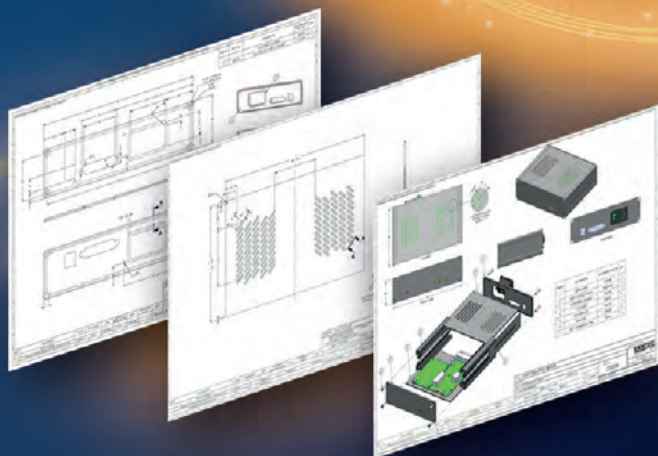
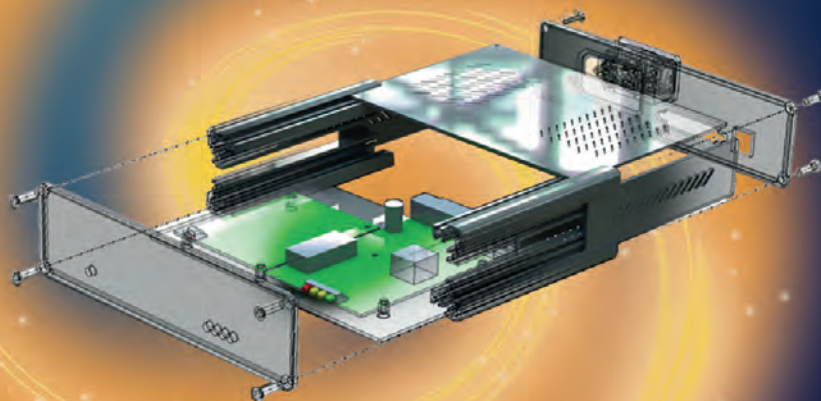
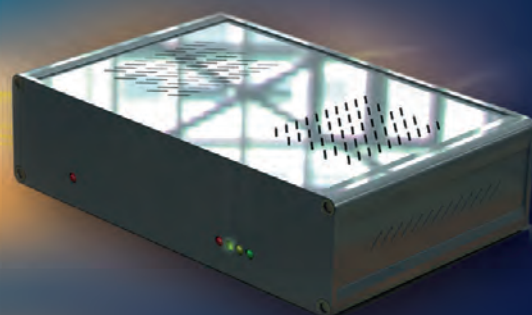


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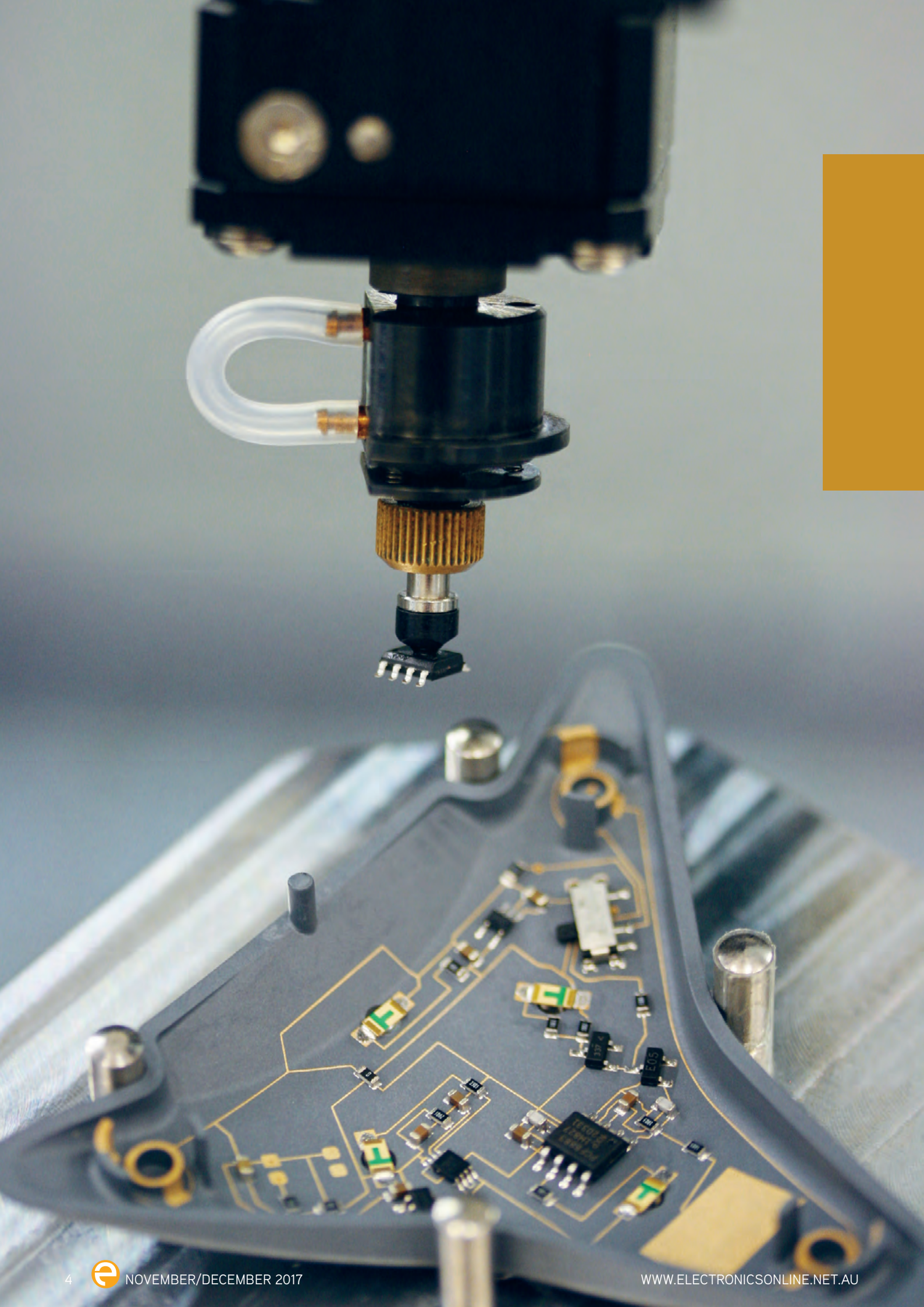
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# WILL FINE CIRCUIT TRACES SOON BECOME UBIQUITOUS?

3D-MID technology is already in everyday use, for example in the latest generation of smoke detectors. Design simplification and the integration of switches and cables save hardware and assembly costs.



In the manufacture of industrial applications, more and more industry sectors are turning to a new technology as an alternative to classic PCBs. The revolution is called 3D-MID (moulded interconnect devices or mechatronic integrated devices) — injection-moulded plastic parts with conductive traces integrated by using laser direct structuring (LDS). This technique adds power to the trend towards miniaturisation in the electronics industry and provides product developers with new design opportunities.

The projects which 3D-MID supplier Multiple Dimensions have realised illustrate the diversity of possible applications for the technology. They simplify the operation of household appliances, improve driver experience in power steering systems and open up new ways of saving space — for example, in sensing and industrial electronics.

Johannes Schmid, managing director of Multiple Dimensions, explains how these fine, golden traces on formed plastic are transforming industrial production. The basis of all 3D-MID applications is a thermoplastic material.

“Using injection moulding, we first manufacture the part to fit the customer’s application. We use different types of thermoplastic, which contain an additive that can be activated by laser,” said Schmid, describing the underlying principles of the technology. A laser ray then engraves the surface of the plastic and activates the additive. A copper bath then follows, which lets the conductive traces form directly on the thermoplastic. Depending on the type of application, the MID parts may have to be extremely robust or temperature resistant.

“Some even have to be acid or sweat resistant, for example applications for hear-

ing aids or headphones,” continued Schmid. In a final step, a barrier layer of nickel is applied and then conditioned with a thin layer of gold to ensure good solderability.

What differentiates the company from the competition is that it produces traces in almost microscopically small dimensions, with Schmid saying, “Our manufacturing expertise is capable of competing with anyone in the world, especially our uniquely fine trace width and the narrow spacing between traces.”

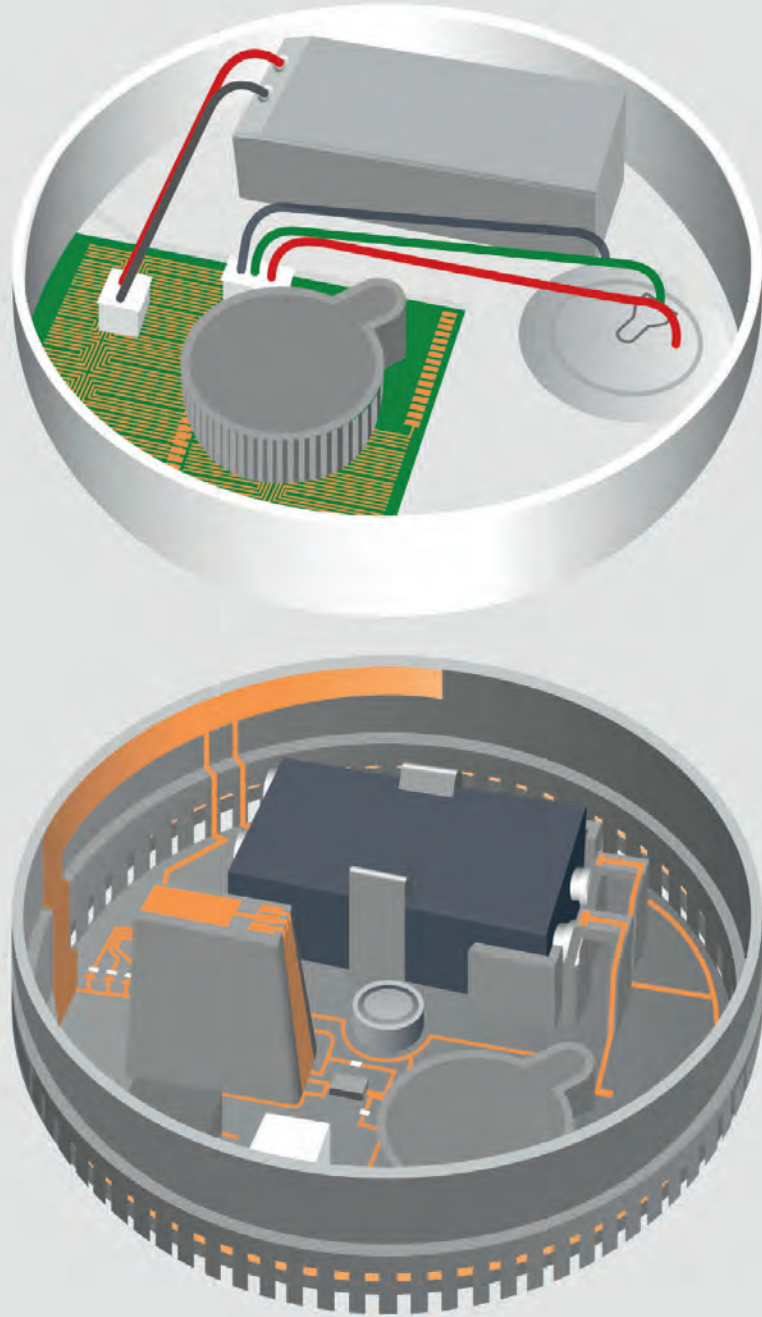
Most suppliers are currently working with 300–400  $\mu\text{m}$  spacing between traces. “At Multiple Dimensions, however, the technological limit for trace width is 80  $\mu\text{m}$ ,” said Schmid. “These fine structures are now often used in point-of-sales (POS) terminals as a protection from hacking attacks. The fine traces allow attacks on the data in the payment cards to be detected.”

## From washing machines to steering wheels

It is the trace width and spacing between the traces that differentiates the top players in the new 3D-MID technology from the rest of the pack. It is the main factor affecting the degree of miniaturisation and it is decisive in terms of the number of functions that can be integrated in a component.

There are already many concrete examples of applications using the technology, with Schmid noting, “We manufacture for a range of very diverse industries. I’m sure you are familiar with the rotary switches for program selection in washing machines. These switches are normally made of a whole kit of small mechanical parts — with our 3D-MID technology, none of these are now needed.”





The washing program is selected using a capacitive switch, ie, virtually touch-free. This has far-reaching consequences: unlike with a mechanical solution, there is no friction to wear out the parts. "Our operator control device has a much simpler design, costs less to produce and, on top of that, it has a longer service life," said Schmid.

The Swiss company also manufactures sensors for the automotive industry which are used to measure the torque and position of steering wheels. "Depending on the position and the measured value, the drive of the power steering is increased or decreased," explained Schmid. "The more accurate the measurement, then the more directly the vehicle response is felt."

Just like in the example of the washing machine, the conventional solution contains numerous mechanical parts. When all these parts work together, deviations and tolerances cumulate and impair the driving

experience. "We are able to eliminate an entire chain of tolerances," said Schmid. The technology not only saves components and costs, it also makes the application more precise and efficient. Last but not least, it increases the user's driving pleasure.

### **A maximum amount of functionality in minimal space**

Exceptional functional integration in a minimum of space is demonstrated by a solution currently produced by Multiple Dimensions for a toy manufacturer. For enhanced player experience, an electronic circuit has been built into a tiny space in a plastic component — including a battery, a capacitive switch and an LED.

"There simply would not have been enough space there for a printed circuit board," said Schmid. "Here, too, the operating control device, in this case a capacitive switch, is totally wear-free, and there is no mechanical contact."

In future, the new 3D-MID technology will also be used in human-like robots. In Biel currently, experts from Multiple Dimensions are equipping the fingertips of a robotic hand (in the size of a human hand) with conductive traces. The surface of the robot's tactile organ is covered with sensors, and their pressure signals are routed centrally to a connector.

"Thanks to our 3D technology, we can place the required electronics accurately in spite of the complexity of working with a curved surface," Schmid remarked, emphasising the advantages of three-dimensional processing.

### **An example of 3D-MID in a smoke detector**

The current generation of smoke detectors are ideal candidates for a technological update using 3D-MID. The enclosure is made of plastic, the conducting traces can be applied directly and the printed circuit board can be completely eliminated. Cables and connector plugs, and even the battery holder, can be integrated into the moulded part. In production, complex soldering processes are eliminated and the assembly as a whole is simplified, due to the small number of parts.

Another advantage is the easy integration of additional functions. For example, a capacitive switch can now be used, replacing the previously used mechanical switch.

### **The trend towards miniaturisation is growing in importance in everyday life**

Customers of Multiple Dimensions benefit from the potential of the new technology at many levels. All production steps are fully automated and performed in-house at Multiple Dimensions.

"We cover the complete process chain, from the injection-moulding process to laser processing and galvanisation, and even go as far as populating the electronic components," said Schmid. This saves transport costs, he noted — savings that the company is happy to pass on to its customers.

Schmid is convinced that as far as the development potential of 3D-MID technology is concerned, the end of the road is still a long way off. He stated, "Advances in miniaturisation which are being made in all areas of our industrial society, combined with the trend to intelligent connectors for Industry 4.0, ensure that 3D-MID technology will be used even more widely in future."

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# Digitiser to help generate record-breaking magnetic fields



The International MegaGauss Science Laboratory, part of the Institute Solid State Physics (ISSP) at the University of Tokyo, is attempting to set a new world record for the highest ever indoor magnetic field. Looking to improve the precision of the firing processes with subnanosecond measurements, the ISSP installed a digitiser from Spectrum Instrumentation.

To optimise the magnetic fields generated by the laboratory's MegaGauss machine, the trigger events that fire banks of large capacitors have to be triggered within 10 ns of each other. To achieve this high level of precision, the trigger signals for each capacitor have to be examined to determine their key characteristics and timing relationships to ensure optimal firing every time, as the physical parameters of the MegaGauss machine restrict firing to just a few shots per day.

In order to capture and analyse the trigger signals, ISSP required a fully synchronous, 10-channel digitiser system that delivers a single shot sampling rate in excess of 1 GS/s. The high sampling rate allows the shape and frequency content of individual trigger pulses to be revealed, while fully synchronous sampling ensures interchannel timing

measurements can be consistently made with subnanosecond precision.

A further complication is the fact that the MegaGauss machine generates dangerously high magnetic fields that are potentially unsafe and can easily interfere with the measuring instrumentation. Great care needs to be taken to shield both equipment and operators. The measurement system needs to be located in the laboratory while the operator adjusts and monitors the experiments from the safety of a control room. As such, the digitiser system must be able to operate remotely and controlled over the laboratory's network.

The solution was to use a DN6.221-12 digitizerNETBOX system from Spectrum Instrumentation. The unit met all the necessary technical requirements, offering 12 fully synchronous channels, each sampling at 1.25 GS/s.

As digitizerNETBOX units are LXI compliant instruments, they allow full remote control and data transfer over a Gigabit Ethernet connection. The system also provides a turnkey solution to multichannel acquisition, with users simply selecting the desired number of digitiser channels as well as fundamental specifications such as the sampling rate, resolution and onboard acquisition memory.

The unit also comes with SBench 6-Pro software that allows the user to quickly set up the system and start making measurements. SBench 6-Pro features an easy-to-use graphical user interface that allows multichannel waveform display, data analysis and documentation. Acquired and analysed signals can be stored and exported to other devices, or other software programs, in a number of formats such as MATLAB, ASCII, binary and wave.

The laboratory is now able to further optimise the performance of the MegaGauss machine, with the expectation that it will be able to generate the world's highest ever indoor magnetic fields later this year.

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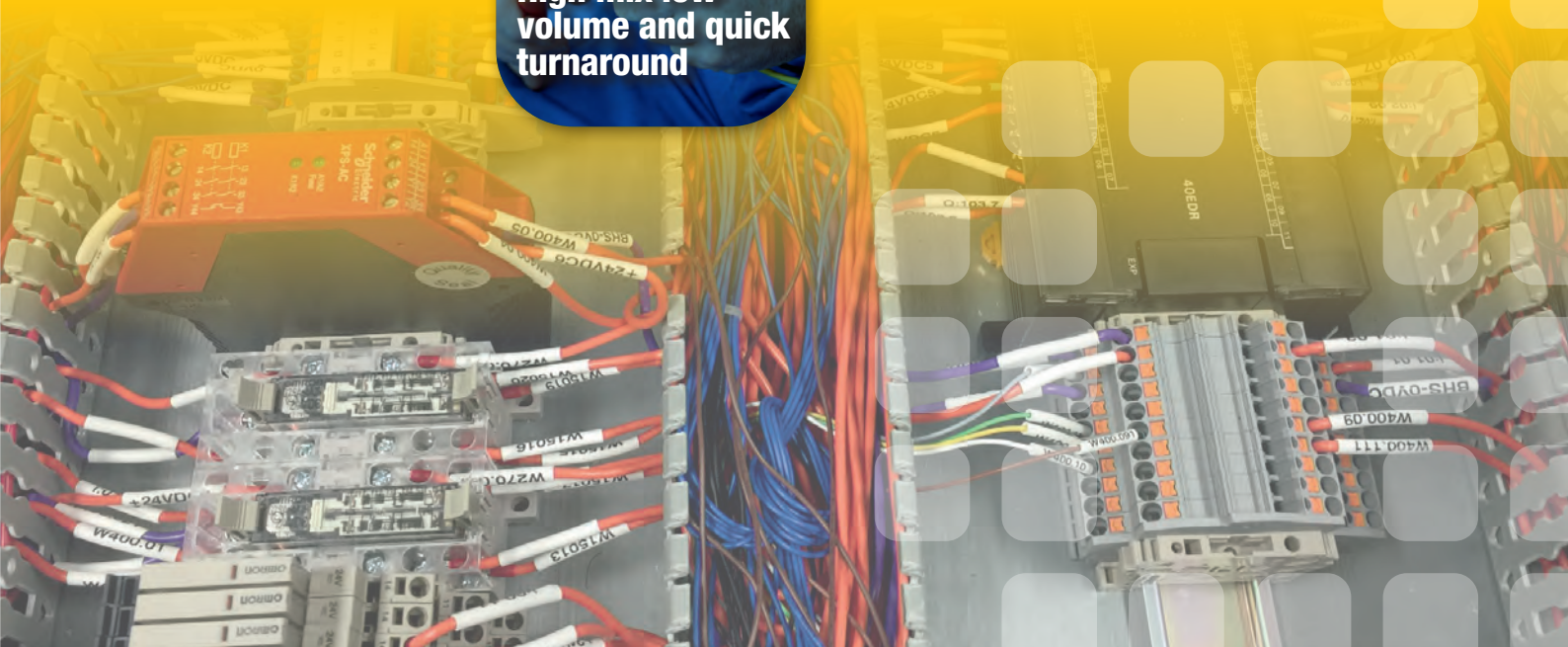
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## POLYMER-BASED CAPACITOR COULD IMPROVE ELECTRICAL CIRCUITRY

Saudi Arabian researchers have used a blend of polymer materials to develop a novel type of component — one that could substantially improve the performance of electrical circuits.

Electronic circuitry is traditionally constructed from three primary elements: a resistor, a capacitor and an inductor. A sinusoidal electrical signal passing through these devices will change in signal strength, or amplitude, and the relative timing of the crest of the wave, known as its phase. A resistor will change amplitude only while a capacitor and an inductor can also change phase but only by exactly one-quarter of the length of the wave, or  $90^\circ$ .

Components that could alter the phase of the electrical signal by a different amount would enable electrical circuits with more varied functionality. One such device, known as a fractional-order capacitor, was realised by Agamyrat Agambayev, an electrical engineering doctoral student at King Abdullah University of Science and Technology (KAUST), under the supervision of Hakan Bagci and Khaled Salama.

"We use a solution-casting method to fabricate fractional-order capacitors," explained Salama. "This method allows us to easily blend different polymers and provide a mechanism to tune the device's properties."

Numerous approaches to creating a fractional-order capacitor have been demonstrated in the past, but all have drawbacks. Using a liquid medium, for example, results in large devices that cannot be integrated with microelectronic circuits. Ideally, a fractional-order capacitor should be made from a dielectric material that is compatible with printed-circuit-board technology. It should also operate over a wide range of signal frequencies and have a controllable phase change, known as the constant phase angle or CPA.

The KAUST team created a fractional-order capacitor using a polymer based on poly (vinylidene fluoride). They deposited a thin film on a layer of gold on a silicon substrate. The film was patterned as required and bonded to the printed circuit board to create the final device. The electrical properties of the polymer were controlled using a simple solution-mixing approach to add different amounts of trifluoroethylene and/or chlorofluoroethylene.

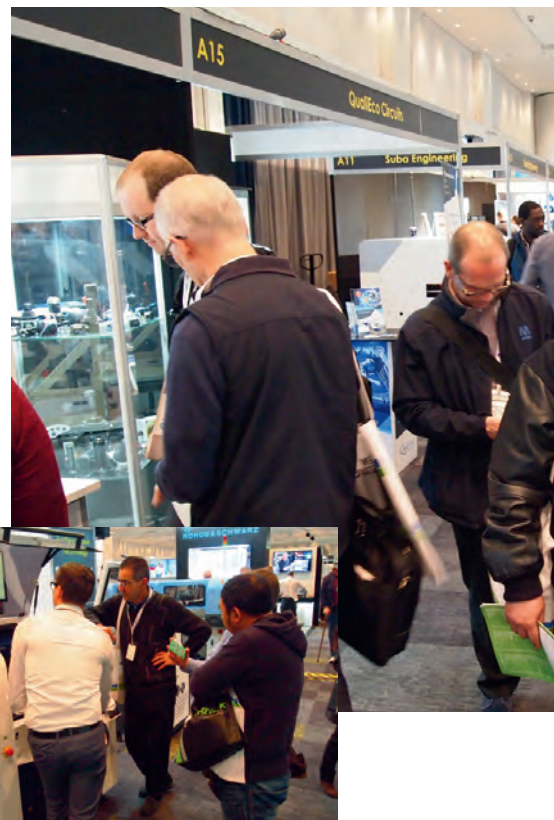
Writing in the journal *ChemElectroChem*, the researchers revealed they could tune the CPA of their devices from  $66^\circ$  to  $88^\circ$ , depending on the blend composition. What's more, the devices acted over a wide range of frequencies from 0.1 to 10 MHz.

The team members believe the tunability offered by polymers represents a huge advance. Their next move, said Bagci, is to look into modelling these structures to better understand their behaviour.

"This will help design fractional capacitors with better performance," he said.



Blending polymer materials in the right combination can create fractional-order capacitors that are compatible with printed circuit boards. ©2017 KAUST



## DATA STORAGE BREAKTHROUGH BRINGS QUANTUM INTERNET ONE STEP CLOSER

Australian National University (ANU) scientists have discovered a new and improved way to store quantum data, thus taking a major leap forward to providing the building blocks for a global quantum internet. The team was led by Associate Professor Matthew Sellars, who said better storage is an important part of a viable quantum internet.

"The effort to build a quantum computer is often described as the space race of the 21st century, but today's computers didn't realise their full potential until we had the internet," said Dr Sellars, who is program manager for the Centre for Quantum Computation and Communication Technology (CQC<sup>2</sup>T) at ANU.

Writing in the journal *Nature Physics*, Dr Sellars and his team reveal how to dramatically improve the storage time of a telecom-compatible quantum memory — a challenge that has eluded researchers worldwide. As noted by study co-author Dr Rose Ahlefeldt, also from CQC<sup>2</sup>T, quantum memory allows scientists to buffer and synchronise quantum information — operations necessary for long-range and ultrasecure encrypted communications.

"At the moment researchers are using memories that don't work at the right wavelength, and have to employ





## ELECTRONEX 2017 DECLARED A SUCCESS

From 6–7 September, Electronex — The Electronics Design & Assembly Expo was held at the Melbourne Park Function Centre. Around 1000 trade visitors and delegates attended the two-day event, which alternates annually between Melbourne and Sydney, leading event organiser Australasian Exhibitions and Events (AEE) to declare the expo an outstanding success.

The official post-show survey found that although overall visitor numbers were similar to the 2015 Melbourne event, over 48% of visitors had not attended the previous show. The large number of first-time attendees was said to reflect the transition towards niche manufacturing applications in the marketplace, with around 20% of attendees involved in electronics design and R&D.

Over 100 companies were represented on stands at the expo, with many showcasing new products to the interested attendees. The survey found that 89% of visitors met companies they were not previously aware of, while 83% discovered new products or services they were not aware of.

“We were delighted with the visitor attendance and support from the industry for this specialised industry event,” said AEE Managing Director Noel Gray. “The atmosphere was very positive at this year’s show, with many companies upbeat about the future of the industry in Australia. It is very encouraging to see Electronex continuing to thrive in what has been a challenging time for the manufacturing sector, and the expo continues to provide a real focal point for the industry in Australia.”

The SMCBA Surface Mount Conference was held concurrently with the expo and was similarly well attended, with over 100 delegates participating in the two-day technical workshops. Free seminars were also held on the expo floor on a range of hot topics to complement the conference workshops.

Electronex will be held next year in Sydney at Rosehill Gardens Function Centre from 5–6 September 2018.

For details on exhibiting, contact AEE on (03) 9676 2133 or email [info@auexhibitions.com.au](mailto:info@auexhibitions.com.au).

a complicated conversion process to and from the communications wavelength,” said Dr Ahlefeldt. “This can be inefficient, and means they have to do three very difficult things instead of just one.”

The team used a rare earth element, called erbium, in a crystal to increase the storage time of telecom-compatible quantum memory by 10,000 times compared to previous efforts — long enough to one day send quantum information throughout a global network. Erbium has unique quantum properties and operates in the same bandwidth as existing fibre-optic networks, eliminating the need for a conversion process.

“Our technology ... operates in the same 1550 nm band as today’s telecommunications infrastructure, making it compatible with the fibre-optic cables found in existing networks,” noted first author Miloš Rančić, also from CQC<sup>2</sup>T.

Rančić said the new technology can also be operated as a quantum light source or used as an optical link for solid-state quantum computing devices, connecting them to the quantum internet. He noted, “Our technology can connect with many types of quantum computers including CQC<sup>2</sup>T’s silicon qubits and superconducting qubits, which Google and IBM are developing.”

Dr Sellars concluded that the erbium-doped

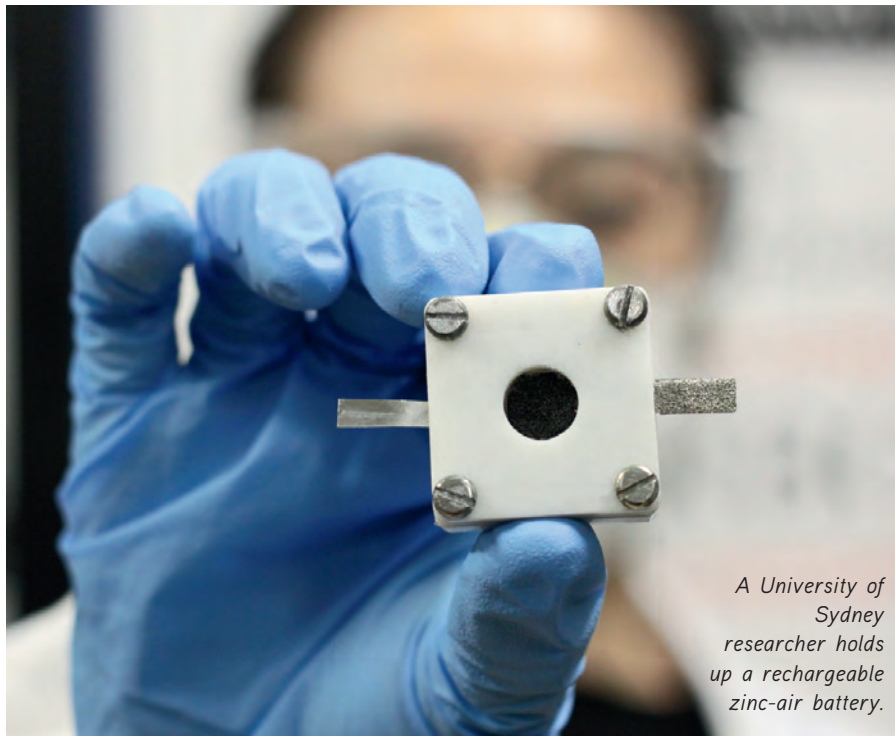


crystal is “the perfect material to form the building blocks of a quantum internet that will unlock the full potential of future quantum computers”. It’s a result that’s been worth the wait for him and his team, who originally came up with the idea 10 years ago.

“Many of our peers told us that such a simple idea couldn’t work,” Dr Sellars revealed. “Seeing this result, it feels great to know that our approach was the right one.”

*Fluorescence from a rare earth crystal when viewed under UV light. Image credit: Stuart Hay, ANU.*





*A University of Sydney researcher holds up a rechargeable zinc-air battery.*

Image credit: The University of Sydney.

## CREATING ELECTROCATALYSTS FOR ZINC-AIR BATTERIES

Researchers at The University of Sydney have solved what is said to be one of the biggest stumbling blocks preventing zinc-air batteries from overtaking conventional lithium-ion batteries as the power source of choice in electronic devices.

Zinc-air batteries are batteries powered by zinc metal and oxygen from the air. Due to the global abundance of zinc metal, these batteries are much cheaper to produce than lithium-ion batteries. They can also store more energy (theoretically five times more than that of lithium-ion batteries) and are much safer and more environmentally friendly.

While zinc-air batteries are currently used as an energy source in hearing aids and some film cameras and railway signal devices, their widespread use has been hindered by the fact that, up until now, recharging them has proved difficult. This is due to the lack of electrocatalysts that successfully reduce and generate oxygen during the discharging and charging of a battery.

Now, chemical engineering researchers have outlined a three-stage method to overcome this problem. According to Professor Yuan Chen, lead author of the paper published in *Advanced Materials*, the method can be used to create bifunctional oxygen electrocatalysts for building rechargeable zinc-air batteries from scratch.

"Up until now, rechargeable zinc-air batteries have been made with expensive precious metal catalysts, such as platinum and iridium oxide," he said. "In contrast, our method produces a family of new high-performance and low-cost catalysts."

These new catalysts are produced through the simultaneous control of the composition, size and crystallinity of metal oxides of earth-abundant elements such as iron, cobalt and nickel. They can then be applied to build rechargeable zinc-air batteries.

Dr Li Wei, a co-author on the paper, said trials of zinc-air batteries developed with the new catalysts had demonstrated excellent rechargeability — including less than a 10% battery efficacy drop over 60 discharging/charging cycles of 120 hours.

"We are solving fundamental technological challenges to realise more sustainable metal-air batteries for our society," Professor Chen said.

## 2D OXIDE LAYERS CREATED WITH LIQUID METAL

Australian researchers have used liquid metal to create two-dimensional materials no thicker than a few atoms that have never before been seen in nature. Published in the journal *Science*, the breakthrough is expected to revolutionise chemistry, data storage and electronics in general.

The work was led by Professor Kourosh Kalantar-zadeh and Dr Torben Daeneke from RMIT's School of Engineering, who have been experimenting with the method for the last 18 months. Dr Daeneke explained how the idea came about, stating, "When you write with a pencil, the graphite leaves very thin flakes called graphene that can be easily extracted because they are naturally occurring layered structures. But what happens if these materials don't exist naturally?

Seeking to create atomically thin flakes of materials that do not naturally







exist as layered structures, the researchers dissolved metals in liquid metal to create very thin oxide layers, which are easily peeled away. Once extracted, these oxide layers can be used as transistor components in modern electronics.

"We use non-toxic alloys of gallium (a metal similar to aluminium) as a reaction medium," Dr Daeneke explained. "This covers the surface of the liquid metal with atomically thin oxide layers of the added metal rather than the naturally occurring gallium oxide.

"This oxide layer can then be exfoliated by simply touching the liquid metal with a smooth surface. Larger quantities of these atomically thin layers can be produced by injecting air into the liquid metal, in a process that is similar to frothing milk when making a cappuccino."

According to the researchers, the process is so cheap and simple that it could be done on a kitchen stove by a non-scientist. Dr Daeneke stated, "I could give these instructions to my mum, and she would be able to do this at home."

Professor Kourosh Kalantar-zadeh said the discovery now places previously unseen thin oxide materials into everyday reach, with profound implications for future technologies. The researchers noted that thinner oxide layers result in faster electronics, which need less power in order to operate.

"We predict that the developed technology applies

to approximately one-third of the periodic table," Professor Kalantar-zadeh said. "Many of these atomically thin oxides are semiconducting or dielectric materials.

"Semiconducting and dielectric components are the foundation of today's electronic and optical devices. Working with atomically thin components is expected to lead to better, more energy-efficient electronics. This technological capability has never been accessible before."

The breakthrough could also be applied to catalysis, the basis of the modern chemical industry, reshaping how scientists make all chemical products including medicines, fertilisers and plastics.

*Metal droplets leave no thin layer of oxide skin on the surface, if this oxide skin is dissolved in an alkali base or acid.*

Image credit: RMIT University.

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## ENCLOSURE RANGE

The STYLE-CASE range of handheld enclosures is suitable for remote controls of all types, especially in the hospital and social sectors, in the household and in industry. OKW Gehäusesysteme has now enhanced the range with the addition of two more sizes.

The enclosures are designed as three-part units, with a top and bottom part and a battery compartment lid. Each version has an integrated battery compartment and is equipped for mobile use. Matching sets of battery clips are available as accessories.

The product has an elegant appearance due to its highly polished surface. The ergonomic design makes it comfortable to hold and facilitates work in any application. A further feature of the enclosure is the sweeping design when viewed from the side.

In addition to the STYLE-CASE L, with the dimensions 166 x 64 x 31 mm, the unit is now also available in the sizes S with 123 x 48 x 24 mm and M with 147 x 56 x 27 mm. All versions are available in the colours traffic white made of ASA with high UV protection or in black made of the infrared-permeable material PMMA (Perspex).

For optimum protection of the electronics, a sealing kit to increase the ingress protection to IP65 is offered as an accessory. Due to the recessed surfaces in the top part, decor foils and membrane keypads can be safely positioned. There are enough fastening pillars for mounting printed circuit boards and other components. Self-tapping screws are available in the range of accessories.

Standard enclosures can be processed or finished in the company's service centre. The STYLE-CASE can be modified according to users' requirements, eg, with mechanical processing for interfaces, printing of logos, a functional EMC aluminium coating on the inside of the enclosure or through membrane keypads/decor foils. For the simple planning of the required modifications and installations, CAD drawings or 3D models of the enclosures can be downloaded from the company website.

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## COMPACT CAN AND FLEXRAY DATA LOGGER

The Ipetronik  $\mu$ CROS XL is a compact unit that is suitable for standard logger applications that require CAN and FlexRay protocol measurements along with traffic measurements. Integrated Wake-on-CAN, Wake-on-FlexRay and NoMessageLost functions ensure the recording of all messages after the trigger event.

Also suitable for harsh conditions, the product includes an internal storage capacity of 128 GB, four CAN high-speed and two FlexRay interfaces, Quick-start, multiplex video channels for USB and IP cameras, an integrated 3G modem, Wi-Fi, a GPS receiver and configuration via the Phoenix software and web interface.

A major advantage of the data logger is the easy integration of camera systems. Via the USB interface, all common USB cameras using the MJPEG data format can be connected. IP camera systems (AXIS, BASLER, LINKSYS, etc) are supported with the Real Time Streaming Protocol.

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## MODULAR CONNECTOR WITH PLASTIC HOUSING

ODU has launched the ODU-MAC Blue-Line, a hybrid, manual-mating modular connector designed for a wide range of test and measurement, medical and mechanical engineering applications.

The product comes with standard plastic housing and a spindle or lever locking mechanism. It offers a high packing density of 2.4 mm/unit, 10,000 mating cycles and modules for signals, power, high current, coax, compressed air, data and fibre optics, and a PCB termination option.

The connector features four docking frames, plus tool-free clip mounting and dismounting of modules up to 2500 V, 12 Bar, 1 Gbps and 4 GHz.

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Further information at [www.faulhaber.com](http://www.faulhaber.com)



## VIDEOSCOPE

The GE Mentor Visual iQ Inspect videoscope allows the user to make informed decisions about critical assets and improve overall inspection productivity. It is available to rent from TechRentals.

With this device, users can capture both video and still images using a high-intensity LED light and advanced processing for enhanced image brightness. The product is easy to operate as it features an ergonomic joystick and hard keys for use.

Powered by rechargeable lithium-ion batteries, the product eliminates the need for a charging cradle as batteries have an in-built charging circuit. These lithium-ion batteries are compliant with air travel regulations, making it even easier to travel with this lightweight, handheld device.

Other features include 5 x digital zoom SUPER HAD CCD video camera; comparison measurement; 440,000 pixel count; and 6.5" active matrix XGA colour LCD. TechRentals offers a set-up and download service for the product.

### TechRentals

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

## LIGHTWEIGHT, SEALED LED PANEL INDICATOR

Marl's 677 Series is an 8.1 mm mounting professional LED panel indicator featuring a high-intensity LED element. Internal circuitry is designed for a range of voltage options and includes a reverse protection diode. Termination is achieved by standard solder/crimp tags.

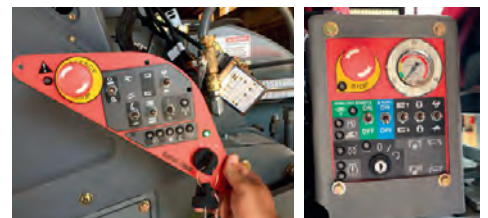
The device is fitted with a low-profile, smoked lens assembly to provide wide-angle viewing and an on/off contrast ratio. It is internally potted, making it suitable for high-vibration applications. A range of LED colour options are available.

The precision-turned housing is manufactured from aluminium with a black anodised finish, making it lightweight and suitable for portable equipment. Benefits include high optical performance, vandal resistance and sealing specifications in excess of IP67. The indicator is supplied complete with full mounting hardware.

Applications include defence platforms, industrial equipment, medical, rail (rolling stock and plant), power stations, steel foundries and coal mines, power stations, control panels, heavy plant and equipment, theme parks and leisure equipment, and transportation.

### Aerospace & Defence Products

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



## PANEL PCs

Aplex Technology's ARCHMI-9XXA Series of 12.1" to 32" panel PCs are powered by Intel's 6th generation of i5 and i3 iCore processors.

The series supports Intel's 6th Generation Core i platform and is equipped with Intel HD Graphics. It offers a good balance of high computing performance and power efficiency, providing effective real-time monitoring and integrating data transmission. The high-quality graphic experience enables the series to control complex visual information action.

The series is capable of expanding functionality through the use of optional expansion I/O boards in the TB-528 Series, including Mini-PCIe, CAN bus, POE, USB and isolation

I/O modules. This provides critical flexibility and expansibility for a variety of applications and requirements. It also supports smart battery UPS modules, so when facing power issues such as a voltage spike or reduction in power input, it offers emergency power backup for up to 30 min.

The series supports wireless communication (3G/4G LTE/WiFi/Bluetooth/GPS) and has diverse I/O interfaces, as well as an expansion slot for intelligent multitasking capabilities to meet customised application requirements. Other features include: a PCT/resistive touch screen; an SO-DIMM DDR4 slot up to 32 GB; an IP66-compliant front bezel; an easy accessible storage design; and an aluminium die-cast chassis.

### Backplane Systems Technology Pty Ltd

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



[illegible]

# ORDER CONFIDENCE

## THREE ASPIRATIONS FOR LONG-DISTANCE EVs

*Dr Peter Harrop, Chairman*

When it comes to the electric vehicle (EV), all the publicity currently goes towards the race to make regular and premium cars with longer range.

**T**his is because most people want only one car, so it must be capable of the long-distance trip — however rare that might be. Furthermore, this must be achieved despite the inadequacy of charging points in number, speed and compatibility of interface and payment means.

This article highlights three approaches currently underway in order to produce EVs that quite literally go the distance.

### The incremental approach

Mainstream pure electric cars typically now have a doubled range of 300–400 km. A premium vehicle such as the Sun Flyer pure electric aircraft or Tesla S gets around 560 km, though this is usually achieved by nearly doubling the battery cost and size, therefore delaying purchase price parity with internal combustion engine vehicles — the killer blow. Better is achieved by abnormal driving not practicable in regular real-world conditions. For instance, Elon Musk recently sent a tweet to congratulate the owners of a Tesla S who had achieved 1000 km.

### The new chemistry approach

Next we are promised nanoFlowcell sports cars with a flow cell battery and 500–1000 km range with regular driving. Toyota is working on an electric car powered by a solid-state battery that significantly increases driving range and reduces charging time to minutes, aiming to begin sales in 2022. Range may be over 600 km, but no official figure has been announced. Solid-state batteries use solid electrolytes rather than liquid ones, making them safer than lithium-ion batteries currently on the market — even non-flammable.

### The energy independence approach

Energy independent electric vehicles (EIVs) never need to carry fuel or find a charger. Progress towards them can be found in the Sun Flyer type of aircraft, with solar surfaces increasing range by 30% and a reversing propeller using wind to charge the battery when soaring, descending and when parked on a windy airfield. There is also a solar bike that travels in sunshine without battery or pedalling.



Achievement of total energy independence can be found in many naval DC solar electric boats, some of which have sails. Other boats make all their electric power from wind turbines or a combination of this with photovoltaics. Some manufacturers quote 'perpetual' speed, which may be only a few knots for a 'glider' autonomous underwater vehicle that surfaces to charge its batteries from waves and sun or seven knots for a surface boat.

Raghu Das, CEO of market research company IDTechEx, recently organised what was said to be the world's first conference on EIVs at the Technical University of Delft, held from 27-28 September. He said, "This is an idea whose time has come, with road vehicles having affordable 40% efficient photovoltaics in future that expands when parking, at which time super-efficient wind turbines erect. The many on- and off-road vehicles that are only used in daylight may need no battery."

Elon Musk usurped the traditional motor industry with his Tesla becoming the 'Apple of automotive', based entirely on gorgeous pure electric cars using one-fifth of the parts. According to Das, "Next will come disruption of automotive, aerospace and marine industries, with energy independence bypassing even electricity utilities and charging stations and reducing the importance of batteries."

"During the initial period of niche products and limited sales, savvy companies will be improving and adopting these technologies to leapfrog the industry in the years to come. Remember how the industry laughed at the Toyota Prius then at Tesla. They now laugh at the Sion and Hanergy solar street legal cars at their peril, because these or other proponents are going to shock the industry again. Better to keep up with the subject and be ready to lead the change."

IDTechEx  
www.idtechex.com

## REED RELAY

The Pickering Series 120 is a range of single-pole reed relays that require a board area of only 4 x 4 mm. Two switch types are available: a general-purpose sputtered ruthenium switch rated for up to 20 W, 1 A and a low-level sputtered ruthenium switch rated at 10 W, 0.5 A.

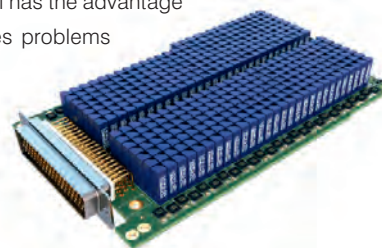
The products are the same reed switches as used in other Pickering Electronics ranges but are orientated vertically within the package, enabling the high density. The small size of the package does not allow an internal diode.

The relays feature an internal mu-metal magnetic screen. Mu-metal has the advantage of a high permeability and low magnetic remanence and eliminates problems that would otherwise occur due to magnetic interaction.

The device has pins on a 2 mm square pitch. SMD and through-hole connectors will allow the relays to be stacked in either a row or in a matrix on a 4 mm pitch.

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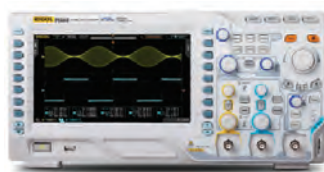
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## VECTOR NETWORK ANALYSER

Copper Mountain Technologies' C2220 2-port vector network analyser operates in the frequency range of 100 kHz to 20 GHz and adds direct receiver access for special applications involving external directional coupling, including load pull and high power measurements.

It offers a typical dynamic range of 145 dB (1 Hz IF BW), an output power range of -60 to +10 dBm and up to 5,000,001 measurement points. Designed for operation with any Windows PC or laptop, the device can reach a measurement speed of 10 us per point.

The product efficiently handles test applications, providing good S-parameter measurement for this frequency range.

**Clarke & Severn Electronics**  
[www.clarke.com.au](http://www.clarke.com.au)

## MODBUS TCP TO 2-PORT CAN BUS GATEWAY

The IoT (Internet of Things) has been a much-discussed topic in recent years. Using the IoT concept, it is easy to integrate the environment of heterogeneous networks and let all of the things be digitised, making life more convenient. In order to provide additional access to IoT applications related to industry based on the CAN bus, ICP DAS has developed the ECAN-240 Ethernet product.

The ECAN-240 is a Modbus TCP to 2-port CAN bus gateway. The module provides communications via the Ethernet based on the Modbus TCP industrial protocol, meaning that it can be easily integrated with an industrial network.

The module includes two CAN bus interfaces, meaning that various CAN applications can be supported, such as a CAN bridge or a CAN message router. The CAN message router function means that the module can be used to connect to four different CAN networks, ensuring they can communicate with each other.

The product is fully compatible with the ISO 11898-2 standard and provides support for the CAN bus ID filter function. It also provides support for the CAN bus bridge mode via configuration; the CAN bus listen-only mode via configuration; the Modbus TCP Client/Server function via configuration; TCP/UDP pair connection function via configuration; and web configuration functions.

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



## ELECTRONIC LOAD FOR FUEL CELL AND POWER SUPPLY TESTING

The PT04-FC electronic load has been developed to accommodate testing of both fuel cells and low-voltage power supplies, including 24 V telecommunications power systems or power supplies. It is also useful as a general-purpose variable load.

The load is continuously rated to operate fully over the specified current and voltage ranges. The standard model gives constant current control, with a differential 0–5 V input for simple control systems, or can be paralleled for use in large systems.

The product includes constant power, resistance and voltage modes, as well as full ATE/remote control. The D9 connector on the rear panel provides access to the analog demand input, as well as all logic controllable functions and status lines.

Other features include: a simple, rugged and robust design; selectable range, with current control from 0 to 120 A on 24 V range or from 0 to 60 A on 48 V range; a 2.88 kW plus rating (at 40°C ambient); ultralow electrical noise; temperature-controlled quiet fans; and a 19", 4U rack case.

**Manatronics Pty Ltd**  
[www.manatronics.com.au](http://www.manatronics.com.au)





## PROTOCOL GATEWAYS

Advantech extends its protocol gateway product line with the introduction of the EKI-1221EIMB and EKI-1221PNMB Protocol Gateway Series for protocol conversion. The protocol gateway devices support protocol conversion from Modbus TCP to EtherNet/IP, and Modbus TCP to PROFINET. They enable seamless connection between different devices with different protocols, and also provide a high level of device management efficiency.

EKI-1221EIMB and EKI-1221PNMB are designed for protocol extensibility and seamless integration with existing network devices. They offer a viable solution for efficiently converting data from legacy devices and reduce the possibility of expensive device purchase or software programming errors. With the addition of these protocol gateway devices into existing network infrastructures, customers can build a seamless data path between otherwise incompatible network devices and extend their useful life without a major upgrade.

The implementation of Advantech's EKI-1221EIMB/PNMB Protocol Gateway Series is simple and fast. They are easy to set up and configure, and they are compatible with Siemens and Rockwell HMI/PLCs. They have a built-in diagnostic tool that can connect data and monitor the status of connected devices in real time. This allows operators to utilise collected data, analyse it and find suitable solutions to prevent potential problems. Instrument data from each machine/device can be sent via EtherNet/IP or PROFINET PLC protocol conversion performed by an Advantech Protocol Gateway for further analysis in order to monitor the condition of in-service equipment.

Their fast deployment not only facilitates a productive workflow, but also enables easy machine automation management and maintenance on the shop floor. This is a crucial function for predictive maintenance management.

**Advantech Australia Pty Ltd**

[www.advantech.net.au](http://www.advantech.net.au)



## CAN & LIN Products for Next-Generation Vehicles

Largest Portfolio Now Available From Microchip

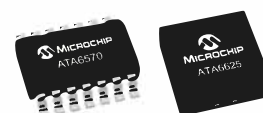
Microchip offers the most complete portfolio for Controller Area Network (CAN) and Local Interconnect Networking (LIN) solutions worldwide. Our solutions have ultra-low power design in mind and a high level of integration, minimizing system cost and complexity.

### CAN – Key Features

- Flexible data-rate/partial networking capable (ISO 11898-1/2/5/6 and SAEJ2284)
- Unique features and high levels of EMC performance with and without Common Mode Choke
- Grade 0 (Temperature: -40 to +150°C) automotive-approved options

### LIN – Key Features

- Industry's first to comply with new automotive OEM hardware recommendations
- Broad portfolio of transceivers, System-Basis Chips (SBCs) and System-in-Package (SiP) devices
- SBC options allow for easy transition to different product options



### Contact Information

Microchip Technology Australia  
Email: [aust\\_nz.inquiry@microchip.com](mailto:aust_nz.inquiry@microchip.com) Phone: +61 (2) 9868-6733

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## POWER ROCKER SWITCHES

APEM's K range, known for its robustness, is now complemented with a model named KH. Designed for harsh environments, KH series rocker switches are protected against accidental actuation, with a protection guard on two or four sides.

Featuring IP69K front panel sealing, the KH series is the most robust product of the K range. Due to its panel seal, the series is adapted to harsh environments, withstanding high-pressure cleaners, dust, salt spray, etc.

The customisable series is available illuminated and non-illuminated, with numerous symbols and rocker colours, to meet user requirements. It is suitable for vehicle cabins and dashboards subjected to harsh environments and for applications including agriculture, off-road vehicles, material handling and automotive.

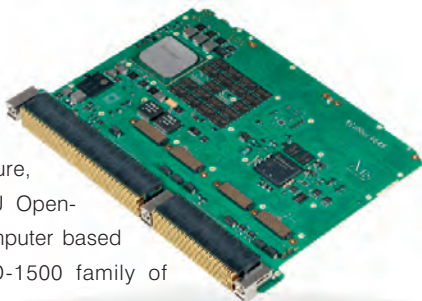
**Control Devices Australia**

[www.controldevices.net](http://www.controldevices.net)



## SINGLE-BOARD COMPUTER

The XCalibur4646, from X-ES, is a secure, high-performance, 6U Open-VPX single-board computer based on the Intel Xeon D-1500 family of processors.



The processor can provide up to 16 Xeon-class cores for high-bandwidth processing and I/O applications. The integrated SecureCOTS technology can protect critical data from being modified or observed and provides a suitable solution where stringent security capabilities are required.

The product includes a customisable Microsemi SmartFusion2 security SoC with 1 GB of ECC DDR3 to implement the SecureCOTS features. It can host many types of custom functions, such as data encryption, and additionally supports the ability to control, intercept and monitor the Xeon D subsystem, implement penalties and interface to the system through I/O directly connected to the VPX backplane. Circuit board enhancements and optional, optimised two-level maintenance (2LM) metalwork provides added protection to the physical hardware.

The SBC optimises network performance and power efficiency with two 10GBASE-KR Ethernet interfaces direct from the CPU and two 1000BASE-T Ethernet interfaces to the VPX backplane. It accommodates up to 32 GB of DDR4-2133 ECC SDRAM in two channels and up to 64 GB of SLC SATA NAND flash in addition to other I/O ports, including USB, SATA and four configurable RS232/422/485 serial ports through the backplane connectors. It supports additional expansion from two XMC sites.

The product is a powerful, feature-rich SBC for the next generation of compute-intensive embedded applications. Wind River VxWorks and X-ES Enterprise Linux (XEL) BSPs are available. The device uses coreboot to provide fast boot times and simplify code traceability over legacy BIOS implementations.

**Metromatics Pty Ltd**

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

## BLUETOOTH LOW ENERGY MODULE

To help product innovators streamline prototyping and development of connected smart objects, STMicroelectronics' SPBTLE-1S ready-to-use Bluetooth Low Energy (BLE) module integrates all the components needed to complete the radio subsystem. The BLE module integrates ST's BlueNRG-1 application-processor system-on-chip (SoC) and balun, high-frequency oscillators, and a chip antenna among others.

Developers can use the module to bypass hardware-design and RF-circuit layout challenges. The SPBTLE-1S is BQE-approved and FCC, IC and CE-RED (Radio Equipment Directive) certified to simplify end-product approval for North America and EU markets. ST's Bluetooth 4.2 certified BLE protocol stack is included, and the supporting software-development kit (SDK) contains a wide range of Bluetooth profiles and sample application code.

Coming in a space-efficient 11.5 x 13.5 mm profile, and with a wide supply-voltage range of 1.7–3.6 V, the module is suitable for small, battery-operated objects powered by various types of sources such as a primary button cell or rechargeable Li-ion battery. High RF output power of +5 dBm and good receiver sensitivity help to maximise communication range.

The SoC at the heart of the module implements the complete BLE physical layer (PHY), link layer and network/application-processing engine comprising a low-power ARM Cortex-M0 core with 160 KB Flash, 24 KB RAM with data retention, and a security co-processor. The SoC also implements smart power management, with a DC/DC converter capable of powering the module to ensure optimum energy efficiency.

Users can leverage an extensive set of interfaces, including a UART, two I<sup>2</sup>C ports, SPI port, single-wire debug and 14 GPIOs, as well as peripherals including two multifunction timers, a 10-bit ADC, watchdog timer and real-time clock, a DMA controller and a PDM stream processor interface, which is suitable for developing voice-controlled applications.

**STMicroelectronics Pty Ltd**

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





## CONFORMAL COATING KIT

Following the launch of the two-part conformal coating range (2K series), Electrolube has introduced a kit to mix, dispense and spray its 2K300 conformal coating. The kit offers key advantages for user trials and spray-testing requirements, as it facilitates full testing and evaluation of the 2K300 series without taking existing dispensing equipment out of production.

2K300 is a two-part system, offering high flexibility and low stress across an operating temperature range of -40 to +130°C. The coating is hydrophobic and highly resistant to condensation, salt mist and chemicals, and is fully IPC-CC-830 compliant.


Throughout the development of the entire 2K range, Electrolube has worked closely with selective coating machine manufacturers to ensure that formulations are optimised for application using commercially available dispensers. The coating kit takes this one step further, enabling easy testing and for small production volumes to be coated without the necessity for dispensing equipment.

The easily assembled kit will allow small production trials of the 2K300 series without a specialist dispenser. It comprises a resin kit, dilution fluid and a ready assembled aerosol for dispensing. It is designed as a one-time-use kit, making it suitable for small production volumes.


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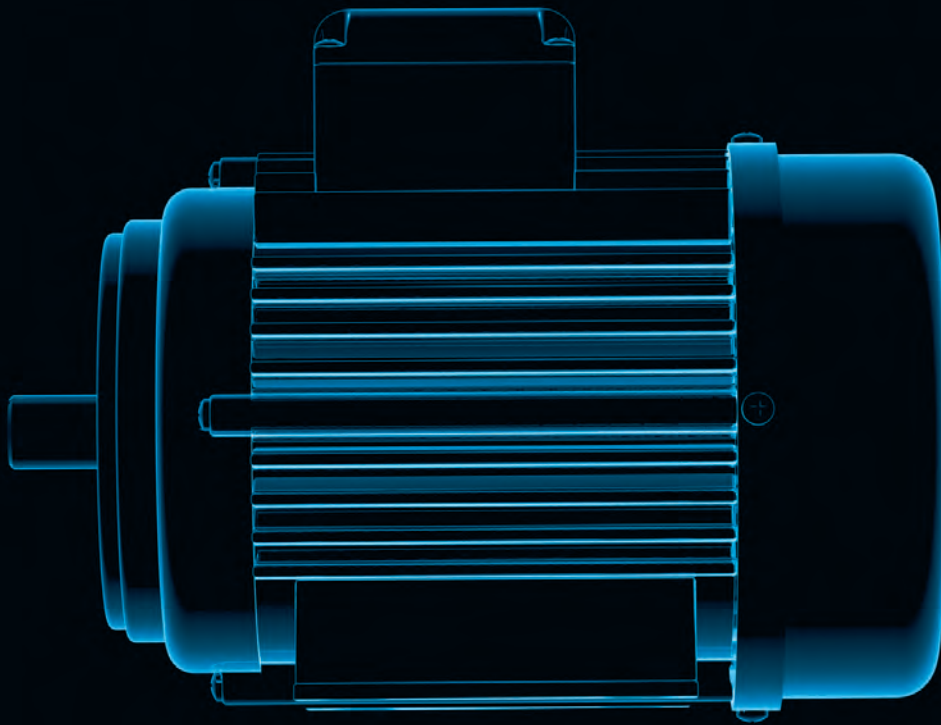
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# PICK THE TORQUE SENSOR FOR YOUR SERVO MOTOR

## IN THREE EASY STEPS

At the heart of many automated assembly platforms and robots is an electric motor. If the motor is the heart, then the brain is the controller and closed loop control system.

However, the motor and controller wouldn't be complete without sensors to provide relevant control information and complete the control loop. So, to extend the analogy, these sensors would be the nerves. One of these nerves would be a torque sensor, but just like an organ transplant, you cannot add any torque sensor to your system; the torque sensor needs to have the necessary specifications to meet your system's needs.

To preliminarily determine your sensor's specifications, you will need to:

- determine the maximum torque to be measured;
- determine the necessary system accuracy;
- determine electrical interface requirements.

### Step 1: Determine the maximum motor torque

When selecting a torque sensor, you must determine the maximum torque you expect the motor and/or gearhead to produce. A common misconception is that the nominal or maximum continuous torque determines the maximum capacity, when in reality the nominal or maximum continuous torque does not take into consideration the potential for a motor to stall.

Since stall torque can be several orders of magnitude greater than nominal or continuous torque, you would damage or destroy

the sensor in a stall scenario if you chose the nominal maximum torque. Therefore, it is important that you size your torque sensor based on the expected stall torque to prevent damaging the sensor.

### Step 2: Determine the necessary system accuracy

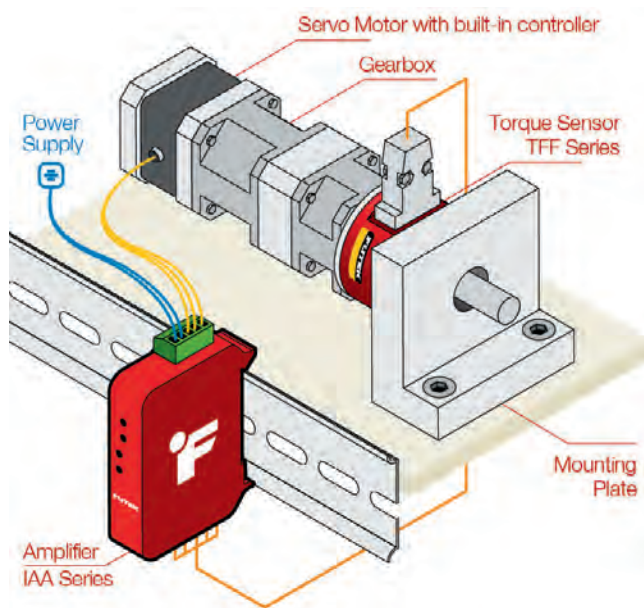
The accuracy of your torque sensor can be defined by the smallest amount of torque the sensor can reliably measure. If the minimum generated torque has not yet been determined for your system, then you can preliminarily determine your minimum torque using the torque gradient and minimum operating speed of the motor.

For example, a servo motor that has a torque gradient of 0.017 mNm/RPM at 1000 RPM will have a minimum operating torque of 0.017 Nm. This value would represent the system accuracy that would be necessary for selecting the proper torque sensor.

### Step 3: Determine electrical interface requirements

Your DAQ or PLC has specific signal inputs it can accept, so your sensor solution must be able to output those signals. For instance, some systems can handle  $\pm 10$  VDC or 4–20 mA, while other systems can handle mV/V or SPI signals. Knowing what





IF YOUR SENSOR CANNOT PRODUCE THE ANALOG SIGNALS YOUR DAQ OR PLC SUPPORTS, YOU WILL NEED AN AMPLIFIER TO BRIDGE THE GAP.

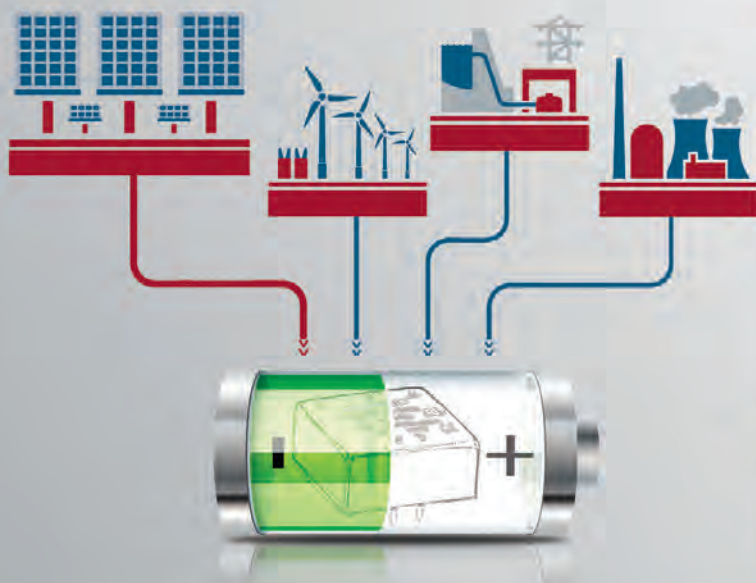
your system supports will allow you to select a sensor that can interface with your system.

However, if your sensor cannot produce the analog signals your DAQ or PLC supports, you will need an amplifier to bridge the gap. (In the diagram, we see an example of the relationship between a FUTEK TTF Torque Series sensor, a FUTEK IAA Series Amplifier and a PL/Motor Controller). The amplifier, used for full bridge sensors with mV/V signal output, will convert a mV/V signal to voltage, current or the correct signal for your DAQ or PLC. With the requirements of your DAQ and PLC in mind, you'll be able to select the sensor and any supporting hardware you need for your system.

You are now ready to explore torque sensor options and pick the perfect one for your application. Keeping your torque maximum, minimums and electrical requirements in mind, you'll be able to narrow down your selection of sensors to find the sensor that fits your needs perfectly.

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\* For the detailed information, please refer to datasheet.

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# TRANSPORTATION INNOVATION

## AUTONOMOUS ROBOTS COMPETE FOR GLORY

*Lauren Davis*

In September this year, two dozen autonomous robots converged on the Great Hall at the University of Technology Sydney (UTS). But don't worry, they weren't plotting to take over the world — they were competing in the 7th Annual National Instruments Autonomous Robotics Competition (NIARC).

**N**IARC is a student competition designed to encourage development and innovation in the field of robotics. Over a period of around six months, more than 120 participants from Australia, New Zealand and Singapore — ranging from first-year university students to PhD candidates — utilised an NI Robotics Development Kit to design and program intelligent vehicles that would qualify for the competition finals. The kit comprised an NI myRIO embedded measurement and control platform, the LabVIEW 2016 Robotics Software Suite and samples of the competition materials, as well as access to advice and support from NI applications engineers.

"The myRIO Student Embedded Device ... includes analog inputs, analog outputs, digital I/O lines, LEDs, a push-button, an onboard accelerometer, a Xilinx FPGA, a dual-core ARM Cortex-A9 processor and Wi-Fi support," NI Senior Field Marketing Manager — ANZ and South East Asia Mark Phillips explained. "It is an ideal platform for this type of project or application, and it takes advantage of the same RIO architecture as our industrial platforms.

"[Participants] also receive the NI LabVIEW Robotics Module, which features an extensive robotics library with built-in connectivity to robotic sensors and actuators, foundational algorithms for intelligent operation and motion functions. The combination of this open, user-defined software and flexible hardware allows the students to create their autonomous robotics systems.

"Based on the requirements of the tasks and the track considerations, they build out their complete system by adding the mechanical build, and take advantage of a variety of I/O, such as

sensors that are best suited to this kind of application: LIDAR, IR and sonar, for example, are very popular choices of sensor, as are Mecanum wheels."

Built around the theme 'Transportation Innovation', in line with the rise of self-driving cars, the 2017 competition asked students to design a vehicle that could make its way through a miniature city. The robotics application areas of focus were navigation, obstacle avoidance and object handling, with participants challenged to optimise their robot's performance to conduct a series of tasks within the least amount of time in order to earn points.

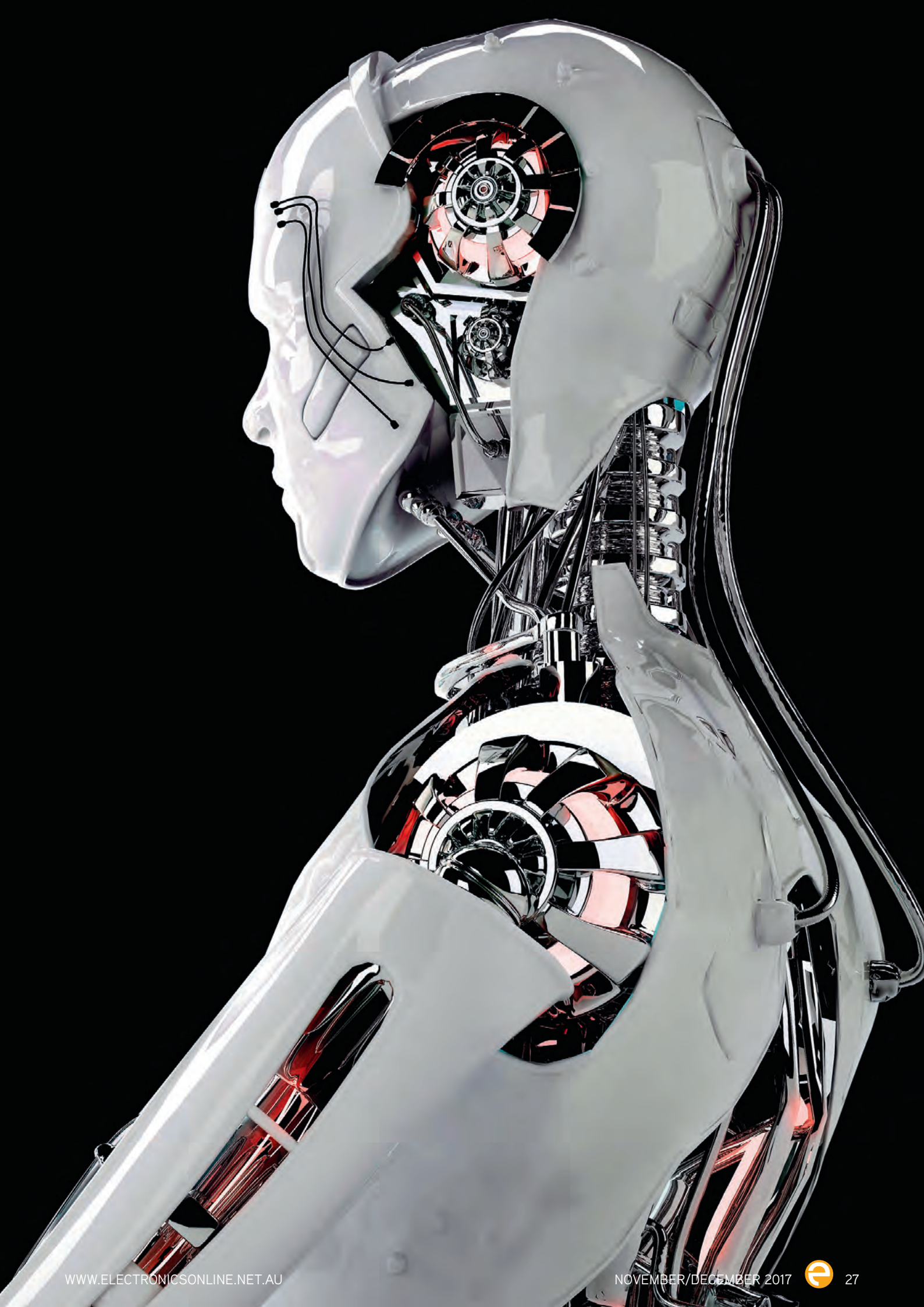
The finals saw each team's robot set out on a confined course, with only a 2-minute time limit in which to complete as many tasks as possible. The robot began its quest by driving to a pick-up point, where a team member would drop several 'passengers' (in reality, small cubes) on to the robot. The more pick-up points the team chose to use, the more points they received.

The robot was then tasked with making its way through the city, which was complete with roads, buildings, barriers and other obstacles. It even had to face the equivalent of a school zone, with the LabVIEW Academy building equipped with its own 'speed camera' courtesy of LabVIEW and myRIO. If the robot went faster than its designated speed limit in the vicinity of the building, the act was logged and the team lost points.

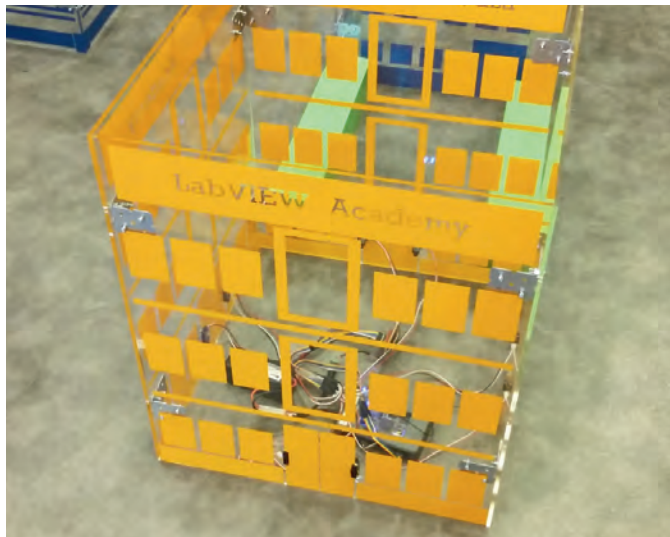
"[The speed detection system] is a real-time monitoring system that takes advantage of eight infrared (IR) sensors to determine the speed of any object passing through the field," said Phillips. "In theory, the distance between the sensors is known, so when

© Jim/Della Photo Club









the object passes through our sensors we calculate the time it takes to pass to the next sensor, and the algorithm in LabVIEW simply uses the following equation to determine the speed:  $\text{Speed} = \text{Distance}/\text{Time}$ ."

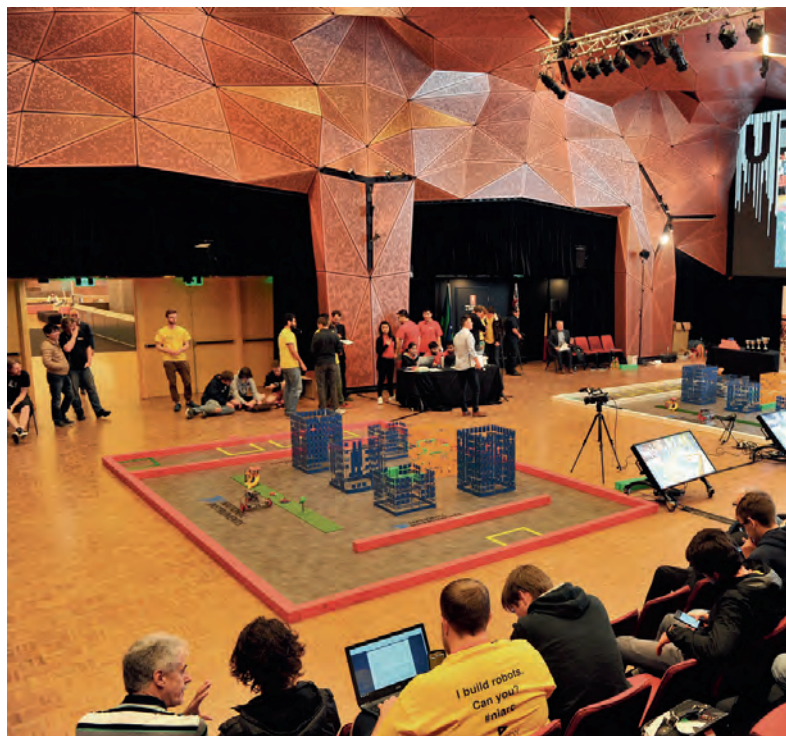
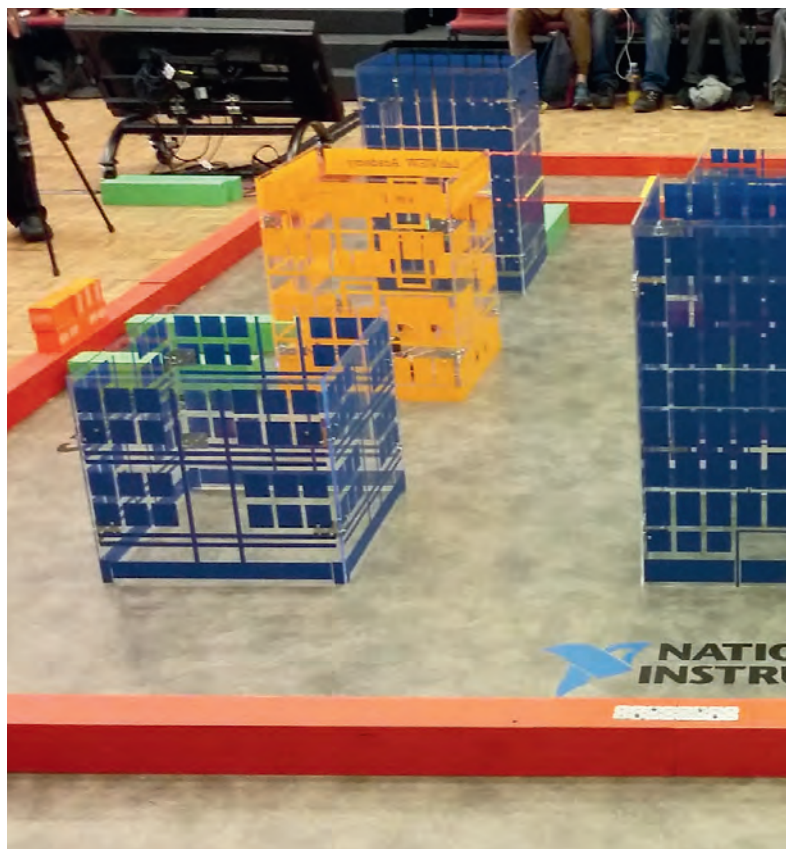
Once the robot got to the far end of the course, it was required to stop at a drop-off point from which its passengers could be removed. From there, it was a matter of making its way back to the beginning of the course before time ran out, continuing to avoid obstacles along the way. Once the end buzzer sounded, it was up to the judging panel to decide the winner, depending on how well each task was accomplished.

It was a long day of competition, with robots going head to head throughout the event on two identical courses. Slowly but surely, teams were knocked out — some for speeding, some for crashing and some for stalling at the starting line — until there were only two remaining: the reigning champions, from the University of Wollongong (team name UOW Robotics), and quiet achiever RMIT University (Ferrum Carrus).

The two final teams had two very different robot designs and, consequently, two very different strategies. UOW had designed a quite tall but otherwise compact robot, with the ability to move at an impressive speed and in any direction. By contrast, RMIT went with a large, circular design, similar to that of a robot vacuum cleaner. It moved slowly but precisely, in only one direction — so every time it reached a corner, it had to rotate on the spot until it was facing the right way again.

The robots set out in the first of up to three rounds. As expected, UOW reached the end of the course quickly, with RMIT still a fair distance away. But then, disaster struck — the UOW robot failed to stop at the drop-off point, thus forfeiting its points for that particular task. Then, on its journey back to the start — with passengers still in tow — it began to move off-course, causing it to crash into several obstacles. By the time the buzzer sounded, RMIT's robot was still moving towards the drop-off point and UOW's had left devastation in its wake. RMIT was declared the winner of Round One.

Round Two commenced much the same as Round One for the RMIT robot, which happily trundled along on its quest to the drop-off point. The UOW robot, however, could not recover its

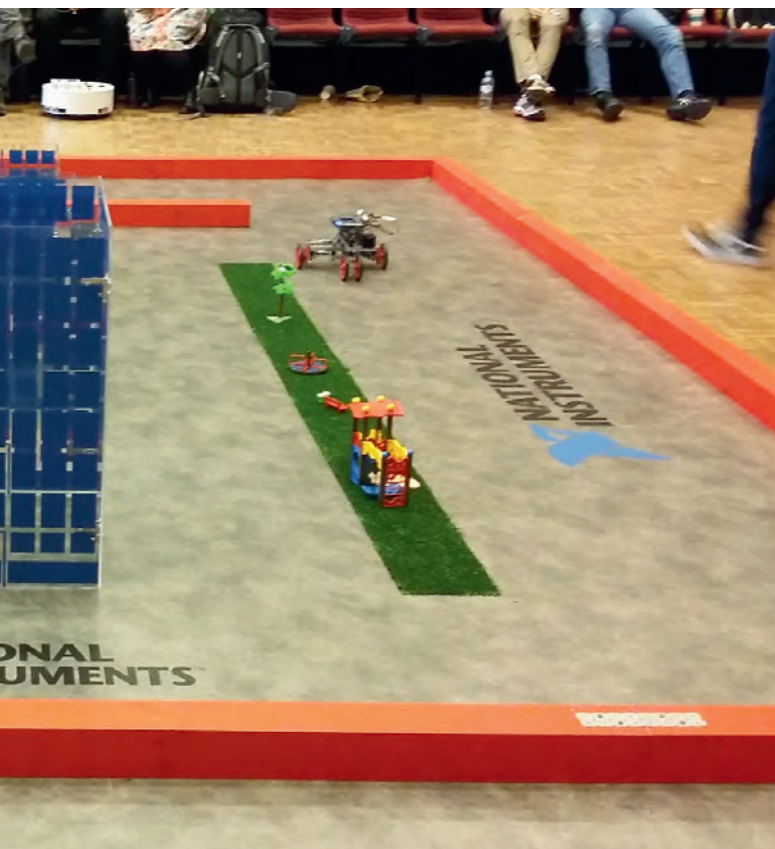


momentum. It hit a couple of obstacles en route, before eventually stalling, preventing it from proceeding any further. The team had no option but to forfeit, leaving RMIT the overall winner of the competition — and of two tickets to NIWeek 2018, to be held in Austin, Texas, in May next year.

The surprising outcome of the final made for entertaining viewing, but it was also a clever way of educating both the participants and the event attendees about the real-life questions that arise when programming robots. Have all variables been accounted for? Should you prioritise speed over accuracy? Can your robot recover if something goes wrong?

"NI really likes this robotics competition because it gives students the opportunity to not just practise things in theory, in textbooks or on computer simulations, but really get their hands dirty, build





"NI REALLY LIKES THIS ROBOTICS COMPETITION BECAUSE IT GIVES STUDENTS THE OPPORTUNITY TO NOT JUST PRACTISE THINGS IN THEORY, IN TEXTBOOKS OR ON COMPUTER SIMULATIONS, BUT REALLY GET THEIR HANDS DIRTY, BUILD SOMETHING THAT'S GOT TO WORK IN THE REAL WORLD." — JEREMY TAYLOR



*The top three teams pose alongside NI representatives.*

something that's got to work in the real world," NI Area Sales Manager Jeremy Taylor said at the conclusion of the competition. "And as we saw, the real world doesn't always work out exactly the same as when you do a practice.

"I think there's something to be said for slow and steady wins the race."

"We're always so impressed with the talent and commitment of the NI ARC participants, and this year was no exception," NI Marketing Director, APAC Ryota Ikeda added. "The students have proven that they have the capabilities to design and develop the smart transportation solutions of the future.

"This type of hands-on learning solidifies what the students learn in the classroom and gives them an opportunity to work with the hardware and software used by today's top engineers.

The transportation industry is just one of many that is being transformed by robotic technology, and these students will certainly have a unique advantage in helping shape the future of these industries."

"The competition has consistently grown since its inception seven years ago, with better, faster, more efficient robots each year," concluded Phillips. "It is always so inspiring and rewarding to see the creativity, innovation and smarts the students incorporate into their designs. Year after year, we are blown away by what they achieve in such a relatively short amount of time.

"We are looking forward to the 2018 competition, and our engineering team is already brainstorming the 2018 task and theme."

National Instruments Aust Pty Ltd  
www.ni.com



## MODULAR TEST PLATFORM

The Viavi OneExpert DSL helps field technicians fix problems. A multitouch, user-friendly interface and OneCheck automated tests ease complex tasks, with clear pass/fail results. Additionally, the DSL allows technicians to quickly test internet connectivity using the built-in web browser. The product is available for rent from TechRentals.

The OneExpert DSL supports ADSL/2/2+ Annex A and VDSL2 on single-line and 2-pair bonded ports. It supports vectoring on both single-line and bonded VDSL connections. Applications of the instrument include G.fast and ADSL networks, as well as copper and spectral testing. The unit is also equipped with TDR test functionality, which is a powerful tool for identifying cable faults that can impair broadband service.

Features include balance and capacitive open measurements; load coil detection and spectral analysis; wideband impairment measurements; and a fault locator and Pulse Echo Tester (PET).

**TechRentals**

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

## BUCK REGULATOR

Vicor has extended the Cool-Power 48 V ZVS 20 A buck regulator portfolio with the release of the PI3523-00-LGIZ (PI3523).

The PI352x family offers 20 A solutions complementing the previously released 10 A, 48 V<sub>IN</sub> PI354x family, enabling scalable power options for 48 V direct to point-of-load (PoL) applications. The PI3523 is a 48 V<sub>IN</sub>, 3.3 V<sub>OUT</sub> nominal buck regulator capable of supplying up to 22 A. The regulators enable 48 V<sub>IN</sub> to 20 A point-of-load voltages spanning 2.2 to 14 V<sub>OUT</sub>.

Offering all the features of the existing 48 V Cool-Power ZVS buck regulators, the PI352x portfolio extends performance by delivering twice the power of the PI354x regulators in a 40% larger package. The PI3523 requires only an output inductor and minimal passives for a design that consumes less than 740 mm<sup>2</sup> of PCB space. Designed to be easily paralleled in combinations of up to three regulators, the regulators can be scaled to support higher current loads.

The range addresses the growing need for 48 V direct-to-PoL solutions in applications including lighting, communications, automotive equipment, data centres and more. The regulators are focused on high power density and high efficiency while delivering ease of use.

**Vicor Corporation**

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



## MIDGET FLANGE LED BULBS

Mar's 202 Series LED bulbs are designed to replace the filament bulb in professional and industrial switch tops. Benefits include high optical performance and low heat generation.

The T1 sized, 3 mm (MF SX3s) midget flanged incandescent replacement indicator features a high-intensity LED element. Integral circuitry has been designed to facilitate a range of voltage options. Termination is centre contact anode (centre contact cathode is available).

The device is manufactured with a flat-topped LED to provide wide-angle viewing for switch top and annunciator illumination. It comes in a water-clear lens which gives a clear 'off' state. A range of LED colour options is available, so no colour filter is required.

The product features solid construction, making it suitable for high-vibration applications. Examples include defence platforms, aerospace indication, industrial equipment control panels, audio switch illumination, simulator switch illumination, power stations control panels, theme parks and leisure equipment panels, and transportation panels.

**Aerospace & Defence Products**

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



## MULTICORE SINGLE-BOARD COMPUTER

The A25 multicore SBC, from MEN Mikro Elektronik, offers up to 16 independent CPU cores, a variety of I/O options and an FPGA-based VMEbus interface.

The product is a powerful multicore VMEbus board, based on Intel's Xeon D-1500 server CPU. The board is available in versions with four, eight and 16 cores and thus provides a concentrated computing power. It features 32 GB DDR4 memory and scalability for the standard models. The VMEbus interface is implemented as an FPGA-based open-source solution, making the product futureproof.

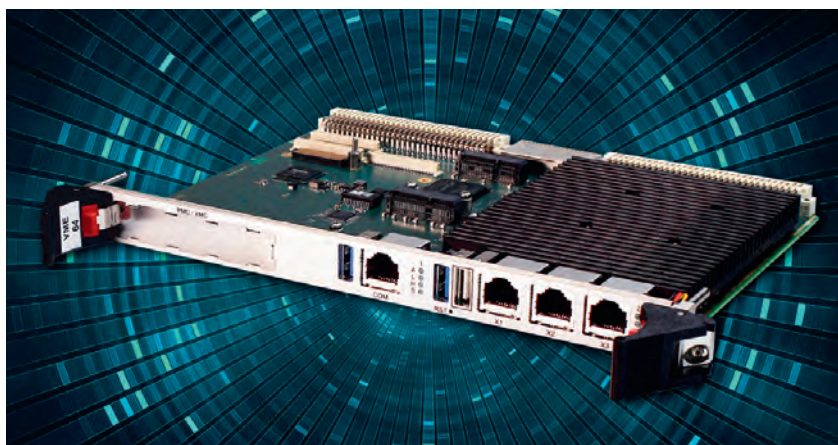
The interfaces are also versatile. With two USB, three Gigabit Ethernet and two RS232 ports at the front, the board provides the essentials for application in the industrial sector.


In addition, the product can be equipped with an XMC/PMC mezzanine card and a PCI Express Mini Card, providing additional front I/O for functions such as graphics, mass storage or further Ethernet. This modularity allows the configuration of customised systems from open standard components, thus reducing integration time.


The device supports applications in the temperature range from -40 to +60°C. All components have been prepared for coating and soldered, ensuring solid operation and a long product life. The VMEbus card is particularly suitable for critical embedded applications in the field of industrial automation, or in the energy segment.

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## RS485 AND CAN TRANSCEIVERS

MORNSUN has announced the TDx21D485x, TDx21DCANx and TDx22DCAN compact CAN and RS485 transceivers, which assist fast signal response in power grid industries, industrial control and instrumentation. They are designed to offer good performance and an improved manufacturing process.

All the devices feature good EMC performance and 3 kVDC isolation, with a baud rate for the low-speed RS485 transceivers from 9.6 to 19.2 Kbps. The nodes of the low- and high-speed transceivers are doubled, ie, 64 nodes. The nodes of the auto-switch interface increase by four times, ie, 128 nodes. All devices in the series feature output isolation of 5 V at the bus terminal, making default configuration of the bus easy.

The TDx21D485x and TDx21DCANx series apply SMT to enhance product automation. The single-output TDx21D485x and TDx21DCANx series are in open frame using pin terminals to match the corresponding female header, so that users can easily achieve automated processing, maintenance and replacement at the same time. The TDx22DCAN features dual-channel isolation to 2500 VDC, with input-output and output-output mutually isolated. The devices have many desirable features, including integrated power supply, bus isolation and ESD protection in the one module, as well as two-terminal isolation to 3000 VDC (input and output are mutually isolated).

The TDx21D485x has a baud rate up to 500 Kbps and can connect up to 256 nodes on one bus, with an operating temperature range of -40 +85°C. It comes in a compact size in a DIP10 package. The TDx21DCANx has a baud rate up to 1 Mbps and can connect up to 110 nodes on one bus, with an operating temperature range of -40 to +105°C. It comes in a compact size in a DIP8 package.



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



## DC/DC CONVERTERS FOR FAST-SWITCHING GAN DRIVERS

RECOM has developed two isolated 1 W DC/DC converter series, RP-xx06S and RxxP06S, offering an output voltage of 6 V, which is sufficient to efficiently switch GaN HEMTs without causing a gate dielectric breakdown.

The high slew-rate GaN transistor drivers require isolated 6 V supplies with high isolation voltage and low isolation capacitance. Typically, a safe DC/DC isolation voltage should be at least twice the working voltage, but the high ambient temperature and fast switching edges generated by these high-power transistors cause additional stress to the insulation barrier. Therefore, the internal transformer design of the converters uses a pot-core to physically separate the input and output windings providing up to 6.4 kVDC isolation to ensure that the isolation barrier stands up to even the harshest operating conditions.

Despite the high isolation grade, the converters still fit into an industry-standard SIP7 case, thus saving valuable space on the circuit board. They are available with input voltages of 5, 12, 15 or 24 V and feature a low isolation capacitance (<10 pF). They are IEC/EN-60950-1 certified and fully compliant to RoHS2 and REACH.

For certain GaN applications, where higher noise and transients have to be accommodated into the design, RECOM also offers converters with 9 V output, which can be split via a Zener diode circuit to 6 V and -3 V to provide a negative switching gate voltage as well.

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



## MOTORISED LINEAR STAGE FOR ROBOT APPLICATIONS

To extend the reach and versatility of modern robots, a motorised linear stage is often needed. Rollon Italy has now developed a standardised Seventh Axis system from its extensive linear product range.

Mounts are available for height-adjustable floor-, wall- and ceiling-mount applications. Larger sizes can be fitted with a walk-over plate. Energy chains come with all sizes.

Available in strokes of up to 46 m and with a total load capacity up to 2000 kg, the range features precision aluminium extrusions, rack and pinion drives, as well as mounting pads to suit common robots such as FANUC, MITSUBISHI, ABB, KUKA and NACHI. Units are supplied servo motor-ready to suit a wide range of manufacturers.

Designed around speeds of up to 4 m/s, acceleration up to 4 m/s/s and repeatability of  $\pm 0.05$  mm, the products are suitable for robot OEMs and end users alike. The range can also be factory customised as needed.

**Motion Technologies Pty Ltd**  
[www.motiontech.com.au](http://www.motiontech.com.au)



## ELECTRONICS ENCLOSURES

With its BoPad series of electronics enclosures, BOPLA has developed modern-styled enclosures for the integration of membrane keypads, touch screens and displays.

The electronics enclosure is coordinated specially to meet the requirements of mobile handheld devices which are used in demanding conditions. It is not only suitable for mobile devices — variants for desktop applications or accessories for wall mounting are also available.

The BoPad enclosures are supplied in five basic sizes and two colours (black and white). Special colours are also available on request. In addition, the user can choose between inclined and flat BoPad variants, with or without a battery compartment.

The two 'large' BOP 7.0 and BOP 10.1 BoPad enclosure versions have been optimised for the integration of touch screens and Li-Ion rechargeable batteries with the standard 18650 shape. This allows devices with touch operation to make use of standard components, which makes them especially user friendly. In contrast to the three 'small' versions, the two-hand design — horizontal format — contributes to this feature.

In order to allow the integration of membrane keypads and touch screens, all BoPad handheld and console enclosures have a recessed section in the lid. Their polished frame creates a high-quality appearance and protects the operating surface. The enclosures offer IP40 ingress protection, which can be increased to as high as IP65 at any time — including at a later date if required.

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## LITHIUM-ION BATTERIES WITHOUT EXPLOSIVE RISKS

US researchers have developed a lithium-ion battery that uses a water-salt solution as its electrolyte, with their results published in the journal *Joule*. Not only does the battery reach the 4 V mark desired for household electronics, it does so without the fire and explosive risks associated with some commercially available non-aqueous lithium-ion batteries.

4 V Li-ion batteries assembled with a water-in-salt gel electrolyte.



Image credit: Jhi Scott, ARI, photographer

“In the past, if you wanted high energy, you would choose a non-aqueous lithium-ion battery, but you would have to compromise on safety,” said Dr Kang Xu, a lab fellow at the US Army Research Laboratory and co-senior author on the study. “If you preferred safety, you could use an aqueous battery such as nickel/metal hydride, but you would have to settle for lower energy. Now, we are showing that you can simultaneously have access to both high energy and high safety.”

The research follows a 2015 study in the journal *Science* that produced a similar 3 V battery with an aqueous electrolyte but was stymied from achieving higher voltages by the so-called ‘cathodic challenge’, in which one end of the battery, made from either graphite or lithium metal, is degraded by the aqueous electrolyte. To solve this problem, University of Maryland assistant research scientist Chongyin Yang designed a new gel polymer electrolyte coating that can be applied to the graphite or lithium anode.

This hydrophobic coating expels water molecules from the vicinity of the electrode surface and then, upon charging for the first time, decomposes and forms a stable interphase — a thin mixture of breakdown products that separates the solid anode from the liquid electrolyte. This interphase, inspired by a layer generated within non-aqueous batteries, protects the anode from debilitating

side reactions, allowing the battery to use desirable anode materials, such as graphite or lithium metal, and achieve better energy density and cycling ability.

“The key innovation here is making the right gel that can block water contact with the anode so that the water doesn’t decompose and can also form the right interphase to support high battery performance,” said co-senior author Chunsheng Wang, a professor of chemical & biomolecular engineering at the University of Maryland. The gel coating also boosts the safety advantages of the new battery when compared to standard non-aqueous lithium-ion batteries and boosts the energy density when compared to any other proposed aqueous lithium-ion batteries, according to the researchers.

All aqueous lithium-ion batteries benefit from the inflammability of water-based electrolytes, as opposed to the highly flammable organic solvents used in their non-aqueous counterparts. The new battery is unique, however, in that even when the interphase layer





is damaged (eg, if the battery casing was punctured), it reacts slowly with the lithium or lithiated graphite anode. This prevents the smoking, fire or explosion that could otherwise occur if a damaged battery brought the metal into direct contact with the electrolyte.

This technology will thus bring the soldiers a “completely safe and flexible Li-ion battery” that provides identical energy density to state-of-the-art lithium-ion batteries, according to Dr Xu, who said the batteries “will remain safe — without fire and explosion — even under severe mechanical abuses”.

According to the researchers, the power and energy density of the new battery are suitable for commercial applications currently served by more hazardous non-aqueous batteries. The team also noted that the electrochemical manipulations behind the jump to four volts have importance within battery technology and beyond.

“This is the first time that we are able to stabilise really reactive anodes like graphite and lithium in aqueous media,” said Xu.

“This opens a broad window into many different topics in electrochemistry, including sodium-ion batteries, lithium-sulfur batteries, multiple ion chemistries involving zinc and magnesium, or even electroplating and electrochemical synthesis; we just have not fully explored them yet.”

The researchers acknowledged that they would also like to implement certain improvements in order to make their battery even more competitive, with Xu saying the interphase chemistry needs to be perfected before the product can be commercialised — hopefully in about five years. He and his fellow researchers say more work needs to be done on scaling up the technology in big cells for testing, and that they are looking to increase the number of full-performance cycles that the battery can complete.

“Right now, we are talking about 50–100 cycles, but to compare with organic electrolyte batteries, we want to get to 500 or more,” said Wang.

## CAPACITIVE TOUCH CONTROLLERS

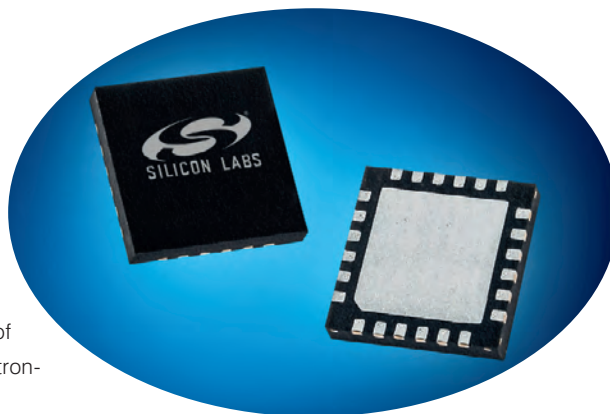
Silicon Labs' CPT212B and CPT213B TouchXpress capacitive touch controllers eliminate time-consuming firmware development, providing a simple turnkey solution for adding touch-based designs to a wide range of products, including home appliances, medical equipment, consumer electronics, instrument and control panels, and lighting control.

The controllers provide a fast and easy way for design engineers to add low-power capacitive touch interfaces to embedded designs. The I<sup>2</sup>C interface provides an easy way to track the status of touch sensors, and an interrupt pin can wake the host processor from sleep after touch detection.

The CPT212B device features up to 12 sensor inputs and features ultralow-power operation, rated at 200  $\mu$ A in optimised active mode and 1  $\mu$ A in sleep mode. The CPT213B device offers up to 13 sensor inputs and adds IEC 60730 Class B safety library support, designed for preventing unsafe operation of household appliances.

**Mouser Electronics**

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



## DIN RAIL POWER SUPPLY

The compact PIC240.241D power supply, by PULS, is the latest addition to the PIANO series. It has many useful characteristics, including an efficiency level of 94.8% and a lifetime of 74,000 h.

The 24 V, 10 A DIN rail power supply has a wide range of 100–240 V and comes with a DC-OK signal relay contact. The terminals are robust and the unit has low power losses.

The product has a slim, single-board design in a high-quality polycarbonate housing. It is 49 mm in width.

**Control Logic Pty Ltd**

[www.control-logic.com.au](http://www.control-logic.com.au)

## TELEMATICS AND CONNECTIVITY PROCESSORS FOR CONNECTED CARS

STMicroelectronics is protecting connected cars against cyber threats with its latest automotive microprocessors that feature a dedicated, built-in security module. The Telemaco3P telematics and connectivity processors (STA1385 and its variants) integrate a powerful, dedicated, isolated Hardware Security Module (HSM), which acts like an independent security guard to watch data exchanges and encrypt and authenticate messages.

The HSM securely checks the authenticity of received messages and any external devices that try to connect, and protects against eavesdropping. This

places the Telemaco3P devices ahead of the general-purpose application processors typically found in current connected-car systems, according to the company, which lack dedicated hardware-based security.

The chips are also robust, with a 105°C maximum temperature rating for use in locations that can become very hot, such as

on top or directly beneath the roof in a smart antenna. They are part of a comprehensive ST strategy to offer products with embedded security functions that include standalone Secure Elements (ST33) and embedded Flash microcontrollers (SPC5).

**STMicroelectronics Pty Ltd**

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## ENCLOSURE FOR CONTEMPORARY DESKTOP APPLICATIONS

The EVOTEC 250, with the dimensions 250 x 155 x 54 mm, is the latest addition to the EVOTEC enclosure range. The product offers sufficient space for the installation of 5.7" displays with or without touch-screen function.

Depending on the application, the user has the choice between three control panels: flat; inclined without recess; and inclined with recess to protect a membrane keypad. The gentle contour ensures that the user's devices have an elegant appearance.

Due to the high-quality ASA+PC-FR material with high UV protection and the option with a seal, the robust desktop enclosures are particularly suitable for industrial use in harsh environments and for visually demanding applications. The two 'desk' versions are available with or without a recessed surface for membrane keypads or decor foils.

Due to its height, the EVOTEC has a large interface panel on the rear of the top part, suitable for D-SUB connectors, round plugs, etc. The flat surfaces are particularly practical, allowing the enclosure to be used in a wide variety of ways. For a stable position on the desktop, the enclosure has non-slip rubber feet that can be mounted on the bottom part. The standard range of accessories also includes self-tapping screws for installing PCBs.

The enclosure range can be modified directly in-house according to user specifications. Possible options are, for example, special colouring in accordance with users' CI guidelines, a functional EMC aluminium coating on the inside of the enclosure, machining processes for interfaces, individual lettering and printing, the production and fitting of digital printed foils and more. Applications include measurement and control technology, medical and laboratory technology as well as environmental technology.

**ROLEC OKW Australia New Zealand P/L**

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



## CMOS IMAGE SENSOR FOR 4K NETWORK SECURITY CAMERAS

Renesas Electronics has announced a high-sensitivity, high-resolution 8.48 MP CMOS image sensor that supports 4K video cameras. In conjunction with the existing Renesas 2.12 MP product, the company will be providing full-scale sales support for its high-end CMOS image sensor for network security cameras.

To meet the increasing needs for network security cameras in financial institutions, transportation systems and commercial establishments, the RAA462113FYL CMOS image sensor provides functions appropriate for imaging under the varied environmental conditions required by high-end devices and contributes to increased system performance.

The sensor achieves clear, high-visibility, full-colour imaging even in a moonlit environment. It captures clear, high-visibility images even when digital zoom is used due to its capture of high-reliability 4K video at 60 fps.

The sensor supports a line-by-line HDR (high dynamic range) mode in which long exposure data and short exposure data are output separately for each line. This allows video capture, even for high-contrast scenes.

Renesas also provides a reference board that was developed together with a camera module manufacturer to allow users to evaluate the performance of the image sensor. The company plans to work with camera module manufacturers to supply camera modules with a variety of features such as autofocus functions, HDR functions, wide-area monitoring functions and vibration reduction (image stabilisation) functions.

**Renesas Electronics**

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



## SINGLE-BOARD COMPUTER

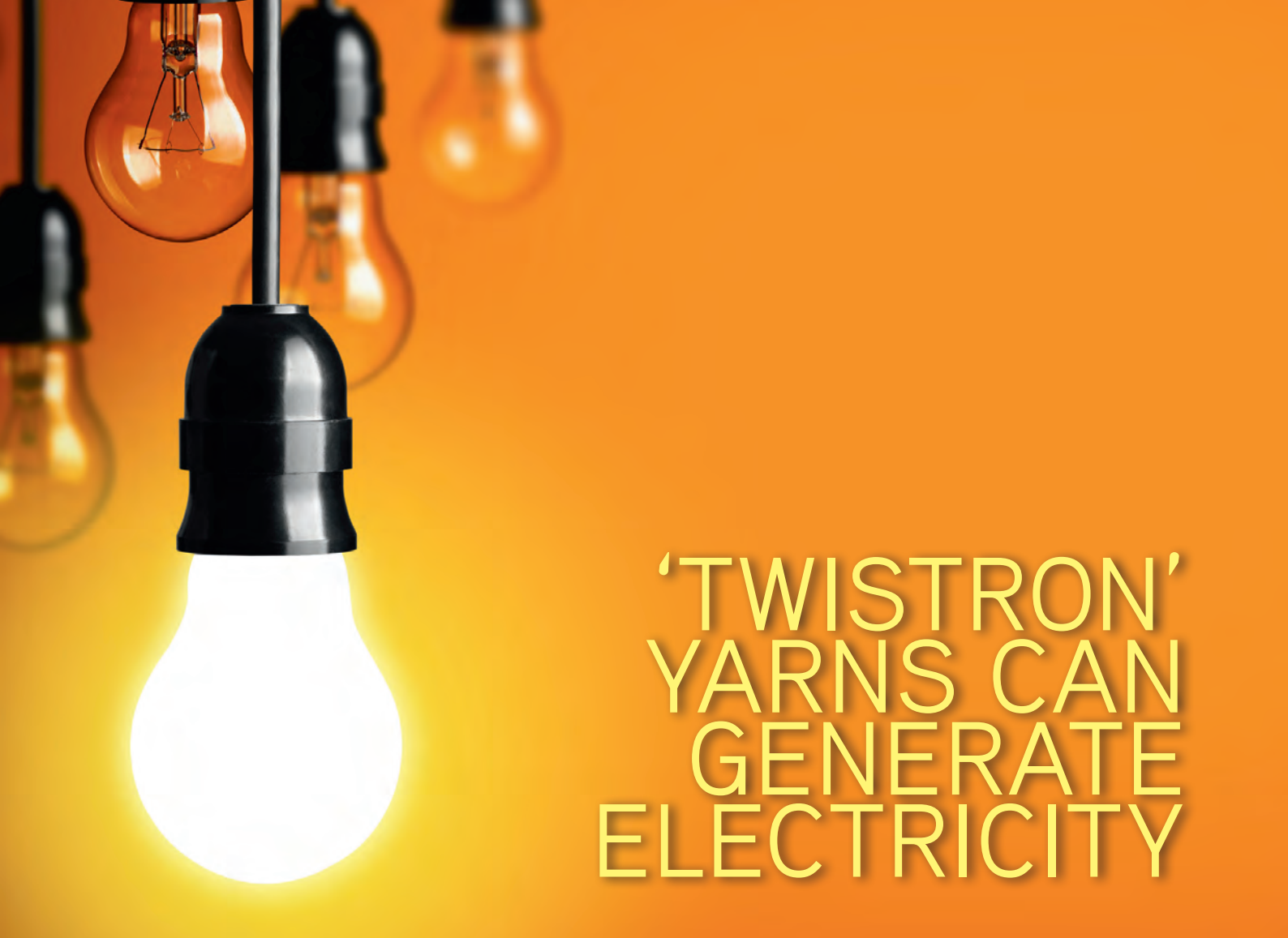
Liger is a high-performance PC104 Plus embedded computer for applications requiring high-speed processing and high-quality graphics capabilities.

Its powerful CPU and video processing capability, combined with a relatively moderate power draw and standard PC/104-Plus expansion, will enable high-performance systems that are small, light and energy efficient. The powerful SBC is suitable for compute-intensive high-end applications such as flight navigation, guidance systems and medical scanning/imaging.

The dual-core Liger is available in Core i3, Core i5 and Core i7 processor options to meet a variety of performance and application requirements. It provides compatibility with a broad range of x86 application development tools for reduced development time.

**Unitronix Pty Ltd**

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



# 'TWISTRON' YARNS CAN GENERATE ELECTRICITY

An international research team has developed high-tech yarns that generate electricity when they are stretched or twisted. And before you ask: no, we're not spinning you a yarn.

**N**amed 'twistron' yarns by the research team, which includes scientists from the US, South Korea and China, the yarns are constructed from carbon nanotubes, which are hollow cylinders of carbon 10,000 times smaller in diameter than a human hair. They are described by the researchers in the journal *Science*.

"The easiest way to think of twistron harvesters is, you have a piece of yarn, you stretch it and out comes electricity," said co-lead author Dr Carter Haines, from the Alan G. MacDiarmid NanoTech Institute at The University of Texas at Dallas.

The researchers first twist-spun the nanotubes into high-strength, lightweight yarns. To make the yarns highly elastic, they introduced so much twist that the yarns coiled like an over-twisted rubber band. In order to generate electricity, the yarns must be either submerged in or coated with an ionically conducting material, or electrolyte, which can be as simple as a mixture of ordinary table salt and water.

"Fundamentally, these yarns are supercapacitors," said Dr Na Li, a research scientist at the NanoTech Institute and co-lead author of the study. "In a normal capacitor, you use energy — like from a battery — to add charges to the capacitor. But in our case, when you insert the carbon nanotube yarn into an electrolyte bath,

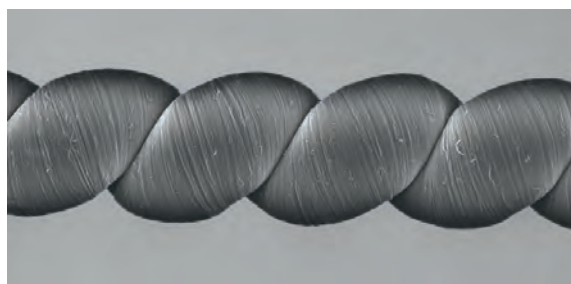
the yarns are charged by the electrolyte itself. No external battery, or voltage, is needed."

When a harvester yarn is twisted or stretched, the volume of the carbon nanotube yarn decreases, bringing the electric charges on the yarn closer together and increasing their energy, explained Dr Haines. This increases the voltage associated with the charge stored in the yarn, enabling the harvesting of electricity.

Stretching the coiled twistron yarns 30 times a second generated 250 W/kg of peak electrical power when normalised to the harvester's weight, said Dr Ray Baughman, director of the NanoTech Institute and a corresponding author of the study.

"Although numerous alternative harvesters have been investigated for many decades, no other reported harvester provides such high electrical power or energy output per cycle as ours for stretching rates between a few cycles per second and 600 cycles per second," Dr Baughman said.

In the lab, the researchers showed that a twistron yarn weighing less than a housefly could power a small LED, which lit up each time the yarn



*Coiled carbon nanotube yarns, created at The University of Texas at Dallas and imaged here by a scanning electron microscope, generate electrical energy when stretched or twisted.*



was stretched. They also demonstrated that twistrons can harvest waste thermal energy from the environment, with Dr Li connecting a twistrion yarn to a polymer artificial muscle that contracts and expands when heated and cooled. The twistrion harvester converted the mechanical energy generated by the polymer muscle to electrical energy.

"There is a lot of interest in using waste energy to power the Internet of Things, such as arrays of distributed sensors," Dr Li said. "Twistrion technology might be exploited for such applications where changing batteries is impractical."

The researchers also sewed twistrion harvesters into a shirt. Normal breathing stretched the yarn and generated an electrical signal, demonstrating its potential as a self-powered respiration sensor. As noted by Dr Baughman, "Our yarns produced over a hundred times higher electrical power per weight when stretched compared to other weaveable fibres reported in the literature."

Having demonstrated that their energy harvesters worked using table salt as an electrolyte, Dr Baughman revealed that the next step was to "show that they would also work in ocean water, which is chemically more complex".

In a proof-of-concept demonstration, co-lead author Dr Shi Hyeong Kim, a postdoctoral researcher at the NanoTech Institute, waded into the surf off the east coast of South Korea to deploy a coiled twistrion in the sea. He attached a 10 cm-long yarn, weighing only 1 mg, between a balloon and a sinker that rested on the seabed. Every



**NORMAL BREATHING STRETCHED THE YARN AND GENERATED AN ELECTRICAL SIGNAL, DEMONSTRATING ITS POTENTIAL AS A SELF-POWERED RESPIRATION SENSOR.**

time an ocean wave arrived, the balloon would rise, stretching the yarn up to 25%, thereby generating measured electricity.

Even though the investigators used very small amounts of twistrion yarn in their study, they have already shown that harvester performance is scalable, both by increasing twistrion diameter and by operating many yarns in parallel. Dr Baughman revealed, "If our twistrion harvesters could be made less expensively, they might ultimately be able to harvest the enormous amount of energy available from ocean waves."

"However, at present these harvesters are most suitable for powering sensors and sensor communications. Based on demonstrated average power output, just 31 mg of carbon nanotube yarn harvester could provide the electrical energy needed to transmit a 2 KB packet of data over a 100 m radius every 10 seconds for the Internet of Things."



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## 5 W AC/DC CONVERTERS

RECOM has developed a 5 W AC/DC converter, the RAC05-K series, in a tiny 1" x 1" package, offering a power density of 7.7 W/in<sup>3</sup>.

The modules are specially designed to supply IoT and factory automation applications, providing high performance without additional components necessary. Their low no-load power consumption of only 75 mW and good light load efficiency make them suitable for 'always on' IoT systems.

Standard output voltages are 3.3, 5, 12, 15 and 24 VDC with sufficient power to operate relays, data gateways and building automation nodes. A universal mains input voltage range from 85 to 264 VAC makes them suitable for worldwide use. The modules feature a 60 ms hold-up time at 230 VAC input, which means that missing mains cycles do not affect the output.

RECOM fabricated the converters into a lightweight fully encapsulated plastic casing taking up only a square inch on the PCB, allowing them to be designed into space-constrained applications. The series operate over a temperature range from -25 to +50°C at full load (up to +70°C with derating) and are output overvoltage and short-circuit protected. An EMC Class B filter is built in without the need for any additional components, further saving space.

The converters are fully certified to UL/IEC/EN60950-1 and UL/IEC/EN62368-1 with CB reports. They are CE-marked and have a 3-year warranty.

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

## 4-SLOT USB/LXI MODULAR CHASSIS

Pickering Interfaces has announced the model 60-105 4-Slot USB/LXI Modular Chassis. The product complements the company's model 60-104 2-Slot USB/LXI Modular Chassis in that they both offer a small, lightweight form factor suitable for portable, benchtop and space-restrictive applications.

The chassis is designed for desk or rack mounting and features remote control via USB or LXI Ethernet. Remote control over a network enables the switching function of a test system to be located as close as possible to the target equipment.

The 4-slot chassis supports between one and four of Pickering's 3U PXI modules. Possible systems include switching matrices up to 2208 crosspoints or up to 72 channels of programmable resistor/sensor simulation.

The chassis is USB 3 compatible and has a fully compliant LXI interface. These communications standards enable the chassis to be controlled directly through standard interfaces found on most personal computers and tablets that support HTML5, allowing for a practical route into a variety of applications in the modular test and measurement market.

**Scientific Devices Australia**  
[www.scientific-devices.com.au](http://www.scientific-devices.com.au)



## EMBEDDED SYSTEM

Advantech has announced its latest thin, barebone fanless system, the EPC-S101, with Intel Celeron N3160/N3060 and the Intel Atom-E8000 processor. Designed with Advantech 3.5" PCM-9310 PCBA, the product provides abundant I/O ports, easy function expansion, IoT software WISE-PaaS/RMM implementation for remote devices management and flexible mounting methods, making it ready for use in various industrial and commercial application fields.

The device measures only 188 x 39 x 150 mm and is less than 1U in height. The slim, fanless system provides six USB ports, four COM ports (RS-232/422/485), two Gigabit Ethernet ports, one HDMI, one VGA, an 8-bit digital I/O port, an audio jack w/ mic in and a line out port. It has reserved spaces for a 2.5" SATA SSD with SATA power, mSATA and a full-size mini-PCIe with SIM holder for multiple expansion.

For flexibility, the product supports wall mount, VESA mount and DIN rail mounting to cope with different application scenarios. With its reduced system size, multiple IO ports and flexible mounting methods, it is suitable for retail, commercial kiosk and signage applications, environmental monitoring and HMI device implementation. The system is small but versatile and powerful, making it suitable for a wide range of work and tasks.

The product utilises Advantech's WISE-PaaS/RMM software — part of the WISE-PaaS cloud solution, which focuses on remote device management and monitoring. WISE-PaaS/RMM provides centralised management features including HW/SW status monitoring, remote control and system back-up/recovery. It supports server redundancy and hierarchical server management, which increases service availability. WISE-PaaS/RMM utilises standard IoT protocols, like MQTT from IBM, to communicate with IPCs and IoT gateways and sensors. It provides a WISE Agent framework for data acquisition from devices, as well as the RESTful API web service, which allows the user to integrate RMM functions with other applications or do further customisation. WISE-PaaS enhances connectivity for hardware, software, devices and sensors, and helps users to transform their business by including IoT cloud services.

**Advantech Australia Pty Ltd**  
[www.advantech.net.au](http://www.advantech.net.au)



## RUGGED HANDHELD TABLET

Panasonic has announced the Toughpad FZ-F1 fully rugged handheld tablet, powered by Windows 10 IoT Mobile Enterprise.

The thin and lightweight 4.7" tablet is intended to support those who are exposed to tough and high-risk work environments, due to its fully ruggedised design. The product has 3-in-1 capabilities, combining a mobile barcode reader, phone and tablet into one device.

The ergonomically designed, angled rear barcode reader allows the user to scan items without bending at the elbow or wrist while also being able to clearly read the screen. The device also features a quad-core Qualcomm Snapdragon processor, which gives companies the ability to develop in an open environment.

The product has a daylight-readable display and is built to withstand a 1.8 m drop on concrete. It even works with a wet screen or with gloves on. It is fully sealed against dust and is submersible in 100 cm of water for 30 min, meeting IP65 and IP68 certification requirements. It can withstand temperatures from below -100 to above +500°C.

The product is a full multicarrier Band 28 4G LTE phone with dual SIM card support and up to 630 h standby time. It comes with 100 dB speakers with noise suppression and triple noise-cancelling microphones. It can operate beyond a typical 8 h work shift on its field-replaceable battery, and with an optional extended life battery it can go well beyond two full work shifts.

The device is suitable for the transportation and logistics, manufacturing and retail industries, with possible applications including inventory management, shipping and receiving, delivery routing and parcel tracking, and retail store queue busting.

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## Improved cleaning performance for silicon wafer assemblers

**E**lectrochemicals manufacturer Electrolube has developed an innovative cleaning solution called Safewash Super (SWAS) for PCB wafer assemblers, following close collaboration with a number of manufacturers to improve their cleaning capabilities as well as speed up throughput, reduce costs and decrease environmental impact.

While cleaning processes can vary from plant to plant, the silicon wafer manufacturers in all had many issues in common. These included a bottleneck in production due to a slow cleaning process; use of a solvent-based cleaning product which produced disappointing cleaning outcomes as well as increased rejects and rework; and concerns with environmental impact with regard to storage, transport, disposal and employee safety. The existing solvent-based products in use also displayed a relatively low-contamination load-bearing capability, which resulted in a more frequent need to replace material for a fresh batch.

Electrolube recently introduced SWAS into the cleaning process of a major multinational water manufacturer. This particular customer used a US-made, solvent-based cleaning agent in a multichamber

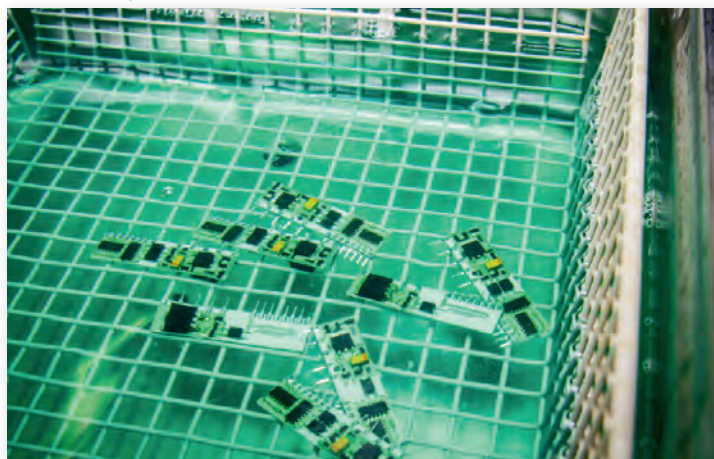
machine, consisting of five cleaning tanks plus a loading and unloading station.

As a direct result of introducing SWAS into the process, the company was able to reclaim considerable floor space at its facility by reducing its existing five-tank configuration to a three-tank configuration (clean/QDR and QDR de-ionised). SWAS significantly improved the assembler's cleaning performance with no residue on the wafer and enabled throughput to increase by as much as 50% — a vast increase assisted by the decreased time in the cleaning tank and the reduced tank configuration.

SWAS can absorb 5–15% of its weight of flux (RA, RMA, no-clean and water-soluble) while still cleaning to military standards. Due to the product's capacity to hold high levels of contaminant particles, the customer effectively reduced the number of cleaning agent changes per week. Costs were reduced even further thanks to the water-based formulation of SWAS, making it cheap to transport and dispose of after use. Designed to clean to well within the world's military cleanliness standards — ANSI-J-001B/IPC TM-650 — SWAS is non-flammable, ozone-friendly and biodegradable. The cleaning agent is low-odour and is safe for employees to work with and store.

SWAS was found to be a cost-effective and technically capable cleaning product in this application, as well as for several other wafer manufacturers and PCB/production equipment cleaning applications. It can remove all types of flux residues quickly and efficiently, with minimal environmental effect using readily available cleaning equipment. It is particularly suitable for the removal of stubborn flux residues and no-clean fluxes, which can be difficult to remove.

*Electrolube*  
[www.electrolube.com.au](http://www.electrolube.com.au)







## TIME-OF-FLIGHT SENSOR MODULE

The RFD77402 Simblee Internet of Things (IoT) 3D time-of-flight (ToF) sensor module, from RF Digital, integrates an embedded light sensor, vertical cavity surface emitting laser (VCSEL) driver, microcontroller and onboard memory to provide distance mapping and 3D imaging technology. It is founded on the Simblee platform, which offers an end-to-end development environment for a variety of IoT applications from whitegoods and consumer and industrial measurement devices to gesture recognition and robotics.

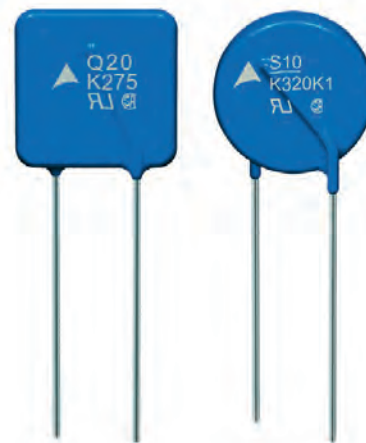
The module uses the eye-safe laser to measure the amount of time it takes to bounce off a given target. The high-repeatability laser features an 850 nm wavelength light source and offers an overall sensing distance from 100 mm up to 2 m.

The module is available in an ultrasmall 4.8 x 2.8 x 1 mm SMD package and is suitable for a broad array of IoT sensor applications that require correct distance measurement, user detection, obstacle detection and avoidance, gesture detection and recognition, directional movement and volume or height control. It offers a 10 Hz maximum refresh rate and an I<sup>2</sup>C interface for device control and data transfer.

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## METAL OXIDE DISK VARISTORS

TDK Corporation's leaded EPCOS metal oxide disk varistors have been approved for an increased operating temperature of 105°C, up from 85°C. Raising the permissible operating temperature to 105°C also changes the climate category from 40/85/56 to 40/105/56. The flammability of the epoxy enclosure complies with UL 94 V-0.

The monolithic EPCOS varistors are available with rated voltages of between 11 and 1100 V<sub>rms</sub> and, depending on type, can withstand surge currents of up to 20 kA (8/20 μs). They are suitable for the protection of power supply and converter inputs for industrial electronics applications, as well as household appliances and telecommunication devices.

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## LITHIUM-ION BATTERIES

LG Chem has introduced the RESU series to the Australian market, offering users high- and low-voltage battery options that give home owners the ability to self-consume solar-generated energy throughout peak electricity times after sunset. The batteries make use of Energy Storage System (ESS) technology.

The RESU series is said to be one of the compact units on the market, yet with some of the high-

est power and energy densities. This is due to a lamination and stacking process that is used exclusively by LG Chem in mass production, according to the company. Encasing the unit is an IP55 battery enclosure that enables flexibility, making the unit suitable for outdoor or indoor installations.

ESS delivers consumers the ability to store and use power at times of their choosing. As their needs evolve, ESS can grow with them. Lithium-ion meanwhile offers high performance, high energy density, high operating voltage and longevity for storage.

The lithium-ion RESU series gives consumers the flexibility to choose a model that meets the required capacity for their household's energy output, while being compatible with a full range of inverter providers. No matter whether the consumer is trying to reduce their electricity spend, carbon footprint or blackout protection, LG Chem offers an ESS solution to meet their needs.

The batteries comply with strict international battery safety standards and are certified for tests that include overcharging, nail penetration, crushing and dropping them in water, and even deliberately setting batteries alight to ensure optimum safety to consumers.

**LG Chem Energy Solution Company**

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

## BYPASS DIODE TESTER FOR PV PANELS

The Hioki FT4310 bypass diode tester can be used safely in broad daylight, detecting open and short-circuited bypass diodes, as well as measuring cell string losses. The product is Bluetooth compatible, transferring data wirelessly (available for Android and iOS devices).

Failure of bypass diodes frequently goes undetected until the affected panel is in shadow. All testing is conveniently done at the combiner box. Bypass diodes prevent excessive reverse bias on cells that have failed. This failure can cause severe overheating.

The instrument's comparator function can be used to compare measured values to a previously set value to generate pass and fail judgements, making it easier to discover anomalies. Measured values held on the display are sent immediately to a smartphone or tablet via Bluetooth Smart technology.

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# STORING PHOTONIC INFORMATION AS SOUND WAVES

Australian researchers have achieved a massive breakthrough in the field of optical information processing, dramatically slowing digital information carried as light waves by transferring the data into sound waves in an integrated circuit. This allows precious extra time to store, process and then redistribute the data without relying on electronics.

Fibre optics and the associated photonic information — data delivered by light — have huge advantages over electronic information: bandwidth is increased, data travels at the speed of light and there is no heat associated with electronic resistance. Photons, unlike electrons, are also immune to interference from electromagnetic radiation.

However, the advantages of light-speed data have their own problem: you need to slow things down on a computer chip so that you can do something useful with the information. In traditional microchips, this is done using electronics — but as computers and telecommunication systems become bigger and faster, the associated heat is making some systems unmanageable.

Transferring information from the optical to acoustic domain and back again inside a chip is one solution for the development of photonic integrated circuits: microchips that use light instead of electrons to manage data. Moritz Merklein, a doctoral student at the University of Sydney, noted, “For this to become a commercial reality, photonic data on the chip needs to be slowed down so that they can be processed, routed, stored and accessed.”

Merklein and Dr Birgit Stiller, both from the ARC Centre of Excellence for Ultrahigh bandwidth Devices for Optical Systems (CUDOS), have now demonstrated a memory for digital information that coherently transfers between light and sound waves on a photonic microchip. The groundbreaking study co-authored by the researchers has been published in the journal *Nature Communications*.

“The information in our chip in acoustic form travels at a velocity five orders of magnitude slower than in the optical domain,” said Dr Stiller, describing this delay as “like the difference between thunder and lightning”. This allows for the data to be briefly stored and managed inside the chip for processing, retrieval and further transmission as light waves.

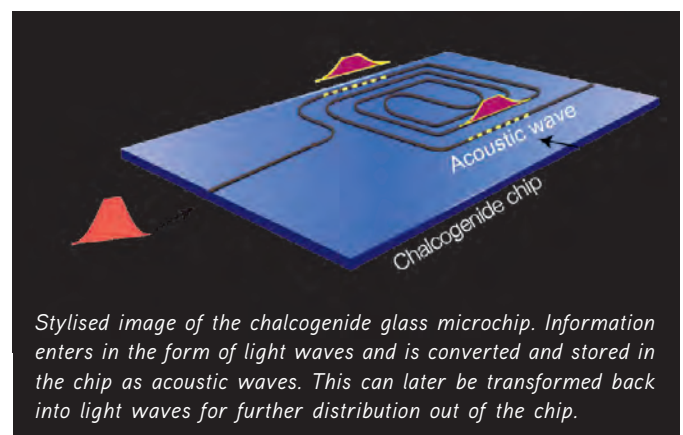
“Our system is not limited to a narrow bandwidth,” added Dr Stiller. “So unlike previous systems this allows us to store and retrieve information at multiple wavelengths simultaneously, vastly increasing the efficiency of the device.”

The researchers used for their experiment a chip that was fabricated at the Australian National University’s (ANU) Laser Physics Centre, also part of CUDOS. The chip is made of chalcogenide glass, which provides optimal guidance of both optical and acoustic waves.

“The high level of performance achieved is the result of 10 years of research at the Laser Physics Centre CUDOS node into materials properties, waveguide device geometry effects and optimised processing methods for chalcogenide glass to produce stable, low-loss, high power handling capacity devices,” said Dr Khu Vu, who fabricated the chip.

The optical acoustic memory system operates at room temperature and can be interfaced with other on-chip components in a straightforward manner, which means it can be easily integrated into photonic circuits. This process eliminates electronic processing steps to some extent and could lead to a paradigm shift in processing technology.

Professor Benjamin Eggleton, CUDOS director and co-author on the study, concluded that the new research marks “an important step forward in the field of optical information processing”, noting that the new concept “fulfils all requirements for current and future generation optical communication systems”.



Stylised image of the chalcogenide glass microchip. Information enters in the form of light waves and is converted and stored in the chip as acoustic waves. This can later be transformed back into light waves for further distribution out of the chip.

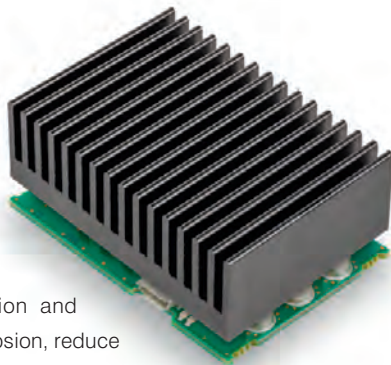
## DC MOTOR CONTROLLER FOR HARSH ENVIRONMENTS

Excessive humidity, condensation and airborne pollution can cause corrosion, reduce surface resistance and trigger metal migration. maxon motor's ESCON 50/8 DC servo motor controller is not affected by these conditions, due to the polymer-coated circuit board. Even silicon or lubricant oils do not stick.

The controller withstands ambient temperatures from -40 to +92°C. The vibration and shock endurance comply with the high requirements of the Environmental Engineering Considerations and Laboratory Tests (MIL-STD 810F). This results in its suitability for a wide range of applications in fields like defence, marine, aerospace and scientific research, and for oil refineries and automotive systems.

The DC motor controller is designed for both brushed and brushless (with Hall sensors) DC motors up to 400 W of continuous power and 750 W of peak power. The servo amplifier has configurable digital and analog inputs along with current limits and speed ramp settings.

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## LOW-POWER AC/DC CONVERTER

Mornsun offers a range of single inline low-power AC/DC converters that are suitable for IoT, smart devices and building automation applications.

The LS series provides 1, 3 and 5 W single output and features an input range of 85–264 VAC (70–400 VDC) with 3000 VAC isolation and an operating temperature range of -40 to +85°C with efficiency of up to 80%. In addition to the standard version there are converters with an extended input voltage range of 90–528 VAC (100–745 VDC). Single output voltages of 3.3, 5, 9, 12, 15 and 24 V are available. Output ripple and noise (20 MHz bandwidth) is typically 50 mV peak to peak. The output features self-recovering continuous short circuit and overvoltage protection.

The compact design of the AC/DC converters, with their ease of application, makes them suitable for applications where low-power AC/DC voltage conversion is required. These applications include but are not limited to IoT devices, smart home control, industrial instruments, utility monitoring and consumer electronics.

Mornsun products are distributed in ANZ by DLPC and in Victoria by Fairmont Marketing.

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## CATEGORY 11 LTE FULL MINI PCIe CARD

Telit has announced the LM940, a Full PCI Express Mini Card (mPCIe) module for the router and gateway industry, supporting LTE Advanced Category 11 (Cat 11) with speeds of up to 600 Mbps.

Said to be the only enabling technology in an mPCIe form factor to support Cat 11 with the Snapdragon X12 LTE modem, the industrial-grade module delivers flexibility to original equipment manufacturers (OEMs) looking to quickly deploy next-generation products — particularly in the router and gateway markets — supporting high-bandwidth dependent applications such as digital signage. The modem, with LTE Advanced technologies, provides peak download speeds of 600 Mbps.

The product allows OEMs to immediately leverage the 3x carrier aggregation and the higher order modulation of the 256 QAM capabilities currently available amongst most mobile operator networks. Combined with a good power efficiency platform, it enables commercial and enterprise applications in the router industry, such as branch office connectivity, LTE failover, digital signage, kiosks, pop-up stores, vehicle routers, construction sites and more.

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### MIXED DOMAIN OSCILLOSCOPE SERIES

The MDO-2000E multifunctional mixed domain oscilloscope series comprises the MDO-2000EG and MDO-2000EX models. The MDO-2000EG has a built-in spectrum analyser and a dual-channel 25 MHz arbitrary waveform generator, while the MDO-2000EX features a built-in a spectrum analyser, an arbitrary waveform generator, a 5000-count DMM and a 5 V/1 A power supply.

While entering the spectrum mode, the series will display a full screen of frequency domain. Users can input centre frequency, span, start frequency and stop frequency based on test requirements so as to rapidly and intuitively observe the required frequency range that allows them to experience the user interface of a real spectrum analyser. While observing frequency domain display, engineers can observe waveform characteristics, which are not easily seen from time domain waveforms; for instance, the harmonic composition of a waveform and the frequency characteristics of a modulation signal. The series allows engineers to effectively conduct signal measurements on frequency domain.

The frequency domain includes spectrum trace type settings (normal, max-hold, min-hold and average). Users can freely select various spectrum traces for simultaneous display. Detection method (sample, +peak, -peak and average) can be individually set for each trace. Additionally, users can manually mark the corresponding positions to reflect frequency and amplitude. Users can use the search function to search and mark the amplitude and frequency of spectrum signal.

The series is claimed to be faster than a general spectrum analyser when it comes to frequency domain waveform display, due to its use of a digital circuit and software to calculate FFT. The spectrum function of the series can test below 9 kHz signals, which is applicable to the frequency domain analysis of audio frequency and vibration. The series can also test the frequency domain signal with the DC component without damaging the instrument.

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# TURNING OFF THE TV WITH A CUP OF TEA

## JOIN THE REMOTE CONTROL REVOLUTION

We've all found ourselves, at one point or another, on that seemingly endless search for the TV remote, only to discover once we find it that the batteries aren't working anyway. It's an experience which could soon be at an end, with Lancaster University researchers having developed gesture control technology that allows body movement, or movement of objects, to be used to interact with screens.

Developed by Professor Hans Gellersen and PhD student Christopher Clarke, 'Matchpoint' technology requires only a simple webcam and works by displaying moving targets that orbit a small circular widget in the corner of the screen. These targets correspond to different functions — such as volume, changing channel or viewing a menu. When selecting volume adjustment or channel selection, sliders appear.

The user synchronises the direction of movement of the target with their hand, head or an object to achieve what researchers call 'spontaneous spatial coupling'. Thus, the user moves their hand, head or object in the required direction indicated by the slider to change the volume or to find the desired channel.

"Spontaneous spatial coupling is a new approach to gesture control that works by matching movement instead of asking the computer to recognise a specific object," explained Clarke.

Unlike existing gesture control technology, the software does not look for a specific body part it has been trained to identify, such as a hand; instead, it looks for rotating movement. This means it does not require calibration, or prior knowledge of objects, thus providing much more flexibility and ease for the user.

As well as televisions, the technology can also be used with other screens. For example, YouTube tutorials, such as mending bikes or baking cakes, could be easily paused and rewound on tablet computers without users having to put down tools or mixing bowls.

"Our method allows for a much more user-friendly experience, where you can change channels without having to put down your drink or change your position; whether that is relaxing on the sofa or standing in the kitchen following a recipe," said Clarke.

The technology can also be utilised for interactive whiteboards, with multiple pointers allowing more than one user to point at



drawings or pictures. Matchpoint also allows users to manipulate images on whiteboards by using two hands to zoom in and out, and to rotate images.

The researchers believe Matchpoint could be particularly beneficial for people who are unable to use traditional pointers, such as remote controls, mice and keyboards. They noted that users do not need to learn specific commands to activate different functions, and they have the option to decouple at will.

In addition to short-term couplings, users can also link stationary objects to controls, which even when left for prolonged periods will retain their control function. For example, a mug sitting on a table could change a track on a music player when moved left or right, and a rolling toy car could be used to adjust volume. Objects can lose their coupling with controls simply by removing them from the camera's field of view.

"Everyday objects in the house can now easily become remote controls, so there are no more frantic searches for remote controls when your favourite program is about to start on another channel, and now everyone in the room has the 'remote'," said Clarke. "You could even change the channel with your pet cat."

The technology has been described in the paper 'Matchpoint: Spontaneous spatial coupling of body movement for touchless pointing', presented at the 30th ACM Symposium on User Interface Software and Technology (UIST) in Quebec from 22-25 October.



Image credit: Lancaster University.

Christopher Clarke selects a channel to watch by using his mug as a remote control. He moves his drink left or right until finding the station he wants to watch.

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# LI-ION BATTERIES

## CREATED AT QUT



Image credit: Anthony Weate/QUT media

Queensland University of Technology (QUT) has established a facility capable of manufacturing rechargeable lithium-ion batteries — the first in Australia at a commercial scale, according to QUT Professor Peter Talbot.

The facility is contained within the university's pilot plant precinct at Banyo, in Brisbane's north. Infrastructure built at the facility is said to include Australia's only electromanufacturing room with zero humidity, which is what enables the production of the batteries.

According to Professor Talbot, he and his fellow researchers have identified "the best lithium-based powders to use to create a battery of the highest energy-efficiency standards possible".

"The powder is a combination of lithium and other compounds. We tested various compositions of chemicals until we were satisfied that we had achieved the best powder possible.

"Our process enables us to rapidly test and prototype rechargeable lithium-ion batteries of various shapes and sizes."

Professor Talbot said the QUT batteries are based on commercial battery formats comparable to those used to power Tesla vehicles. They are said to be extremely safe and efficient, with the technology and processes developed at QUT suitable for use by any commercial battery manufacturing company.

Indeed, Professor Talbot suggested the research could be used to kickstart a commercial lithium-ion battery manufacturing industry in Australia, with the batteries being one of the most popular types of rechargeable batteries used in portable electronics and expected to play an increasingly significant role in the automotive industry of the future.

"As more and more vehicles in the future are manufactured to run on battery power, the development of longer-lasting batteries will be crucial to a vehicle's overall efficiency and appeal to consumers," Professor Talbot said.

Professor Talbot even suggested that the facility could value-add to the mining industry. Lithium is mined in several countries, including Australia, so it is feasible that miners could have their materials validated at the plant.

Now that QUT has developed the purpose-built facilities needed to produce lithium-ion batteries, the university has the capacity to build the batteries for specific commercial applications. Professor Talbot noted, "We will be able to purpose build the most efficient batteries possible to power any number of devices and products including some of QUT's key robots."

The project is the outcome of a three-year, \$4 million project, funded by the Auto Cooperative Research Centre and conducted in conjunction with the Malaysia Automotive Institute. Professor Talbot said the research "wouldn't have been possible without the financial backing of the Australian and Malaysian governments", thus highlighting "the importance of international research partnerships in the efforts to solve global problems".



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