signal processor (DSP) performance. The SoC also incorporates the Arm TrustZone CryptoCell-310 cryptographic accelerator for good security.

The product complies with the Bluetooth 5 specification, which, coupled with increased maximum output power, enables the device to deliver Bluetooth Low Energy wireless connectivity with up to four times the range or up to twice the raw data bandwidth (2 Mbps) compared with the Bluetooth Low Energy implementation of Bluetooth 4.2. In addition to Bluetooth 5 support, the SoC includes NFC-A tag support plus IEEE 802.15.4 capabilities for Zigbee- and Thread-based smart home technologies or as a Network Adaptation Layer with 6LoWPAN and standard internet protocols.

The multiprotocol SoC is suitable for a variety of wireless Internet of Things (IoT) applications, including advanced wearables, virtual reality (VR) and augmented reality (AR), high-performance HID controllers, smart home products and connected industrial devices.

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PCB TERMINAL BLOCKS

The trend towards electronic miniaturisation requires that both power and signal levels be integrated on PCBs. This results in increased power density, requiring connection technologies and pluggable connectors suitable for both compact and high-performance PCB terminal blocks.

Connection technology is also a basic criterion for selecting the right terminal block in demanding applications, such as power supplies, frequency inverters or servo drives. Additional decisive factors include simple and easy operation, as well as wiring flexibility.

WAGO combines all these criteria into a comprehensive and varied range of PCB terminal blocks for power electronics. The WAGO PCB Terminal Blocks are rated for 4, 6 and 16 mm² conductor cross-sections and can be operated either with or without a tool.

Due to WAGO's innovative spring pressure connection technology, the PCB terminal blocks for all applications blend ergonomics and safety. The Push-in CAGE CLAMP enables solid and ferruled conductors to be connected by simply pushing them into the unit, while ensuring secure and maintenance-free connections for all conductor types.

The products are simple to use and offer maximum wiring flexibility.

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EXAIR's Gen4 Ionizing Point delivers a high concentration of positive and negative ions to neutralise static electricity without requiring compressed air.

The compact and shockless static eliminator is suitable for eliminating static electricity problems occurring in small spaces, keeping small parts or products separate or from sticking to other surfaces. It can protect sensors, eliminate improper readings of sensitive electronics, keep powder filling nozzles clear of clogs and prevent jamming, tearing or dust attraction on slitting, winding, rewinding, ink jetting and silk screening applications.

Design features include a metal armoured high-voltage cable to protect against abrasion and cuts, a replaceable emitter point, integrated ground connection and electromagnetic shielding. A 115/230 V selectable voltage power supply has been designed to operate the device.

The product has undergone independent laboratory tests to certify it meets the rigorous safety, health and environmental standards of the USA, European Union and Canada that are required to attain the CE and UL marks. It is also RoHS compliant.

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GALVANIC ISOLATED GATE DRIVER

With 26 V maximum gate-drive output voltage and optional separate turn-on/turn-off outputs or integrated active Miller clamp, STMicroelectronics' STGAP2S single-channel galvanic isolated gate driver can control silicon-carbide (SiC) or silicon MOSFETs and IGBTs across a range of switching topologies.

The STGAP2SCM has a dedicated active Miller clamp pin that provides a convenient solution to prevent unwanted transistor turn-on in half-bridge configurations. Connecting the MOSFET gate to this pin clamps the voltage to isolated ground at turn-off, until the next genuine turn-on signal. The STGAP2SM with separate turn-on and turn-off outputs meanwhile helps optimise switching transitions using two external gate resistors.

The gate drivers have 4 A rail-to-rail outputs for crisp, efficient switching, even with high-power inverters. Input-to-output propagation delay is within 80 ns for precise PWM control at the high switching frequencies suited to SiC devices. High dV/dt common-mode transient immunity prevents energy-sapping spurious switching.

With 1700 V galvanic isolation also built in, the devices can simplify the bill of materials for consumer or industrial motor drives, 600 or 1200 V inverters, DC/DC converters, battery chargers, welders, induction heaters, uninterruptible power supplies and power-factor correction (PFC) controllers.

Extensive integrated protection features include undervoltage lockout (UVLO) to protect the power switch if the supply voltage falls too low. In addition, overtemperature protection is provided, as well as hardware interlocking to prevent high-side/low-side cross conduction in half-bridge circuits. There is also a standby mode, which keeps the output in a safe state while saving power.

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Microchip's new megaAVR[®] microcontrollers (MCUs) extend the capability of real-time control systems by combining intelligent hardware peripherals with the low-power performance of the AVR[®] core. As the first megaAVR device to include Core Independent Peripherals (CIPs), the ATmega4809 can execute tasks in hardware instead of through software. The processing power of the integrated high-speed Analog-to-Digital Converter (ADC) enables faster conversion of analog signals, resulting in faster, more deterministic system responses. These features make the new megaAVR series of an ideal companion MCU in complex microprocessor-based systems, or an excellent standalone processor in command-and-control system designs.

Key Features

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GRAPHENE-INFUSED CONCRETE CAN CONDUCT ELECTRICITY

Australian advanced materials company Talga Resources has achieved high levels of electrical conductivity in concrete by using an additive developed from the company's graphene-graphite research and development laboratory in the UK.

The breakthrough offers substantial potential in existing and emerging industrial applications, particularly as concrete is the world's largest construction material by volume and worth over US\$450 billion per year.

Tests

The concrete samples were manufactured at Talga's German process test facility and the Betotech (Heidelberg Cement Q&C) laboratory in Germany using industry-standard cement with additions of Talga's graphene, graphite and silica-rich by-product of ore processing. The optimised formulation targeted high electrical percolation at low material concentrations and with potentially lower cost factors.

The samples were tested in-house by a European industrial partner and further measurements were undertaken by Professor Ian Kinloch's group at the University of Manchester (UoM). In the UoM study, the conductivity of samples was measured using electrical impedance spectroscopy in both through-plane and in-plane directions over a range of frequencies. For reference, a standard mortar (without Talga additives or aggregates) was used. A summary of results is shown in the table below.

Specimen	Conductivity (siemens/cm)	Resistivity (ohm-cm)
Talga concrete	20	0.05
Standard mortar	0.000001	1,000,000

The UoM tests recorded the Talga graphene-enhanced concrete had high electrical conductivity (low resistivity) to 0.05 ohm-cm. Ohm is the measure of a material's resistance to conduct electricity — the lower the better. This rating compares to a general resistivity level of around 1,000,000 ohm-cm for the reference mortar.

The results have also shown the silica-rich by-product of ore processing is remarkably conductive in itself, tough and highly suitable for use in construction materials. Trial concrete

products developed by Talga are targeting the innovative use of this material, thereby increasing potential economic benefits and sustainability of the future Swedish operation.

Applications

As concrete is effectively an insulator in a dry state, adding the function of high electrical conductivity has been a goal of material scientists for a long time. Previous attempts typically relied on the addition of high loadings of magnetite (iron), steel fibres, synthetic and natural carbons (including graphite) but did not achieve high levels of performance. In addition, the required (high) loadings of active materials tended to cause negative effects on cost, strength, corrosion and abrasion resistance, maintenance costs and weight.

The electrically conductive 'graphene concrete' has applications in current markets such as underfloor heating, where it can provide a long-term, low-maintenance alternative to plumbed hot water installations. Other current applications include the provision of antistatic flooring and EMI shielding (radiofrequency interference) in buildings, and cost-effective grounding and lightning strike protection for a range of infrastructure from bridges to wind turbines.

Additionally, as a 'solid state heater' the technology may enable more rapid and environmentally friendly ways of clearing ice and snow from key transport routes and airports compared to the cost of ploughs, salt, de-icing chemicals and wastewater treatment of chemical run-off.

In future, Talga will investigate the potential of the electrically conductive concrete for a cost-effective role in enabling inductive (wireless) charging technologies for electric vehicles under dynamic (driving) as well as stationary (parking) conditions through the increased range of heating, sensing and other conductive concrete functions.

Markets and next steps

Talga's commercialisation strategy is focused on targeted value-added graphene and graphite products covering the energy, coatings,

Below: A Talga graphene-enhanced concrete sample.

Centre: A Talga concrete sample after melting a 5 cm depth of ice from 9 V of power.

Bottom: Traditional plumbed underfloor heating can be replaced by long-life solid state conductive concrete.



CURRENT APPLICATIONS INCLUDE THE PROVISION OF ANTISTATIC FLOORING AND EMI SHIELDING (RADIOFREQUENCY INTERFERENCE) IN BUILDINGS, AND COST-EFFECTIVE GROUNDING AND LIGHTNING STRIKE PROTECTION FOR A RANGE OF INFRASTRUCTURE

composites and construction sectors. Initial partner work and customer testing is already underway on:

- lithium-ion batteries and a range of energy storage technologies;
- metal pre-treatment, marine epoxy and other coatings;
- cement/concrete additives;
- epoxy resins for carbon fibre (composites).

These applications and products have been developed over the past two years with global-scale industrial and R&D partners, using high-grade graphite ore liberated in successful trial mining from Talga's deposits in north Sweden.

Talga currently has an MoU with the world's second largest concrete manufacturer, Heidelberg Cement, focused on thermally conductive concrete, but is free to explore other market opportunities. The company is currently recruiting a European-based commercial team that will include construction sector and concrete market experience, to use these test results in commercialisation discussions with a range of industrial partners.

"This type of concrete has some exciting and large-volume applications, and in some cases can combine with our thermally conductive concrete," said Talga Managing Director Mark Thompson.

"Furthermore, the conductivity is achieved with a very low loading of our graphene, but a larger amount of ore processing by-products, providing maximum potential for the most cost-effective, scalable and eco-friendly development options."

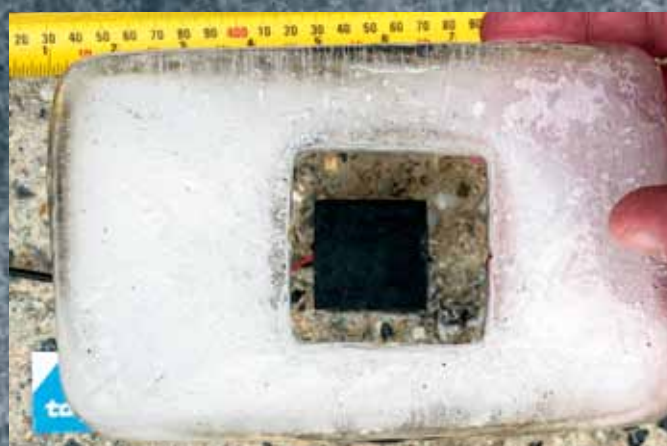
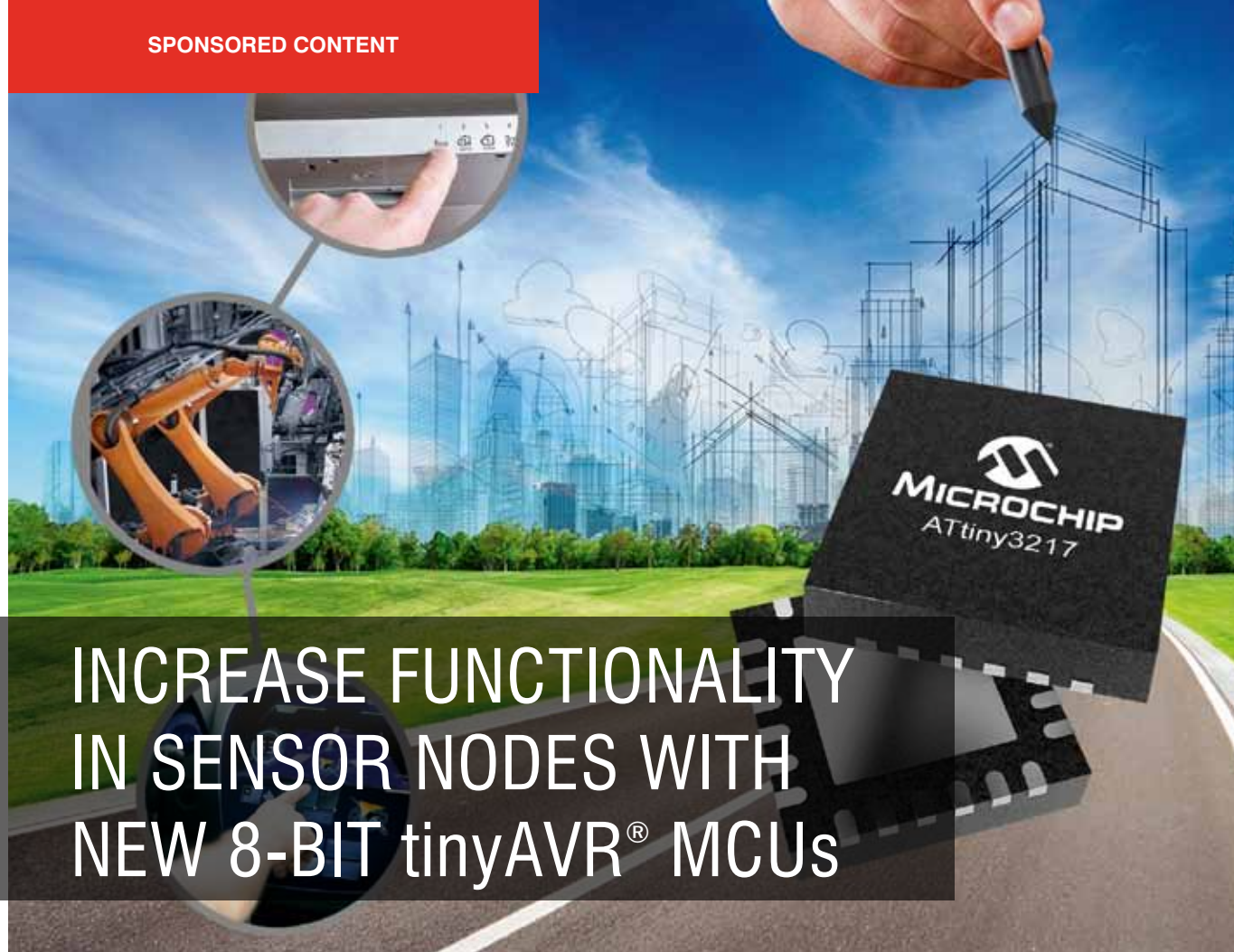


image credit: Hanson Australia



INCREASE FUNCTIONALITY IN SENSOR NODES WITH NEW 8-BIT tinyAVR® MCUs

The ATtiny3217 and ATtiny3216 join Microchip's tinyAVR family with the largest memory in the series.

AVR® microcontrollers (MCUs) have long been used to create highly responsive sensor nodes because of their cost effectiveness and ease of implementation. To enhance the capability and responsiveness of applications in these settings, Microchip Technology Inc. has expanded its tinyAVR MCU series to include two new devices with advanced analog features and the largest memory variant in the family. Designed for reliable operation in harsh environments, the devices come with built-in safety functions to help designers create robust and safe systems.

Ideal for sensor applications including capacitive touch interfaces, the ATtiny3217 and ATtiny3216 bring the benefit of two Analog-to-Digital Converters (ADCs) that enable systems to implement touch control simultaneously with other analog measurements. One ADC can be used with the Peripheral Touch Controller (PTC) for touch signal acquisition, while the second one monitors other inputs such as thermistors and pressure sensors, or both ADCs can be used for faster sampling of different types of sensors. Additional benefits of the ATtiny3217 and ATtiny3216 MCUs include:

- **Improved real-time performance and accuracy:** The dual ADC can be used for synchronous sampling of analog signals, such as voltage and current, thus improving the overall system real-time performance and accuracy. Additionally, the devices feature a hardware-based Event System that enables inter-peripheral communication without CPU involvement, reducing latency and ensuring faster system response.
- **Robust and reliable performance:** Both devices come with built-in safety functions to help designers detect and respond to voltage supply variations or drops, including the Power On Reset (POR), programmable Brownout Detect (BOD), Voltage Level Monitor (VLM) and Windowed Watchdog Timer (WWDT).

- **Improved noise immunity and functionality in extreme environments:** The devices operate at up to 5V and come available in 125°C variants.

- **Increased functionality with more room for application code:** With 32 KB of flash, designers have plenty of room for their application code while retaining a small physical footprint on the PCB.

"We continue to invest in bringing new AVR MCUs to the market with advanced features that meet our customers' needs while easing the development process," said Steve Drehabl, vice president of Microchip's MCU8 division. "The combination of responsive touch sensing and built-in safety functions make it easier for designers to improve the user experience in applications such as home appliances, automotive and industrial automation."

The ATtiny3217 and ATtiny3216 are the latest devices in Microchip's tinyAVR family of MCUs, which are optimized for performance, power efficiency and ease of use in small packages. To learn more about the tinyAVR MCU family, visit www.microchip.com/Tiny1.

All tinyAVR MCU series devices are supported by the Atmel Studio 7 integrated development environment (IDE) and the Atmel START code configurator. For evaluation purposes, the ATtiny3217 Xplained Pro evaluation kit is also available.

For additional information, contact any Microchip sales representative or authorized worldwide distributor, or visit Microchip's website. To purchase products mentioned in this press release, go to Microchip's full-service channel microchipDIRECT or contact one of Microchip's authorized distribution partners.

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Coilcraft's Designers Kits are available for both surface-mount devices and thru-hole devices.

To simplify prototyping, there are kits available for many of the Coilcraft range of products.

Each kit has an assortment of standard values along with detailed product specifications, thus making research and design easy in the user's workshop.

According to the company, free refills are available when parts have been used from the kit.

TRI Components Pty Ltd

www.tricomponents.com.au



ZVS BUCK REGULATOR

The PI354x-00-BGIZ is the latest addition to the 48 V Cool-Power ZVS Buck Regulator portfolio, offering a BGA package option to the existing PI354x-00-LGIZ LGA series.

The buck regulator's high-performance ZVS topology enables 48 V direct to PoL. With step-down regulation from a high voltage source, engineers can deploy efficient power distribution architectures, reduce I²R losses and eliminate inefficient intermediate conversion stages.

Operating from 36 to 60 V_{IN}, the product regulates an output voltage ranging from 2.2 to 14 V and delivers an output current delivery up to 10 A. Power delivery can be further increased by using single-wire current sharing without any additional components.

The series is designed for a wide range of applications leveraging high voltage distribution, including telecom, network infrastructure, data centres, industrial, battery and lighting applications. When used in conjunction with the Vicor front-end products and factorised power products, the series enables a complete power chain from AC or HVDC (200 V+) source to PoL.

Vicor Corporation

www.vicorpower.com



EPOXY RESINS

Electrolube has launched two-part epoxy resins that have been specifically formulated to cope with the harsh operating environment of under-hood requirements, offering a high degree of protection to electronic components.

ER2223 is a black epoxy resin with a wide operating temperature range of -40 to +180°C. The high-temperature-stable epoxy is chemically resistant, enduring a variety of chemicals and fluids found in the under-hood automotive environment. The low viscosity of this resin allows for easy potting of the smallest or tightly packaged components and demonstrates adhesion to a wide variety of substrates.

ER2225 is a black epoxy resin formulated to ensure an identical level of chemical resistance as ER2223, but additionally allows short temperature excursions up to +210°C. It is more viscous than ER2223 due to the inclusion of fillers that give the cured resin a thermal conductivity of 1.1 W/mK. Both resins are RoHS 2 compliant and also suitable for a variety of other electronics applications exhibiting strong resistance to thermal cycling found in engine compartments.

Electrolube

www.electrolube.com.au



INDUSTRIAL PANEL PC

The UPC-F12C-ULT3 is the latest in panel PC technology from iEi Integration. The system is powered by Intel's 6th Generation Skylake i5 and Celeron ULT processors, allowing the panel PC to be completely fanless. It comes equipped with 4 GB of DDR4 RAM and supports the M.2 B-Key (2242) SSD that has a fast transfer rate and is compact.

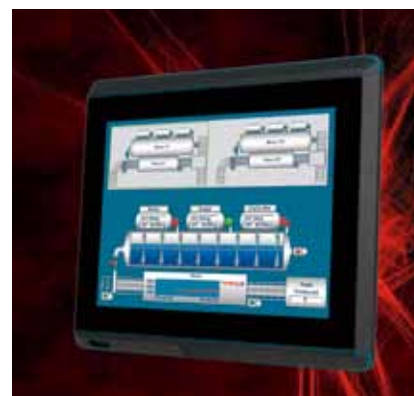
The product features a full aluminium chassis with all six sides of the device being IP66 rated. Its 12.1" IP66 rated screen is available in two options: a resistive touch screen or flat glass PCAP touch screen with 6H hardness. It has an operating temperature of -20 to +60°C.

The panel PC comes in two distinct models: the UPC-F12CM-ULT3 with M12 connectors and the UPC-F12C-ULT3 with standard connectors. Both models support a wide variety of I/O, including RS232 ports, GbE LAN connectors, USB ports and more.

Both panel PCs support Wi-Fi and Bluetooth and have the option to add RFID support. This makes them suitable for the majority of industrial applications.

ICP Electronics Australia Pty Ltd

www.icp-australia.com.au



CONTROLLER FOR FAST SMARTPHONE CHARGING

The EZ-PD CCG3PA USB Type-C and power delivery (PD) controller, from Cypress Semiconductor, supports the fast charging of smartphones, tablets, notebook PCs and power banks. A recipient of Qualcomm Quick Charge 4 certification, the highly integrated controller simplifies designs, allowing for straightforward development of next-generation fast-charging applications and products.

The controller supports USB-C power source and dual-role power source/sink. Additionally, the controller fully supports the USB PD 3.0 programmable power supply (PPS) specification, which allows smartphones to communicate with the charger to determine the ideal voltage and current levels. The Quick Charge 4 certification also incorporates improved safety features to ensure fast charging without overheating.

The programmable controller includes an Arm Cortex-M0 microcontroller and 64 KB of flash, enabling firmware upgrades that support future changes to fast charging standards. The one-chip device integrates several necessary components, including a 30 V-tolerant regulator, high-voltage PFET gate drivers, VBUS-to-CC short protection, a VBUS and current sense amplifier, and hardware dedicated to legacy charger protocols.

The controller is supported by system-level electrostatic discharge (ESD) protection as well as dedicated overcurrent and overvoltage circuitry. Enabling the safe performance of fast charging applications, the integrated safety features defend against faulty operating conditions like power overloads. The speed and consistency of the controller allows for the design of USB Type-C power adapters for a broad range of applications, including consumer electronics, power banks and vehicle chargers.

Mouser Electronics

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RF ABSORBER MATERIALS

ARC Technologies has introduced the Engineer's Survival Kit, containing a variety of RF absorber materials in different thicknesses and form factors that address frequencies from 50 MHz to 110 GHz.

The kit is available at no cost to design engineers to assist in finding solutions to the diverse range of EMI/RFI problems for today's military, aerospace and commercial electronics industry. Standard or custom solutions are available for near-field, far-field, narrowband or broadband applications.

Clarke & Severn Electronics

www.clarke.com.au



CORE ALIGNMENT FUSION SPLICER

The Fujikura FSM70S is suitable for single-fibre, core alignment fusion splicing and comes in a transit case with a CT30A cleaver and work table. The instrument is equipped with a large 4.73" colour screen with an anti-reflective coating for visibility in bright conditions and onboard instructional videos to simplify optical fibre splicing. It is available to rent from TechRentals.

The product has typical splice losses of 0.02 and 0.01 dB on singlemode and multimode fibre respectively. The configurable automation feature allows the user to customise the operation to best suit their desired splicing technique or process.

The unit also features automated tension tests; a long-life battery that provides 200 splice/heat cycles per charge; 7 s splice time and 14 s heat time; and extended electrode performance with 3000 splices per set. Additionally, it has fully automated wind cover and heater operation, and it is fibre holder and FuseConnect compatible.

TechRentals

www.techrentals.com.au

MULTIPHASE PMICs

Renesas Electronics has announced three programmable power management ICs (PMICs) that offer high power efficiency and a small footprint for application processors in smartphones and tablets: the ISL91302B, ISL91301A and ISL91301B PMICs.

The PMICs also deliver power to artificial intelligence (AI) processors, FPGAs and industrial microprocessors (MPUs) and are suitable for powering the supply rails in solid-state drives (SSDs), optical transceivers and a wide range of consumer, industrial and networking devices. The ISL91302B dual/single output, multiphase PMIC provides up to 20 A of output current and 94% peak efficiency in a 70 mm² solution size that is more than 40% smaller than competitive PMICs, according to the company.

In addition to the ISL91302B, Renesas's ISL91301A triple-output PMIC and ISL91301B quad-output PMIC both deliver up to 16 A of output power with 94% peak efficiency. The programmable PMICs leverage Renesas's R5 Modulation Technology to provide fast single-cycle transient response, digitally tuned compensation and ultrahigh 6 MHz (max) switching frequency during load transients. These features make it easy for power supply designers to design boards with low-profile inductors, small capacitors and only a few passive components.

The PMICs do not require external compensation components or external dividers to set operating conditions. Each PMIC dynamically changes the number of active phases for optimum efficiency at all output currents. Their low quiescent current, good light load efficiency, regulation accuracy and fast dynamic response extend battery life for feature-rich, power-hungry devices.

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NEW CATHODE MATERIAL COULD TRIPLE LITHIUM-ION BATTERY STORAGE

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US researchers have developed a new cathode material from iron fluoride that surpasses the capacity limits of traditional lithium-ion batteries, potentially tripling the energy density of lithium-ion battery electrodes. The results of their work have been published in the journal *Nature Communications*.

As the demand for smartphones, electric vehicles and renewable energy continues to rise, scientists are searching for ways to improve lithium-ion batteries — the most common type of battery found in home electronics and a promising solution for grid-scale energy storage. Now, a collaboration led by scientists at the University of Maryland (UMD), the US Department of Energy's (DOE) Brookhaven National Laboratory and the US Army Research Lab has made significant progress towards that goal.

"Lithium-ion batteries consist of an anode and a cathode," said Xiulin Fan, a scientist at UMD and one of the lead authors of the paper. "Compared to the large capacity of the commercial graphite anodes used in lithium-ion batteries, the capacity of the cathodes is far more limited. Cathode materials are always the bottleneck for further improving the energy density of lithium-ion batteries."

Scientists at UMD synthesised a new cathode material, a modified and engineered form of iron trifluoride (FeF_3), which is composed of cost-effective and environmentally benign elements — iron and fluorine. Researchers have been interested in using chemical compounds like FeF_3 in lithium-ion batteries because they offer inherently higher capacities than traditional cathode materials.

"The materials normally used in lithium-ion batteries are based on intercalation chemistry," said Enyuan Hu, a chemist at Brookhaven and one of the lead authors of the paper. "This type of chemical reaction is very efficient; however, it only transfers a single electron, so the cathode capacity is limited.

Some compounds like FeF_3 are capable of transferring multiple electrons through a more complex reaction mechanism, called a conversion reaction."

Despite FeF_3 's potential to increase cathode capacity, the compound has not historically worked well in lithium-ion batteries due to three complications with its conversion reaction: poor energy efficiency (hysteresis), a slow reaction rate and side reactions that can cause poor cycling life. To overcome these challenges, the scientists added cobalt and oxygen atoms to FeF_3 nanorods through a process called chemical substitution. This allowed the scientists to manipulate the reaction pathway and make it more 'reversible'.

"When lithium ions are inserted into FeF_3 , the material is converted to iron and lithium fluoride," said Sooyeon Hwang, a co-author of the paper and a scientist at Brookhaven's Center for Functional Nanomaterials (CFN). "However, the reaction is not fully reversible. After substituting with cobalt and oxygen, the main framework of the cathode material is better maintained and the reaction becomes more reversible."

To investigate the reaction pathway, the scientists conducted multiple experiments at CFN and the National Synchrotron Light Source II (NSLS-II) — two DOE Office of Science User Facilities at Brookhaven.

First at CFN, the researchers used a powerful beam of electrons to look at the FeF_3 nanorods at a resolution of 0.1 nm — a technique called transmission electron microscopy (TEM). The TEM experiment enabled the researchers to determine the exact size of the nanoparticles in the cathode structure and analyse how

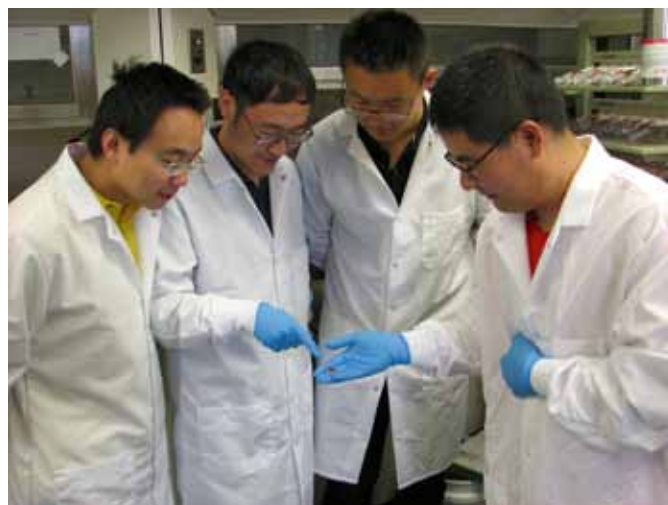
the structure changed between different phases of the charge-discharge process. They saw a faster reaction speed for the substituted nanorods.

"TEM is a powerful tool for characterising materials at very small length scales, and it is also able to investigate the reaction process in real time," said Dong Su, a scientist at CFN and a co-corresponding author of the study. "However, we can only see a very limited area of the sample using TEM. We needed to rely on the synchrotron techniques at NSLS-II to understand how the whole battery functions."

At NSLS-II's X-ray Powder Diffraction (XPD) beamline, scientists directed ultrabright X-rays through the cathode material. By analysing how the light scattered, the scientists could 'see' additional information about the material's structure.

"At XPD, we conducted pair distribution function (PDF) measurements, which are capable of detecting local iron orderings over a large volume," said Jianming Bai, a co-author of the paper and a scientist at NSLS-II. "The PDF analysis on the discharged cathodes clearly revealed that the chemical substitution promotes electrochemical reversibility."

"We also performed advanced computational approaches based on density functional theory to decipher the reaction mechanism at an atomic scale," said Xiao Ji, a scientist at UMD and co-author of the paper. "This approach revealed that chemical substitution shifted the reaction to a highly reversible



The University of Maryland team, pictured from left to right: Xiulin Fan, Xiao Ji, Fudong Han and Zhaohui Ma.

state by reducing the particle size of iron and stabilising the rocksalt phase."

Scientists at UMD say this research strategy could be applied to other high energy conversion materials, and future studies may use the approach to improve other battery systems.

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1000 AND 1500 W INDUSTRIAL POWER SUPPLIES

Helios has added the RWS1000B and RWS1500B industrial AC-DC power supplies. The power levels of 1000 and 1500 W will complement the existing RWS300B (300 W) and RWS600B (600 W) supplies. The series is suitable for industrial, test and measurement, broadcast, communications and LED signage equipment.

The 1000 and 1500 W additions are available with 12, 15, 24, 36 and 48 V outputs, adjustable from -15/+10% of nominal. All models accept an 85 to 265 VAC input and can operate at full load in -20 to +50°C ambient temperatures, derating linearly to 60% load at +60°C. High operating efficiencies of up to 88% reduce internal waste heat and component temperatures, resulting in electrolytic capacitor service life predictions of at least 10 years.

To facilitate safe and easy installation, output cable connections are made to screw terminal blocks with covers rather than busbars. The terminal block can also be quickly configured for either a vertical or horizontal wiring orientation. The RWS1000B measures 127 x 63 x 198 mm and the RWS1500B 127 x 63 x 261 mm.

Options for the power supplies include double-sided board coating, reverse airflow (which extends operation to +70°C ambient temperatures), remote on/off, current share and an isolated DC good/fan fail signal.

Helios Power Solutions

www.heliosps.com.au

SYSTEMS ENGINEERING SOFTWARE

NI has announced the release of LabVIEW 2018, designed to help engineers exceed their speed of innovation by taking advantage of tools that simplify system integration and grant more control through hardware accessibility.

Engineers can use the software to address a multitude of challenges. They can integrate more third-party IP from tools like Python to make the most of the strengths of each package or existing IP from their stakeholders. Test engineers can automate the building and execution of software through integration with open interface tools like Jenkins for continuous delivery. For test engineers using FPGAs for high-performance processing, deep learning functions and improved floating-point operations can reduce time to market.

With InstrumentStudio providing an interactive multi-instrument experience, TestStand test management software handling overall execution and reporting and SystemLink managing assets and software deployments, the productivity of test and validation labs can be improved across many industries. Each piece of the workflow is also interoperable with third-party software to maximise code and IP re-use and draws on the LabVIEW Tools Network ecosystem of add-ons and tools for more application-specific requirements.

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SMARC 2.0 MODULE WITH ARM PROCESSOR

congatec has launched the conga-SMX8, the company's first SMARC 2.0 computer-on-module based on the 64-bit NXP i.MX8 multicore ARM processor family.

The ARM Cortex-A53/A72-based module is suitable for ultralow-power embedded computer designs, offering an ARM processor with good performance, flexible graphics and numerous embedded features for all kinds of IIoT applications. It provides high-performance multicore computing along with extended graphics capabilities for up to three independent 1080p displays or a single 4K screen.

Further benefits of the native industrial-grade platform include hardware-based real-time and hypervisor support along with broad scalability, as well as resistance against harsh environments and extended temperature ranges. All these features make the module meet the recent performance and feature set needs for low-power embedded, industrial and IoT applications as well as the mobility sector.

The SMARC 2.0 modules with NXP i.MX8 processors, hardware-based virtualisation and resource partitioning are suitable for a range of stationary and mobile industrial applications, including real-time robotics and motion controls. Since the modules are qualified for the extended ambient temperature range from -40 to +85°C, they can also be used in fleet systems for commercial vehicles or infotainment applications in cabs, buses and trains as well as electric and autonomous vehicles.

The modules are application-ready subsystems that come with a comprehensive ecosystem such as ready-to-go boot loader implementation, pre-qualified Linux and Android BSPs and fully featured evaluation carrier boards, as well as personal integration support and a broad range of individually selectable technical services to simplify integration of the processor.

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COMPACT EMBEDDED BOX PC

With the powerful BC51M box PC, MEN expands its innovative, modular family concept. The fanless and maintenance-free device is used in graphics and memory-intensive applications in trains, buses or commercial vehicles and, due to its numerous communication interfaces, is highly variable.

The product is based on the Intel Atom E3900 series — optionally with two or four cores, up to 1.6 GHz. The scalability within the series gives the user flexibility.

With 8 GB DDR3 SDRAM memory, a rear accessible SD card, an integrated eMMC memory and an optional SATA HDD/SSD, the box PC has the necessary storage capacity for entertainment servers or video surveillance systems, for example. It was designed for mobile use in trains, buses or commercial vehicles and takes over wireless onboard functions such as internet on board, positioning via GNSS, entertainment or predictive maintenance.

The box PC supports up to two DisplayPort interfaces with a maximum resolution of 4K, as well as two Gigabit Ethernet interfaces, one USB 2.0, one HD audio and two variable connections for serial I/O, CAN bus, MVB or IBIS. Two PCI Express Mini Card slots and two micro-SIM slots provide flexibility in implementing mobile service standards up to 4G LTE or WLAN.

The system is designed for fanless operation at temperatures from -40 to +85°C. Due to the integrated 30 W/24 VDC wide-range power supply, the box PC complies with the railway standard EN 50155 and ISO 7637-2 for road vehicles.

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GIGABIT ETHERNET XMC MODULES

Acromag's XMC610 Series modules provide four independent Gigabit Ethernet interface ports when used on VME, VPX, PCIe or other embedded computing carrier boards. The Intel I350 Ethernet Controller interfaces with the PCIe bus via four high-speed serial lanes on the XMC P15 connector.

Three models are available. The XMC611 model offers four RJ45 connectors on the front panel for copper cabling, while the XMC612 substitutes four SFP connectors to additionally support fibre-optic media. The rear I/O model XMC613 routes four 1000BASE-T connections to the P16 connector and is compatible with conduction-cooling frames.

Designed for COTS applications, the XMC modules are suitable for use in defence, aerospace, industrial and scientific research computing systems. Employing Intel's I350 4-port gigabit Ethernet controller, the networking modules introduce power management technologies such as energy-efficient Ethernet and direct memory access coalescing.

Other enhancements add flexibility for virtual functions and increased offload capabilities. Auto-negotiation supports 10/100/1000 Mbps data rates. A 3.3 V low power design and extended temperature operation from -40 to 85°C further simplify system integration. Software support is available for embedded applications running on Linux, Windows or VxWorks operating systems.

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TDK Corporation has available the latest series of EPCOS MKP AC capacitors for filter applications. The components of the B33331V* series are designed for a rated voltage of 460 V_{rms}, corresponding to a peak voltage of 650 V, and cover a capacitance range from 2 to 50 µF. Both the cans and the tops are constructed of aluminium, making the overall design particularly robust. Despite this, the dimensions — depending on the type — range from 30 x 55 mm to 50 x 100 mm.

The reliability of the capacitors, even under harsh conditions, has been verified by a temperature, humidity, bias (THB) test at 85°C, 85% relative humidity and an applied rated voltage for 1000 h. In compliance with IEC 61071, the life expectancy is at least 100,000 h. The capacitors bear the CE symbol, types with a can diameter of >40 mm are UL approved and the insulation of the connections conforms to UL 94 V0. In the event of excessive pressure in the capacitor case due to an overload, the integrated overpressure disconnection safety device isolates both terminals from the winding.

The capacitors can be used as output filters of photovoltaic inverters, frequency converters and uninterruptible power supplies, as well as for general filtering applications.

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ARE WEARABLES THE ANSWER FOR AN AGEING POPULATION?

The World Health Organization (WHO) predicts that by 2050, the worldwide population over 60 will have doubled to reach 2 billion people. With most age-related illnesses beginning at the age of 50, it's clear that this will have an impact on the world's medical services. Neil Oliver, Technical Marketing Manager of global battery manufacturer Accutronics, looks at how wearables could help medical services manage the long-term health conditions that an ageing population brings.

The growth in wearable devices and the ageing population may seem like two disconnected trends, but what if they were connected? Wearable technology is set to be worth \$34 billion by 2020, according to research by CCS Insight, so there is clearly investment in the market.

When you think of medical wearable devices, you may think of step-tracking devices, geared towards the young and active, but you may not think of smoking cessation patches or a device to monitor the breathing of sleep apnoea sufferers. In fact, a study by the *Journal of the American Medical Association* showed that few senior citizens were using digital health technology, despite high ownership of mobile phones and computers.

Therefore, there seems to be a gap in the market for original equipment manufacturers (OEMs) to create wearable devices to track long-term health conditions. However, they must consider what is powering these devices, so that they can function correctly.

As an experienced battery manufacturer, we often find that for many devices, medical included, OEMs come to us for advice far too late in the design process. They will have a space for us to fill, but there is not always adequate room to fit a battery that delivers the required energy density and runtime. Especially in wearable devices, where space is at a premium, OEMs must consider what is powering their device early on in the process.

Before creating a wearable medical device, OEMs must conduct detailed research in order to determine the usage profile for the

battery. They must choose between rechargeable and non-rechargeable batteries, and removable and non-removable batteries, depending on what the best option is for the end user.

For example, an elderly patient with little awareness of technology may be best equipped with a non-rechargeable device with a removable battery. This means that the medical practitioner can be responsible for replacing the battery for the wearable device, rather than them having problems with charging the device.

Similarly, if a removable battery is used, patients may be given the opportunity to purchase their own batteries, which may not be the best option for a medical device. For example, consumers are often tempted to purchase the cheapest version of AA batteries, which will not last as long as a higher quality battery. While this may be acceptable for a child's toy, it is not reliable enough for a medical device.

Security concerns are also a problem with a removable battery. With the prevalence of counterfeit batteries on the market, which the end user may easily purchase online, OEMs should incorporate algorithmic security to protect the end user of the medical device.

Accutronics offers this function to protect the end users of the medical device. When a new battery is inserted into the device, if it fails to solve the same calculation as the device, the device will flag it as an inauthentic battery, indicating the danger to the user. It will then either display a pop-up message or shut down the device, depending on the preference of the OEM.

If the OEM decides that a rechargeable battery is the best option for the device and the end user, they must consider how long they

expect the battery to last. Previous wearable medical devices have failed because OEMs fail to undertake adequate market research and the consumer uses the product differently than was intended. For example, the device may use more power than expected when not actively being used.

Rechargeable devices used for medical purposes must also have accurate fuel gauging. If the battery is inaccurate, suddenly drops or jumps between charge levels, this is unacceptable for a device that is used to monitor vitals. Accutronics' CMX series batteries use an impedance tracking algorithm to predict remaining capacity, which is displayed in increments on a visual state of charge indicator.

Wearable medical devices have the potential to revolutionise health care, especially in the context of the ageing population. Not only will doctors be able to monitor daily changes in a person's health and receive alerts when vitals reach dangerous levels, a well-designed device will also allow the elderly to become advocates for their own health care, monitoring changes themselves.

However, to do this, the batteries that power the devices must be well suited to the device itself, the end user and their needs. Rather than considering the battery as an afterthought in the process, OEMs should remember that by including a battery manufacturer early on in the process, they will be able to optimise the design to make it as lightweight, portable and well adapted to the end user as possible.

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ANALOG OUTPUT IC PHOTOCOUPLER

Toshiba Electronic Devices & Storage has launched an analog output IC photocoupler that enables high-speed communications in automotive applications — especially electric vehicles (EV) and hybrid electric vehicles (HEV).

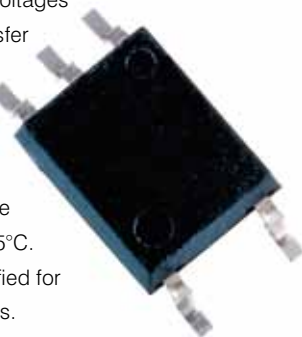
The TLX9309 consists of a high-output GaAlAs light-emitting diode (LED) that is optically coupled to a high-speed detector. The detector consists of a photodiode and a transistor integrated onto a single chip. A Faraday shield has been integrated onto the photodetector chip to provide enhanced levels of common-mode transient immunity — typically up to 15 kV/ μ s — an important parameter in electrically noisy automotive environments.

By separating the photodiode and amplification transistor, the collector capacitance is reduced. This is said to reduce propagation delays and make the open-collector TLX9309 faster than transistor output devices. Propagation delay times are between 0.1 and 1 μ s, with the difference between high to low and low to high transition ($|t_{pLH}-t_{pHL}|$) no more than 0.7 μ s. This makes the product suitable for high-speed communications such as inverter control or as an interface to intelligent power modules (IPM).

Electrically, the device offers 3750 V_{rms} of isolation with 5 mm of creepage and clearance for safety isolation. It operates from a supply in the range -0.5 to 30 VDC and can drive up to 25 mA at output voltages up to 20 V. The current transfer ratio is in the range 15–300%.

The product is packaged in a 3.7 x 7 x 2.2 mm RoHS-compliant 5-pin SO6 package and operates over the temperature range -40 to +125°C. The device is AEC-Q101 qualified for use in automotive applications.

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MINI-ITX MOTHERBOARD

The latest in motherboard technology from iBASE, the MI988 features an AMD Ryzen V1000 APU with four CPU cores and eight threads, making it suitable for multicore workloads. The product also features integrated Vega graphics with up to 11 Vega GPU compute units, which can be harnessed to achieve high processing throughput for demanding graphics and compute workloads.

The unit supports the latest in embedded processors from AMD as well as technology like M.2 devices. It comes equipped with 1 x M.2 M-Key for super fast storage, 1 x Mini-PCIe Socket and 1 x PCIe(x8) slot for all the user's expansion needs.

A system's I/O is important in an industrial environment, and the motherboard has plenty even with its Mini-ITX form factor. This includes 2 x GbE ports, 4 x RS232 Ports, 2 x internal RS232/422/485 ports, 2 x USB 3.1 Gen 1 ports and 2 x USB 3.1 Gen 2 ports. For display outputs the product has a 1 x HDMI 2.0a port, 1 x display port 1.4, 1 x eDP port and a 24-bit dual channel LVDS port.

The device is suitable for applications in the digital signage, industrial control, automation and gaming machine markets due to its small size and powerful processor.

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WEARABLE CONNECTOR

The Fischer LP360, the first product in the Fischer Freedom Series, meets design engineers' needs for connecting portable and body-worn applications quickly and easily, due to three breakthrough technology innovations: 360° mating 'freedom'; a ball-locking mechanism with sealing and variable predefined force; and specially designed pins on the plug that are IP68 sealed with a membrane.

The series facilitates integration, maximises usability and optimises cable management for a wide variety of applications within markets such as defence, security, medical, industrial and civil engineering. Mating the product becomes as intuitive as buttoning up a vest, without compromising on the high-performance reliability required in harsh environments.

The connector is fully cleanable (both plug and receptacle) and is easy to use and maintain with a fast set-up and good durability. The series also meets users' needs to easily and seamlessly integrate connectors — with or without cables — into multifunctional portable or body-worn devices.

Due to its compact and low-profile design, the device is easy to integrate into clothing with devices and subsystems; via the panel-mounted plug interface, cables can even be removed completely, and the connector can be directly integrated into the housing of such devices as a camera, a sensor, a light or a GPS.

As the product has no key code, it can be plugged and routed in any direction, ensuring that the cable can always go straight to the device. No more twists and turns means shorter cables in the equipment body-worn by dismounted soldiers, healthcare professionals or patients, civil engineers, surveyors and operators, and law enforcement officers and security guards. In certain applications, the need for cable can be eliminated completely.

The series enables design engineers to build an intelligent vest that works as a hub with multiple portable and body-worn devices connected to a shared data and power bus. Clutter is reduced and usability increased, making equipment light and quick to set up. These benefits also open up further opportunities in the Internet of Things (IoT).

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ELECTRICAL SAFETY GUIDE FOR BATTERY SYSTEMS RELEASED



The Clean Energy Council, the Australian Industry Group, CSIRO, the Smart Energy Council and the Consumer Electronics Suppliers Association have developed a best practice electrical safety guide for battery systems.

The Best Practice Guide: Battery Storage Equipment — Electrical Safety Requirements will work in tandem with a risk matrix to provide important guidance for professionals installing energy storage units. The risk matrix will help professionals working with battery storage technology to identify and manage any risks and ensure a safe installation of battery systems.

Clean Energy Council Director of Smart Energy Darren Gladman said the new guidelines for battery products would put Australia “at the head of the pack worldwide” when it comes to battery product safety. “The best practice guidelines for battery products released this week combine the best of international and US standards, along with a few other belts and braces,” Gladman said.

“There is now a robust Australian system of standards and guidelines in place for batteries being installed in Australia. What is missing is this framework being a prerequisite for state and federal government battery programs. The clean energy industry is working with all governments to ensure this framework is in place to protect consumers as the rollout of battery technology accelerates.”

The guide applies to lithium-based battery storage equipment and includes suggested safety requirements for the following:

- A battery module (BM) is one or more cells linked together. May also have incorporated electronics for monitoring, charge management and/or protection. Battery modules are installed within pre-assembled battery system equipment or pre-assembled integrated battery energy storage system equipment or as part of a master/slave configuration of such equipment.
- A pre-assembled battery system (BS) is a system comprising one or more cells, modules or battery system, and auxiliary supporting equipment such as a battery management system and protective devices and any other required components as determined by the equipment manufacturer. A BS system does not include a Power Conditioning Equipment (PCE). Pre-assembled battery system equipment comes in a dedicated enclosure. The

equipment is a complete package for connection to a DC bus or DC input of a PCE.

- A pre-assembled integrated battery energy storage system (BESS) is a battery energy storage system manufactured as a complete integrated package with the PCE, one or more cells, modules or battery system, protection devices, power conditioning equipment and any other required components as determined by the equipment manufacturer. Pre-assembled integrated battery energy storage system equipment is supplied in a dedicated enclosure. Integrated battery energy storage system equipment is a complete package that has AC output for connection to the electrical installation.

The guide covers battery storage equipment with a rated capacity of equal to or greater than 1 kWh and up to and including 200 kWh of energy storage capacity when measured at 0.1C. Products can comply with the guide by one of four mandatory methods. Each method has different primary and secondary safety standards as well as additional requirements that equipment must meet to be compliant.

Optional criteria for manufacturers and importers to show that they have processes and procedures in place that are over and above the current minimum requirements are also provided. This will help manufacturers and importers differentiate themselves from the competition and continue to improve the safety standards within the industry.

Products that meet the guide show a consistent level of safety and should give customers confidence that these products can be safely installed and operated in or outside their house. Devices that comply with the guide will have protection against many hazards that may occur during normal or abnormal operation of equipment.

The guide will be reviewed on a regular basis to determine ongoing suitability and relevance. Users should ensure they have the latest version of the guide to reference.

The guide and associated risk matrix are online and available for download at batterysafetyguide.com.au.



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HEAT- CONDUCTING CRYSTALS COULD HELP COMPUTER CHIPS STAY COOL



US researchers have created a new way to whisk heat away from the circuitry in a computer's innards to the outside environment, thus preventing computer chips from overheating and causing permanent damage.

Described in the journal *Science*, their breakthrough lies in crystals made of boron arsenide — a material that has excellent thermal properties that can effectively dissipate the heat generated in electronic devices.

Most of today's computer chips are made of the element silicon, a crystalline semiconducting material that does an adequate job of dissipating heat. But silicon, in combination with other cooling technology incorporated into devices, can handle only so much — and as consumers demand smaller, faster and more powerful electronic devices that draw more current and thus generate more heat, the issue of heat management is reaching a bottleneck.

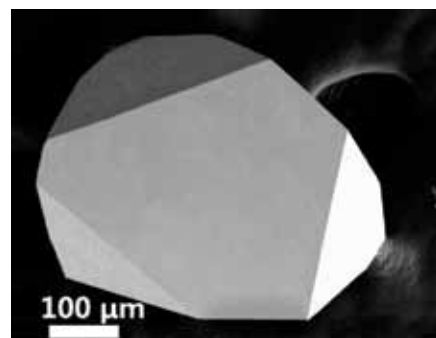
Diamond has the highest known thermal conductivity, at around 2200 watts per meter-Kelvin (W/mK), compared to about 150 W/mK for silicon. But although diamond has been incorporated occasionally in demanding heat-dissipation applications, the cost of natural

diamonds and structural defects in manmade diamond films make the material impractical for widespread use in electronics. It is also an electrical insulator and, when paired with a semiconductor device, expands at a different rate than the device does when it is heated.

Now, researchers at The University of Texas at Dallas have collaborated with the University of Illinois at Urbana-Champaign and the University of Houston on a potential solution, growing a semiconducting crystal from two relatively common mineral elements — boron and arsenic. Their boron arsenide crystals were found to have far higher thermal conductivity than any other semiconductors and metals currently in use, including silicon, silicon carbide, copper and silver.

In 2013, researchers at Boston College and the US Naval Research Laboratory predicted that boron arsenide could potentially perform as well as diamond as a heat spreader. One such researcher was David Broido, a theoretical physicist at Boston College and one of the authors of the current paper, who proposed that the combination could yield a high thermal conductivity crystal, defying the conventional theory that ultrahigh lattice thermal conductivity could only occur in crystals composed of strongly bonded light elements, limited by anharmonic three-phonon processes.

But according to Paul Ching-Wu Chu, founding director of the Texas Center for Superconductivity at UH, combining boron with



The tiny crystals of boron arsenide, like the one shown here imaged with an electron microscope, have high thermal conductivity.

growing crystals larger than 4 x 2 x 1 mm. A larger crystal could be produced by extending the growing time beyond the 14 days used for the experiment, they said.

The researchers also had to combine extensive materials characterisation and trial-and-error synthesis to find the conditions that produced crystals of high enough quality. Eventually they succeeded, achieving thermal conductivity up to 1000 W/mK — second only to diamond in bulk materials, according to Dr Lv.

“To jump from our previous results of 200 W/mK up to 1000 W/mK, we needed to adjust many parameters, including the raw materials we started with, the temperature and pressure of the chamber, even the type of tubing we used and how we cleaned the equipment,” he continued.

Dr David Cahill and Dr Pinshane Huang’s research groups at the University of Illinois at Urbana-Champaign played a key role in the work, using electron microscopy and a technique called time-domain thermoreflectance to determine if the lab-grown crystals were free of the types of defects that cause a reduction in thermal conductivity.

“We measure the thermal conductivity using a method developed at Illinois over the past dozen years called ‘time-domain thermoreflectance’ or TDTR,” said Dr Cahill. “TDTR enables us to measure the thermal conductivity of almost any material over a wide range of conditions and was essential for the success of this work.”

“We measured dozens of the boron arsenide crystals produced in this study and found that the thermal conductivity of the material can be three times higher than that of the best materials being used as heat spreaders today,” added Illinois postdoctoral researcher Qiye Zheng.

The way heat is dissipated in boron arsenide and other crystals is linked to the vibrations of the material. As the crystal vibrates, the motion creates packets of energy called phonons, which can be thought of as quasiparticles carrying heat. Dr Lv said the unique features of boron arsenide crystals — including the mass difference between the boron and arsenic atoms — contribute to the ability of the phonons to travel more efficiently away from the crystals.

The researchers believe their discovery has the potential to address a range of technological challenges, including cooling electronic devices and nanodevices. The next step in the work will include trying other processes to improve the growth and properties of this material for large-scale applications, Dr Lv said.

“I think boron arsenide has great potential for the future of electronics,” he said. “Its semiconducting properties are very comparable to silicon, which is why it would be ideal to incorporate boron arsenide into semiconducting devices.”

arsenic is a complex challenge. Boron arsenide needs to have a very specific structure and low defect density for it to have peak thermal conductivity, he said, so that its growth happens in a very controlled way.

“The mismatch between the physical properties of boron and arsenic makes the synthesis of boron arsenide extremely difficult and boron arsenide single crystals almost impossible,” said Chu.

In 2015, Dr Bing Lv — then a researcher at UH — successfully produced such boron arsenide crystals, but the material had a fairly low thermal conductivity of around 200 W/mK. Now a faculty member at UT Dallas, Dr Lv has been working for the past three years to optimise the crystal-growing process to boost the material’s performance.

Dr Lv worked with Dr Sheng Li and Xiaoyuan Liu, both from UT Dallas, to create the high thermal conductivity crystals using a technique called chemical vapour transport, in which raw boron and arsenic are placed in a chamber that is hot on one end and cold on the other. Inside the chamber, another chemical transports the elements from the hot end to the cooler end, where they combine and condense into small crystals.

Previous reported efforts to synthesise boron arsenide have yielded crystals measuring less than 500 μm — too small for useful application — but the researchers have since reported

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Image credit: University of Texas at Dallas.

Researchers used a single photon, stored in a quantum memory, to toggle the state of other photons.

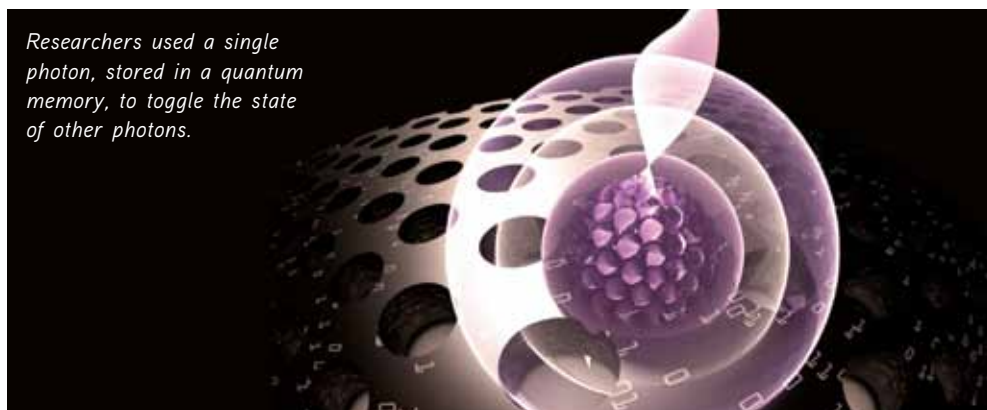


Image credit: E Edwards/JQI.

QUANTUM TRANSISTOR MADE FROM A SEMICONDUCTOR

Researchers at the University of Maryland have made one giant leap towards quantum computing with their demonstration of the first single-photon transistor using a semiconductor chip.

Transistors are tiny switches that route electrical signals around inside the computers that power our smartphones, tablets and other devices. Quantum computers will need analogous hardware to manipulate quantum information. But the design constraints for this new information technology are stringent, and today's most advanced processors can't be repurposed as quantum devices. That's because quantum information carriers, or qubits, have to follow the radically different rules laid out by quantum physics.

Scientists can use many kinds of quantum particles as qubits, even the photons that make up light. Photons have added appeal because they can swiftly shuttle information over long distances, and they are compatible with fabricated chips. However, making a quantum transistor triggered by light has been challenging because it requires that the photons interact with each other, something that doesn't ordinarily happen.

Now, researchers from Maryland's Joint Quantum Institute (JQI) have used a quantum memory to make photons interact, creating the first single-photon transistor made from a semiconductor. Writing in the journal *Science*, the researchers reveal that around 1 million of these transistors could fit inside a single grain of salt. The device is also fast and able to process 10 billion photonic qubits every second.

The transistor device has numerous holes in it, making it appear much like a honeycomb. Light entering the chip bounces around and gets trapped by the hole pattern. A small crystal sits inside the area where the light intensity is

strongest and, analogous to conventional computer memory, this crystal stores information about photons as they enter the device. It can then effectively tap into that memory to mediate interactions with other photons that later arrive at the chip.

The team observed that a single photon could, by interacting with the crystal, control the transmission of a second light pulse through the device. The first light pulse acts like a key, opening the door for the second photon to enter the chip. If the first pulse didn't contain any photons, the crystal blocked subsequent photons from getting through. This behaviour is similar to a conventional transistor where a small voltage controls the passage of current through its terminals. Here, the researchers successfully replaced the voltage with a single photon and demonstrated that their quantum transistor could switch a light pulse containing around 30 photons before the device's memory ran out.

"Using our transistor, we should be able to perform quantum gates between photons," said Edo Waks, who co-led the research. "Software running on a quantum computer would use a series of such operations to attain exponential speed-up for certain computational problems."

According to lead author Shuo Sun, who was a grad student at Maryland at the time of the research, engineering improvements could enable many quantum light transistors to be linked together. The team hopes that such speedy, highly connected devices will eventually lead to compact quantum computers that process large numbers of photonic qubits.



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Head Office
Cnr Fox Valley Road & Kiogle Street,
(Locked Bag 1289)
Wahroonga NSW 2076 Australia
Ph: +61 2 9487 2700 Fax: +61 2 9489 1265

Editor
Lauren Davis
wnie@wfmedia.com.au

Publishing Director/MD Geoff Hird

Art Director/Production Manager
Julie Wright

Art/Production
Wendy Blume, Colleen Sam

Circulation Dianna Alberry, Sue Lavery
circulation@wfmedia.com.au

Copy Control Mitchie Mullins
copy@wfmedia.com.au

Advertising Sales

Industrial Group Sales Manager
Nicola Fender-Fox – 0414 703 780
nfender-fox@wfmedia.com.au

Account Manager
Sandra Romanin – 0414 558 464
sromanin@wfmedia.com.au

Asia
Tim Thompson - 0421 623 958
tthompson@wfmedia.com.au



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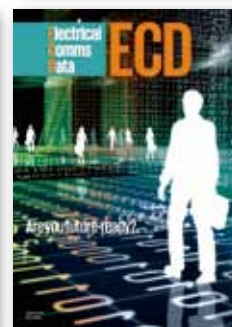
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