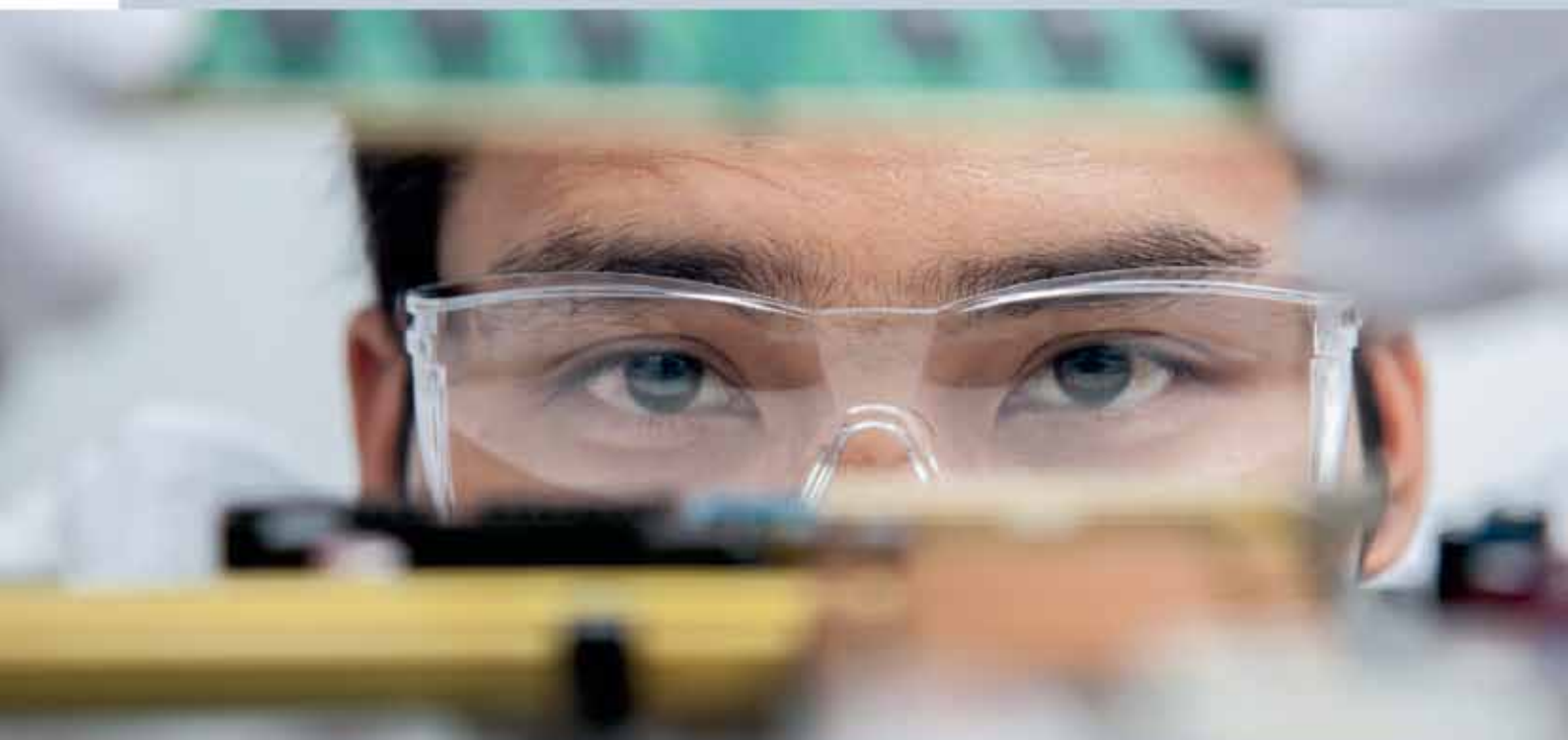


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# CONTENTS

- 4 AI on the agenda
- 14 Making miniaturised wireless medical wearables
- 16 How to 'design out' production problems
- 26 Silicon chip created for a quantum processor
- 36 'Spray-on antennas' can transmit and direct radio waves
- 40 Towards a 5G future
- 42 'Touch' virtual objects with these ultralight gloves



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## COVER STORY



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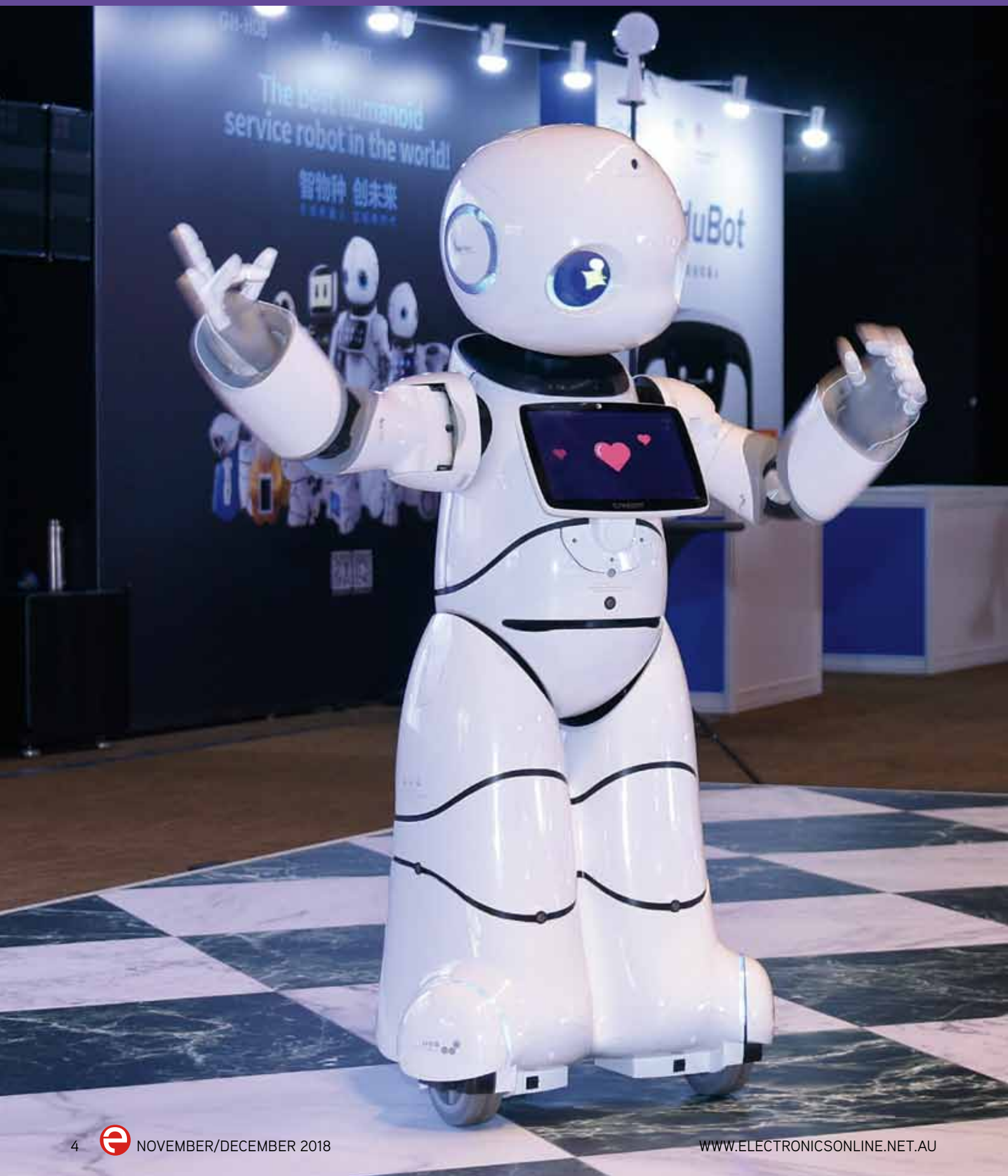
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# AI ON THE AGENDA

*Lauren Davis*





Artificial intelligence (AI) is no longer on the horizon — it's here, and we need to be ready to make use of it.

That was the key takeaway of the 2018 Hong Kong Electronics Fair (Autumn Edition), organised by the Hong Kong Trade Development Council (HKTDC) and held from 13–16 October in conjunction with electronicAsia. But rather than being an ominous warning about robots taking our jobs, the overall tone of the show was one of optimism, with the future being a world where AI is simply a tool — albeit a very useful one — that is set to make life easier both at work and at play.

The fair opened on 13 October with the Symposium on Innovation & Technology, exploring the theme 'AI Empowerment — Grow Without Limits'. Opening remarks from the Hon Nicholas W Yang, Secretary for Innovation and Technology from the Hong Kong Government, revealed that AI is developing rapidly around the globe, particularly in the manufacturing industry in order to improve efficiency, and the government has set AI as a key focus area.

First studied as a serious field of research in the 1950s, AI these days refers to a collective umbrella of connective technology that analyses behaviour and predicts and develops patterns based on this behaviour. Some examples include computer vision, machine learning, speech recognition and translation, and robotic process automation, to name a few.

For example, Hong Kong-based company SenseTime specialises in computer vision — a technology which can be deployed in a wide variety of areas. In the area of autonomous driving, computer vision enables cars to 'see' other cars as well as pedestrians, at any time of day and in any kind of weather condition. It is also useful for assisted driving, alerting the driver if it senses the car drifting lanes, or even if the driver is using their phone or smoking. Insurance companies are especially fond of the technology, as it encourages responsible driving, as are logistics companies who want to be able to monitor their drivers.

SenseTime also works in the area of smart retail, offering data analytics on customer

flow (particularly useful at stores such as IKEA) and facial recognition using in-store cameras. The technology has even led to the rise of unmanned convenience stores in China, where a camera acknowledges the customer as they pick up items from the shelves, scans them at the checkout and deducts money from their eWallet.

We're also moving closer to the world of service robots as depicted in *The Jetsons*, with the fair including a demonstration of a robot named 'Yoyo' from CANBOT in Beijing. Featuring facial and voice recognition, plus obstacle avoidance and motion, Yoyo can be used as a novelty guide in hotels, shopping malls, banks, hospitals and even schools. It is also a modular robot, meaning its parts can be easily replaced so they are more suitable for specific tasks.

Less humanoid, but similarly useful, is the PudoBot delivery robot from PuduTech, which can be used as a waiter in a restaurant as well as in casinos, hotels and hospitals. Deployed from a restaurant kitchen, for example, a member of staff simply needs to place the food on the robot's antislip mat and input the number of the customer's table. PudoBot then maps out the most efficient route and begins its journey, detecting and avoiding other robots, humans and objects as it slides along. Once it has arrived, the customer can take their food and press a button to send the robot back where it came from.

So what do businesses themselves want out of AI? This question was answered by Vincent Wong, Associate Director, Consulting, from Deloitte China. His company conducted a survey of 250 senior executives which saw 87% of respondents say AI is important to products and services offerings and 92% say AI is important to internal processes.

Wong suggested that AI can be deployed for processes included back-office accounting, human resources, supply chain management, IT maintenance, data analytics and even customer service. Yet when asked what benefits they sought from AI, the majority of senior executives were focused on enhancing



"AI IS PROVIDING THE TOOLS THAT ARE ENABLING US TO PUT A DOCTOR ON THE SHOULDERS OF TODAY'S ELECTRONICS." — PROFESSOR MICHAEL PECHT

products and services, rather than reducing headcount.

"AI is a tool," Wong said. "AI is your friend. AI is coming to enhance the products and services you are offering ... Your people will be part of the journey."

Of course it cannot be denied that automation will replace some jobs, as noted by Dr MeiKei leong, Chief Technology Officer of the Hong Kong Applied Science and Technology Research Institute (ASTRI). He referred to two reports: one from the University of Oxford, which claimed that up to 47% of current jobs were at risk from automation, and one by the OECD, which concluded the number was only 9%. Why the discrepancy? Dr leong listed three possible reasons: adopting new technology is normally a slow process; workers can adjust to changing technology by retraining to do other tasks; and technology change typically generates more jobs.

Training and retraining are therefore key to keeping employment steady. And this is already happening, with Dr leong pointing out that cities such as Paris and San Francisco provide free coding universities and even free housing for students, and work with companies to supply tech workers.

"AI will take over a lot of tasks, but will free humans to adopt more value-added, personalised and analytical roles," Dr leong concluded. SenseTime Vice President Jessie Lin added that AI simply would not work without human intervention: the future is therefore human + AI.

Two days later, AI-enhanced reliability was discussed at the event as part of the Hong Kong Electronic Forum. This covered AI less as a way to improve a company's products and more as a way to ensure such products are fit for purpose in the first place.

Professor Michael Pecht is Director of the Center for Advanced Life Cycle Engineering (CALCE) at the University of Maryland, which specialises in assessing the health and predicting the failure of electronics. He claimed that AI, particularly through machine learning, can be used to categorise data, discover relationships, identify patterns and determine anomalies.

Specifically, CALCE's machine learning systems use Mahalanobis-based detection methodology, which looks at how different parameters should work together and recognises when they don't. This enables them to predict when subassemblies, including motherboards, power supplies and disk drives, should be replaced. Like a doctor, he said, the system becomes more experienced over time, taking a prognostics-based approach that ultimately helps with preventing catastrophic failure, forecasting maintenance and planning logistics.

"AI is providing the tools that are enabling us to put a doctor on the shoulders of today's electronics," Prof Pecht said.

This idea was expanded on by Norbert Meuser, Managing Director of Viscom. He focused particularly on machine vision in surface-mount technology (SMT), noting that humans are typically good at identifying objects and classifying them — but less

reliable when it comes to mass inspection of electronics in the factory. That's where machine vision comes in.

Unlike machine learning, machine vision is based on very specific programming, with deterministic algorithms ensuring the same input always results in the system providing the same output. This is far less likely in humans, who could give two different interpretations of the same information.

Viscom's machine vision technology has culminated in a process called automated optical inspection (AOI), in which a machine is programmed to look for specific defects in PCBs. Once the system has identified a defect, this is confirmed via human verification (Meuser suggested that we may one day reach autonomous verification — with no human operator at all — but this day is not yet upon us). And if defects are consistently identified in product after product, that could be an indication that there's an issue with the production equipment itself — perhaps it just needs to be cleaned?

Product reliability can even be monitored on an ongoing basis, according to Patrick Kabasci from the KEX Knowledge Exchange and INC Invention Center, whose field of choice is Industry 4.0. Kabasci noted that Industry 4.0 is often associated with automation but is also about using data — particularly real-time data — for predictions and decision-making.

According to Kabasci, data integration can be an ongoing process over the entire product life cycle — from predicting its original lifetime, to tracking and tracing it in the field, and finally seeking to improve it based on the real-time data collected. This could prevent companies from being subjected to mass recalls, with tiny changes in product parameters (eg, a raised temperature) enabling manufacturers to pick up on potential failures sooner and faster than previously. This will become easier in the future, Kabasci said, with the emergence of 5G and the increasing integration of small, cheap sensors into products.

It's clear that AI has come a long way since the '50s, and there's no going back. So if your company has been reluctant to enter this brave new world, you might want to consider taking a look at what's out there. Shows such as the Hong Kong Electronics Fair and electronicAsia are a great source of new and innovative products, as well as informative seminars featuring industry experts. And who knows — you might just be surprised to learn how AI can enhance your business for the better.

*Lauren Davis travelled to the 2018 Hong Kong Electronics Fair (Autumn Edition) as a guest of the Hong Kong Trade Development Council.*





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## DUAL-LAYER SOLAR CELL SETS EFFICIENCY RECORD

Materials scientists from the University of California, Los Angeles (UCLA) have developed a highly efficient thin-film solar cell that generates more energy from sunlight than typical solar panels, thanks to its double-layer design.

Described in the journal *Science*, the device is made by spraying a thin layer of perovskite — an inexpensive compound of lead and iodine that has been shown to be very efficient at capturing energy from sunlight — onto a commercially available solar cell. The solar cell that forms the bottom layer of the device is made of a compound of copper, indium, gallium and selenide, or CIGS.

The CIGS base layer, which is about 2  $\mu\text{m}$  thick, absorbs sunlight and generates energy at a rate of 18.7% efficiency on its own, but adding the 1  $\mu\text{m}$ -thick perovskite layer improves its efficiency. The two layers are joined by a nanoscale interface that the UCLA researchers designed; the interface helps give the device higher voltage, which increases the amount of power it can export. The entire assembly sits on a glass substrate that's about 2 mm thick.

"With our tandem solar cell design, we're drawing energy from two distinct parts of the solar spectrum over the same device area," said research leader Professor Yang Yang. "This increases the amount of energy generated from sunlight compared to the CIGS layer alone."

The cell has been found to convert 22.4% of the incoming energy from the sun — a record in power conversion efficiency for a perovskite-CIGS tandem solar cell and similar to that of the polysilicon solar cells that currently dominate the photovoltaics market. This was confirmed by independent tests at the US Department of Energy's National Renewable Energy Laboratory and easily surpassed the previous record of 10.9%, set in 2015 by a group at IBM's Thomas J. Watson Research Center.

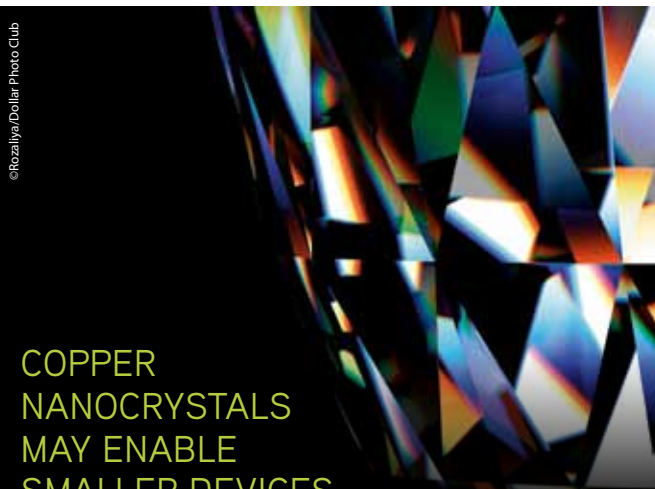
"Our technology boosted the existing CIGS solar cell performance by nearly 20% from its original performance," Prof Yang said. "That means a 20% reduction in energy costs."

Prof Yang noted that the technique of spraying on a layer of perovskite could be easily and inexpensively incorporated into existing solar-cell manufacturing processes. He added that devices using the two-layer design could eventually approach 30% power conversion efficiency, which will be his team's next goal.



*Qifeng Han, a visiting research associate, holds the new solar cell developed by UCLA.*

Image credit: Ozile Tarada/UCLA



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## COPPER NANOCRYSTALS MAY ENABLE SMALLER DEVICES

Curtin University researchers have developed a tiny electrical circuit — made from crystals of copper that are grown and electrically wired at nanoscale — that may enable an entirely new design of digital devices, with increasing amounts of computational power packed into a smaller space.

The researchers used a single nanoparticle to create an ensemble of different diodes — a basic electronic component of most modern electronic devices, which functions by directing the flow of electric currents. PhD candidate Yan Vogel, lead researcher on the project, said the single copper nanoparticle was used to compress a single physical entity that would normally require many individual diode elements.

"Instead of wiring up a large number of different sorts of diodes, as is done now, we have shown that the same outcome is obtained by many wires landing accurately over a single physical entity, which in our case is a copper nanocrystal," he said.

Published in the journal *ACS Nano*, the research shows that each nanoparticle had an in-built range of electrical signatures and had led to something akin to 'one particle, many diodes', thereby opening up the concept of single-particle circuitry. Vogel claimed the breakthrough will enable new concepts and methods in the design of miniaturised circuitry.

Team leader Dr Simone Ciampi said the research follows work published by himself and colleague Dr Nadim Darwish in 2017, when they created a diode out of a single molecule with a size of approximately 1 nm. He said the new study will help to continue the downsizing trend of electronic devices.

"Last year, we made a breakthrough in terms of the size of the diode, and now we are building on that work by developing more tuneable diodes, which can potentially be used to make more powerful and faster-thinking electronic devices," Dr Ciampi said.

"Current technology is reaching its limit, and molecular or nanoparticle diodes and transistors are the only way that we can continue the improvement of computer performances. We are trying to contribute to the development of the inevitable next generation of electronics."

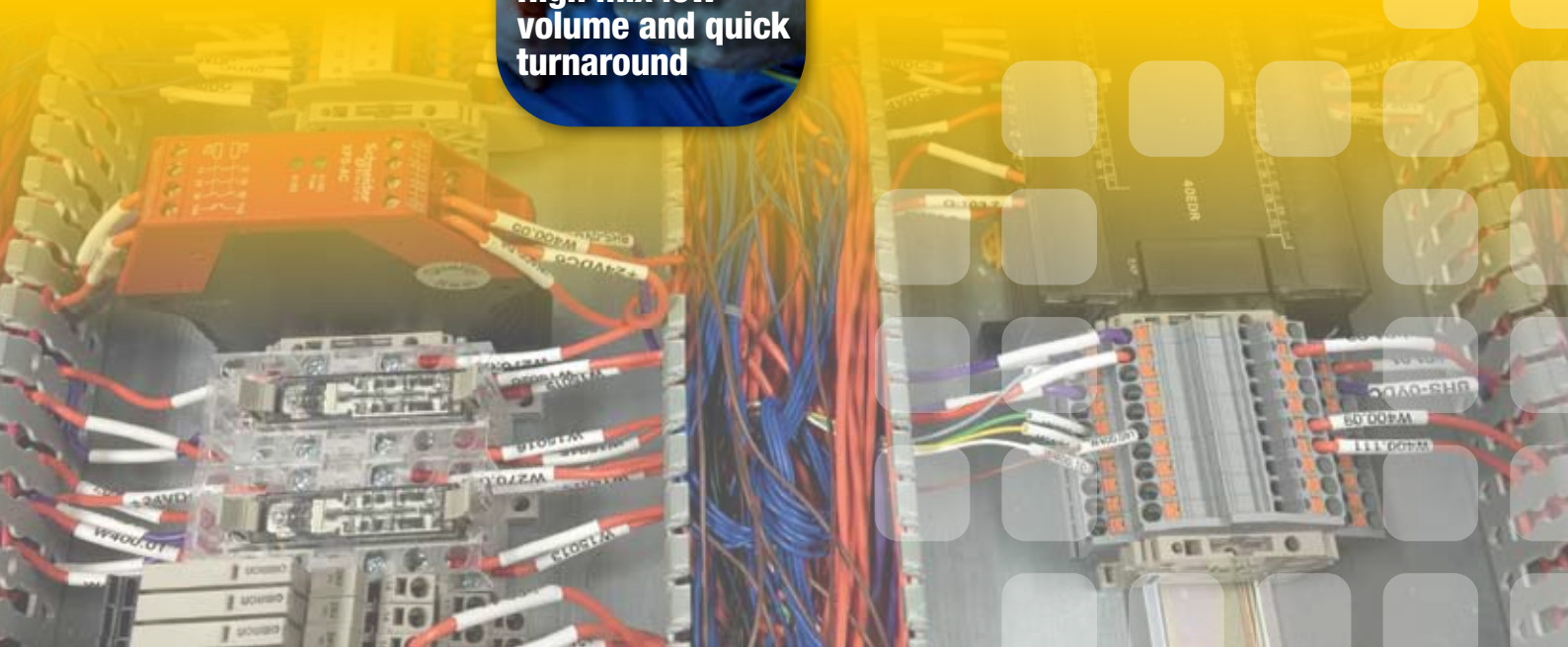


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## ELECTRONIC SKIN MIMICS HUMAN-LIKE SENSE OF TOUCH

Inspired by human skin, Chinese researchers have constructed a tactile sensor that detects pressure and pulses, replicating the experience of pressurised human touch.

Described in the journal *Science Robotics*, the technology may represent a critical step forward in the development of smart prosthetics that can functionally replace — or potentially even surpass — the sensing ability of natural limbs.

Human skin perceives pressure as part of touch, which is subsequently transformed into signals to nerves that finally reach the brain, creating a pulse-like feeling. Restoring this sense of pressurised touch remains an important feature needed to make artificial limbs more lifelike and thus more acceptable for their users.

Yuanzhao Wu and colleagues from the Chinese Academy of Sciences developed an 'e-skin' that can convert pressure from touch to internal electric signals. Based on giant magneto-impedance (GMI) material embedded with an air gap, the skin encases a magnetic sensor and is composed of a hollow polymer membrane with magnetic particles on its top surface.



When pressure is applied to the magnet-dotted membrane roof, the membrane inverts, causing the magnetic particles on the top to inch towards the magnetic sensor on the inside. The resulting resistance created is transmitted as signals using an electrical circuit, and these signals are converted as pulses with various frequencies that increase with greater pressure.

Mounted on a mechanical arm, an artificial finger equipped with the e-skin was able to perceive the subtlest touches, such as the wind blowing. In subsequent experiments, the e-skin was also able to detect and pulse in response to drops of water that contained different volumes, as well as a moving trail of ants. In some cases, the pulses responded to pressures exceeding even the sensing threshold value of humans.

"The proposed tactile sensor not only showed desirable sensitivity and low detection limit but also exhibited transduction of digital-frequency signals like human stimuli responses," the researchers wrote. "These features of the GMI-based tactile sensor show potential for its applications in smart prosthetics, especially prosthetic limbs that can functionally replace natural limbs."

## 3D-PRINTING A BIONIC EYE

Researchers at the University of Minnesota have fully 3D-printed an array of light receptors on a hemispherical surface. Published in the journal *Advanced Materials*, their discovery marks a significant step towards creating a 'bionic eye' that could someday help blind people see or sighted people see better.

"Bionic eyes are usually thought of as science fiction, but now we are closer than ever using a multimaterial 3D printer," said Michael McAlpine, a co-author on the study.

The researchers started with a hemispherical glass dome to show how they could overcome the challenge of printing electronics on a curved surface. Using their custom-built 3D printer, they started with a base ink of silver particles. The dispensed ink stayed in place and dried uniformly instead of running down the curved surface. The researchers then used semiconducting polymer

materials to print photodiodes, which convert light into electricity. The entire process takes about an hour.

McAlpine said the most surprising part of the process was the 25% efficiency in converting the light into electricity they achieved with the fully 3D-printed semiconductors. He noted, "We have a long way to go to routinely print active electronics reliably, but our 3D-printed semiconductors are now starting to show that they could potentially rival the efficiency of semiconducting devices fabricated in microfabrication facilities. Plus, we can easily print a semiconducting device on a curved surface, and they can't."

McAlpine and his team received international attention a few years ago for printing a 'bionic ear' and have since 3D-printed life-like artificial organs for surgical practice, electronic fabric that could serve as 'bionic skin', electronics directly on a moving hand, and cells and scaffolds that could help people living with spinal cord injuries regain some function. However, McAlpine's drive to create a bionic eye is a little more personal.

"My mother is blind in one eye, and whenever I talk about my work, she says, 'When are you going to print me a bionic eye?'" McAlpine said.

McAlpine said the team's next steps are to create a prototype with more light receptors that are even more efficient. They'd also like to find a way to print on a soft hemispherical material that can be implanted into a real eye.



Image credit: University of Minnesota, McAlpine Group.





## PLUG AND PLAY ON THE LOOKOUT FOR VIC START-UP COMPANIES

The Plug and Play Tech Center, believed to be the largest start-up accelerator in the world, has announced it will work with the newly formed Australian Graphene Industry Association (AGIA) to identify a Victorian start-up company in the advanced materials field that will become part of its accelerator program in Silicon Valley.

Considered one of the world's most important start-up accelerators, Plug and Play provides selected start-ups with a platform to present to and communicate directly with companies that are highly motivated to work with them in commercialising new products and/or investing strategically. The company understands that innovation can come from anywhere and often requires a culture that is diametrically different to the companies themselves.

Meanwhile, the AGIA was recently established to act as a point of contact and

information for businesses interested in pursuing the use of graphene to improve their products. The board of directors is chaired by Chris Gilbey, CEO of Geelong graphene manufacturer Imagine Intelligent Materials, with initial funding provided by the Victorian Government.

Plug and Play is now evaluating a potential partnership with the Victorian Government and AGIA to encourage Australian start-ups with cutting-edge technology to step forward — possibly granting them entry to Plug and Play's global ecosystem. The move would enable them to fast-track business development, access capital and engage with Fortune 500 companies eager to identify and/or invest in the next big technology innovation.

At the AGIA's Graphene+2018 conference, held in Hawthorn on 8 October, Plug and Play Vice-President

Omer Gozen guaranteed at least one Australian graphene start-up would make the shortlist of 100 start-ups globally that is circulated to Plug and Play's corporate partners — they could then potentially become one of the final 20 brought into the accelerator program.

"We believe Australia has real depth in the quality of its start-up community and we believe we will find the next Uber or Airbnb of advanced materials start-ups right here in Australia," Gozen said.

"After meeting with the team at Australia's leading graphene company, Imagine, and selecting them to go through our accelerator program in Silicon Valley during the first half of 2018, we became excited by the possibility of identifying other Australian start-ups, given this country's tremendous depth of talent in materials science — graphene in particular."

## FOUR-ELECTRON CONVERSION ACHIEVED IN LITHIUM-AIR BATTERIES



Chemists from the University of Waterloo have resolved two of the most challenging issues surrounding lithium-oxygen batteries — and in the process created a working battery with near 100% coulombic efficiency.

The high theoretical-energy density of lithium-oxygen ( $\text{LiO}_2$ ) batteries and their relatively light weight have made them the Holy Grail of rechargeable battery systems. But longstanding issues with the battery's chemistry and stability have kept them a purely academic curiosity.

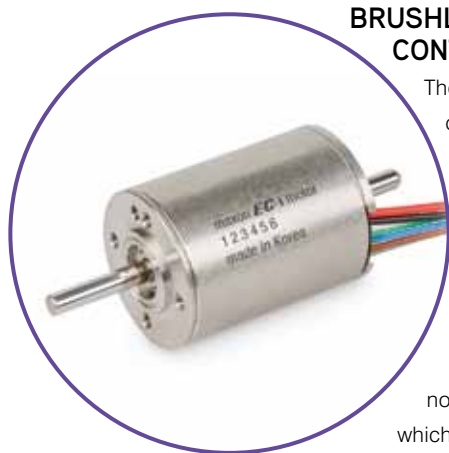
Two of the more serious issues involve the intermediate of the cell chemistry (superoxide,  $\text{LiO}_2$ ) and the peroxide product ( $\text{Li}_2\text{O}_2$ ) reacting with the porous carbon cathode, degrading the cell from within. In addition, the superoxide consumes the organic electrolyte in the process, which greatly limits the cycle life.

Seeking a solution, Waterloo's Linda Nazar and her colleagues switched the organic electrolyte to a more stable inorganic molten salt and the porous carbon cathode to a bifunctional metal oxide catalyst. By operating the battery at  $150^\circ\text{C}$ , they found that the more stable product  $\text{LiO}_2$  is formed instead of  $\text{Li}_2\text{O}_2$  — resulting in a highly reversible Li-oxygen battery with coulombic efficiency approaching 100%. By storing  $\text{O}_2$  as lithium oxide ( $\text{Li}_2\text{O}$ ) instead of lithium peroxide ( $\text{Li}_2\text{O}_2$ ), the battery not only maintained excellent charging characteristics, it achieved the maximum four-electron transfer in the system, thereby increasing the theoretical energy storage by 50%.

"By swapping out the electrolyte and the electrode host and raising the temperature, we show the system performs remarkably well," said Nazar, Canada Research Chair in Solid State Energy Materials and senior author on the study.

Published in the journal *Science*, the team's work proves that four-electron conversion for lithium-oxygen electrochemistry is indeed highly reversible. According to Nazar, "There are limitations based on thermodynamics; nevertheless, our work has addressed fundamental issues that people have been trying to resolve for a long time."

## BRUSHLESS DC MOTOR WITH INTEGRATED CONTROLLER



The EC-I 30IE brushless DC motor features a five-wire connection to simplify implementation and still give a wide functionality. An independent set speed value connection allows for a greater motor operating speed range over the common two-wire approach to integrated brushless motor control. Additional features include a disable, direction and speed monitor output.

The product has an enclosed design that does not require any airflow through the body for cooling, which makes it suitable for harsh environments typical of the manufacturing industry. Despite the internal motor control board, the motor has still been designed with a shaft on both ends of the body for orientation convenience and is still part of the modular construction program, allowing the addition of ceramic planetary gearheads (reduction gearboxes).

The motor is 30 mm in diameter and 41 mm long, including the control unit. It has four-quadrant control, meaning it can control dynamic acceleration and deceleration in both directions. The controlled top speed is 6000 rpm from a 24 V supply and the 20 W power rating indicates a high power density ratio.

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## SINGLEMODE FIBRE SOURCE AND POWER METER

The Kingfisher KI-28010 is a singlemode, handheld light source and comes with a KI-2600 power meter. It is available to rent from TechRentals.

The product's large and clear LCD display is both sunlight readable and backlit. The unit itself is rugged, lightweight and simple to use, making it suitable for all field applications. It offers good optical power stability, reconnection repeatability and real-time PC reporting software.

The Kingfisher KI-28010 offers wavelengths such as 1310, 1550 and 1625 nm, while its autotest provides fast, easy and automatic multiwavelength loss testing. Compatible with APC and PC singlemode networks, its other features include encircled flux compliant testing, mixed MMF/SMF testing, being a tone source for fibre identifiers, and having memory with text, timestamp and USB dump.

TechRentals offers a set-up and download service for the product.

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## NATA ACCREDITATION FOR APPROVAL OF CELLULAR DEVICES

EMC Technologies has achieved NATA ISO 17020 accreditation for the assessment of ACMA compliance of products connecting to the mobile phone and cellular network.

The company can now issue NATA-endorsed reports showing compliance of GSM, 3G, 4G devices and satellite phones with the applicable mandatory standards: AS/CA S042.1 (Requirements for connection to an air interface of a Telecommunications Network – Part 1: General); AS/ACIF S042.3 (Requirements for connection to an air interface of a Telecommunications Network – Part 3: GSM Customer Equipment); and AS/CA S042.4 (Requirements for connection to an air interface of a Telecommunications Network – Part 4: IMT-2000 Customer Equipment).

A NATA-endorsed report gives a high level of confidence of compliance with the complex regulatory requirements in the mobile telecommunications sector. The mandatory standards above apply to devices such as mobile phones, cellular devices, satellite phones and any device that connects to the cellular network.

NATA accreditation for S042 complements EMC Technologies' extensive NATA accreditations for EMC, EMR, SAR and safety.

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## 19" RACKMOUNT ENCLOSURES

METCASE's COMBIMET 19" rackmount enclosures are available in all sizes from 1U to 6U — now including 5U, which was previously available only as a custom size. The versatile device is METCASE's rackmount enclosure for networking and communications, industrial computers, sound and studio systems and laboratory instrumentation.

The smart, modern aluminium enclosures offer complete access to the PCBs: the top, base and rear panels are removable. The top and base can be specified as either vented or unvented. An open-top version is also available.

Features include ergonomic front panel handles and mounting holes for PCBs and chassis. All case parts feature an M4 earth stud for electrical continuity.

COMBIMET is offered in two standard colours — light grey (RAL 7035) and black (RAL 9005) — and in depths of 265 and 365 mm. Custom depths can be supplied on demand.

The enclosures are supplied fully assembled. Accessories include a PCB mounting kit, internal mounting plates for fitting PCBs and assemblies, and a 19" mounting kit for fitting the case in a rack.

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

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# MAKING MINIATURISED WIRELESS MEDICAL WEARABLES

Traditionally, small chip antennas used in RF-enabled medical devices have required a designated ground 'keep out' area to minimise interference from other components and ensure the ideal radiation pattern for wireless signals. In some cases, this reserved space can eat up as much as 15 x 20 mm of the printed circuit board (PCB).

**H**owever, with the drive to further miniaturise next-generation medical biosensors and wearables, new alternatives are entering the market that allow the chip antenna to be mounted directly above metal surfaces. By doing so, as much as 10 to 20% of the space traditionally reserved for the keep out area is no longer required, allowing designers to reduce the overall size of the product.

This has major implications for wireless medical devices in which even miniaturised PCBs, along with coin-cell batteries often utilised, are limiting factors in the minimum form factor. Products that could be positively affected by this development include an array of 'smart' devices such as watches, clothing, eye glasses, patches, pills and even adhesive bandages.

## Mobile health biosensors and wearables

For the medical industry, the future is now when it comes to miniature battery-powered sensor devices that can be located near, attached to or implanted in the body to monitor physiological signs such as temperature, blood pressure and pulse rate.

These smart devices will soon monitor everything from fitness to health, the environment, lifestyle and behaviour. Biological parameters that can be tracked include vital signs, sleep, emotions, stress, breathing, movement, efforts, posture, gait, body shape, lesions, mental acuity, toxins, blood glucose, ECGs and drug adherence.

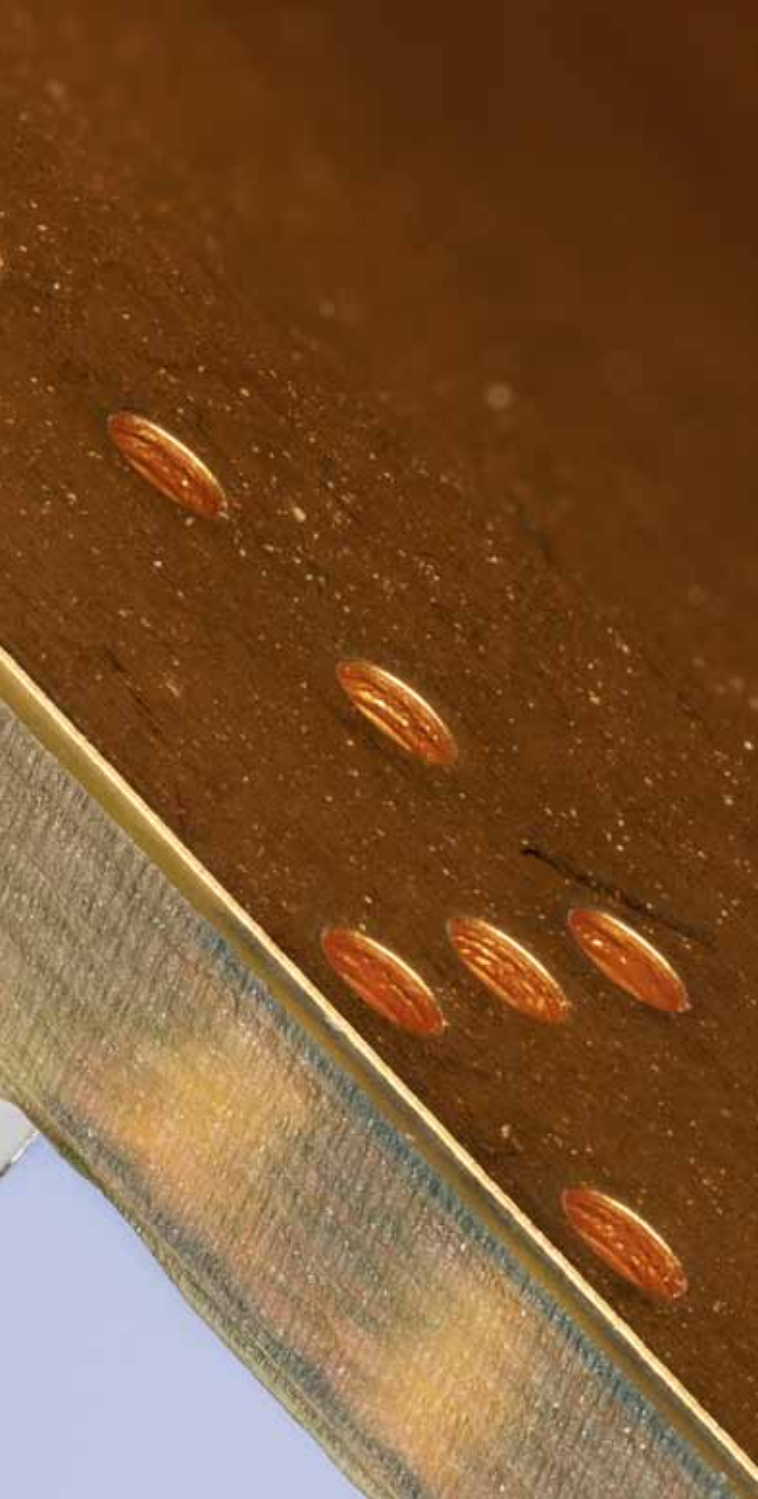
The information collected is then wirelessly transmitted to nearby mobile phones, remote monitoring stations or through Wi-Fi over the internet to backend servers for further analysis, assessment and decision-making.

Collecting data in this manner is expected to facilitate the development of disease models and an understanding of the complex behaviour of biological networks. Mobile health data can also be a valuable tool for drug discovery and clinical research.

Among the products already incorporating this type of technology are adhesive bandages that contain built-in sensors that measure heart rhythm, respiratory rate and temperature.

These readings can be used, for example, to determine the precise amount of insulin that should be dispensed from wirelessly controlled insulin pumps worn by diabetics.





## Embedded chip antennas

To transmit and receive RF wireless signals in the appropriate frequency range, smart devices must contain small RF chip antennas embedded on the PCB or behind the scenes underneath the encasement of the product.

These chip antennas radiate and receive electromagnetic waves as other types of antennas, but the most notable difference is its small size. In fact, today's mobile phones incorporate a minimum of four antennas and up to 13 in some models. Smaller wearable devices may only contain one or two antennas.

To work properly, chip antennas have typically been ground plane dependent, meaning they require an appropriately sized and positioned ground plane to form a complete, resonant circuit.

While the PCB can serve as the ground plane, the antenna itself must typically be placed on the edge of the board in an isolated section which is free from ground and metal components that would distort its radiation. Without the isolation distance, the performance of the antenna is significantly affected.



"The keep out area is fundamental to ensure the chip antenna can electromagnetically radiate to antenna applications, because everything affects the radiation pattern including the package size, where the antenna is mounted and its proximity to the human body," said Manuel Carmona of Johanson Technology, a leader in high-frequency ceramic components including chip antennas, High Q capacitors and EMI chip filters.

According to Carmona, Johanson Technology has been able to eliminate the requirement for a designated ground keep out area through optimisation of materials (ceramics and inks), manufacturing processes and RF circuit design.

A 2.4 GHz antenna can now be mounted directly onto the metal ground plane. The product measures 2 x 5 mm and is designed for small coin-cell battery-operated IoT, 2.4 BLE, wearable, ISM, ZigBee and 802.11-standard applications where metal or a battery/display covers the entire length or side of the PCB.

"With PCB real estate at a prime, the size and placement of the chip antenna is critical because as everything gets smaller it becomes increasingly difficult to place more components on the board," explained Carmona. "Therefore, design engineers are looking to component manufacturers to deliver miniaturised solutions that occupy next to no real board space."

The design of the antenna itself is also critical to its range and performance. With medical devices, radio interference or some other glitch could result in interrupted connectivity.

There can be legal ramifications as well. As with any wireless device, products that utilise RF technology, including Bluetooth, to collect or transmit information are subject to regulation by the Federal Communications Commission (FCC). Therefore, it is critical that the device performs at the designated frequency and the design and placement of the antenna is critical to proper tuning.

Despite the critical nature of the antenna, Carmona said it is often overlooked until late in the design process, at which point optimal antenna performance may not be achievable within the space provided.

To assist with chip antenna design and selection, Johanson Technology offers a program where design engineers can send in a miniaturised device and the company will tune the antenna for optimum functionality.

"A chip antenna that can be mounted over a ground plane opens up many applications for products that want to incorporate wireless," said Carmona. "To date, we have received everything from smart shirt buttons to jewellery and other wearables in various shapes and sizes."

Contact Fairmont Marketing for more information.

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# HOW TO 'DESIGN OUT' PRODUCTION PROBLEMS

Phil Kinner\*, Global Business and Technical Director for Electrolube's Conformal Coatings Division, provides some design pointers that will help you avoid some common pitfalls when applying conformal coatings.

I have quite a few years' experience and knowledge of the coatings business, and I'm still learning, but there are certain production-related issues that cause problems time and time again — problems that could so easily have been resolved at the design stage.

I intend to highlight these and, by doing so, hope to get the design guys fully on-side with their production colleagues. So, here you are: five essential facts to consider if you intend to conformally coat your electronics products.

## Fact 1: All things are not equal...

...and this is certainly the case with solder resists. Adhesion results with conformal coatings can be very varied when utilising what appears to be the 'same' spec of solder resist from different suppliers and this can create havoc. A quick and very effective solution to this can be to specify a surface energy of >40 dynes/cm on incoming bare boards and ensure that each batch is religiously tested and rejected if it does not meet this minimum value.

## Fact 2: Leave a buffer

Conformal coatings are usually liquid when applied and will flow with a combination of gravity and the capillary forces present. Whether you are masking or relying specifically on selective conformal coating, a production team will be greatly relieved if you leave a buffer of at least 3 mm clear between the area to be coated and uncoated areas. This small buffer will make the production process easier.

## Fact 3: Simplify the coating process at the design stage

By the simple mechanism of placing connectors and components that must not be coated along one edge of the assembly, the conformal coating application process will be simplified. This will also allow dip coating to be explored as a potential methodology and the net result will be quicker application times and reduced costs.

## Fact 4: Discrete components have a downside

Large arrays of discrete components represent a massive coating challenge due to the high levels of capillary forces present and the result is often quite disastrous, with areas of no coverage/protection on the board and conversely areas of excessive thickness prone to stress cracking, de-lamination and other coating defects. Ultimately this will lead to premature failure of the assemblies. Try to avoid this if at all possible!

## Fact 5: Bigger isn't necessarily better

Tall components present challenges of their own by creation of shadowed or hard-to-reach areas. Splashing is another associated problem. Try to avoid siting tall components next to 'must coat' components to minimise this.

Remember: Thoughtful design will pay huge dividends down the line — and the designers among you will have friends for life among your production colleagues by making their jobs just that little bit easier!

*\*Phil Kinner has spent his entire career within the coatings industry, including employment at Concoat, Humiseal and PVA; this experience has produced a thorough understanding of problems and processes associated with both materials and equipment. During his career, Phil has been instrumental in the development and commercialisation of the first generation of UV cure coatings and has further undertaken the pioneering development of revolutionary 2K conformal coatings. An active member of the IPC-830 Committee and regular speaker at SMTA events, he has a long association and close working relationship with NPL and is a prolific columnist and producer of technical articles/white papers.*



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# CESCOM ENTERPRISES

## WHAT THEY ASKED FOR:

An Australian company designing, manufacturing and supporting serial, RS422, 485, Ethernet and USB interfaces for data communication, CesCom engaged us to build frames to its design.

## HOW WE THOUGHT OUTSIDE THE BOX:

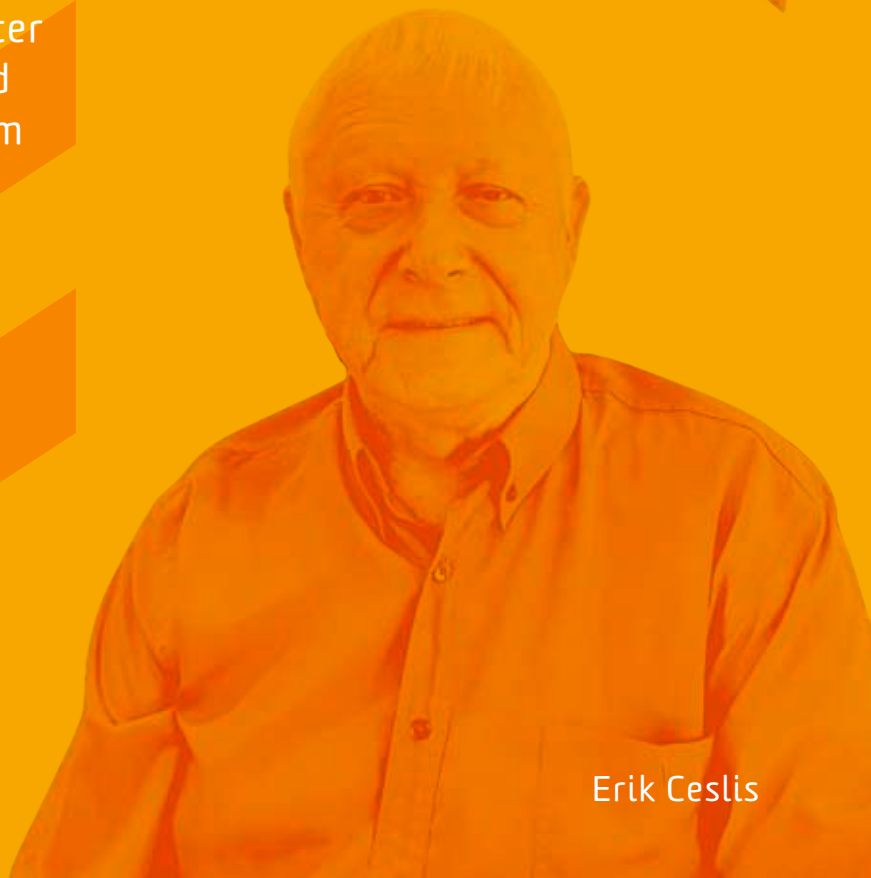
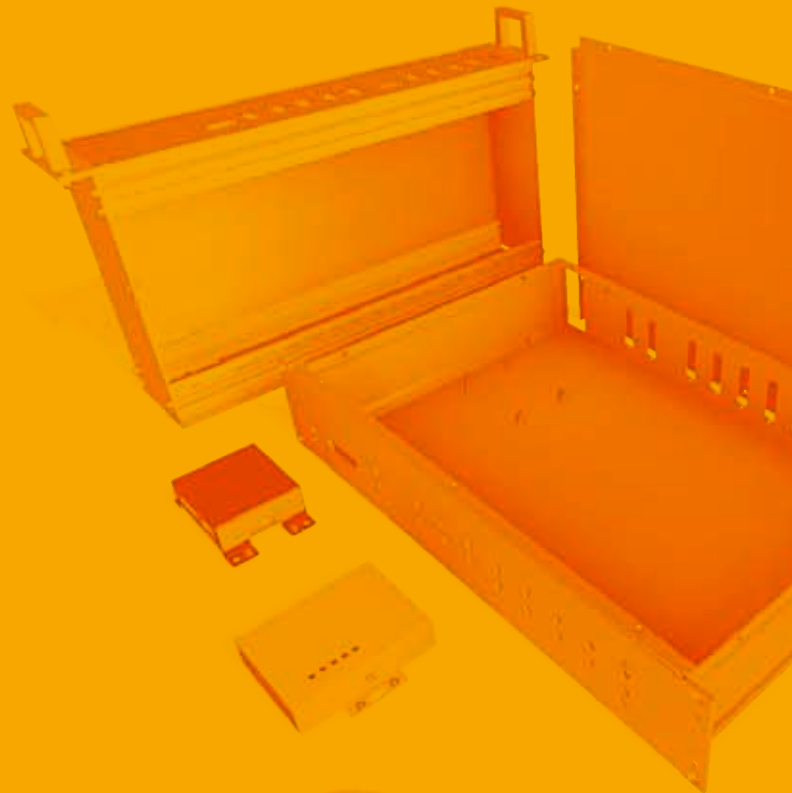
Pro-actively, we proposed a new design for an eight-channel splitter unit, which is far more robust and practical than the original CesCom produced itself.

## AND THE CLIENT SAID:

"Whoever thought Erntec could design such an exciting new chassis, which meets all compliance issues?"

Erik Ceslis, Technical/ Sales.

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Erik Ceslis



### 3000 W POWER SUPPLIES

Artesyn Embedded Technologies has announced the LCM3000 series AC-DC single-output enclosed power supplies, which can supply up to 3000 W output power with medical and industrial safety approvals.

Designed to be a forced-air bulk front end power supply, the series offers configurable nominal outputs of 12, 24, 36 or 48 V with output adjustability of  $\pm 25\%$  and maximum current of 250 A. A standard 5 V/2 A housekeeping output enables OEM standby functions even when the equipment is nominally off.

Features include power factor correction, variable speed 'smart fans', digital control and a typical efficiency of greater than 90%. The power supplies measure approximately 280 x 177.8 x 63.5 mm and offer power density of 0.96 W/cm<sup>3</sup>.

The series is suitable for industrial applications such as test and measurement equipment, industrial robotics, laser-carving machines and factory automation; non-patient contact and non-patient critical medical, dental and laboratory applications; as well as for telecom and datacom equipment. With simple firmware options, it can be used for battery charging and driving LED lights.

**Helios Power Solutions**  
[www.heliosps.com.au](http://www.heliosps.com.au)



### FANLESS DIN-RAIL EMBEDDED SYSTEM

The DRPC-130-AL CAN-bus fanless DIN-rail embedded system is a small form factor embedded PC from iEi Integration. It is powered by Intel's x5-E3930 1.8 GHz Dual Core Atom CPU and supports up to 8 GB of DDR3L RAM, making it a powerful and versatile system for its size.

The system supports CAN bus, allowing communication between the unit and a vehicle. Its small form factor and CAN bus support make it suitable for deployment in most vehicle applications. It has an operating temperature of -20 to +60°C with air flow (SSD).

The fanless embedded system is rich in I/O and supports four USB 3.0 ports, two Gigabit Ethernet ports, four RS232/422/485 COM ports, 8-bit digital input/output and a CAN bus port. It comes equipped with two HDMI ports and has room for storage, featuring a 2.5" HDD or SSD bay and one full-size mini PCIe slot that can accommodate an mSATA SSD. It also features one half-size mini PCIe slot that can support a Wi-Fi card for wireless network access.

**ICP Electronics Australia Pty Ltd**  
[www.icp-australia.com.au](http://www.icp-australia.com.au)



### DC/DC CONVERTERS FOR HIGH-ISOLATION APPLICATIONS

RECOM has released the RKZE series, a low-cost solution for applications that require high isolation and operate in wide temperature ranges. The PCB mount DC/DC modules are pin-compatible to RECOM's RK and RH converter series, enabling easy power upgrade options with identical footprint.

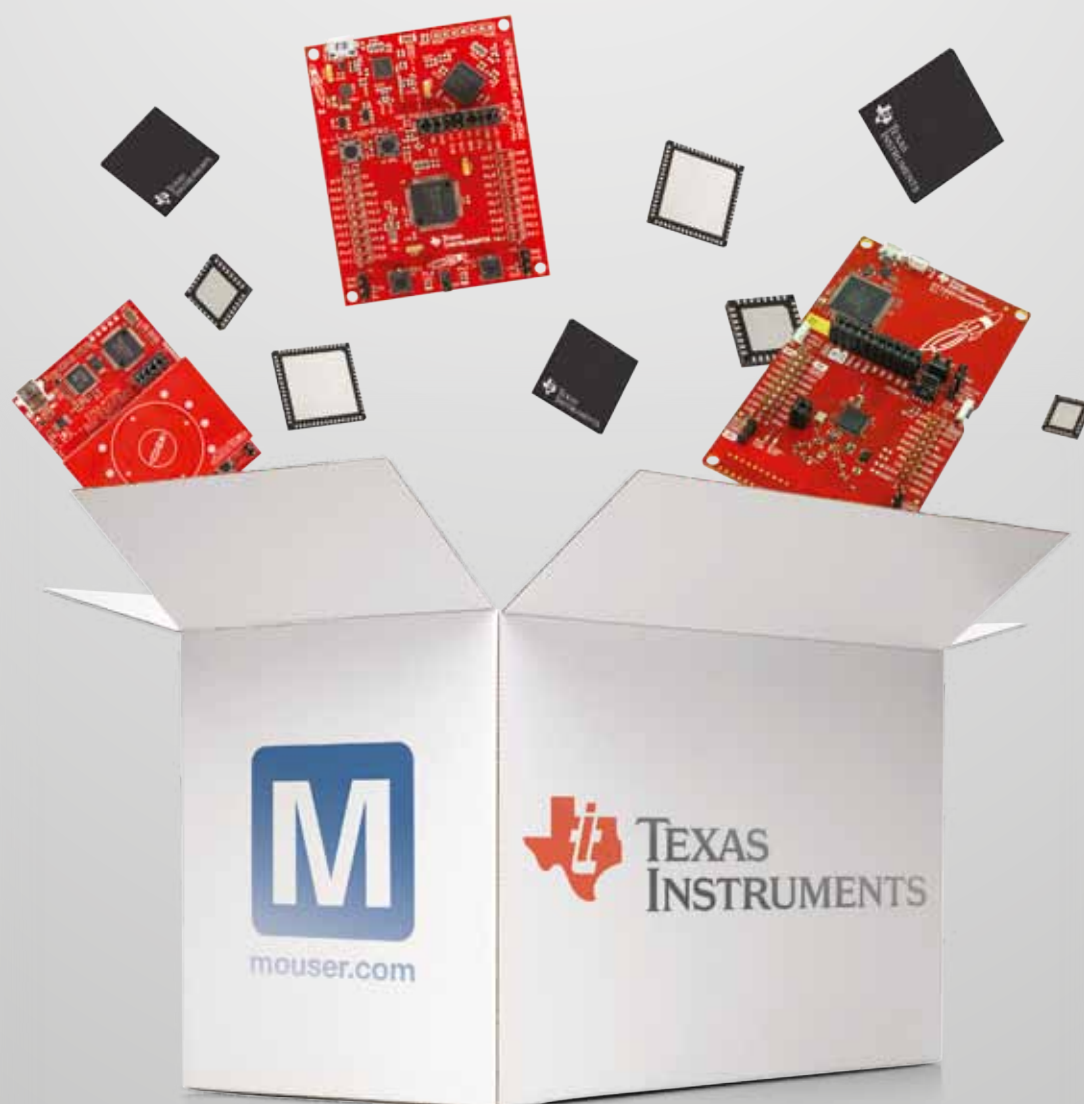
The RKZE series is a 2 W DC/DC converter in an industry-standard SIP7 case. The extended operating temperature range runs from -40 to +95°C, making these converters suitable for demanding environments in industrial, test and measurement applications as well as high-volume manufacturing. They are pin-compatible with the RK and RH converter series, offering a simple way to upgrade to a 2 W high isolation supply from 1 W. Standard isolation is 3 kVDC and the /H version is factory tested to 4 kVDC. Single or dual outputs are available with optional continuous short circuit protection (/P suffix).

EN62368-1 certification and EN55032 EMC compliances make these converters ready for easy integration into any IoT and Industry 4.0 PCB design.

**RECOM Power GmbH**  
[www.recom-power.com](http://www.recom-power.com)



**au·thor·ized** *adjective*  
having permission or approval  
*as in, "Mouser is an authorized source."*



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### PoE+ POWERED DEVICE ICs

The Si3406x Power over Ethernet Plus (PoE+) powered device (PD) family, from Silicon Labs, integrate all necessary high-voltage discrete components on a single PD chip.

The ICs are said to reduce time to market and system cost for a variety of high-efficiency, high-power PoE+ PD applications. They deliver 30 W of power to support feature-rich Internet of Things (IoT) products like voice over IP (VoIP) devices, motor-positioned IP and security cameras, and other industrial devices.

As the demand for high-wattage IoT applications increases, developers must rely on powered devices that support the PoE+ standard. The ICs convert the high voltage supplied over Ethernet copper cabling into a regulated, low-voltage DC supply. They offer a broad array of feature options, including reduced EMI; flexible power conversion options; a robust sleep mode augmented with mode control, wake pin and LED driver; and full IEEE 802.3at compliance.

The family includes the flagship Si3406 IC; the Si34061 variant, which adds support for external FETs and to improve power conversion efficiency; and the Si34062 variant, which includes support for sleep modes with wake function, as well as LED drive capability. The 20-pin Si3406 IC and 24-pin Si34061 and Si34062 are housed in a compact, 5 x 5 mm QFN package and support an operating temperature range of -40 to +85°C.

**Mouser Electronics**

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### ROBUST DIP SWITCH WITH GOLD CONTACTS

The WS-DITU DIP switch, from Würth Elektronik eiSos, features gold-plated contacts that ensure the switch has stable contact resistance.

The robust switch is durable and its pins are securely protected against deformation. The product's design ensures exact compliance to the grid dimensions of 2.54 mm.

DIP switches are used everywhere that specific, basic settings need to be made swiftly and directly on board the PCB. The WS-DITU DIP switch can be easily mounted manually and is available with 2–10 switch units (evenpoles).

The insulation material has a UL94 V-0 flammability rating and is capable of operating at temperatures between -40 and +85°C. The rated current is 25 mA, the dielectric strength is 500 V and the contact resistance is 50 mΩ.

**Würth Electronics Australia Pty**

[www.we-online.com](http://www.we-online.com)



### TABLET ANALYSER

The Rover HD Tab 7 Lite is a tablet analyser used for the installation, maintenance and commissioning of terrestrial, satellite and DVB T/C/S/S2 cable TV systems. It performs measurements that include power level, MER, BER, noise margin, SNR, error constellation chart, network and streams IDs as well as MPEG4 HD programs for DVB-T and -C. It is available to rent from TechRentals.

The Foxtel-approved unit includes an exclusive Rover Autodiscovery system which automatically detects and selects analog and digital COFDM/QAM TV signals in both measurement and spectrum mode. It also includes a high-resolution 7" TFT touch-screen display.

The product features a help function that automatically identifies all signals with digital modulation SAT, TV and CATV. It also includes an Automatic Assistant for signal quality analysis and channel scan memorisation. Other special features include a Barscan TV and CATV function from 10 to 100 channels on one screen, as well as a buzzer and noise margin real-time graph.

**TechRentals**

[www.techrentals.com.au](http://www.techrentals.com.au)



## BIDIRECTIONAL BUCK-BOOST CONTROLLERS

Renesas Electronics has announced a family of bidirectional four-switch synchronous buck-boost controllers. The ISL81601 and ISL81401 are true bidirectional controllers that sense peak current at both ends and provide cycle-by-cycle current limit in both directions while in buck or boost mode. The controllers generate point-of-load (POL) and voltage rail conversions with peak efficiency up to 99%.

The ISL81601 has a wide input range of 4.5 to 60 V and produces a 0.8 to 60 V output to support most industrial batteries: 12, 24, 36 and 48 V. Also available is the ISL81401, a 4.5 to 40 V input and 0.8 to 40 V output version, and its unidirectional counterpart, the ISL81401A. The controllers are suited to DC power backup and battery-powered medical, industrial and telecommunication systems.

The controllers' bidirectional peak current sensing capability eliminates complex external circuitry required for charging and discharging a battery to supply power to the loads. Their proprietary algorithm provides smooth mode transitions between buck, boost and buck-boost, while reducing low frequency ripple at Vout, ensuring minimal disturbances during line or load transients. The algorithm also ensures predictable ripple voltage under all conditions.

The addition of multilayer overcurrent protection and a precision control algorithm delivers constant current down to 0.1 V at Vout for ongoing operation. Designers can expand system power by paralleling an unlimited number of controllers. The controllers operate two switches at a time to minimise power loss and achieve higher efficiency.

**Renesas Electronics**

[www.renesas.com](http://www.renesas.com)



## Why TRI Components ?

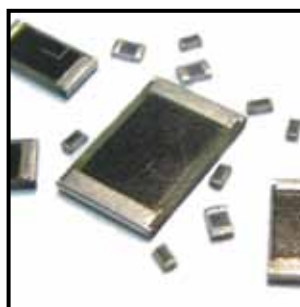
For nearly 50 years TRI Components has been operating in Victoria, supplying and stocking only the best electronic components for Australia and New Zealand customers.

Our depth of experience and expertise in the RF, POWER and EMI fields ensure that we can help to solve any requirement and provide the very best solutions quickly.

- Warehouse stocked parts here in Melbourne to reduce lead-times
- FREE Samples to evaluate
- Engineering Designer KITS for prototyping
- Custom made parts

Our team are dedicated to providing good old fashioned service with a smile that ensures that our customers repeatedly and confidently return time and again.

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## ETHERCAT TO MODBUS RTU GATEWAY

The ICP DAS ECAT-2610 is an EtherCAT to Modbus RTU gateway. Serial RS232/422/485-based industrial devices and equipment can be integrated into an EtherCAT-based control system without the need for any changes to the device: just connect and configure, and it's finished.

The ECAT-2610 communicator is a protocol converter gateway that connects non-networked industrial devices and equipment to EtherCAT. The gateway performs an intelligent protocol conversion and presents the serial data to the Master PLC/controller as easily processed I/O data.

The device supports maximum 256-word input and 256-word output data, and a maximum baud rate of 115,200 bps, allowing system integrators to retrofit older automation devices into modern EtherCAT communication systems. Requiring no hardware or software changes to be made to the connected device, it is compatible with all PLCs with EtherCAT support. No PLC function blocks are required.

**ICP Electronics Australia Pty Ltd**  
[www.icp-australia.com.au](http://www.icp-australia.com.au)

## SPACE-SAVING, WIDE INPUT VOLTAGE DC/DC CONVERTERS

Two more MORNSUN 10 W SIP converters have been added to the SIP8 R3 DC/DC converters family: the URB\_S-10WR3 and VRB\_S-10WR3 series. The company has increased the power density of its converters in the international standard sized SIP8 package, now offering a power range including 1, 3, 6 and 10 W.

The 10 W URB\_S-10WR3 and VRB\_S-10WR3 series offer a 4:1 and 2:1 wide input voltage range (9–36 V) and are available with regulated output voltages of 3.3, 5, 9, 12, 15 and 24 VDC. Due to their wide -40 to +85°C operating temperature range, the two 10WR3 series are suited to a wide range of applications including industrial control, grid power, instrumentation, communication, etc. In addition to meeting EN62368 certification, protections for input undervoltage, output short circuit and overcurrent are also included.

With high efficiency up to 88%, MORNSUN's wide-input R3 DC/DC converters are designed for high power density based on upgraded product performance, which meets demands for space and high power density in different applications. MORNSUN products are distributed in Australia & New Zealand by DLPC.

**DLPC Pty Ltd**  
[www.dlpc.com.au](http://www.dlpc.com.au)



## AUGMENTED REALITY SMARTGLASSES

Epson Australia's Moverio BT-35E augmented reality smartglasses have a transparent Si-OLED display. The smartglasses feature an interface unit with HDMI and USB Type-C ports to easily connect to popular output devices and seamlessly blend digital content into the real world.

The product is suitable for a range of applications, including enterprise drone piloting often used by real estate companies and engineers to survey ground or housing, remote field support such as the checking of powerlines, health, and visitor experience in museums and galleries where 'wearable' information is the best way to communicate facts.

The smartglasses function as a wearable display for any standard HDMI (HDMI1.4) output device, as well as any USB Type-C output device supporting DisplayPort Alt Mode, reducing the need to create or port content to the Moverio platform.

Comfortably and durably designed for daily use, the smartglasses allow users to keep their display in front of them as they carry out their tasks, allowing for increased productivity. Offering an easy out-of-box experience, they provide easy plug-and-play operation with no special software required.

**Epson Australia Pty Ltd**  
[www.epson.com.au](http://www.epson.com.au)







## ULTRALOW-POWER MICROCONTROLLERS

STMicroelectronics is bringing sophisticated cyber protection to power-conscious connected devices with the STM32L5 microcontroller (MCU) series featuring the Arm Cortex-M33 core.

Building on the Cortex-M33, which boosts protection for small devices by integrating Arm's TrustZone hardware-based security, the MCUs add enhancements including flexible software isolation, secure boot, key storage and hardware cryptographic accelerators. They also provide rich functionality, high performance and long runtimes powered by coin cells or energy harvesting. Consuming as little as

33 nA in shutdown mode and achieving 402 ULPMark-CP in the EEMBC ULPBench, the MCU series builds on STMicroelectronics' expertise in low-power techniques such as adaptive voltage scaling, real-time acceleration, power gating and multiple reduced-power operating modes.

The STM32L5 series with TrustZone and additional custom protection features strengthens and hardens cyber protection for small IoT devices. Also featuring the company's energy-saving technologies, rich connectivity, and smart digital and analog peripherals, the devices are a good choice for hosting cutting-edge connected applications.

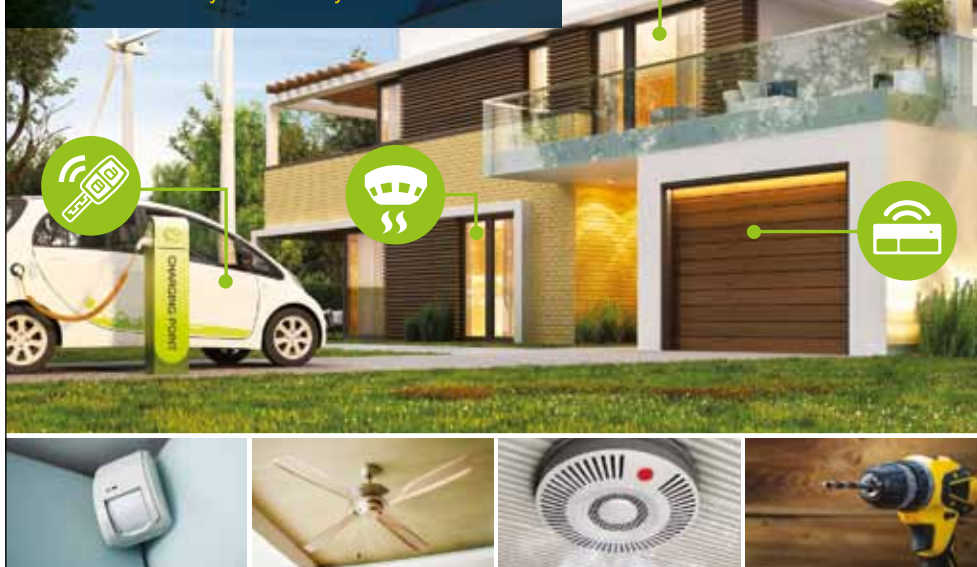
With extensive integrated digital and analog peripherals, and consumer and industrial interfaces such as CAN FD, USB Type-C and USB Power Delivery, the MCUs provide a suitable platform for products such as industrial sensors or controls, home-automation devices, smart meters, fitness trackers, smart watches, medical pumps or meters, and many others. The series is available in standard temperature grade for consumer and commercial applications, or high-temperature grade specified from -40 to 125°C for challenging environments.

**STMicroelectronics Pty Ltd**

[www.st.com](http://www.st.com)

## Closing the Loop on Real-Time Control Systems

Real-Time Control in Minimal Space with the ATtiny1607 Family



Take the frustration out of adding determinism and real-time control to your embedded system. The ATtiny1607 family of AVR® microcontrollers (MCUs) is optimized for space-constrained, closed-loop control systems such as handheld power tools and remote controls. This family of MCUs combines set-and-forget configurable hardware peripherals that automate the handling of many control tasks with an ultra-small physical footprint that helps you optimize your board layout. Additionally, these MCUs are supported by a development ecosystem that enables you to take your ideas from prototype to production with ease.

### Key Features:

- Reduce cost with our integrated peripheral event system and Configurable Custom Logic (CCL) module
- Improve noise suppression and accuracy using the 10-bit 115 kSPS Analog to Digital Converter (ADC)
- Easily connect with built-in USART, SPI and I²C interfaces
- Simplify your code creation with Atmel START, our web-based code configuration tool



### Contact Information

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- Stainless steel housing
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- Coloured diffused lens
- Internal potting
- Reverse protection diode fitted in all voltage models
- Range of LED colour options
- Range of voltage options

614 SERIES



- Ø8.1mm mounting
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- Water clear lens
- Internal potting
- Reverse protection diode fitted in all voltage models
- Range of voltage options

677 SERIES



- Ø8.1mm mounting
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- Black chrome aluminium housing
- Sealed to IP67 - weatherproof
- Wide viewing angle - smoked lens
- Internal potting
- Reverse protection diode fitted in all voltage models
- Range of LED colour options
- Range of voltage options

671 SERIES



- 25.4mm mounting
- High Voltage, High Intensity version from 24 to 440V and up to 1125lm
- Bi-polar circuitry for AC or DC operation in any orientation
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- Colour diffused lens
- Sealed to IP67
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## HARDWARE AND SOFTWARE REFERENCE DESIGN

The Renesas Synergy AE-CLOUD2 kit is a complete hardware and software reference design that allows embedded developers to quickly evaluate cellular connectivity options and build low-power wide-area (LPWA) cellular Internet of Things (IoT) applications.

Together with the Synergy Software Package (SSP) version 1.5.0, the kit is said to simplify connecting IoT sensor devices to enterprise cloud services using 4G/LTE Cat-M1 and Cat-NB1, also called NB-IoT, with fallback to 2G/EGPRS cellular networks. Its rich functionality is said to accelerate prototyping cellular-enabled IoT devices for asset tracking, retail and agriculture monitoring, smart cities/utilities, mobile health care and industrial automation.

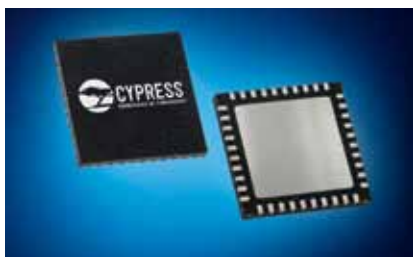
Each kit includes a Synergy S5D9 microcontroller (MCU) baseboard, tri-mode cellular modem with cellular and GPS antennas, Wi-Fi, Ethernet and various sensors such as lighting, microphone, temperature, humidity, pressure, air quality, geomagnetic, accelerometer and gyroscope. For cellular access, developers simply insert a SIM card with a data plan purchased from a local cellular carrier.

The hardware kit's software allows developers to provision the kit to connect to a 4G/LTE IoT cellular network and their preferred cloud service provider: Amazon Web Services, Google Cloud Platform, Microsoft Azure or Medium One Cloud. Users can visualise their sensor data on a customisable, password-protected dashboard.

The hardware kit ensures good EMC performance, having passed global RF emissions tests. In addition, the kit complies with global regulatory certifications for FCC, CE, RoHS, WEEE and Japan MIC. Its fully optimised hardware/software is designed to save developers months of design time and resources, creating a scalable, energy-efficient and secure end-to-end LPWA cellular IoT application that can be used anywhere in the world.

**Renesas Electronics**  
[www.renesas.com](http://www.renesas.com)





## DUAL-MODE BLUETOOTH WIRELESS MICROCONTROLLER

The CYW20719 dual-mode Bluetooth wireless microcontroller, from Cypress Semiconductor, has been optimised for Internet of Things (IoT) applications.

The ultralow-power microcontroller device complies with Bluetooth core specification version 5.0 (with LE 2 Mbps optional feature) with support for mesh networking. Forged using a 40 nm CMOS low-power fabrication process, the system-on-chip (SoC) employs a high level of performance

and integration to help reduce external components while minimising the footprint of the application.

The microcontroller subsystem consists of a 96 MHz Arm Cortex-M4 microcontroller with floating point unit (FPU), 512 KB of RAM, 2 MB of ROM (containing the stack and drivers) and 1 MB of probe-proof flash memory. The probe-proof flash, once programmed, not only prevents hackers from reprogramming the device to gain access to sensitive user data or payment information, it also inhibits competitors from doing a flash dump to reverse engineer the firmware IP. For additional security, the product includes various security functions — such as ECDH, RSA, AES and SHA/MD5 hashing functions — as well as a hardware accelerator to ensure best-in-class encryption for Bluetooth.

The ultralow-power radio in the device delivers a Bluetooth low energy (BLE) receive current (Rx) of 5.9 mA with sensitivity of -95.5 dBm and a transmit current (Tx) of 5.6 mA at 0 dBm. Ultralow current consumption enables extended battery life for a variety of wireless IoT devices, including wearables and fitness bands, home automation, medical devices and proximity sensors.

It is supported by the CYW920719Q40EVB-01 evaluation kit and the Cypress Wireless Internet Connectivity for Embedded Devices (WICED) Studio IoT development platform, which provides all the application programming interfaces, code snippets and demo applications to accelerate the development process.

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## The Error-Free Cable Certification Solution

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The CertiFiber Pro Optical Loss Test Set helps cabling professionals accomplish more than ever. The OLTS focuses on accuracy, error-free certification, making jobs easier to manage, and certifying fiber optic cabling to industry standards. As part of the Versiv family, the unit incorporates ProjX to ease job set-up making it suitable for users of all skill levels.

### Features:

- ✓ Three-second Autotest optical loss measurement
- ✓ Automatic Pass/Fail analysis
- ✓ Interchangeable power meter adapter
- ✓ Built-in visual fault locator



# SILICON CHIP CREATED FOR A QUANTUM PROCESSOR

Light may be the missing ingredient in making usable quantum silicon computer chips, according to an international team led by the University of Bristol.

"Qubits can be 1 and 0 at the same time or can link in much more complicated ways — a process known as quantum entanglement — allowing us to process enormous amounts of data at once."

One challenge of quantum computers is to make processors that can be reprogrammed to perform different tasks, just as we have computers today that can be reprogrammed to run different applications. A second challenge is how to make a quantum computer in a way that its many parts can be made with very high quality and ultimately at low cost.

The Bristol team has been using silicon photonic chips — the same technology used to make today's computer processors — as a way to try to build quantum computing components on a large scale. Now, they have demonstrated that it is possible to fully control two qubits of information within a single integrated chip — meaning any task that can be achieved with two qubits can be programmed and realised with the device.

"What this means is that we've effectively created a programmable machine that can accomplish a variety of tasks," said Professor Ralph.

"And since it's a very small processor and can be built out of silicon, it might be able to be scaled in a cost-effective way."

The integrated photonics effort started in 2008 as an answer to the growing concern that individual mirrors and optical elements are just too big and unstable to realise the large complex circuits that quantum computers will require.

"We need to be looking at how to make quantum computers out of technology that is scalable, which includes technology that we know can be built incredibly precisely on a tremendous scale," said co-author Dr Jonathan Matthews, based at the Quantum Engineering Technology Labs at the University of Bristol.

"We think silicon is a promising material to do this, partly because of all the investment that has already gone into developing silicon for the microelectronics and photonics industries. And the types of devices developed in Bristol ... are showing just how well quantum devices can be engineered."

Lead author Dr Xiaogang Qiang, who undertook the work while studying for a PhD at the University of Bristol and now works at the National University of Defense Technology in China, noted that the new device is "a very primitive processor, because it only works on two qubits, which means there is still a long way before we can do useful computations with this technology".

"But what is exciting is that it the different properties of silicon photonics that can be used for making a quantum computer have been combined together in one device," Dr Qiang said.

"This is just too complicated to physically implement with light using previous approaches."

A surprising result of the experiment is that the quantum computing machine has become a research tool in its own right, with Professor Jingbo Wang from The University of Western Australia stating, "The team have used the silicon chip to perform delicate quantum information experiments with 100,000 different reprogrammable settings.

"One of the experiments is to implement a special class of quantum walk, which allows simultaneous traversing of all possible paths in arbitrarily complex network structures," Professor Wang said.

According to Professor Ralph, "This is just the beginning; we're just starting to see what kind of exponential change this might lead to.

"It's still early days, but we've aimed to develop technology that is truly scalable, and since there's been so much research and investment in silicon chips, this innovation might be found in the laptops and smartphones of the future," he said.

**T**he team has engineered a silicon chip that can guide single particles of light known as photons along optical tracks, encoding and processing quantum bits of information known as 'qubits'. The results of their work have been published in the journal *Nature Photonics*.

International effort is growing to develop quantum computers, in order to increase the types of tasks that computers can solve for us. Quantum computers hold the promise of solving complex problems that would be otherwise intractable, such as the ability to predict and design properties of molecules, make sense of data involved in space exploration and build automated navigation systems.

Today's computers and smartphones are encoded with information called 'bits' which take the form of either a '1' or a '0'. Quantum computers are instead based on qubits that can be in a superposition of the 0 and 1 states, and multiple qubits can be linked in a special way called quantum entanglement. These two quantum physical properties provide the power to quantum computers.

"Current computers use a binary code — comprising 1s and 0s — to transfer information, but quantum computers have potential for greater power by harnessing the power of qubits," said Professor Timothy Ralph, a researcher at The University of Queensland and co-author on the study.





## HANDHELD MICROWAVE SPECTRUM ANALYSERS

Rohde & Schwarz has expanded its R&S Spectrum Rider FPH family with three more base models providing frequency ranges from 5 kHz to 6, 13.6 and 26.5 GHz.

The R&S Spectrum Rider FPH was the industry's first handheld spectrum analyser to offer a capacitive touch screen and a frequency upgrade concept via key codes. Since upgrades require neither downtime nor recalibration, users can effortlessly upgrade their base models, eg, from 26.5 to 31 GHz.

Higher-frequency models enable the rugged device to perform a vast range of measurement tasks in the field and lab. In combination with a number of useful options, the spectrum analyser is a handy tool for diverse applications, such as verifying signal transmission over 5G, broadcast, radar and satellite communications links. The instrument will appeal to field technicians and lab engineers alike, as it supports everyday measurement tasks in aerospace and defence, mobile network testing and broadcasting, as well as tasks to be performed by regulatory authorities and tasks in education.

Weighing just 2.5 kg, the unit is suitable for mobile use. Its battery lasts more than 6 h, making the instrument capable of working a full day without recharging.

The analyser can be remotely controlled via USB or LAN. For even more convenience, the R&S MobileView app for iOS and Android provides wireless remote control from a mobile device.

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## WIRELESS BATTERY-CHARGER TRANSMITTER

The STMicroelectronics STWBC-MC 15 W wireless battery-charger transmitter can control multiple charging coils, making charging less dependent on the precise position of the battery-powered device.

Compliant with the latest Qi 1.2.4 specification, the transmitter is specifically designed to support the Qi MPA15 EPP (Extended Power Profile) topology. In addition to detecting a valid receiver and selecting the most efficient coil for power transfer, it ensures extended foreign object detection (FOD) through bidirectional communication with the receiver. The product also supports the proprietary wireless fast-charge extensions of leading smartphone manufacturers.

To ensure fast and stable charging for all types of devices, the transmitter monitors coil current and voltage. By integrating a digital DC-DC controller, it delivers the required power to the coil at a fixed frequency and so minimises interference with other systems inside smartphones and tablets. Given the EU's intention to extend the scope of the Radio Equipment Directive (RED) to include wireless-charging transmitters and restrict H-field emissions above 145 kHz to -5 dBm, the unit's low-EMI design eases compliance.

ST's triple-path modulation technique for communication between the transmitter and receiver increases noise immunity and the IC's low standby consumption minimises wasted energy when not charging.

**STMicroelectronics Pty Ltd**

[www.st.com](http://www.st.com)

## CABINET COOLERS WITH SIDE MOUNT KITS

EXAIR's NEMA 4X Cabinet Coolers are used to purge and cool electrical control panels, protecting sensitive electronics from heat, dirt and moisture.

The compact cabinet coolers convert an ordinary supply of compressed air to  $-7^{\circ}\text{C}$  without refrigerants or CFCs. The cold air is circulated through the enclosure to eliminate high-temperature malfunction. Cooling capacities up to 5600 Btu/h are available.

The cabinet cooler systems include a compressed air filter to ensure no moisture or dust is introduced inside the panel. Optional thermostat control minimises compressed air use. The cabinet coolers are UL Listed, conform to the CE general safety directive for machinery and have no moving parts to wear out.

The corrosion-resistant Type 316 Side Mount Kits make the mounting of a NEMA 4X Cabinet Cooler possible when an electrical enclosure has limited space on the top or side. Applications include cooling PLCs, microprocessors, variable frequency drives, industrial computers and robotics.

The side mount kits maintain the NEMA 4X rating of large and small electrical enclosures. Models for use on NEMA 4 and 12 enclosures are also available.

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## MINIATURISED PoE PD MODULE

The Ag9900 series modules are said to push the boundaries of PoE miniaturisation, yet still offer all the features expected from Silvertel's PoE devices. The LP variant offers a low-profile module that is only 8 mm tall to match the low-profile RJ45 connectors.

The module is designed to extract power from a Cat5 cable, fully conforming to the 802.3af Power over Ethernet (PoE) standard, and includes 1.5 kV isolation, a PoE signature and an integral DC to DC converter. The module provides a Class 0 signature.

The device provides signature and control circuitry to provide full PoE compatibility. This signature is required by the power sourcing equipment (PSE) before it will provide power to the port. The module's integrated DC/DC converter operates over a wide input voltage range with high efficiency (up to 87%).

The product offers a simple, ultrasmall PoE solution using minimal external components. External bridge rectifiers enable the device to be powered from mid- or end-span PSE, accepting power from either the spare or data pairs of the cable. The regulated DC output voltage is easily adjusted using a simple pull up/down resistor.

The overtemperature protection reduces the output power if the maximum operating temperature is exceeded. Normal operation resumes when the temperature drops back below the threshold. Built-in protection against overloads and short circuits is also provided.

The device is suitable as a PoE solution for any application, but particularly for small devices and space-limited designs such as IoT, WAPs, sensors, access control and small IP cameras.

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## 5 W AC/DC MODULES FOR INDUSTRY 4.0, IoT AND SMART HOME

RECOM expands its low-power AC/DC portfolio with encapsulated 5 W power supplies, which operate up to +90°C. They accept input voltage lines of up to 305 VAC and offer peak power capability up to 6 W. The modules are suitable for Industry 4.0, IoT and smart household applications requiring features that go beyond the industry standard.

With its RAC05-K/277 series, RECOM introduces 5 W AC/DC converters that support peak power needs and are specially designed for extended input lines and operation at extreme temperatures from -40 up to +90°C. The devices are built to operate from extended input lines with mains voltages from 85 up to 305 VAC. They are EMC compliant to EN55022 class 'B' with a minimum 6 dB margin on both radiated and conducted readings without the need for external components. At a 1" x 1.25" footprint, these PCB-mount or wired modules feature fully protected outputs and international safety certifications for industrial, household and ITE for worldwide use.

The RAC05-K/277 series is an addition to RECOM's ultracompact RAC05-K converters with a 1" x 1" footprint, as well as the RAC05-K/480, an AC/DC module dedicated for phase-to-phase operation up to 528 VAC and exclusive only to RECOM. Wired versions of the RAC05-K/277 series are available now.

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## MEMS-VCSEL LASER SOURCES

Thorlabs has released next-generation versions of its 1300 nm MEMS-VCSEL Swept-Wavelength laser sources. With a coherence length of over 100 mm and sweep rates of either 100 or 200 kHz, the SL131090 and SL132120 are claimed to be the only commercially available MEMS-VCSEL laser sources on the market. Based on a microelectromechanical system (MEMS) tunable vertical cavity surface emitting laser (VCSEL), the light sources include an active power control that maintains constant output power over the lifetime of the laser.

All drive electronics and trigger signals needed to seamlessly integrate the laser sources into custom swept-source optical coherence tomography (OCT) systems are provided. An output digital 'k-clock' signal generated by the integrated Mach-Zehnder interferometer (MZI) and drive electronics can be used as a data acquisition sampling clock, with no further resampling in k-space required. The k-clock signal delay and maximum output power of the laser can be user adjusted up to  $\pm 8$  ns and  $\pm 5\%$ , respectively.

Designed for integration into high-speed and long-range OCT systems requiring high sensitivity, the singlemode benchtop sources are also suitable for other applications, including metrology and spectroscopy.

**Lastek Pty Ltd**

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## COMPACT PCB CONNECTORS

Phoenix Contact has extended its range of compact PCB connectors, now with a pitch of 2.54 mm. The single- and double-row MCC 0,5 and DMCC 0,5 connectors are suitable for conductor cross-sections from 0.14 to 0.75 mm<sup>2</sup>.

The 2- to 16-position connectors are designed for currents up to 6 A and voltages up to 160 V. Corresponding crimp contacts with a gold-plated surface are available as bulk or taped products, and enable manual or automated processing of small and large numbers of positions.

The PCB connectors are connection-compatible with the FMC 0,5 and DFMC 0,5 series with Push-in spring connection, enabling the user to choose freely between crimp or Push-in spring connection, depending on the application.

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## PCB SUPPORTS/SPACERS

Suitable for PCB packaging and stacking applications, NPA's latest spacers/supports come in seven styles. Used for board-to-board and chassis-to-board requirements, they are available in both push-in mount and screw mount versions. The spacers/supports come in a wide range of spacing heights and will meet almost any PCB packaging need.

Requiring no tools for assembly, the spacers/supports snap in to produce a strong grip. Easily installed and re-usable for repairs, the spacers/supports lock-fit to the chassis and either lock-fit or tension-fit to the PCB. Screw-mount versions screw-down to the chassis and tension-fit to the PCB. They are available for #4, #6 and #8 screw sizes.

Durable and lightweight, the spacers/supports are manufactured from flame-resistant nylon, rated to UL 94V-0. They feature one-piece moulded construction, which ensures consistent, close tolerance dimensions and high strength.

Application engineering services are available to meet special requirements.

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## DRIVE SLEW RINGS

Drive slew rings from Motion Technologies are designed for high axial and radial loads. Often not noticed, they can produce large amounts of torque. For example, the DSR7 model can produce 1500 Nm of output torque with 10.4 kNm of holding torque. Larger units can produce 18 kNm of continuous torque.

The units are manufactured in steel and pre-drilled for easy mounting. They are available in a range of sizes and can be fitted with hydraulic, stepper, servo and AC motors.

**Motion Technologies Pty Ltd**

[www.motiontech.com.au](http://www.motiontech.com.au)

## SAMPLING OSCILLOSCOPE FOR 53 GBAUD PAM4 OPTICAL SIGNAL ANALYSIS

Anritsu has announced a 53 Gbaud PAM4 analysis function for the company's MP2110A BERTWave sampling oscilloscope targeted at production and inspection of optical modules. As well as featuring both high-sensitivity and high-speed measurements, the MP2110A now supports development and production-line inspection of next-generation QSFP-DD optical transceivers expected to be deployed in data centres.

Data traffic is growing exponentially due to the spread of flat-rate video streaming and other cloud services. Coping with this growth requires deployment of transmission-equipment interfaces exceeding speeds of 100 Gbps, and 200/400 GbE interfaces have already started appearing. Moreover, this 200/400 GbE transmission format uses PAM4 technology, instead of the older NRZ technology.

The MP2110A supports both NRZ and PAM4 signal measurements, including TDECQ, enabling all-in-one quality evaluations of optical modules at speeds from 25 to 400 G. In addition, the MP2110A featuring high-speed measurement and PAM4 analysis will play a key role in improving optical module production-line productivity. Moreover, adding 53 Gbaud support for quality evaluation of next-generation optical modules helps cut capital equipment renewal costs.

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## IP66 SEALED POLYCARBONATE AND ABS ENCLOSURES

Optimised for use in harsh industrial environments, the 1554 flat lid and 1555 styled lid ranges of ABS and UV stabilised polycarbonate enclosures from Hammond Electronics provide IP66 sealing and good mechanical protection.

The light grey RAL 7035 enclosures are designed to house printed circuit boards or DIN rail-mounted components. IP66 sealing is achieved through a one-piece silicone gasket in a tongue and groove seal.

Twenty-three sizes from 66 x 66 x 41 mm to 239 x 160 x 119 mm are available with flat and styled self-coloured, clear and translucent lids. Flanged lids for 10 sizes, from 119 x 66 x 42 mm to 180 x 119 x 62 mm, provide increased security by preventing access to the interior without removing the enclosure from the surface to which it is attached.

The styled lids include a recess suitable for mounting a membrane keyboard and are also fitted with PCB mounting bosses. Bases are fitted with internal DIN rail-mounting tabs in all but two sizes and standoffs for mounting PCBs or optional internal panels are provided in all versions.

To avoid any possible corrosion problems the base inserts and self-captivating lid screws are both stainless steel, located outside the gasket; additional holes in the base, again outside the gasket seal, are provided to allow the enclosure to be wall or shelf mounted. An optional foot kit is also available. Optional steel panels suitable for mounting heavy components can be fitted to the integral mounting points in the base; the bases also feature moulded slots to enable 1.6 mm-thick PCBs to be mounted vertically into the enclosure.

**Hammond Electronics Pty Ltd**  
[www.hammondmfg.com](http://www.hammondmfg.com)

## HART TO ETHERNET GATEWAY SYSTEM

The HES HART to Ethernet Gateway System, from Moore Industries, converts signals from up to 64 wired HART devices to Ethernet MODBUS/TCP and HART-IP.

The product allows HART transmitters and smart valves to interface directly with MODBUS/TCP-based monitoring and control systems over Ethernet, with field device data viewable in any web browser via the HES's built-in web server. It communicates with HART field devices in point-to-point and digital multidrop networks and supports both Normal and Burst Mode communications.

The system is available in a single- or 4-channel configuration. Single-channel configuration supports up to 16 HART devices in digital multidrop mode or can support just one device in a standard point-to-point 4-20 mA loop configuration. The 4-channel configuration can support up to 64 total HART devices for high-density installations.

The device supports communication with HART 5, 6 and 7 field devices that includes Coriolis, magnetic, vortex, ultrasonic and multivariable mass flowmeters along with pressure, pH, level, temperature transmitters and even smart valve positioners. It has sufficient memory to handle thousands of process variable and diagnostic data points from connected smart HART devices.

All HART data from connected field devices is viewable in read-only mode with any web browser via the product's built-in web server or a MODBUS/TCP compliant host. The unit also supports HART-IP, allowing any of the connected HART device variables, HES variables or diagnostics to be monitored. Support for these open industrial protocols enables interface with any process control or asset management system while taking advantage of any Industrial Internet of Things (IIoT) initiatives that facilitate the propagation of process data to higher level corporate or analytical systems.

The system is simple to configure over Ethernet using PACTware or other FDT-compliant hosts with supplied HES DTM. Easy-to-use menus provide full configuration of the HES including HART channel communications, MODBUS communication and mapping settings and network security parameters.

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## SPLASHPROOF IEC PLUG AND CIRCUIT BREAKER

SCHURTER has enhanced its IEC inlet and circuit breaker power entry module with IP protection. The DG11 multimount power entry module includes the IEC plug C14/C18 with the integrated device circuit breaker TA35 to meet the requirements of a variety of applications. The power entry module is IP67 rated, which prevents ingress of dust and jetting water.



The module integrates an IEC C14/C18 with cord retention (V-Lock) inlet and a 2-pole TA35 circuit breaker, which provides the function of a switch and offers thermal overcurrent (overload) protection. The thermal overprotection is achieved with a bimetal mechanism; the 2-pole circuit breaker comes with one or two bimetals and has gradually rated currents between 0.05 and 20 A.

The unit features an IP67 rating and comes with a water-resistant protective cover on top of the circuit breaker, sealing bed and sealing screws to protect the device from dusty or wet environments. An IP40 rating is also available.

The product is available for almost every mounting variant with snap or screw mounting. The latter can be achieved with the front- or rear-mount version. In addition, holes for the screws are available in either a vertical or horizontal arrangement.

With its compact form factor and broad functionality, the device can be used in various industrial appliances. It is particularly suitable for appliances with medical or laboratory use, such as shaking water baths, ultrasonic cleaners, overhead stirrers and more.

**SCHURTER (S) PTE LTD**

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## MINI-ITX SERVER BOARD

The Mini-ITX AIMB-290 supports up to 16 cores for high performance. Its height meets 1U chassis dimensions and is 170 x 170 mm, making it suitable for small business servers with limited installation space.

AIMB-290 supports EMMC5.1, dual-channel DDR4 with ECC and non-ECC memory for U-DIMM and R-DIMM types. Its key features include 4x LAN (dual 10 GbE and dual Gigabit Ethernet), 3x USB 2.0 ports and 3x USB 3.0 ports. AIMB-290 also has 2x serial ports (1x RS232/422/485, 1x RS232) and 1x mPCIe w/ mPCIe module or mSATA. For flexible application requirements, it has two power inputs, a 4-pin DC 12 V input or an ATX 24-pin connector. It also supports external storage (NAS), SDN/NFV equipment, security appliances (VPN, firewall), routing, dedicated hosting, control planes and more.

AIMB-290 supports IPMI with BMC controllers that administrators can manage and monitor servers to make sure equipment is operating normally. If any problems occur, administrators can read event logs and restart equipment. It also can be set up for special situations and the system will send an alert message to the manager by email or text message. IPMI uses an independent LAN port on AIMB-290 to ensure the system cannot be compromised. AIMB-290 can also support TPM to add hardware/data management security features.

Furthermore, AIMB-290 has the ability to combine with Advantech's WISE-PaaS/RMM solution to add more applications. WISE-PaaS/RMM is an IoT device management software platform which comes with more than 100 RESTful APIs. These include account/device management, device control and database management. WISE-PaaS/RMM not only helps create new web services but also helps to integrate functions and data with its powerful management tools. Furthermore, IPMI and WISE-PaaS enhance connectivity for hardware, software, devices and sensors to help customers quickly develop their own services.

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# 'SPRAY-ON ANTENNAS'

## CAN TRANSMIT AND DIRECT RADIO WAVES

Thanks to a breakthrough from Drexel University's College of Engineering, installing an antenna could soon be as easy as applying some bug spray.

**T**he promise of wearable devices, functional fabrics, the Internet of Things and their next-generation technological cohort seems tantalisingly within reach. But researchers in the field will tell you a prime reason for their delay is the problem of seamlessly integrating connection technology — namely, antennas — with shape-shifting and flexible 'things'.

Now, Drexel University researchers have reported on a method for spraying invisibly thin antennas, made from a type of two-dimensional, metallic material called MXene, that perform as well as those being used in mobile devices, wireless routers and portable transducers. Their work has been published in the journal *Science Advances*.

"This is a very exciting finding because there is a lot of potential for this type of technology," said Professor Kapil Dandekar, who directs the Drexel Wireless Systems Lab and was a co-author of the research. "The ability to spray an antenna on a flexible substrate or make it optically transparent means that we could have a lot of new places to set up networks — there are new applications and new ways of collecting data that we can't even imagine at the moment."

The researchers report that the MXene titanium carbide can be dissolved in water to create an ink or paint. The exceptional conductivity of the material enables it to transmit and direct radio waves, even when it's applied in a very thin coating.

"We found that even transparent antennas with thicknesses of tens of nanometres were able to communicate efficiently," said Asia Sarycheva, a doctoral candidate in the A.J. Drexel Nanomaterials Institute. "By increasing the thickness up to 8  $\mu\text{m}$ , the performance of the MXene antenna achieved 98% of its predicted maximum value."

Preserving transmission quality in a form this thin is significant because it would allow antennas to easily be embedded — literally, sprayed on — in a wide variety of objects and surfaces without adding additional weight or circuitry or requiring a certain level of rigidity.

"This technology could enable the truly seamless integration of antennas with everyday objects which will be critical for the emerging Internet of Things," Prof Dandekar said. "Researchers have done a lot of work with non-traditional materials trying to figure out where manufacturing technology meets system needs, but this technology



*Researchers developed and tested spray-applied antennas made from a type of two-dimensional material called MXene.*

could make it a lot easier to answer some of the difficult questions we've been working on for years."

Initial testing of the sprayed antennas suggests that they can perform with the same range of quality as current antennas, which are made from familiar metals, like gold, silver, copper and aluminium but are much thicker than MXene antennas. Making antennas smaller and lighter has long been a goal of materials scientists and electrical engineers, so this discovery is a sizeable step forward both in terms of reducing their footprint as well as broadening their application.

"Current fabrication methods of metals cannot make antennas thin enough and applicable to any surface, in spite of decades of research and development to improve the performance of metal antennas," said Professor Yury Gogotsi, Director of the A.J. Drexel Nanomaterials Institute, who initiated and led the project.

"We were looking for two-dimensional nanomaterials, which have sheet thickness about a hundred thousand times thinner than a human hair; just a few atoms across, and can self-assemble into conductive films upon deposition on any surface. Therefore, we selected

MXene, which is a two-dimensional titanium carbide material that is stronger than metals and is metallically conductive, as a candidate for ultrathin antennas."

Drexel researchers discovered the family of MXene materials in 2011 and have been gaining an understanding of their properties, and considering their possible applications, ever since. The layered two-dimensional material, which is made by wet chemical processing, has already shown potential in energy storage devices, electromagnetic shielding, water filtration, chemical sensing, structural reinforcement and gas separation.

MXene materials have naturally drawn comparisons to promising two-dimensional materials like graphene, which has itself been explored as a material for printable antennas. The Drexel researchers put the spray-on antennas up against a variety of antennas made from these new materials, including graphene, silver ink and carbon nanotubes. The MXene antennas were 50 times better than graphene and 300 times better than silver ink antennas in terms of preserving the quality of radio wave transmission.

"The MXene antenna not only outperformed the macro and micro world of metal antennas, we went beyond the performance of available nanomaterial antennas, while keeping the antenna thickness very low," said Babak Anasori, a research assistant professor in the A.J. Drexel Nanomaterials Institute.

"The thinnest antenna was as thin as 62 nm — about a thousand times thinner than a sheet of paper — and it was almost transparent. Unlike other nanomaterials fabrication methods that require additives called binders, and extra steps of heating to sinter the nanoparticles together, we made antennas in a single step by airbrush spraying our water-based MXene ink."



*Spray-applied MXene antennas could open the door for new applications in smart technology, wearables and IoT devices.*

The group initially tested the spray-on application of the antenna ink on both a rough substrate (cellulose paper) and a smooth one (polyethylene terephthalate sheets). The next step for their work will be looking at the best ways to apply it to a wide variety of surfaces from glass to yarn and skin.

"Further research on using materials from the MXene family in wireless communication may enable fully transparent electronics and greatly improved wearable devices that will support the active lifestyles we are living," Anasori said.



*Power Distribution Unit (PDU) with integrated light pipes.*

# PERFECT LOAD BALANCING IN PDUs

**In addition to one-phase systems, three-phase systems are also used in many places in industry and commerce. They often offer decisive advantages. It is important to ensure safe load balancing in order to prevent overloads.**

**P**ower Distribution Units with multiple IEC outlets are a practical, space-saving solution for supplying power to a variety of devices. Nevertheless, this large number of loads can also tempt you to want to operate the electrical power capacity of the PDU up to its limit or even above it. This must be prevented under all circumstances. SCHURTER provides a wide range of technologies and components to ensure the safe use of power distribution units in one-phase and three-phase systems.

## Choice of IEC appliance outlets

The correct dimensioning and selection of the IEC outlets (type J with 10 A or type F with 16 A) must be the very beginning. How much power is required from the distribution unit? How many loads must the distribution unit be able to supply? Should or must the supply be one-phase or three-phase for power reasons? These questions are elementary for a safe load distribution of the PDU. A primary fuse on the respective phase ensures that the permissible supply power of 2.5 kW, for example, is not exceeded.

## Light pipe for status display

A typical application for light pipes is power distribution units in data centres. Switched outlets today have displays. However, these are usually located at the head of the strip. With the latest SCHURTER appliance outlets, the available information can be used intelligently.

The service technician on site, for example, can see at a glance which outlets are working or where a problem exists. For example, a failure can be signalled with a red LED or a critical power consumption pattern with a yellow LED. This makes both repairs and preventive interventions easier and more efficient.

The integration of the light pipe into the appliance outlet has several advantages. The light indicator is located directly at the socket, which makes it easy to assign the signal even in large power cabinets with many outlets and cables. The space requirement is also minimal and fewer openings are required in the PDU. The installation effort is significantly reduced.

## Cord retention systems: V-Lock and Twylock

The high packing density of servers in modern data centres demands the same on PDUs. However, in order not to unintentionally

pull out the wrong cable, high-quality, modern outlets offer a pull-out protection. Depending on the arrangement of the outlets in the PDU — horizontal or vertical — the SCHURTER V-Lock or other systems with lateral locking (eg, SCHURTER Twylock, SecureLock, etc) are available. Both cord retention versions, which are approximately equal in value, are available as standard.

## Tamper Resistant Outlet Lock Type F/Type J

In order to prevent overload of modern power distribution units with multiple IEC outlets, individual outlets can be blocked by means of protective caps: so-called Tamper Resistant Outlet Locks. In most cases, you have more outlets than loads on one strip. These Tamper Resistant Outlet Locks are plugged onto the power distribution unit just like a plug. For safety reasons, the optionally available protective caps cannot be removed without a special tool. This solution is particularly suitable for the supply of very different loads, which are also noticeable by increased operating temperatures.

## Colour coding of the outlets by phase

Power distribution units in three-phase systems are ideal for colour-coding the individual phases. Various IEC outlets of SCHURTER types J and F are therefore no longer only available in black, but also in white and grey. In the often poorly lit server and control cabinets of a data centre, this makes it easier to visually distinguish the individual phases.

## The matching connector

SCHURTER stands for safe and easy power supply and, in addition to the components for PDUs, also offers the appropriate plug connections. Mains connection cables, country-specific or also connection plugs for cable installation are included in the range of device plugs.

## About SCHURTER

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mation, intelligent customer experiences, self-driving vehicles and intelligent transportation.

The series is powered by the AMD Ryzen APU (CPU+GPU), which will be able to support up to four CPU cores, eight threads and four DisplayPort 1.4 cables. It comes with the AMD E9260 or the Nvidia GTX-1050TI, its GPU following Vega GPU architecture. Three full-size Mini-PCIe slots for internal expansion and one M.2 A-E Key 2230 for Wi-Fi/GPS/4G LTE are also available.

Deep learning relies on GPU acceleration, which the series delivers with a small footprint while being fully operable in harsh environments, making it suitable for industrial automation, transportation and smart city applications. The series can be applied to a scalable AI car platform, spanning the entire autonomous driving range.

It offers 9-48 VDC input with Intelligent Power Management, allowing timed delay settings for powering on/off, and a completely fanless design. The series also supports the MXM Version 3.1 Type A and PCIe x8 interfaces. The operating temperature is -40 to 70°C and the storage temperature is -40 to 80°C.

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## RUGGED COM EXPRESS MODULE

CM50C is a low-power and space-saving Rugged COM Express module that was developed around the Intel Atom E3900 series of processors. Due to the low power consumption, the virtualisation support of the processor and the safe board management controller, the robust module is a multifaceted solution for individual designs in harsh environments and safety-critical applications.

The unit is an ultrarugged COM Express Mini module for rolling stock, public transportation and industry applications. It is compatible with COM Express Type 10 Pin-Out and conforms to the VITA 59 standard, which specifies the mechanics to ensure operation in harsh environmental conditions.

Based on the Intel E3900 CPU series with a low power dissipation of 7-16 W, the product provides scalable performance with up to four cores and integrated quality graphics, as well as Intel VT-x virtualisation support. This allows it to run multiple applications on a single hardware platform, saving physical hardware.

The board management controller is designed to reduce downtime and is certifiable up to SIL 2. With the Trusted Platform Module and secure/measured booting features, fast cryptographic execution is supported. The product comes with a large variety of interfaces, including, eg, Digital Display Interfaces, HD Audio, PCI Express and Gigabit Ethernet.

In accordance with the Rugged COM Express standard, the module is embedded in a solid aluminium frame that protects the electronics from environmental influences such as humidity, dust, vibrations or EMC radiation and also enables operation in the extended temperature range from -40 to +85°C via conduction cooling. The processor's long-term availability of 15 years ensures an extended product life for a wide range of applications.

For less demanding applications, a standard COM Express variant without frame is also available.

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# TOWARDS A 5G FUTURE



A European consortium of engineers and scientists has demonstrated real-world point-to-multipoint transmission of data within the part of the wireless frequency spectrum known as millimetre wave, or W-band, which is between 92–95 GHz.

**T**his was the first significant breakthrough of the European Commission Horizon 2020 TWEETHER project, headed by Lancaster University, which is producing the future communication ‘arteries’ of 5G. Conducted at the Universitat Politècnica de Valencia (UPV), Spain, the field test came after more than three years of work designing cutting-edge components and systems to enable a point-to-multipoint wireless system above 90 GHz.

Millimetre waves are a part of the frequency spectrum that is currently unused, but appear very promising, from the wide frequency bands available, for supporting high data rates. Challenges with wireless communication data volumes and speeds can only be met by exploiting millimetre waves and TWEETHER is addressing these technical hurdles.

“The development of European technology at millimetre wave aims to solve two major challenges of modern communications — a way to wirelessly transmit to and from a grid of new 5G small cells networks, and the digital divide that affects millions of houses without broadband in areas where the fibre cannot be deployed,” said Project Coordinator Professor Claudio Paoloni from Lancaster University.

“It has been an emotional moment to see the TWEETHER equipment installed on the masts of the Universitat Politècnica de Valencia and watch the monitor showing the first data transmitted.”

The TWEETHER millimetre wave technology, when it becomes available to mobile network providers, will be deployed as part of future 5G networks, enabling up to 100 times faster internet connections than 4G currently offers.

The project partners have developed radio technology and manufactured the circuits and amplifier devices with a similar capacity to that of optic fibre — without requiring cables. According to the tests carried out, the technology enabled the transmission of

up to 10 Gbps over a large area to feed base stations for mobile networks or wireless fixed access broadband.

“A travelling wave amplifier has been designed during this European initiative, which would allow for the proper functioning of the 5G communication infrastructure in the millimetric wave bands across long distances,” said Roberto Llorente, Deputy Director of the UPV’s Centre of Nanophotonic Technology.

With the results of this project, companies will be able to offer ubiquitous access to broadband internet. Users will have greater bandwidth, coverage and capacity than that offered by current wireless networks, which will make it possible to enjoy services of high added value and with great quality, both when emitting and receiving information.

“To set a day-to-day example, with this technology, cuts or pixelated images during video calls will disappear, and we will be able to enjoy 4K contents on our mobile devices,” said Llorente.

The 5G infrastructure will also make it possible to offer services that require a very low latency for advanced applications — such as connected vehicles, for example, which don’t require large amounts of data, but where it is essential for that data to move quickly from one vehicle to another in the case of an emergency.

“Our technology guarantees these levels of latency due to its point-to-multipoint configuration, ensuring that — if there is an accident, for example — other vehicles in close cells will have that information almost instantly,” said Llorente.

Furthermore, TWEETHER will also help decrease the digital divide, which leads to millions of users worldwide — mainly in suburban or rural residential areas where optic fibre cannot be deployed — not having access to advanced services over the internet. The technology developed in the project allows the establishment of wireless coverage in broad geographical areas in a cost-effective way and in a matter of days.





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# 'TOUCH'

## VIRTUAL OBJECTS WITH THESE ULTRALIGHT GLOVES

Scientists from Switzerland's EPFL and ETH Zurich have designed a haptic glove that provides extremely realistic feedback, enabling users to touch, grasp and manipulate virtual objects while feeling like they are actually touching something in the real world.

Images ©Marc Delachaux/EPFL

The hardware for the glove was developed by EPFL at its Microcity campus in Neuchâtel, while the virtual reality system was created by ETH Zurich, which also carried out the user tests. The result of their collaboration was an ultralight haptic glove, dubbed DextrES.

The glove is able to generate up to 40 newtons of holding force on each finger, with just 200 V and only a few milliwatts of power. It also has the potential to run on a very small battery. That, together with the glove's low form factor (only 2 mm thick) and light weight (under 8 g per finger) translates into a high level of precision and freedom of movement.

"We wanted to develop a lightweight device that — unlike existing virtual-reality gloves — doesn't require a bulky exoskeleton, pumps or very thick cables," said Herbert Shea, Head of EPFL's Soft Transducers Laboratory (LMTS).

DextrES is made of nylon with thin elastic metal strips running over the fingers. The strips are separated by a thin insulator. When the user's fingers come into contact with a virtual object, the controller applies a voltage difference between the metal strips causing them to stick together via electrostatic attraction — this produces a braking force that blocks the finger's or thumb's movement. Once the voltage is removed, the metal strips glide smoothly and the user can once again move his fingers freely.

For now the glove is powered by a very thin electrical cable, but thanks to the low voltage and power required, a very small battery could eventually be used instead. "The system's low power requirement is due to the fact that it doesn't create a movement, but blocks one," Shea explained.

The researchers also need to conduct tests to see just how closely they have to simulate real conditions to give users a realistic experience, with Otmar Hilliges, Head of the Advanced Interactive Technologies Lab at ETH Zurich, noting, "The human sensory system is highly developed and highly complex."

"We have many different kinds of receptors at a very high density in the joints of our fingers and embedded in the skin," said Hilliges. "As a result, rendering realistic feedback when interacting with virtual objects is a very demanding problem and is currently unsolved. Our work goes one step in this direction, focusing particularly on kinesthetic feedback."

The glove has already been successfully tested on volunteers in Zurich and was recently presented at the ACM Symposium on User Interface Software and Technology (UIST). The next step will be to scale up the device and apply it to other parts of the body using conductive fabric.

"Gamers are currently the biggest market, but there are many other potential applications — especially in health care, such as for training surgeons," said Shea. "The technology could also be applied in augmented reality."



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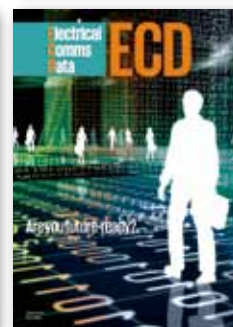
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