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## COVER STORY



Oscilloscope manufacturer Rohde & Schwarz delivers products with good signal fidelity, a high acquisition rate, an innovative trigger system and a clever user interface. Users can match their needs with the right oscilloscope platform, probing options and software applications — from general-purpose test to solutions for specific industry standards.

The R&S RTC1000 series is designed to feature the highest instrument integration in its compact form factor. The instrument's comprehensive features are tailored to meet the needs of users in the field of education, engineers with low budgets and hobbyists.

The oscilloscope can double as an eight-channel logic analyser; a four-channel pattern generator; a protocol analyser for I<sup>2</sup>C, SPI, UART/RS-232, CAN and LIN; a digital voltmeter; a component tester; and a spectrum analyser and counter. With this eight-in-one instrument integration, users get more value with a minimal footprint.

The R&S RTM3000 offers bandwidths of 100 MHz, 200 MHz, 350 MHz, 500 MHz and 1 GHz. The products incorporate a 5 GS/s 10-bit ADC, and each model includes 40 MS (80 MS interleaved) per channel acquisition memory with an optional 400 MS segmented acquisition memory.

The R&S RTA4000 offers bandwidths of 200 MHz, 350 MHz, 500 MHz and 1 GHz. These models include the same 10-bit ADC, but have even more memory, with 100 MS (200 MS interleaved) per channel acquisition memory and standard 1 GS (1000 MS) segmented acquisition memory. Both series feature a 10.1" capacitive touchscreen display to operate quickly and efficiently.

With the addition of these products to the R&S RTB2000 series launched in March 2017, Rohde & Schwarz is claimed to have the most up-to-date 1000, 2000, 3000 and 4000 class instruments on the market.

Rohde & Schwarz (Australia) Pty Ltd  
[www.rohde-schwarz.com.au](http://www.rohde-schwarz.com.au)



# IS THERE A STANDARD FOR SMART MANUFACTURING?

Dave Vasko\*





Waiting for smart manufacturing standards to develop before implementing the Industrial Internet of Things into your operations may not be the most productive choice.

Smart manufacturing is called different things in different countries: Manufacturing USA (United States), Industrie 4.0 (Germany), China 2025 (China) or Industrie du Futur (France). The UK, Sweden, Japan, Korea and India all have country-specific efforts as well.

What do these initiatives have in common? They are all:

- creating a vision for smart manufacturing;
- using the power of digitalisation to help manufacturers reduce capital expenditures, improve time to market, reduce inventory and improve productivity;
- extending existing standards to realise the vision.

The last point is an important distinction: these initiatives are not creating new standards — they are classifying how best to use existing standards.

That means the groundwork for smart manufacturing, Industry 4.0 and other initiatives is being done in standard developing organisations such as the IEC, ISO, ISA, IEEE and the OPC Foundation. These organisations are where the influence starts and leadership takes hold.

This is particularly important as thought leaders prepare for the G20 Digital Economy (or Group of Twenty) in August. This international forum for governments from 20 major economies is host to high-level discussions of policy issues pertaining to, among other things, global economic growth.

On the agenda is digital technology. Countries and companies around the world are eager to adopt digitalisation strategies because it levels the playing field for smaller companies, allowing them to reap the same benefits as larger firms, and remain globally competitive and relevant.

This means if you look only at one country's initiative, you'll have a limited view of the global movement. You must look at global standards to understand global impact. So rather than the name of the initiative that differentiates the work, it's the standards behind that initiative that make the difference.

### The time to start is now

For organisations hesitant to start their journeys to smart manufacturing, don't wait until new standards are complete to get started.

Industrial Internet of Things (IIoT) standards (I4.0) will take time to come to the ideal state in which data flows seamlessly among multivendor applications and devices. But rather than see that as a reason to delay, I see that as a reason to start now.

Industry is slow to adapt to new technologies, mostly because replacing existing assets with new, smart manufacturing versions can be complex and take time. The transition should take place in phases.

Smart manufacturing is not a moment in time. A good strategy thinks about how to use current standards to facilitate change that matters today — and support future evolution. In the case of digital industrial technology, the highest priority is connectivity — or connecting assets throughout the enterprise. This is the first step in realising the value of the cloud and big data. Then, the next priority is cybersecurity, or helping confirm information shared via the cloud is secure from outside threats.

### Why it matters

Digitally connected organisations will be able to capitalise on the best of the international standards that define smart manufacturing today. National initiatives





and industry consortia are monitored and enhanced so that it will be possible to incorporate the best of future international standards as they emerge.

That's going to be important when we talk about another aspect of smart manufacturing: speed.

Speed is a challenge for everyone. International standards that support operations technology (OT) are mature and can take a few years to evolve. In IT, the timing is more in months. Like apps on your phone, there's always something new. By the time a standard can form around it, there's something newer.

## Constant incremental change

Initiatives need to be agile enough to address emerging trends and technology.

Right now, that's not the case. Industry 4.0, for example, plans to release yearly updates on its interfaces and relevant standards, but is probably five years from describing the requirements for compli-

ant products. That doesn't seem realistic, because we just don't know what our IT and OT landscape will be in a year, much less five. Some applications in the IT space will evolve, gain acceptance and become absolute within five years.

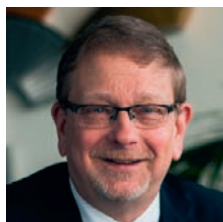
It's smart to look for and implement improvements continually. The goal is to sort through standards, apps and services to find the right ones for right now and to constantly assess using a cost-benefit analysis. That's how you determine where you can make the biggest impact for manufacturing — and find the next opportunity for improvement.

## Harnessing the power

In just the past few years, industry has harnessed never-before-seen levels of processing power, mobility and visualisation. We now can get any information we need, from anywhere and at any time.

Standardisation is working behind the scenes, and we continue to align. A well-connected enterprise with standards to support it can achieve smart manufacturing in whatever terms you want to use: Manufacturing USA, Industrie 4.0, China 2025 or Industrie du Futur.

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*\*David A Vasko is Director of Advanced Technology at Rockwell Automation. He is responsible for applied R&D and Global Product Standards and Regulations within Rockwell. He is responsible for developing and managing technology to enable the future generation of Rockwell Automation's industrial automation products.*



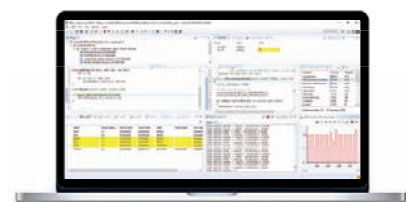


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## SYSTEM-ON-CHIP

ON Semiconductor's RSL10 multiprotocol system-on-chip (SoC) is designed to bring ultralow-power connectivity to Internet of Things (IoT) devices and high-performance wearables. The highly integrated SoC includes a DMA controller, oscillators and ultra-efficient power management units.

The SoC features a 48 MHz Arm Cortex-M3 processor bolstered by a 32-bit

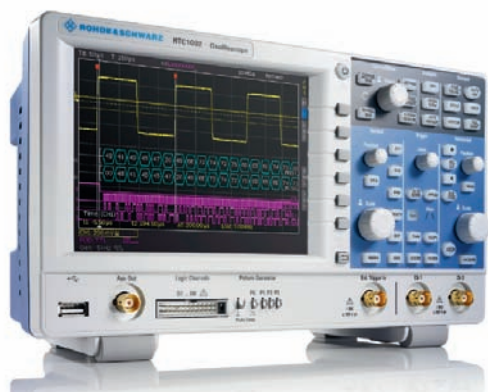
dual-Harvard DSP core that supports the audio codecs necessary for wireless audio communication. Including both flash and RAM, the versatile Bluetooth 5-certified SoC supports Bluetooth low energy technology as well as 2.4 GHz proprietary or custom protocol stacks.

The unit is designed for use in applications with 1.2 and 1.5 V batteries and supports a supply voltage range of 1.1 to 3.6 V without the need for an external DC/DC converter. It supports a wide range of medical applications including fitness trackers, hearing aids, heart rate monitors, glucose monitors and pulse oximeters.

The SoC is supported by the RSL10 Evaluation Board, which provides access to all input and output connections through standard 0.1" headers. Additionally, the evaluation board offers an onboard communication interface circuit and a J-Link solution to enable users to debug the board through a USB/PC connection.

**Mouser Electronics**

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## OSCILLOSCOPE

The R&S RTC1000 oscilloscope series features high instrument integration in its compact form factor. The instrument's comprehensive features are tailored to meet the needs of users in the field of education, engineers with low budgets and hobbyists.

The compact oscilloscope can double as an eight-channel logic analyser, a four-channel pattern generator and a protocol analyser for I<sup>2</sup>C, SPI, UART/RS232, CAN and LIN; and as a digital voltmeter, component tester, spectrum analyser and counter. With this eight-in-one instrument integration, users get more value with a minimal footprint on bench space.

The oscilloscopes are available in models from 50 to 300 MHz. They are the first in the 1000 class to offer bandwidth upgrades via software licence all the way to 300 MHz bandwidth; these upgrades can be purchased as test needs increase over time. The two-channel oscilloscopes have maximum sample rates of 2 GSa/s and a memory depth of 2 MSa. All models come with LAN and USB interfaces.

**Rohde & Schwarz (Australia) Pty Ltd**

[www.rohde-schwarz.com.au](http://www.rohde-schwarz.com.au)



## TOUCH SCREEN INTEGRATION FOR ENCLOSURES

Touch screens and displays for plant control systems are useful for enclosures in industrial environments. Not only does BOPLA meet this development with its own series of enclosures, it also integrates the screens with an input function in all BOPLA standard enclosures.

With its BoTouch product range, the company offers a series of enclosures that enable the mainly standardised fitting of commercial displays in different sizes as well as resistive and capacitive touch screens. By using the technologies which have been developed for this purpose, the components can also be integrated in all standard enclosures. If the user requires, the touch screen can be combined with a conventional membrane keypad.

In some applications, eg, in medical technology or the foodstuffs sector, dirt-collecting edges are unacceptable. For these situations, the company also offers solutions with a continuous front membrane for resistive touch screens or cover glass for capacitive touch screens.

For mounting displays, BOPLA makes use of grouting technology developed in-house: a floating mounting compensates effectively for measurement and machining tolerances, as well as for the effects of thermal expansion or mechanical stresses. The selection of a suitable compound ensures that different requirements can be satisfied.

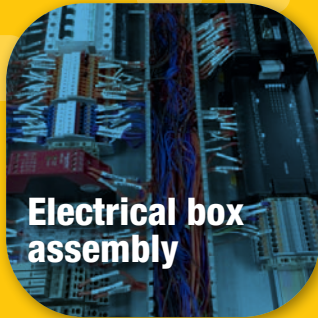
In addition, the company can use optical bonding to combine the touch and glass units. The liquid gluing of both components achieves an attractive look, and no air bubbles can form between the display element and the front glass pane. BOPLA's own specialist team of experts deals with complex HMI projects.

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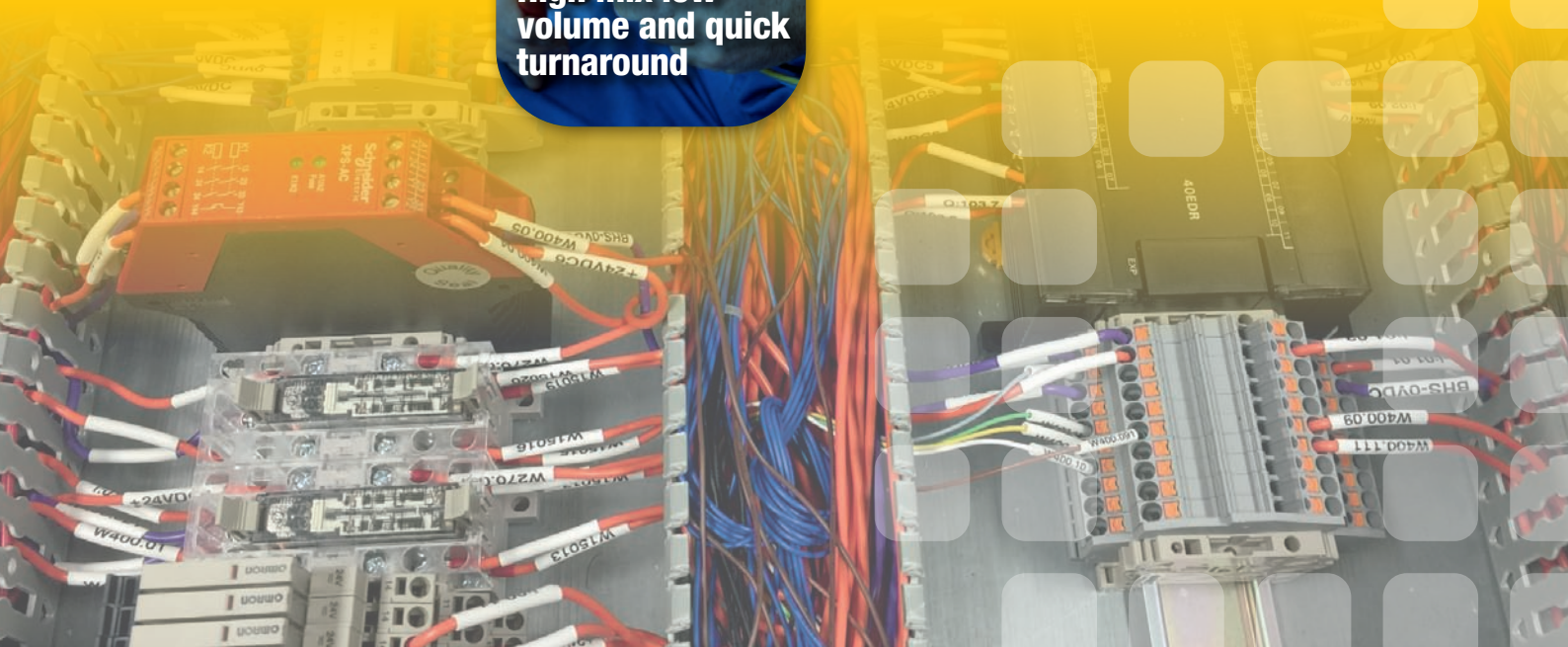


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# SHORTCIRCUITS

## SATELLITE COMMS COMPANY TO OPEN ADELAIDE IoT LAB



*Myriota CEO Dr Alex Grant with one of Myriota's low-cost, long battery life satellite transmitters.*

Satellite communications company Myriota has announced it will invest \$1.36 million in an 'Internet of Things (IoT) Laboratory' in Adelaide, creating more than 50 new jobs in IT and advanced manufacturing in the process.

Founded in 2015 to commercialise technology generated at the University of South Australia, Myriota has developed an ultralow-cost satellite IoT service based around tiny satellite transmitters that send low-powered messages directly to a constellation of low-Earth-orbit nanosatellites. These satellites relay the messages to Earth, where they are decoded and sent to the end user.

Myriota's technology makes IoT possible for a wide range of remote industries, with current deployments including asset tracking and monitoring, agricultural water monitoring, environmental monitoring and more. Last September it was announced that the company was one of two selected to help develop the equivalent of a Black Box for soldiers, known as a 'Fight Recorder', in a \$700,000 deal with the Australian Department of Defence.

Myriota's investment in the new IoT lab will be matched by a grant from the South Australian Government's Future Jobs Fund, which will allow the company to integrate its satellite IoT solution into a wide range of global products and services. Jobs to be created at the lab include highly skilled software and hardware developers, data networking and satellite communications professionals.

"This new IoT lab will enable us to build on our core technology and apply it across a wide range of industries including agriculture, defence, utilities, environmental monitoring, asset tracking and logistics," said Myriota CEO Dr Alex Grant.

Dr Grant believes the IoT industry is set to boom across the globe and that Myriota has the potential to create significantly more advanced manufacturing jobs over the coming years — and to undertake production runs of millions of units for export.

"Our low-cost IoT system has been deployed in field trials for months now, and there are hundreds of companies here and overseas interested in using our product to provide connectivity for a huge range of applications," he said.

"Our system works from any location on earth, and we look forward to taking our product global."

## EMC COMPLIANCE AND DESIGN COURSES COMING UP

Keith Armstrong, a well-known author and expert in cost-effective EMC, safety management and design, is returning to Australia in April and May to present new and updated seminars on designing EMC for compliance.

Sponsored by EMC Technologies, Armstrong's courses are aimed at helping companies enjoy greater success while using more advanced and complex electronic technologies in their products. The courses describe practical low-cost techniques to ensure quick and easy compliance with functional specs (signal integrity and power integrity) and achieve electromagnetic compatibility (EMC) for all electronic applications, for any test standards (civilian, automotive, military, aerospace, rail, etc).

The series include an updated seminar on the new EU CE marking directives that came into force in 2016–17, with a special focus on Radio Equipment Directive (RED) compliance for 'combined equipment' — products that



incorporate Bluetooth, Zigbee, Wi-Fi, GSM, 3G, 4G or similar wireless datacomms — that used to comply with LVD and EMC directives but since June 2017 must comply with the RED instead. There will also be an updated seminar on medical EMC, including risk management of EMI for medical devices.

One of the newer seminars covers EMC engineering techniques for systems and installations (including rail), controlling EMI and complying with the right EMC standards even in the toughest applications. There will also be a new seminar with a focus on

shielding and filtering to meet military EMC standards, to be presented in Adelaide only.

The series also includes a free half-day RCM course explaining compliance requirements and the process involving EMC, EMR, radio, electrical safety and cellular approvals for Australia and New Zealand. Presented by Chris Zombolas, technical director EMC Technologies, the session will explain the ACMA and EESS regimes including the testing, certification and administrative requirements for all product categories, including mobile phones and cellular devices.

The courses will be held at the following:

- 23–27 April: Adelaide — location TBC
- 30 April–4 May: Melbourne — EMC Technologies conference room, 176 Harrick Road, Keilor Park
- 7–11 May: Sydney — EMC Technologies training room, 3/87 Station Road, Seven Hills

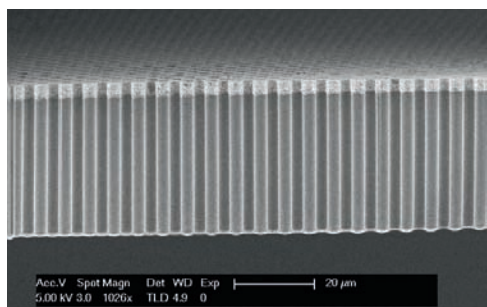
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## BOOSTING SOLAR FUEL EFFICIENCY USING MICROWIRES

Researchers from the University of Twente have made significant efficiency improvements to the technology used to generate solar fuels, involving the direct conversion of energy from sunlight into a usable fuel. Using only earth-abundant materials, the researchers developed what has been called the most efficient conversion method to date.

Scientists around the world are working on generating sustainable fuels using only sunlight, CO<sub>2</sub> and water — the basic ingredients used by plants. The University of Twente researchers have now developed a method for converting light into hydrogen, avoiding the use of scarce and expensive precious metals in the process.



*Electrodeposition of earth-abundant catalysts, nickel-molybdenum (Ni-Mo), on silicon microwire arrays.*

The system consists of silicon microwires less than one-tenth of a millimetre long, the tops of which are coated with a catalyst. The photons (light particles) are collected between the microwires. The chemical reaction in which hydrogen is formed takes place on the catalyst at the tips of the microwires.

By varying the density and length of the microwires, the researchers ultimately achieved a maximum efficiency of 10.8%. They achieved this by decoupling the site where the photons are collected from the site where the conversion reaction takes place. This is necessary because catalysts usually reflect light. Yet to make the conversion as efficient as possible, you want them to absorb as much light as possible. It is important to achieve this decoupling at the microscale, because at larger scales the conductivity of the silicon microwires becomes the limiting factor.

Professor Jurriaan Huskens, one of the researchers involved, states that 10.8% is the highest ever efficiency for a silicon-based design. A further increase in efficiency, to 15%, would make the technology economically viable.

This study has been published in the journal *Nature Energy*.



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## 'SAFETY BATTERIES' DESIGNED TO BREAK APART DURING CAR ACCIDENTS

US researchers have modified the design of lithium-ion batteries to mitigate the risk of battery failure during automobile accidents. Published in the journal *Joule*, their prototype could allow manufacturers to scale down the housing materials that commonly protect batteries in electric cars from mechanical damage, improving the overall energy density and cost.

Many electric and hybrid cars use lithium-ion batteries, which are known to be very safe. However, an impact may occasionally disrupt the battery's function, creating an electrical short.

Researchers at Oak Ridge National Laboratory, led by Nancy Dudney, lowered the risk of a battery failing during an accident by adding slits as perforations along the electrodes. These slits are designed to break the electrodes into tiny fragments during an impact, dividing the battery's energy into smaller components so it is more difficult for the temperature to rise beyond a level the battery can handle. In the event that a short does still occur, the fragments limit the current and heating around the short.

"Small batteries pose a much smaller hazard when they are accidentally shorted than do very large batteries," said Dudney. "Our innovation may allow the large batteries used in most vehicles to fragment into many small batteries if damaged in a collision."

The team tested their model against a standard lithium-ion battery by pressing a large metal ball into each. The modified battery was distorted like a potato chip but continued to function at 93% of its original capacity. Similar damage to a standard battery causes a full discharge and failure.

"Safety glass was our inspiration," revealed Dudney. "Sometimes the best way to help protect against a dangerous failure is to allow a component to fail or break gracefully and safely under mechanical abuse."

Since the electrode slits only added a minimal cost to the production of their redesigned lithium-ion battery and didn't call for significant changes in how the battery was made, the team believes this technology could be scaled up in the future.

"With such an innovation, device manufacturers can reduce the weight and expense of heavy-duty containers that are normally needed to protect their batteries from mechanical abuse," said Dudney.

The team still has many more tests to run, with Dudney noting that "this impressive performance needs to be replicated 100 or 1000 times for good statistics under a wide range of duty cycles".







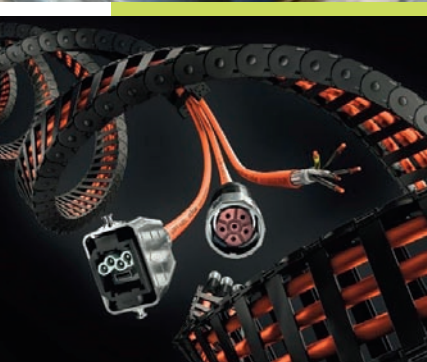
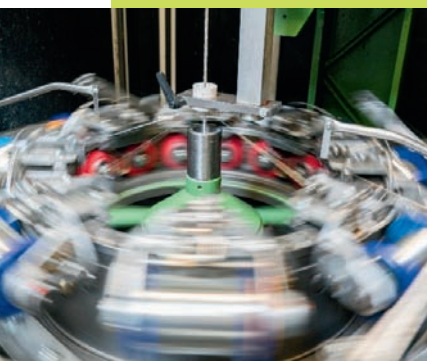
## CABLE AND CONNECTOR PROVIDER LAPP LAUNCHES IN AUSTRALIA

Lapp, a family-owned provider of cable and connector systems and integrated electrical and automation engineering solutions, is establishing a fully fledged subsidiary in Australia.

Headquartered at a 3100 m<sup>2</sup> premises at Eastern Creek, Sydney, Lapp Australia will meet demand nationally for technologies used in future-focused areas of industry, such as automation, robotics, energy management, data distribution and intelligent manufacturing, buildings, infrastructure and process engineering.

Lapp Australia General Manager Simon Pullinger said the new facility, opened on 1 February, will bring new levels of service and choice to the Australian market, offering strong inventory of over 1000 product lines onshore as well as direct access to more than 40,000 standard items from Lapp's global ranges.

"We are offering a one-stop shop for highly integrated, efficient and reliable systems which comply with the leading Australian, European and American compliance and quality standards, which are among the most demanding in the world," Pullinger said.



"In addition to major Lapp brands of product — such as OLFLEX, UNITRONIC, HITRONIC, SKINTOP, SILVIN, EPIC, FLEXIMARK and ETHERLINE — Lapp Australia will focus strongly on world-class total solutions incorporating highly compatible components from the one source. This integrated approach will save customers time and money when assembling optimum solutions to their particular needs, while ensuring proven reliability in service."

Lapp Australia will work in close cooperation with its established key local Lapp distribution partner

in Australia, Treotham Automation, which brings its local expertise. Lapp Australia will also extend its strong association with ECS New Zealand, a family-owned business that has been a Lapp distributor for more than 30 years.

ECS Investments is a 50% shareholder in the new Lapp Australia business, with the other 50% owned by Lapp Holding Asia. The existing online Lapp Express website will continue to expand in both countries, complementing the new strengths delivered by Lapp Australia.

## WATER-REPELLENT CIRCUITS FOR WASHABLE ELECTRONICS



Image credit: Christopher Gannon

US researchers have developed graphene printing technology that can produce flexible, low-cost, conductive and water-repellent electronic circuits. Described in the journal *Nanoscale*, the technology would lend itself to self-cleaning wearable/washable electronics that are resistant to stains, ice and biofilm formation.

Nanoengineers at Iowa State University, led by Assistant Professor Jonathan Claussen, used inkjet printing technology to create electric circuits on flexible materials. The ink in question was in fact flakes of graphene — a great conductor of electricity and heat that is additionally strong, stable and biocompatible. The printed flakes, however, aren't highly conductive and have to be processed to remove non-conductive binders and welded together, boosting conductivity and making them useful for electronics or sensors.

This post-print process typically involves heat or chemicals, but Claussen and his research group previously developed a rapid-pulse laser process that treats the graphene without damaging the printing surface — even if it's paper. Now, they've found another application of their laser processing technology: taking graphene-printed circuits that can hold water droplets (they're hydrophilic) and turning them into circuits that repel water (they're superhydrophobic).

"We're micro-patterning the surface of the inkjet-printed graphene," Claussen said. "The laser aligns the graphene flakes vertically — like little pyramids stacking up. And that's what induces the hydrophobicity."

Claussen said the energy density of the laser processing can be adjusted to tune the degree of hydrophobicity and conductivity of the printed graphene circuits. This opens up all kinds of possibilities for new electronics and sensors.

"One of the things we'd be interested in developing is anti-biofouling materials," said study co-author Loreen Stromberg. "This could eliminate the build-up of biological materials on the surface that would inhibit the optimal performance of devices such as chemical or biological sensors."

The technology could also have applications in flexible electronics, washable sensors in textiles, microfluidic technologies, drag reduction, de-icing, electrochemical sensors and technology that uses graphene structures and electrical simulation to produce stem cells for nerve regeneration.

The Iowa State University Research Foundation is working to patent the technology and has optioned it to Iowa-based start-up company NanoSpy, which is developing sensors to detect pathogens in food processing plants for possible commercialisation.



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### RF REAL-TIME SPECTRUM ANALYSERS

Rigol Technologies has released the RSA5000 Series of RF real-time spectrum analysers with a frequency spectrum of 9 kHz to 3.2 or 6.5 GHz and a maximum sample rate of 51.2 MS/s. They are said to offer performance improvements over traditional swept spectrum analysers with a 1 ms full span sweep, an expanded vertical range to 30 dBm, reduced phase noise to -108 dBc/Hz, 1 Hz RBW (resolution bandwidth) and a reduced noise floor (DANL) to -165 dBm. They can also be used in a traditional swept scan mode.

Offering up to 40 MHz real-time bandwidth, the series calculate >146,000 FFTs/s, delivering down to 7.45  $\mu$ s for a 100% probability of intercept. They provide seven display modes (Normal, Density, Spectrogram, Power vs Time, Density & Spectrogram, PVT & Spectrum, PVT & Spectrogram) and include a frequency mask trigger. The frequency mask trigger is especially useful for triggering measurements of sporadic or transient events.

The flexible user interface gives users several options for interaction since they feature a 10.1" capacitive touch-screen display with gesture support, mouse/keyboard support and traditional knob and button control. Rigol calls the high-speed real-time measurement technology of the units 'Ultra-Real' to describe the rapid signal acquisition and data analysis, together with various display modes that facilitate comprehensive signal interpretation. Tracking generator versions are also available that add a built-in signal source of 100 kHz to 3.2/6.5 GHz with an output range of -40 to 0 dBm for plotting circuit or component frequency responses.

The analysers are suitable for users in spectrum monitoring, transmitter test, RF component characterisation and EMI applications.

**Emona Instruments Pty Ltd**

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### RUGGED NETWORK FIREWALL

Crystal Group has introduced the RCS5516FW Rugged Network Firewall, designed to secure and protect networks deployed in harsh environments such as those found in defence, transportation and energy sectors.

The product is a commercial off-the-shelf (COTS) firewall based on the Cisco 5516 Adaptive Security Appliance and encased in a military-grade rugged chassis. It provides eight integrated Ethernet 10/100/1000BASE-T(x) copper ports, supports Cisco FirePOWER services and offers 1.8 Gbps maximum throughput. It also provides up to 250,000 concurrent sessions and handles up to 20,000 new connections per second.

The firewall features an all-aluminium chassis and is available in either a standard 19" rack mount or transit case EIA form factor. The 1U firewall can be mounted using Delrin glides or as a fixed mount (front and rear). The unit measures under 33 cm deep, weighs 6.35 kg and is engineered to MIL-STD-810 and MIL-STD-461 with EMI, humidity, vibration and shock kits available.

The unit is specifically designed to provide high-performance connectivity for cybersecurity protection, secure communication, remote monitoring and maintenance in situations where security, quality, low power consumption and long-term availability are important.

**Metromatics Pty Ltd**

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



### PICK-AND-PLACE MACHINE

The NeoDenL460 is a productive pick-and-place machine that is especially suitable for LED board production.

Built for speed, the product features a fast XY motor and tape feeders, as well as a head that achieves 18,000 chips/h. It supports parts from 0603 to LQFP80 being used in mass production.

The machine has a smart feeder with a high-precision design, featuring ultrasmooth electronic actuation and tape advance. There is a full range of feeder sizes available, with unique IDs able to access relevant feeder data when the feeder is plugged in.

The on-the-fly vision system inspects parts up to LQFP80 during head travel to placement location. This enables the machine to update position while maintaining speed and stability.

The Dual Gantry 4 Head System meanwhile enables simultaneous pick-up to reduce production time.

**Embedded Logic Solutions Pty Ltd**

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



## DC/DC CONVERTERS

Mornsun's URB\_S-6WR3 and VRB\_S-6WR3 are isolated, 6 W, compact DC/DC converters. They offer input under-voltage, output short-current and over-current protection.

Other features include: input voltage of 4:1/2:1 (9–36 VDC, 9–18/18–36 VDC); high efficiency up to 87%; operating temperature of -40 to +105°C; isolation voltage of 1600 VDC; single output of 3.3, 5, 9, 12, 15 and 24 V; and compliance with UL62368/EN62368 (pending).

Suitable applications include medical care, industrial control, electric power, instruments and communication fields.

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## SDR DONGLE

The Sigfox SDR Dongle is a powerful and configurable radio receiver and transmitter emulating the Sigfox network. It provides an easy way for device and solution makers to speed up development and tests, without the need for network coverage and for every country's radio-frequency configuration. It also allows for the development of Sigfox devices independent from Sigfox public network coverage.

The dongle is the hardware platform on which to run the Sigfox Device Test Suite, a comprehensive device developer software toolkit. The suite includes the Network Emulator — developed to test end-to-end and bidirectional data transport services between the user's device and application — and the Radio Signal Analyzer, developed to test radio compliance requirements.

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# DIGITALISATION AND THE FUTURE OF MEDTECH

For the past 20 years, medical technology (medtech) has been the largest category of patent applications to the European Patent Office. With the recent Compamed exhibition bringing together the world's medtech experts, Neil Oliver, Technical Marketing Manager at professional battery manufacturer Accutronics, looks at the three trends dominating the current healthcare market.

**A**mong the 779 exhibitors at the fair, digitalisation was prevalent on many of the stands. From virtual reality to healthcare apps, digitalisation is influencing the medical market as it is with countless others. The technology surrounding medtech is subsequently responding to this, with miniaturised components and cybersecurity being hot topics around the trade fair.

## Miniaturisation

For the past few years, the medical wearables market has grown substantially. With many countries facing an ageing population with increasing long-term health conditions to manage, home health care or health care outside of the traditional hospital setting is playing a greater role in care plans.

Wearables have been featured at Compamed for many years now and are able to measure numerous types of data for numerous health conditions. Every year, more and more vitals become measurable with wearables. For example, devices exhibited this year could monitor a person's pulse, arterial oxygen saturation, heart rate variability, respiratory rates, vascular stiffness and blood pressure. This will help with diagnostics, reducing the time that people need to spend in hospital and allowing patients and

medical practitioners to monitor conditions over a long period of time without the need to come in for regular tests.

Another concept that was exhibited at Compamed was diagnostics at the point of care. For example, lab-on-a-chip technology aims to perform genetic analysis and diagnosis of pathogens on a single integrated circuit from a few millimetres to a few square centimetres. While this is a field that is still developing its applications, the microcomponents that power this type of technology were on show at Compamed.

Exhibitors of all components recognised that as the devices get smaller, the components need to work just as effectively, but must take up less room in the device. However, it is vital that the device manufacturers understand that power is one of the most essential components of a wearable device and take steps from the start of the design process to recognise this.

It is far too late in the design process to create a small space for a battery to go in the device and then simply ask a battery manufacturer to fill the space. While it is often possible to do this, it is often not the most effective use of space in the device.

When battery manufacturers are involved from the start of the design process, they can work with the original equipment manufacturer (OEM) to create a battery that fits the power requirements



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of the device, whether these are in terms of overall lifespan and cycle life, energy density or any additional security requirements for medical devices.

## Cybersecurity and digitalisation

With digitalisation a hot topic at Compamed and recent high-profile cyber attacks across the world, it came as no surprise that the topics were linked in many discussions. Despite the attack not being aimed at medical devices, the recent WannaCry ransomware attack still had a dangerous impact, with a well-known US medical company receiving two reports of US customers with infected medical devices.

Device manufacturers are waking up to the recommendations of the US Food & Drug Administration (FDA), which argues that medical device manufacturers are responsible for identifying risks and hazards involved with their medical devices, including those related to cybersecurity, and must put appropriate mitigation in place to address these risks.

One of the fundamental aspects of ensuring cybersecurity of devices is data encryption and, in particular, ensuring that software uses an up-to-date algorithm to reduce the risk of devices being compromised. But it's not just the device itself using algorithms for security, batteries can use it too.

In the electronics industry, battery counterfeiting is an ongoing concern as the quality of fake duplicates is constantly increasing. The security risk of this for a medical device is clear. The counterfeit battery could shut down unexpectedly, provide erroneous runtime data or be electrically unsafe.

Device manufacturers must take responsibility and follow the FDA's regulations and ensure that this could not happen in their device by working with experienced suppliers. At Accutronics, we offer algorithmic security based on a secure hashing algorithm (SHA-1) which allows devices to integrate their installed battery and alert the user if a counterfeit battery is being used.

## New medical device regulations

One of the key challenges facing medtech manufacturers in coming years is the introduction of the new EU regulations for medical devices. Regulation (EU) 2017/745 for medical devices and Regulation (EU) 2017/746 for in vitro diagnostic medical devices will replace all preceding directives and come into force in spring 2020 and spring 2022 respectively.

The EU Commission argues that the regulations will establish a more "modernised and robust EU legislative framework to ensure better protection of public health and patient safety". For example, an EU database of medical devices will be created to increase transparency, as well as a device traceability system based on unique device identification. This introduces new design and manufacturing considerations for OEMs.

With the increase of implantable devices as part of the wearable trend, the new rules have been updated to ensure the safety of patients that have these devices. While often limited and varying information was given to the patients before, an implant card must be provided by the manufacturer and will be given to all patients with implanted devices. Information such as the serial number and the origin of the implant will be given to the patient on the card, to ensure transparency and reduce the risks that any malfunction may present.

Manufacturers have some years to perfect their approach to these new regulations before they come into play, but it is essential that they devote time and expertise to ensuring that they are prepared for them. In the medical device market, it is always best to follow good practice.

As the medical device market continues to grow in both size and complexity, OEMs must work with experienced suppliers who can advise on issues such as device design, cybersecurity and new regulations. In doing this, they can ensure that they will produce a device that is compliant and successful in meeting the needs of the market.

Accutronics  
www.accutronics.co.uk

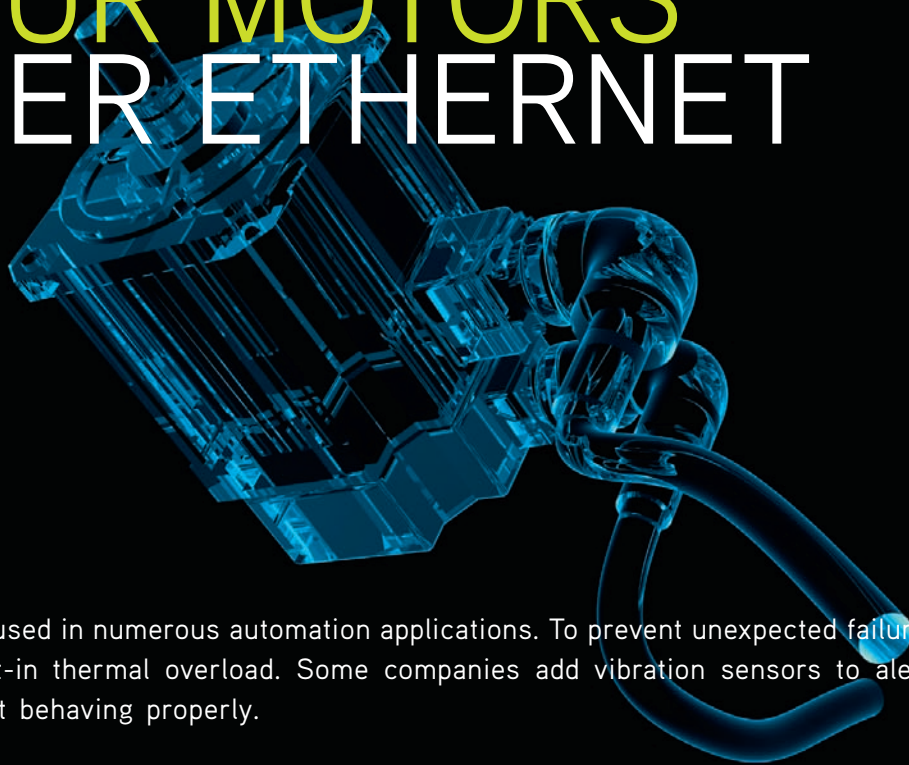


Image credit: Accutronics

Neil Oliver, Technical Marketing Manager, Accutronics.



# REMOTELY MONITOR YOUR MOTORS OVER ETHERNET



Motors are used in numerous automation applications. To prevent unexpected failures, many motors have a built-in thermal overload. Some companies add vibration sensors to alert them when a motor is not behaving properly.

However, there is another simple motor monitoring option to indicate when service is required. By using current sensing transducers and Ethernet I/O modules, remote motors located anywhere in your operation can be easily monitored.

As motor bearings begin to wear, the motor must work harder creating a measurable increase in current draw to the motor. This higher current draw is an early warning that an impending failure of the motor is about to occur. By installing a current sensing transducer on any of the wires that supply power to the motor and interfacing the measurements to your control system, you can identify a motor under stress before it becomes a problem.

Often, the process controller is not located near the motors. In this case, you can connect the analog output (4–20 mA or 0–10 VDC) from current sensing transducers at the motors to Acromag's BusWorks XT Ethernet I/O modules. The I/O modules are suitable for interfacing collected sensor data to a remote programmable logic controller (PLC), computer or SCADA system across a distributed network. BusWorks XT1210 models can interface eight current inputs while the XT1220 models offer eight voltage inputs. I/O modules convert the sensor's analog output signals to digital data for Ethernet messaging to the control system. They support Modbus/TCP, Ethernet/IP or Profinet communication protocols.

System controllers can retrieve the data from the remote I/O modules across long-distance networks or from hazardous locations for continuous monitoring of the motor's current draw. The I/O modules act as slave units ready for polling by a network master. Alternatively, peer-to-peer communication between two I/O modules can also be used to reproduce the analog signals over any Ethernet

media (copper, fibre, wireless) without a controller for interfacing to a remote display, recorder or other instrumentation.

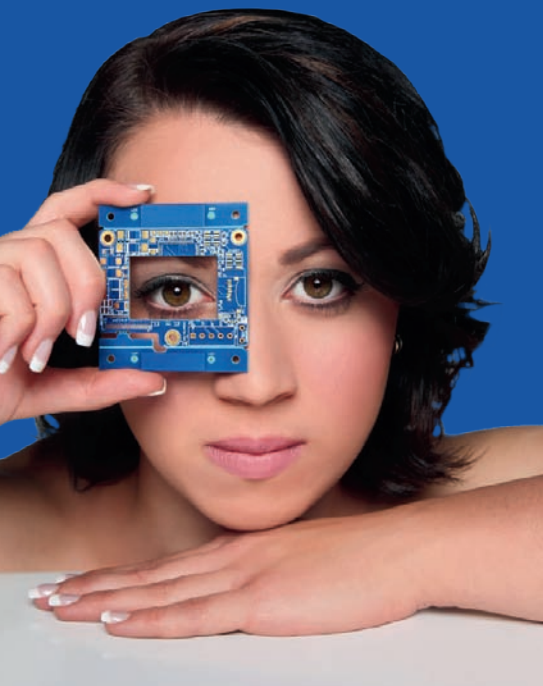
A PLC or networked computer can create an initial profile of the motor's current draw under load. The maximum current draw level establishes the upper control limit. Using this upper limit, the control software is programmable to issue alerts if the motor current draw exceeds the upper limit for a sustained period. The alert can serve as an early warning for preventive maintenance action to ensure the process served by the motor continues to operate.

If an alert identifies the motor requires servicing, such as a bearing repack or replacement, the maintenance can then be scheduled at a convenient time to minimise process interruptions and greatly reduce service costs. Without current draw monitoring, the motor could fail unexpectedly at the least opportune time and at great cost.

Monitoring motor performance is especially important for a process that operates 24/7. Under these circumstances, unplanned maintenance costs would include lost production plus collateral consequences. Loss of raw material, damage to related equipment and expedited repair fees may all be incurred when the motor fails unexpectedly.

Acromag and NK Technologies have partnered to provide a networkable solution for monitoring multiple motors used in a manufacturing process or any other operation. NK Technologies designs and manufactures current sensing transducers that work seamlessly with several I/O device options that Acromag offers. This allows companies to effectively and efficiently keep an eye on the motors that are required to keep their process up and running.

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## PROGRAMMABLE REMOTE I/O MODULE

Artila Electronics has announced the RIO-2017PG, a high-performance, compact, remote I/O module interface with up to eight isolated A/I channels. The module provides programmable input ranges on all channels and is powered by an ARM processor and the FreeRTOS operating system to achieve high performance and low power consumption in a compact size.

The analog input channel can be configured as current and voltage. It is auto calibrated and 2500 V<sub>rms</sub> isolated, protecting the module and peripherals from damage due to high input-line voltages. In addition to the analog input, the product also has one relay output. It is therefore suitable for remote data acquisition and control, as well as being useful for industrial measurement and monitoring applications.

For users who would like to develop their application software using the module, Artila provides a tool chain which includes C program compiler and debug as a free download that features a flexible development environment, which makes programming easier.

**Micromax Pty Ltd**

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



## ACCESS POINT FOR LORA TECHNOLOGY

The MultiConnect Conduit AP, from MultiTech, is a high-performance LoRa IoT gateway that harnesses the power of the LoRaWAN protocol to provide deep in-building penetration and connectivity to thousands of IoT assets.

Designed for indoor applications, it is easy to deploy with integrated antennas. It can be mounted on walls or ceilings to extend LoRa connectivity in commercial buildings like hotels, convention centres, offices and retail facilities, providing coverage in difficult-to-reach areas that cell tower or rooftop deployments may not penetrate.

The product offers two development environments for developers and users alike. For advanced developers, the Yocto Linux BSP integrates directly to a cloud-based LoRaWAN network server, enterprise data centre or public operator's core network. The access point meanwhile features an easy-to-use graphical interface set-up and includes a built-in LoRa network server to connect locally clustered assets on a private LoRaWAN network directly to the user's choice of IoT data platforms.

Other features include Ethernet RJ-45 10/100 BaseT for IP backhaul; support for maximum 27 dBm transmitter power output; and LoRa Alliance certification.

**Elecom Electronics Supply**

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## CATV ANALYSER

The VeEX VePAL CX350s is a portable, all-in-one test solution for legacy analog and digital cable TV networks. It is available to rent from TechRentals.

With a frequency range from 5 MHz to 1 GHz, the device supports SLM, DOCSIS 3.0/3.1, HD DVB-C carriers and Ethernet. Comprehensive SLM measurements include single channel, system scan, tilt and installation check.

The product is equipped with 10/100/1000-T/X Ethernet interfaces, BERT, RFC2544 and related test applications. It can test and troubleshoot backbone connections to the CMTS and verify the full bandwidth of a DOCSIS 3.0 and 3.1 network while operating in modem pass-through mode.

The analyser has a lightweight chassis packed with powerful features including a high-resolution, 7" colour touchscreen with a graphical user interface. Test results can be transferred quickly and efficiently to a USB memory stick or FTP upload via LAN or DOCSIS ports.

**TechRentals**

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## ELECTRONICS ENCLOSURES WITH UL 94 V-0 DESIGN

Because of their sensitive contents, electronics enclosures need especially good protection against external influences. Many BOPLA models are now available as standard ex-warehouse products with a UL 94 V-0 design. The polycarbonate enclosures are particularly flame-resistant and self-extinguishing, making them a suitable choice when safety is a critical factor for use.

When used on railway tracks, the electronics enclosures correspond to the requirement set R 22 in accordance with DIN EN 45545-2 hazard level HL 3. In addition, high levels of ingress protection prevent penetration by water and dust in harsh environments. As per the f1 listing in accordance with UL 746C, outdoor use of the rugged enclosures is not a problem. BOPLA offers various models with these features in the BOCUBE, EUROMAS and REGLOCARD PLUS ranges.

The BOCUBE range of enclosures is not only especially sturdy, but also easy to handle. This is because BOPLA's hinged catch technology does not require any screws at all. To open them quickly and easily, simply use a screwdriver, and close them by hand. The captive lid can be opened to the left or the right as required. All models can be used as operating enclosures or display enclosures and have a surface which is recessed by 2 mm for HMI solutions.

The flame-resistant polycarbonate REGLOCARD PLUS enclosures are available with a hinged, crystal-clear lid with a snap lock, so it is easy to see the relevant display and operating panel. The separately accessible terminal compartment, which is available with metric or Pg pre-punchings, ensures that connections are easy to make. The electronics enclosures offer IP65 ingress protection.

The EUROMAS electronics enclosures are available in 19 sizes and provide plenty of space for the relevant application. BOPLA manufactures them with large processing surfaces and versatile mounting opportunities for connectors, switches and keys. Depending on the model, the sturdy enclosures provide IP65 or 66 ingress protection.

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# FROM HAZY TO CLEAR, AND BACK AGAIN

## GLASS WITH SWITCHABLE OPACITY

Using nanoscale grass-like structures, researchers at the University of Pittsburgh have created glass that lets through a large amount of light while still appearing hazy. This is the first time that glass has been made with such high levels of haze and light transmittance at the same time, according to the researchers.

**P**aul W Leu and his team developed the new glass to improve the ability of solar cells to capture light and turn it into power, working off the notion that nanostructure patterns can prevent light from reflecting off the solar cell's surface. These structures also scatter the light that enters the glass, helping more of the light reach the semiconductor material within the solar cell.

The researchers utilised a unique pattern of nanostructures that looks much like grass, measuring anywhere from 0.8 to 8.5  $\mu\text{m}$  in height. Because the structures are taller than previously used nanostructures, they increase the likelihood that light will be scattered. Although glass with the nanostructures appears opaque, tests showed that most of the scattered light makes its way through the glass.

The researchers found that shorter nanoglass improved the antireflection properties of the glass while longer nanoglass tended

to increase the haze. Glass with 4.5  $\mu\text{m}$ -high nanoglass showed a nice balance of 95.6% transmittance and 96.2% haze for light with a 550 nm wavelength (yellow light, a component of sunlight). The results were published in *Optica*, the journal of The Optical Society.

The glass additionally exhibits another remarkable quality, in that it can be switched from hazy to clear by applying water — the result of a serendipitous discovery by project lead Sajad Haghaniyar.

"I was cleaning the new nanoglass glass when I discovered that cleaning it with water made the glass become clear," said Haghaniyar.

"The water goes between the extremely hydrophilic nanostructures, making the nanoglass glass act like a flat substrate. Because water has a very similar index of refraction to the glass, the light goes straight through it. When the water is removed, the light hits the scattering nanostructures, making the glass appear hazy."



The researchers also showed that in addition to water, applying acetone and toluene can also switch the glass from hazy to clear.

This switchability could make the glass useful for creating smart windows that change haze or opacity to control the privacy of a room or to block glare from sunlight — it would simply require placing a piece of traditional glass over the nanoglass glass. Pumps could be used to flow liquid into the space between the two glasses, and a fan or pump could be used to remove the water.

The fact that the glass is highly hazy and exhibits high transmittance could also make it useful for LEDs, which work in a way that is essentially the opposite of a solar cell — by using electricity that enters a semiconductor to produce light that is then emitted from the device. The glass could potentially increase the amount of light that makes it from the semiconductor into the surroundings.

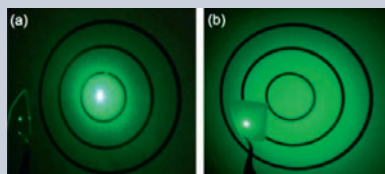
Although more work is needed to estimate the exact cost of manufacturing the new glass, the researchers predict that their glass will be inexpensive because it is easy to make. The nanostructures are etched into the glass using a process known as reactive ion etching, a scalable and straightforward method commonly used to make PCBs.

“Switchable glass available today is quite expensive because it uses transparent conducting layers to apply a voltage across the entire glass,” said Leu. “Our glass would be potentially less expensive to make because its opacity can be switched in a matter of seconds by simply applying or removing liquid.”

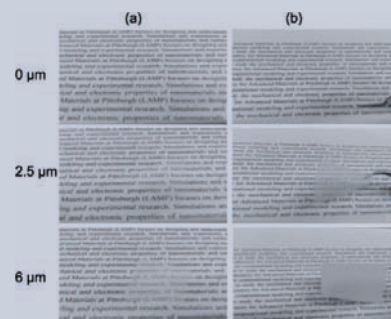
“We are now conducting durability tests on the new nanoglass glass and are evaluating its self-cleaning properties,” said Haghaniifar. “Self-cleaning glass is very useful because it prevents the need for robotic or manual removal of dust and debris that would reduce the efficiency of solar panels, whether the panels are on your house or on a Mars rover.”



*New glass etched with nanoglass structures can be switched from hazy to clear by applying water. As shown here, removing the water from the glass makes it appear hazy again. Image credit: Sajad Haghaniifar, University of Pittsburgh.*

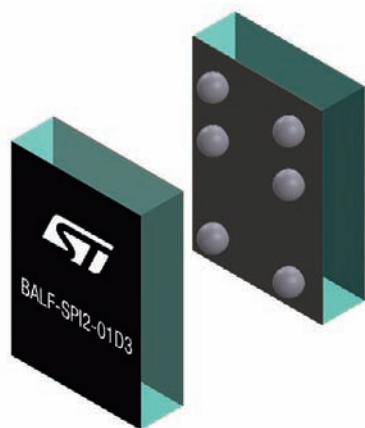


*Scattering ability of (a) flat fused silica and (b) 6  $\mu\text{m}$  height nanoglass. The scattering ability is demonstrated by shining a laser through a sample onto a target. The rings on the target are spaced 5 cm apart. The distance between the sample and target is 30 cm. Image courtesy of the study authors.*



*Optical images of smooth glass and glass with 2.5 and 6  $\mu\text{m}$  height nanoglass when placed (a) directly on paper with text and (b) about 1 cm above. The top image shows that text can be read through normal flat glass, while the glass etched with nanostructure scatters light, making the glass appear opaque. Image credit: Sajad Haghaniifar, University of Pittsburgh.*

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## SINGLE-CHIP BALUN FOR LOW-POWER RADIO

STMicroelectronics has introduced a matched balun for its S2-LP 868-927 MHz low-power radio transceiver to help engineers save board space and minimise RF-circuit design challenges in size-conscious products like IoT sensors, smart meters, alarms, remotes, building automation and industrial controls.

The 3.26 mm<sup>2</sup> BALF-SPI2-01D3 integrates all the impedance-matching and filtering components needed to connect an antenna to the S2-LP radio, replacing a conventional network of 16 discrete capacitors and inductors that can occupy up to 100 mm<sup>2</sup> of board real estate — a footprint reduction of more than 96%.

In addition to saving space, circuit design is simplified, with no need to select component values or tackle exacting layout challenges. Fully optimised for the S2-LP, the balun comes with placement and connection recommendations that are tested and verified and can be directly replicated to maximise RF performance.

As a critical enabling technology for these highly integrated matching devices, ST's integrated passive device (IPD) on non-conductive glass-substrate ensures low RF signal losses, with low amplitude and phase imbalances. This is said to result in better RF subsystem performance and longer operating life for battery-powered devices.

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## CONTROLLERS WITH TSN-ENABLED ETHERNET PORTS

National Instruments' latest CompactRIO controllers include NI-DAQmx and Time-Sensitive Networking (TSN). The controllers are designed to offer deterministic communication and synchronised measurements across standard Ethernet networks to increase performance and help improve productivity and flexibility.

Engineers can use TSN to synchronise distributed systems across networks, which eliminates the need for synchronisation cables. They are thus suitable for industries such as automotive, oil and gas, where acquiring synchronised data across distributed nodes has become increasingly challenging due to the ongoing implementation of the Industrial Internet of Things (IIoT).

The controllers feature: submicrosecond synchronisation with TSN over standard Ethernet for tightly synchronised, distributed measurements and control; shorter time to measurement than previous CompactRIO controllers due to intuitive NI-DAQmx driver software; open and secure processing at the edge of the IIoT with the NI Linux Real-Time OS; and high-performance data analysis and control with an industrial-grade processor and onboard FPGA, programmable with a LabVIEW FPGA. They have an operating temperature range of -40 to +70°C, making them suitable for harsh environments, as well as shock resistance up to 50g and vibration resistance up to 5g.

The NI-DAQmx enables engineers to access I/O directly from ready-to-use functions. The intuitive driver, coupled with the openness of the NI Linux Real-Time OS, means users can continue to leverage the vast ecosystem of IP available for Linux, like Security Enhanced Linux (SE-Linux).

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## ALUMINIUM PROFILE ENCLOSURE RANGE

With the SMART-TERMINAL enclosure range, OKW Gehäusesysteme offers an elegant, flexible and robust aluminium profile enclosure. A uniform profile cross-section with variable length design, as well as matching accessories, allows a flexible variety of applications as a tabletop or wall-mounted version.

The range of enclosures consists of a C-shaped top profile made of anodised, glass bead-blasted aluminium. It includes a recessed area for membrane keypads/decor foils and flat interface surfaces on the sides. There is sufficient space here for operating elements, switches or displays. The flat base profile is also made of aluminium and closes the enclosure from below with six screws.

On the open profile ends, the SMART-TERMINAL is closed with covers made of high-quality ASA+PC-FR material in the colour lava. For the plastic parts, there are separate moulded seals in the colours volcano or green.



The complete enclosures are available with profiles in the dimensions 170 x 50 mm (width x height) and in the profile lengths of 160, 200 and 240 mm. They were designed to fit standard display and touch solutions from 4.3" up to a maximum of 8". The 200 mm profile is suitable for a 7" touch solution. To ensure optimum operation, an enclosure canting kit for a 12° angle of inclination is available in the range of accessories.

The enclosures can be further modified by the OKW Service Centre. The options include, among others, mechanical machining for interfaces, a customer-specific profile length, individual lettering and printing, or the manufacture and installation of digitally printed foils.

Areas of application include machine and plant engineering, safety engineering, building services engineering, measurement and control technology, environmental technology, agricultural vehicle technology, construction machines and embedded systems.

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



## RUGGED COLOUR INKJET PRINTER

Nova Integration Solutions (NIS) has released the Model 1101, a rugged COTS colour inkjet printer that utilises a highly ruggedised commercial off-the-shelf print engine. The printer is said to save time and resources with rapid start-up times and print speeds up to 18 ppm. It accepts multiple paper sizes and offers 1200 x 600 dpi optimised photo-quality colour printing.

The product is lightweight and housed in a rigid enclosure, with low power consumption. It is designed to meet MIL-STD shock and vibration, making it suitable for a variety of harsh environment applications — particularly military specifications.

Other features include 18–36 VDC or 110–220 VAC input power; tabletop mounting; Ethernet and USB interfaces via rugged military circular connectors; automatic duplex printing; and 256 MB installed internal memory.

Various I/O and connectorisation options are available, as are custom mounting schemes and paint colour and texture options. A 'short' model is available for space-challenged applications, which reduces the depth from roughly 61 to 43.2 cm.

For further ruggedisation and options, the Model 1151 MIL-Grade Inkjet utilises a more robust internal shock/vibration platform, a more aggressive EMI filter, improved power supply design, heater options, ARINC shock tray mounting and more.

**Metromatics Pty Ltd**

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

## OPTICAL LOSS TEST SET

The Fluke multimode and singlemode (Certifiber Pro Q) OLTS modules for a DSX-5000 (Versiv) measure fibre-optic attenuation, length and propagation delay. They are available to rent from TechRentals.

The test set includes a built-in visible fault locator (VFL) and provides Tier 1 certification at 850, 1300, 1310 and 1550 nm in 3 s (for two wavelengths). The set reference wizard function ensures correct reference settings and eliminates negative loss errors.

The CertiFiber Pro Q provides automatic pass/fail analysis to industry standards or custom test limits. It has interchangeable power meter adapters (available for various connector types) to enable the most accurate 1-jumper reference method, according to the company. As required by ANSI/TIA and ISO/IEC, the test set is Encircled Flux compliant.

The Certifiber Pro is suitable for individuals from a range of skill levels to improve set-up, operation and test reporting while simultaneously managing diverse projects. With a focus on precise, error-free certification, the OLTS is said to increase the efficiency of managing and certifying fibre-optic cabling.

**TechRentals**

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





## RADIO COMMUNICATION TEST STATION

Anritsu will soon launch the Radio Communication Test Station MT8000A platform for developing chipsets, terminals and mobile devices for 5th generation (5G) communications systems.

With a 5G base station emulation function and built-in support for broadband signal processing and beamforming technologies required by ultrafast broadband 5G communications, the all-in-one desktop with the advanced architectures supports RF and protocol tests for the sub-6 GHz and millimeter wave bands used in 5G. Combining it with the OTA Chamber enables both millimeter wave band RF measurements and beamforming tests using call connections specified by 3GPP.

As well as supporting high-speed broadband communications, the modular architecture design provides flexible future-proof support for new 5G test requirements, including URLLC (Ultra-Reliable and Low Latency Communications) and mMTC (massive Machine Type Communications).

A comprehensive test environment is provided utilising the extensive functionality of Anritsu's LTE test platform.

**Anritsu Pty Ltd**  
[www.anritsu.com](http://www.anritsu.com)

## STERILISABLE ENCODER

maxon motor has unveiled the ENX EASY sterilisable encoder for brushless DC motors, creating many opportunities for advances in medical technology.

The sterilisable encoder is available as an incremental (1024 CPT) and an absolute version (4096 CPT). It can be integrated into suitable motors without increasing the length. The encoder has allowed maxon to create a sterilisable drive system featuring a brushless DC motor, gearhead and integrated encoder.

The product is suitable for demanding medical/surgical applications where speed and positioning control tasks are performed. It is available with ball bearings or in a ceramic version. The encoder delivers high speeds, precise commutation, low vibration and reduction of heat build-up. To optimise space restrictions, the encoder is integrated into the brushless DC motor.

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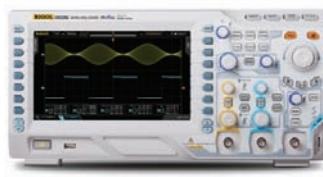


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## RCM COMPLIANCE COURSE

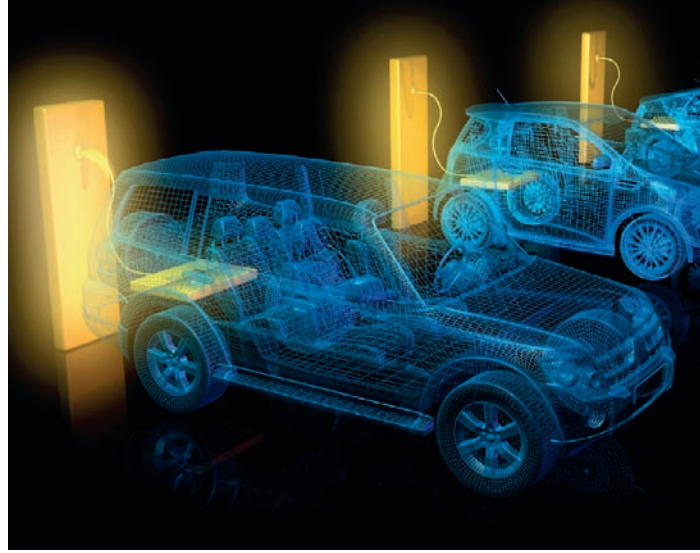
EMC Technologies' half-day RCM compliance course explains compliance requirements and the process involving EMC, EMR, radio, electrical safety and cellular approvals for Australia and New Zealand. It will be presented by Chris Zombolas, technical director of the company.

The Regulatory Compliance Mark (RCM) is now mandatory under ACMA regulations for most electrical equipment that is on the market and operates in conjunction with the Electrical Equipment Safety System (EESS). The use of the RCM requires manufacturers, importers and suppliers to register prescribed products on the EESS national database. The RCM may only be used after establishing compliance with all applicable regulations including EMC, telecoms, radiocomms, electromagnetic radiation (EMR) and electrical safety.

The session will explain the ACMA and EESS regimes including the testing, certification and administrative requirements for all product categories, including mobile phones and cellular devices. It can be supplied on demand to small or large groups, and presented either at the company's purpose-built seminar facility or at a location selected by the client.

### EMC Technologies

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



## BATTERY MANAGEMENT SYSTEM FOR VEHICLES

Maxim is enabling a safe, smart car of the future with the MAX17843 battery management system (BMS) — a 12-channel, high-voltage, smart sensor data acquisition device featuring robust communications and comprehensive diagnostics.

Its differential universal asynchronous receiver/transmitter (UART) uses capacitive isolation and is claimed to reduce bill of materials (BOM) costs and failure in time (FIT) rates. With this, designers can save up to 90% of their isolation BOM cost. The flexible UART enables robust communications in noisy environments.

Using Maxim's daisy-chain architecture and successive-approximation-register (SAR) analog-to-digital converter (ADC), the product captures fast voltage measurements and delivers high EMC performance. It is applicable for a variety of automotive and EV powertrain applications.

The product adheres to ISO 26262 and ASIL D requirements (also applicable for ASIL C), as well as TUV certification in design and management process, and additionally meets various BCI requirements. It supports 100 m daisy-chain segments and high noise immunity.

The battery management system proactively detects faults and is important to the safety of vehicles, giving users the functionality necessary for an intelligent battery management operation. It operates over the -40 to +125°C temperature range and is available in a 64-pin LQFP package (10 x 10 mm).

### Avnet Electronics Marketing

[www.em.avnetasia.com](http://www.em.avnetasia.com)

## DC/DC CONVERTERS WITH EN50155 RAIL COMPLIANCE

Mornsun's 20 W range of DC/DC converters, the URE1D\_LD-20WR3 series, has been added due to market demand for dual-output devices (positive and negative). The converters provide a wide input voltage range of 40–160 VDC due to input voltages of 72, 96 and 110 V used in the railway industry.

The 50 x 25 mm international standard package is available in PCB mount, chassis and DIN-rail mounting with heatsink options, making the series suitable for use in DC distribution systems, railway monitoring, lighting equipment, air-conditioning controllers, information display and other railway vehicle-related equipment.

The devices feature enhanced isolation voltage of 3000 VDC and a wide operating temperature of -40 to 85°C. Protections include input undervoltage, output short circuit, overcurrent and overvoltage, with low ripple and noise. Positive and negative outputs and 3 kVDC isolation voltage ensure the converters meet railway EN50155 standard requirements. Reverse voltage protection is available with A2S (chassis mounting) or A4S (35 mm DIN-rail mounting) packages.

### DLPC Pty Ltd

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



## FULL-BRIDGE SYSTEM IN PACKAGE

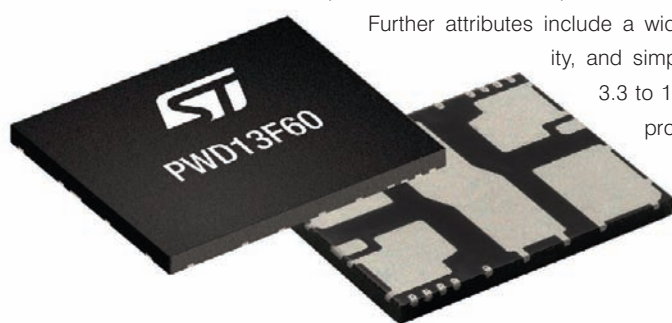
STMicroelectronics' PWD13F60 system in package (SiP) contains a complete 600 V/8 A single-phase MOSFET full bridge in a 13 x 11 mm outline. It is said to save bill-of-materials costs and board space in industrial motor drives, lamp ballasts, power supplies, converters and inverters.

With a footprint 60% smaller than a comparable circuit built from discrete components, according to the company, the PWD13F60 can boost end-application power density. By integrating four power MOSFETs, it presents an efficient alternative to other modules on the market that are typically dual-FET half-bridge or six-FET three-phase devices. Unlike either of these choices, only one SiP is needed to implement a single-phase full bridge, leaving no internal MOSFETs unused. There is also flexibility to configure the module as one full bridge or two half bridges.

Leveraging ST's high-voltage BCD6s-Offline fabrication process, the SiP integrates gate drivers for the power MOSFETs and the bootstrap diodes needed for high-side driving, which simplifies board design and streamlines assembly by eliminating external components. The gate drivers are optimised for switching and low EMI (electromagnetic interference). The product also features cross-conduction protection and undervoltage lockout, which helps further minimise footprint while ensuring system safety.

Further attributes include a wide supply-voltage range, extending down to 6.5 V for maximum flexibility, and simplified design. In addition, the SiP inputs can accept logic signals from 3.3 to 15 V to ensure easy interfacing with microcontrollers (MCUs), digital signal processors (DSPs) or Hall sensors.

**STMicroelectronics Pty Ltd**  
www.st.com



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SAMA5D2 Xplained Ultra Evaluation Board (ATSAMA5D2-XULT)

### Contact Information

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

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# TRANSPARENT CONDUCTIVE FILM COMPANIES AT A CROSSROADS

These coming quarters are crucial decision times for many transparent conductive film (TCF) companies.

Some are losing patience with their programs, questioning if and when their efforts will turn into notable revenues. Others must decide whether their technology is right for emerging larger area and lower resistance applications, and if and when they should make an investment into larger processing facilities. And finally, some are wondering if the market will finally turn a page, enabling them to arrest or exit the current strategy of constantly using price falls as their only real lever to stay relevant.

The report 'Transparent Conductive Films (TCF) 2017-2027: Forecasts, Markets, Technologies', from market research company IDTechEx, provides answers. The report offers comprehensive and global coverage of TCF technologies, assessing silver nanowires, various types of metal mesh, PEDOT, graphene, microwire, carbon nanotubes and more. The report also includes an analysis of existing and emerging applications, a segmented 10-year market forecast, and profiles and updates on companies from across the world.

## Status quo serves no-one well

The market is at an interesting juncture. ITO (indium tin oxide) has managed to stay highly relevant as the dominant incumbent, thanks to its low cost. This is despite it not being the best technology, at least on paper. The alternatives have, however, also now matured as

a technology, with some technologies and suppliers even securing a growing foothold in the market.

The status quo, however, is not sufficient for sustaining all TCF technologies and suppliers. The power still firmly resides with the buyers and price competition reigns supreme amongst suppliers. The TCF technology, for current applications, is highly commoditised. This shows no sign of changing for current applications unless supply is unexpectedly interrupted.

The major question now is whether the market composition will finally change, creating substantial new demand and allowing companies to differentiate also based on performance.

## Markets beyond consumer electronics emerge

A longstanding trend in the TCF business has been the increasing application area. In general, this implies two needs: (1) the ability to process large-area films and (2) the ability to offer lower sheet resistance to maintain performance levels.

Indeed, a few years ago, the market was very excited as it got a whiff of a transition beyond tablet-sized touch screens. This market, however, proved slow to develop, undershooting even the more conservative estimates. This was partly because the value chain was not quite ready.





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This may be about to change. Pro-cap touch sensing is slowly gaining market share even in larger displays. This trend is expected to accelerate as large touch screens become more popular in cars.

Indeed, many are now focusing on the automotive sector as a major addressable market. The need here is to consistently supply reliable, low-resistance, curved and large-area sheets. It is also to address needs in transparent heating as a replacement for printed demisters. In fact, ITO alternatives such as silver nanowires have already established a market here, first for side mirrors and next for bigger windows. Low sheet resistance and high transparency are critical here.

Furthermore, pro-cap is also coming to tables, ultra-large interactive displays, whiteboards and so on. These applications cannot be served by ITO while optical means have their own limitations. The current technologies based on microwires do work, but mostly in their niches such as outdoor advertising. This market will also grow, opening up yet another opportunity outside standard consumer electronics like mobiles, tablets and laptops.

Developments on many fronts like OLED lighting and OPVs will remain muted in the short term. This is because these technologies largely remain overpriced and underperforming. That is, however, not to say that there is no progress: production capacity for OLED lighting is expanding, transitioning to Gen-5 in the hope of supplying

high-differentiated and premium-priced exterior automotive lights. The supply chain for OPVs is also active with both OPV printers and evaporators planning a transition towards wider webs. At these points, TCF suppliers — particularly those offering low resistance and flexibility — will need to engage with module makers now to get embedded in the final designs, but large sales volume will still have to wait.

IME, or in-mould electronics, is also an active development. Here, transparent conductive materials with other functional and graphical inks are coated on a 2D plastic sheet before being formed into a 3D object. This way, the electronics will be structurally embedded, creating novel designs and saving space. This approach requires TCF technologies that can survive a significant stretching event as the film goes from 2D to 3D. This technology has been demonstrated at the prototype level by multiple firms and is now in late-stage qualification period for both home appliance and automotive sectors. This, too, is another front to closely monitor.

There are many other interesting applications around. Film-based smart windows are being produced, requiring large-area flexible TCF technologies. Here, depending on the required response time, the conductivity level requirements may be relaxed, opening the door for the likes of PEDOT. Transparent antennas have meanwhile been commercialised using metal mesh, but there is much further room to grow.

### To invest or not to invest

The rise of these new markets presents risky choices to ITO alternative suppliers and users. Many metal mesh companies succeeded in staying cost competitive by using legacy photo-patterning equipment that was already largely depreciated. They now must decide whether they can replicate their success if they invest in new large-format photo-patterning equipment. Some in Asia have already invested and commissioned facilities to exclusively focus on large-area films, yet others are hesitantly sitting on the fence.

Hybrid metal mesh producers (eg, emboss plus print or fill, or print then photo-pattern) are faced with similar questions since most current machines serve markets only up to the tablet size. Should they take a plunge and prepare to manufacture large-format low-resistance metal mesh films or should they stay put?

Metal mesh printers have come a long way, demonstrating that direct printing can produce sufficiently narrow linewidths. The work thus far, however, has been limited to narrow-format films printed at low speeds. Therefore, while in theory printing lends itself well to large-area production, in practise, the technology still has a long way to go to demonstrate commercial viability at larger areas. Progress, however, has gathered unprecedented momentum, so watch this space.

Solution-coated technologies like silver nanowires, carbon nanotubes and PEDOT also, in theory, lend themselves well to wide width webs. They are, however, also not challenge-free. For example, for silver nanowire, the coating challenge is whether large-area films can achieve low haze and high smoothness. Furthermore, for many applications, the large-area coated films may then need to be patterned. This too will require a commitment to form a stronger ecosystem.

To learn more about the dynamics of the TCF industry, consult the IDTechEx report at [www.IDTechEx.com/tcf](http://www.IDTechEx.com/tcf).

IDTechEx  
[www.idtechex.com](http://www.idtechex.com)



## DC-DC CONVERTER FOR RAILWAY APPLICATIONS

Vicor has released its next generation of DCMs, with a family of wide input range (43–154 V), 36 x 23 mm ChiPs with power levels up to 240 W and 93% efficiency, targeted at rail transportation and infrastructure applications.

Modern rail infrastructure requires a wide range of DC-DC converters to power a variety of services for both freight and commuter markets. Commuter rail systems require mobile office communication capabilities with the infotainment capabilities of home. Freight rail systems require monitoring and control capabilities to assure the safe and timely delivery of all goods onboard. Both commuter and freight systems demand high-performance power systems for the necessary safety and security measures (onboard and at station).

Vicor's DCM is an isolated, regulated DC-DC converter module that can operate from an unregulated, wide-range input to generate an isolated DC output. The ChiP DCM simplifies power system designs by supporting multiple input voltage ranges in a single ChiP.

Contained in a ChiP package less than 10 cm<sup>2</sup>, the DCM offers engineers density and efficiency. All models are also available in an M-Grade version capable of operating down to -55°C.

**Vicor Corporation**

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



## RACKMOUNT AND STANDALONE POWER DISTRIBUTION STRIPS

Hammond Electronics has extended its power distribution offering with an additional 12 variants of rackmounting and standalone 100–240 VAC, 50/60 Hz 10 A power strips, designed for use with IEC power cords. For enhanced safety, two 10 A resettable circuit breakers prevent overloading, and both types are available with either a double-pole, single-throw, green illuminated on/off switch or as a basic unswitched version with a green power-on indicator light.

The 1U rackmount units offer eight front- or rear-facing outlet sockets. The standalone versions are available with four, five, six or eight top-mounted outlets. The rackmount units are housed in a black powder-coated steel enclosure; the standalone versions in an extruded aluminium case with a black powder-coated steel cover.

All versions are TUV, cULus and CAN/CSA certified to IEC 60950-1 and are CE compliant to the EU Low Voltage Directive 2014/35/EU. All are fitted with an IEC320 C14 inlet plug and multiple IEC320 C13 outlet sockets, making them suitable for use anywhere.

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## TWO-PART, UV CURE CONFORMAL COATING

Electrolube's 2K850 two-part, UV cure conformal coating combines the speed and convenience of UV cure, enabling an immediate tack-free coating, with the benefits of Electrolube's 2K conformal coating system, which combines the properties of a resin with the easy application of a coating. The system enables complete cure at room temperature within 24 h, compared to the industry average of about 8–14 days, according to the company.

Most single-part UV cure systems require moisture to diffuse through the UV-cured coating sections. If the material is a decent barrier to humidity, full moisture cure beneath components can be measured in weeks or even months for some components. For sensitive designs, the constant changes in material properties, as the moisture-cure process progresses can affect calibration. In a production scenario, this extended cure time can affect the amount of work in progress (WIP) and require excessive buffering.

The 2K850 product offers advantages over the first generation of single-part UV cure coatings currently available. Users of single-part UV cure coating systems experiencing issues relating to their coating cracking during thermal shock, extended moisture cure processes or both now have a robust alternative solution using their existing production equipment — the only additional requirement is a simple 2K fluid valve modification.



The 2K850 polyurethane system provides a fast processing time with a high level of protection. The UL94V-0, IPC-CC-830C, MIL-I-46058C and IEC 61086 compliant coating features a wide operating temperature range of -40 to +130°C, with good thermal shock performance. It is a tough, flexible, high-performance coating, characterised by good coating thickness (200–400 µm), enhanced edge coverage and good adhesion, hardness and scratch resistance. Ultimately, the coating provides a consistent chemical cure.

Electrolube's 2K range of hydrophobic coatings provides good water, moisture and condensation protection, including salt mist. This makes 2K850 a suitable choice for automotive, aerospace and other tough electronic applications exposed to harsh conditions.

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# LITHIUM-ION BATTERIES

## COULD BE CHARGED FIVE TIMES FASTER



UK researchers have developed a precise test of lithium-ion batteries' internal temperatures and their electrodes' potentials, and found that the batteries can be safely charged much faster than the current recommended charging limits.

If a battery becomes overheated, it risks severe damage — particularly to its electrolyte — and can even lead to dangerous situations where the electrolyte breaks down to form gases that are both flammable and cause significant pressure build-up. Overcharging of the anode can lead to so much lithium electroplating that it forms metallic dendrites and eventually pierces the separator, causing an internal short circuit with the cathode and, subsequently, catastrophic failure.

In order to avoid this, manufacturers stipulate a maximum charging rate or intensity for batteries based on what they think are the crucial temperature and potential levels to avoid. However, internal temperature testing (and gaining data on each electrode's potential) in a battery has previously proved either impossible or impractical without significantly affecting the batteries' performance.

As a result of this, manufacturers have had to rely on a limited, external instrumentation which is unable to provide precise readings. This has led them to assign very conservative limits on maximum charging speed or intensity to ensure the battery isn't damaged and doesn't suffer catastrophic failure.

Now, researchers at the University of Warwick have developed a range of methods that allow direct, highly precise internal temperature and 'per-electrode' status monitoring of lithium-ion batteries of various formats and destination. The technology works in situ during a battery's normal operation without impeding its performance, provides more precise data than external sensing methods and has been tested on commercially available automotive-class batteries.

The technology employs miniature reference electrodes and Fibre Bragg gratings (FBG) threaded through bespoke strain protection layer. An outer skin of fluorinated ethylene propylene (FEP) was applied over the fibre, adding chemical protection from the corrosive electrolyte. The result is a device that can have direct contact with all the key parts of the battery and withstand electrical, chemical and mechanical stress inflicted during the batteries' operation while still enabling precise temperature and potential readings.

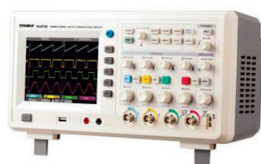
"This method gave us a novel instrumentation design for use on commercial 18650 cells that minimises the adverse and previously unavoidable alterations to the cell geometry," said Associate Professor Rohit Bhagat, a co-author on the study. "The device included an in situ reference electrode coupled with an optical fibre temperature sensor. We are confident that similar techniques can also be developed for use in pouch cells."

Writing in the journal *Electrochimica Acta*, the team from the Warwick Manufacturing Group (WMG) revealed that current commercially available lithium batteries could be charged at least five times faster than the recommended maximum rates of charge. Their technology is expected to enable advances in battery materials science, flexible battery charging rates, and thermal and electrical engineering of new battery materials/technology, and it has the potential to help the design of energy storage systems for high-performance applications such as motor racing and grid balancing.

"This could bring huge benefits to areas such as motor racing, which would gain obvious benefits from being able to push the performance limits, but it also creates massive opportunities for consumers and energy storage providers," said Dr Tazdin Amietszajew, who led the research.

"Faster charging as always comes at the expense of overall battery life, but many consumers would welcome the ability to charge a vehicle battery quickly when short journey times are required and then to switch to standard charge periods at other times. Having that flexibility in charging strategies might even, further down the line, help consumers benefit from financial incentives from power companies seeking to balance grid supplies using vehicles connected to the grid."

Dr Amietszajew stated that the technology is ready to apply now to commercial batteries, though the researchers would need to ensure that these vehicles' battery management systems are able to accommodate variable charging rates. The WMG team have also conducted further research on the subject of battery sensing, according to Associate Professor Bhagat, who says they hope to publish their work on other innovative approaches within the next year.



## MOTION CONTROLLER FOR DC MOTORS

Available on request is the EPOS4 24/1.5 DC motor control module. Weighing just 17 g and measuring 39 x 54 mm, the position controller can also control both brushed DC motors and brushless DC motors (BLDC motors).

The product retains the full motion control capabilities of larger controllers, including RS232, USB, CanOpen and EtherCAT communications onboard or via adaptor modules. Feedback from the DC or BLDC motor is achieved using either hall sensors, incremental encoders or absolute encoders. It can be used with current/torque control, closed-loop speed control and position control.

Designed primarily for use on 12 or 24 V systems, the controller is based on a high PWM frequency of 100 kHz for adaption with highly dynamic ironless and coreless DC motors that have low inductance levels. Current limiting, overcurrent, overtemperature, undervoltage, overvoltage and short circuit protective functions are all included.

Free set-up software for auto configuration and tuning of motors is supplied, along with programming examples for PC, PLC, LabView and Linux environments. IEC61800-5-2 based Safe Torque Off (STO) makes the controller suitable for use in critical applications such as manufacturing processes and collaborative robotics.

**maxon motor Australia Pty Ltd**  
[www.maxonmotor.com.au](http://www.maxonmotor.com.au)

## INTEGRATED STEPPER MOTORS

The ServoStep integrated stepper motor family, from JVL, features a wide range of options and will thus fit into all possible user applications, according to the company.

Integrated motors provide the user with an all-in-one solution, with a single unit including a motor, drive electronics, encoder, motion controller and an easily programmed embedded PLC with eight I/O points on board. The motors can operate as standalone units or be controlled from a master PLC or PC. The I/O points can be individually configured as digital inputs, digital outputs or analog inputs.

Features include: absolute multiturn encoders, CANopen, double shaft, hollow shaft, electromechanical brakes (front or rear mounted), IP protection class up to IP65, special customised connectors and Safe Torque Off (STO) input. Even wireless options exist — including Bluetooth, Zigbee and WLAN — making the motors suitable for AGVs and other battery-supplied applications.

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







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## ULTRASMALL BLUETOOTH 5 MODULE

The EYSHSNZWZ is an ultracompact Bluetooth Low Energy module from TAIYO YUDEN, designed to help developers easily implement Bluetooth 5 technology into designs. The product has a small 3.25 x

8.55 x 0.9 mm footprint for space-constrained applications and pairs well with other sensors that require minimal space and power.

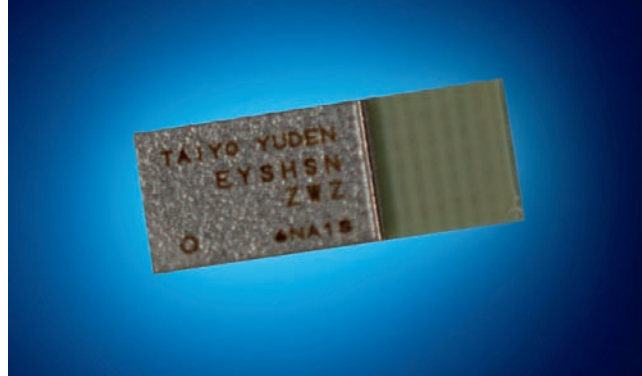
The module is powered by a Nordic nRF52832 system-on-chip (SoC), which contains a 32-bit ARM Cortex-M4F processor with 512 KB of flash memory and 64 KB of RAM. The SoC also includes a 12-bit analog-to-digital converter and support for SPI, UART, I<sup>2</sup>C and I<sup>2</sup>S interfaces.

The unit integrates a high-performance PCB antenna, 32 MHz system clock and support for NFC-A Type-2 for touch-to-pair applications. The module offers typical output power of 4 dBm and works in the low-power 2.4 GHz ISM band.

The RoHS-compliant module is FCC, IC and MIC certified. It is suitable for low-power wireless applications, such as wearables, heart rate and blood pressure monitors, thermometers and mobile accessories.

**Mouser Electronics**

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## NB-IoT MODULE

Quectel's BC68 is a high-performance NB-

IoT module, suitable for the

Telstra and Vodafone NB-IoT network,

which supports multiple frequency bands of

B1/B3/B8/B5/B20/B28 with low power consumption. The ultracompact 17.7 x 15.8 x 2 mm form factor makes it a good choice for size-sensitive applications. Designed to be compatible with the Quectel GSM/GPRS M66 module, it provides a flexible and scalable platform for migrating from GSM/GPRS to NB-IoT networks.

The product adopts surface-mounted technology, making it suitable for durable and rugged designs. The low profile and small size of the LCC package allow the module to be easily embedded into space-constrained applications and provide good connectivity with the applications. This kind of package is suitable for large-scale manufacturing, which has strict requirements for efficiency.

Due to its compact form factor, ultralow power consumption and extended temperature range, the module is suitable for a wide range of IoT applications, such as smart metering, bike sharing, smart parking, smart city, security and asset tracking, home appliances, agricultural and environmental monitoring, etc. It is able to provide a complete range of SMS and data transmission services to meet client-side demands.

The product features high sensitivity and is embedded with abundant internet service protocols. It also enables fast time to market, with reference designs, evaluation tools and timely technical support minimising design-in time and development efforts.

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## MICROCONTROLLERS

Renesas Electronics has expanded its RX65N/RX651 group microcontroller (MCU) line-up that addresses security needs for connected devices operating in industrial automation, building automation and smart metering systems. The expanded MCU line-up provides industrial systems manufacturers with the power efficiency and enhanced connectivity required for operation in industrial systems, while adding the enhanced security and connectivity required for edge devices in increasingly connected environments.

The expansion of devices operating at the edge of the Industrial Internet of

Things (IIoT) has increased system manufacturers' need for secure network connectivity, including secure on-the-go firmware updates. The expanded RX65N/RX651 devices support these evolving security and reprogrammability needs, offering integrated Trusted Secure IP, enhanced flash protection and other technology advancements to create a secure and stable integrated solution. In turn, the security advancements enable seamless flash firmware updates in the field through secure network communications.

Renesas has optimised the MCUs for connected industrial environments. They offer network connectivity and HMI support that makes it possible to: monitor the operating state of machinery from both inside and outside the factory; exchange data for making changes to production instructions; and re-program the MCU's memory to update equipment settings.

**Renesas Electronics Singapore Pte Ltd**

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





### L3 MANAGED SWITCH

The EKI-9600 switch from Advantech is a L3 Managed Gigabit Switch that supports static routing and network address translation (NAT) features.

As connectivity demands continue to grow in the IoT era, constructing a robust network architecture has become a complex task for information technology and operations technology professionals. The EKI-9600 switch is designed to address the issue of growing network bandwidth requirements head-on, by providing mission-critical capabilities to help users build proper network segmentation to achieve better network performance.

The product can provide routing between different segmented networks, which not only helps prevent network traffic over-flooding but also maximises the performance of each network. In addition, with NAT capability, users can better manage their IP resources, increase IP management efficiency and further ensure network security, according to the company.

The switch is available in two models: the EKI-9612G and the EKI-9628G. The EKI-9612G is a DIN-rail L3 managed switch that comes with eight Gigabit ports and four SFP (mini-GBIC) ports. The EKI-9628G is a rackmount L3 managed switch, offering up to 24 Gigabit ports and 4 Gigabit combo ports. Both models are equipped with Advantech's Gigabit X-Ring Pro redundancy technology, which offers an ultrahigh-speed recovery time of less than 20 ms.

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*CDS1, New generation of human-machine interfaces switch. See more: <https://www.youtube.com/watch?v=tSF1bvZk3uo>*

simplify the use of numerous applications. Here, the finger replaces the cursor. You can now tap directly on the action you want to perform. The user does not need to go back to the trackpad. The control is implemented instantly. On the downside, it is unavoidable for the display to become smudged as a result of the screen being constantly touched. The machine communicates differently. It usually gives feedback in an audio form or via the display. It acknowledges the input more or provides options for further, more detailed input by the user.

# INTUITIVE USE MAKES ALL THE DIFFERENCE

**Machines simplify our everyday life in many different ways. But for this to work smoothly and for the machines not to be so complicated that they present us with insurmountable obstacles, the human-machine interface must be kept as simple as possible.**

To keep it simple, here is an example: the smartphone is a highly complex product with a whole bunch of features that most likely overwhelms almost any age group. And yet, both young and old alike have become accustomed to these devices within a very short space of time. How is that possible? The manufacturers managed to design its mode of use in such a way that made a user guide practically irrelevant, intuitive use. And if it is not clear to the user what they should do next, the machine communicates the necessary information to them in a way that is easy to understand (audio, on the display, etc).

## Exchange of information between man and machine

A smartphone can be described as a human-machine system. This denotes systems in which an exchange of information is reciprocated between man and machine. In this respect, man always pursues a specific goal. It is therefore a form of communication between man and machine.

## Forms of communication

On the human side, various technologies are used as input systems. For instance, the language input. Human communication comes closest and will undoubtedly prevail in the future. But others are more well-known and above all (still) more reliable. For example, the keyboard. Over time, this has been extended to include the mouse due to the development of graphical user interfaces.

In addition to the mouse, especially for mobile applications, touchpads and Apple's trackpad have also been added. The features of a mouse have been basically substituted on a touch-sensitive surface. So-called gesture control was added to known features (eg, scrolling): swipe, zoom and rotate.

The touchscreen represents the latest level in this evolution. In principle, this does not offer much more in the way of features than the mouse and keyboard. But it does greatly

## Interface between man and machine

Information is communicated via a human-machine interface. It represents the link. There is a dialogue between the two system partners, which creates an (inter)action. The interface is therefore responsible for translating and communicating the information between the two linked systems of man and machine.

## Requirements for an interface

This human-machine interface must be adapted to the capabilities, demands and characteristics of the users and the tasks to be completed. The following points need to be mentioned as a priority here:

- Intuitive use thanks to a few clearly identifiable input options
- Clear feedback from the interface that input was correctly recognised
- Logical menu structure modelled on human thinking
- Presentation of information must correspond to people's capacity to absorb information

If all these points have been taken into account, it can be referred to as a user-friendly design with high 'usability' in the interface.

## In practice

When it comes to actual use, the machine or developer of the device must of course consider many different points. For example, the interface requires the following characteristics:

- Fast design-in process
- Input and display system in one on the smallest of spaces
- Standardised interface
- Low cost and suitability for mass production
- Customer-specific adjustments in the design, technology and production

## Conclusion

Devices are successful when they are accepted by the users. Once more, the smartphone is the perfect example in this respect. Despite the high complexity of the device, it has become the norm within a short period of time thanks to its easy, intuitive usability. This is what we should all strive for. Usability makes all the difference.

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## EVALUATION PLATFORM

Microsemi has announced the SmartFusion2 system-on-chip (SoC) field programmable gate array (FPGA) maker board, said to lower the barrier for hardware and firmware engineers to develop embedded applications for the ARM Cortex-M3 and 12K logic elements (LE) FPGA fabric in the SmartFusion2 device. Contents include the SmartFusion2 board, a USB cable to provide power, programming and communication, and a QuickStart Guide.

The board family is suitable for jump-starting designs using the Microsemi SmartFusion2 SoC FPGA. It offers several resources in low-density FPGAs, all while delivering low power, security and single event upset (SEU) FPGA configuration immunity.

The key features of the SmartFusion2-010 SoC FPGA are an ARM Cortex-M3 processor, GigE MAC, USB OTG, built-in DDR2/3 controller, numerous other peripherals, 12K FPGA LEs and high levels of security to protect customers' IP. The board also features a 1000BASE-T PHY and connector, two unpopulated interfaces for the ESP32 and the ESP8266 (not included), USB connectivity and more.

The evaluation board enables firmware and design engineers to leverage the power of Microsemi's SmartFusion2 architecture. It is suitable for prototype applications such as Internet of Things gateways, medical instruments, handheld industrial/test products, motor control, secure connectivity designs, etc.

**Digi-Key Electronics**  
[www.digikey.com](http://www.digikey.com)

## SECURITY FLOODLIGHTS

Marl's 742 Series security floodlights offer a powerful yet controlled illumination pattern, drawing only 21 W with a typical power output of 1500 lm. They have a design life exceeding 10 years, based on a rated life of 50,000 h at 12 h continuous operation per day.

The product has been designed to offer an alternative to conventional light sources for security applications and is typically used to replace a 70 W SON fixture. Benefits include high optical performance and low heat generation, with a typical power saving of 50% as well as reduced ongoing maintenance and replacement costs, according to the company.

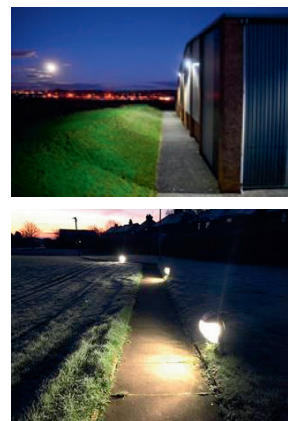
The optical design uses high-intensity LED light engines, which maximise efficiency, minimise light pollution and provide a defined area of high-quality white light (5200K and CRI 66 typical) to assist visual observation and CCTV performance. The standard unit operates from mains voltage (100 to 240 VAC) and could be customised to operate from low-voltage and sustainable power sources.

The rugged die-cast aluminium base unit, complete with polycarbonate lens diffuser, offers ingress protection to IP65 standard. It has an operating temperature of -20 to +45°C, with a wide viewing angle and options for wall or pole mounting.

Potential applications include perimeter lighting, security lighting, path lighting, architectural lighting, driveway lighting, industrial lighting, bay lighting, stair lighting and tunnel lighting.

### Aerospace & Defence Products

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



## PHOTOELECTRIC SENSORS

Leuze electronic has introduced the latest member of its Global Beam family with the compact sensors of the 15 series in an IP67 housing. The series is suitable for the detection of objects in industrial environments — particularly when dealing with standard automation tasks in the areas of conveyor systems, material flow or secondary packaging in which large operating ranges are required.

The SR 15 sensors are available with a cubic design. A bright light spot and an easily accessible potentiometer make installation quick and simple, even in tight installation situations. The series is available with different operating principles and can therefore be used in a flexible way — it is even suitable for special requirements such as detecting glossy objects and reflective surfaces. The high function reserve makes detection possible even in extreme situations, therefore reducing the risk of a system standstill.

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# A DIAMOND-BASED SENSOR

## THE SIZE OF AN ATOM

With electronics components getting ever smaller, quantum technology presents new opportunities for miniaturisation. German researchers are currently developing a quantum sensor that will be able to measure the tiny magnetic fields of the next generation of hard discs.

Integrated circuitry is becoming increasingly complex, with a standard Pentium processor containing some 30 million transistors and the magnetic structures found in hard drives measuring just 10–20 nm across — less than a flu virus. With dimensions rapidly approaching the realm of quantum physics, researchers at the Fraunhofer Institute for Applied Solid State Physics IAF in Freiburg are applying themselves to the quantum technology challenges of tomorrow.

Together with colleagues at the Max Planck Institute for Solid State Research, the researchers are developing a quantum sensor that will be able to precisely measure the tiny magnetic fields we can expect to see in the next generation of hard discs. The sensor itself is just slightly larger than a nitrogen atom, with a synthetic diamond to act as a substrate.

Diamond has a variety of advantages, apart from its considerable mechanical and chemical stability. For instance, one can implant foreign atoms such as boron or phosphorus, thereby turning the crystals into semiconductors. It is also an ideal material for optical circuits. But as far as the Fraunhofer researchers are concerned, its greatest attribute is its thermal conductivity, with the strength of the carbon atom bonds ensuring that heat is rapidly dissipated.

Fraunhofer IAF has spent the past few decades developing optimised systems for producing diamonds. The process for mass

production takes place in a plasma reactor, and Freiburg possesses many of these silver-coloured devices. Plasma is ignited to generate temperatures of 800–900°C so that, when gas is fed into the chamber, diamond layers can form on the square-shaped substrate. The diamond crystals have an edge length of between 3 and 8 mm, and are then separated from the substrate and polished using a laser.

### Diamond as a magnetic detector

Manufacturing a quantum sensor requires a particularly pure crystal, which has inspired further improvements in the process. For instance, in order to grow ultrapure diamond layers, the methane that provides the carbon for the diamond is pre-filtered using a zirconium filter. On top of that, the gas must be isotopically pure, since only <sup>12</sup>C — a stable isotope of the carbon atom — has zero nuclear spin, which is a prerequisite for the magnetic sensor later on.

The hydrogen also undergoes a purification process, after which the ultrapure single crystal diamond must be prepared for its role as a magnetic detector. Either you insert a single nitrogen atom into the extremely fine tip or you add nitrogen at the final phase of the diamond production process. After that, the diamond tip is honed in oxygen plasma using an etching process in the institute's own cleanroom.

The final result is an extremely fine diamond tip that resembles that of an atomic force microscope. The key to the whole design

is the added nitrogen atom together with a neighbouring vacancy in the crystal structure.

This combined nitrogen-vacancy centre acts as the actual sensor, emitting light when it is exposed to a laser and microwaves. If there is a magnet nearby, it will vary in its light emission. Experts call this electron spin resonance spectroscopy.

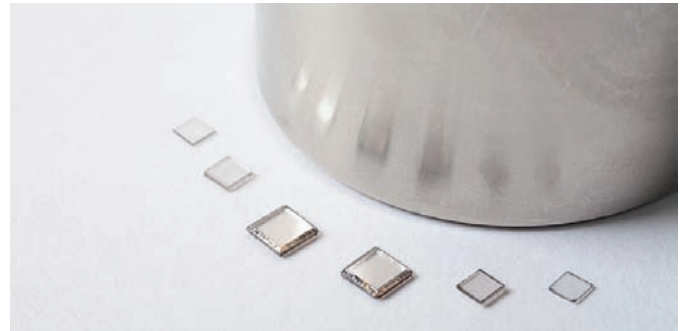
Not only can this technique detect magnetic fields with nanometre accuracy, it can determine their force as well, opening up an extraordinary range of applications. For instance, the tiny diamond tips can be used to monitor hard drive quality. These data storage devices are tightly packed and there are always tiny errors. The quantum sensor can identify defective data segments so that they are excluded from the disc reading and writing process. This reduces the defect rate, which is soaring as miniaturisation continues apace, and cuts down on production costs.

### Quantum sensors could measure brain activity

The tiny sensor can potentially be applied in a wide range of scenarios, since there are weak magnetic fields everywhere — even in the brain.

"Whenever electrons move, they generate a magnetic field," explained IAF expert Christoph Nebel. So when we think or feel, our brains are generating magnetic fields.

Researchers are keen to localise this brain activity to determine the areas of the brain that are responsible for a certain function or feeling. This can be done directly by measuring brainwaves using electrodes, but the results are very imprecise. Magnetic field meas-



Ultraclean diamonds produced at Fraunhofer IAF for quantum applications. ©Fraunhofer IAF

urements offer far better results; however, the sensors in use at the moment have one significant disadvantage in that they must be cooled with liquid nitrogen.

Drawing on the extreme thermal conductivity of diamond, the new technology can operate at room temperature without the need for any cooling. For this application, instead of using fine tips you would use tiny platelets that incorporate multiple nitrogen-vacancy centres. Each centre supplies a point in the image and, together, a detailed picture.

Currently, Nebel and his team are focusing their attention on researching and optimising diamond as a high-tech material. According to the researchers, this application in quantum sensor technology is a promising beginning.

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## LoRaWAN CERTIFIED M2.COM SENSOR NODE

Advantech's highly standardised M2.COM IoT LoRaWAN certified sensor node WISE-1510, with integrated Arm Cortex-M4 processor and LoRa transceiver, is able to provide multi-interfaces for sensors and I/O control such as UART, I<sup>2</sup>C, SPI, GPIO, PWM and ADC.

Powered by LoRa technologies and features, the sensor node is suitable for smart cities, agriculture, metering, street lighting and environment monitoring. With power consumption optimisation and wide area reception, LoRa sensors or applications with low data rate requirements can achieve years of battery life and kilometres of long-distance connection.

The node is flexible enough to support either public LoRaWAN networks or private LoRa ecosystems. It has received LoRaWAN certification from the LoRa Alliance.

Depending on deployment requirements, developers can select to use public LoRaWAN network services or build a private LoRa system with a WISE-3610 LoRa IoT gateway. The WISE-3610 is a Qualcomm Arm Cortex A7 based hardware platform with a private LoRa ecosystem solution that can connect up to 500 WISE-1510 sensor node devices. Powered by the WISE-PaaS IoT Software Platform, WISE-3610 features automatic cloud connection through its WISE-PaaS/WISE Agent service, manages wireless nodes and data via WSN management APIs and helps users streamline their IoT data acquisition development through sensor service APIs and WSN drivers.

Developers can leverage microprocessors on WISE-1510 to build their own applications. The product offers unified software — Arm Mbed OS and SDK for easy development with APIs and related documents. Developers can also find extensive resources from Github such as code review, library integration and free core tools.

The node also offers worldwide certification, which allows developers to leverage their IoT devices anywhere. Using the WISE-3610 LoRa IoT Gateway, it can be connected to WISE-PaaS/RMM or Arm Mbed Cloud service with IoT communication protocols including LWM2M, CoAP and MQTT. End-to-end integration assists system integrators to overcome complex challenges and helps them build IoT applications quickly and easily.

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

## HANDHELD DIGITAL MAGNIFIER AND INSPECTION DEVICE

Vision Engineering has launched Camß (CamBeta) — a digital handheld magnifier for portable inspection and documentation.

The inspection device is designed for electronics, mechanical inspection, automotive manufacture, watchmaking, plastics engineering, medical inspection and wherever rapid visual, digital documentation is needed. It provides magnification up to 20x, stores up to 20,000 images and uses grids and cursors for X and Y dimensioning, allowing objects to be inspected in situ and information to be recorded and shared.

With a high-resolution colour display, easy button operation and image capture, and download capability, the inspection device is suitable for roving inspection tasks, documenting faults and inspecting large or immobile subjects. It is equipped with dual LED illumination with four settings, high-contrast imaging and 30-frame video capture. A live-view video output via micro HDMI allows for images to be displayed on a larger screen, making the device suitable for training purposes.

The product is suitable for production environments where company policy disallows the use of mobile phones. Its lightweight and ergonomic design is said to be superior to a smartphone and allows the unit to be easily manipulated with one hand and operated by right- or left-handed users.

The device offers a convenient way of meeting critical inspection and documentation requirements. The simple design helps to optimise the inspection process, as it requires minimal training. When time is of the essence, the portable design helps to speed up the process of inspection and decision-making for operators.

**Vision Engineering Ltd**  
[www.visioneng.com](http://www.visioneng.com)



## DIGITAL MULTIMETER

The UT195DS, from UNI-T, is an IP65-rated rugged multimeter. Waterproof and drop-proof, the digital TRMS multimeter is designed to Cat IV 600 V/Cat III 1000 V. Other features include a bar-graph display and an in-built flashlight.

The product measures DC and AC voltage to 1000 V and AC/DC current to 20 A. It also measures phase rotation, and AC + DC combination signals with low-pass filter, as well as resistance, conductivity, capacitance, diode test, frequency and duty cycle.

The instrument features backlit display, auto power off, peak hold and relative measurement.

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## ATX INDUSTRIAL MOTHERBOARD

ADLINK Technology has announced its latest industrial ATX motherboard, the IMB-M43H, featuring support for both 6th Gen Intel Core i7/i5/i3 processors and 7th Gen Intel Core processors, as well as compatibility with Windows 7. It improves on the previous generation with a computing power increase of as much as 10% and graphics performance increase of up to 30%, benefiting multiple simultaneous complex motion and vision processes.

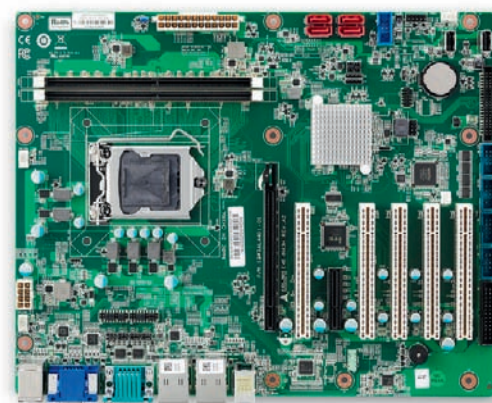
The device's dedicated mainstream expansion slots include one PCI Express Gen3 x16 slot, one PCI Express Gen2 x4 slot and five PCI slots, providing PCI Express expansion options for frame grabbers, digitisers and high-resolution dynamic signal acquisition and generation modules. Multiple PCI expansion options for motion and I/O control enable instant implementation of machine vision and industrial automation operations. From traditional machine automation applications in the semiconductor and flat panel display (FPD) industries where motion control, machine vision and optical inspection operations are critical, Industrial IoT solutions where collaboration between machines, humans and enterprise systems is essential, there are a number of industrial automation applications that can benefit from the product.

The unit features I/O ruggedness to enhance operational stability, including a power design that ensures stable power for each USB port at  $5\text{ V} \pm 5\%$ , with all USB ports able to achieve full loading, even from a 300 W power supply. IEC 61000-4-2~6 (Performance Criterion A) immunity performance ensures no degradation during operation, while EN 55032 Class B-certified EMI emission performance is said to enable 10 dB less radiation compared with most competitors.

The product accommodates integration of ADLINK's full spectrum of frame grabbers, motion controllers and data acquisition cards, delivering an application-specific platform with versatile ADLINK I/O cards for automation applications.

**ADLINK Technology Inc**

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



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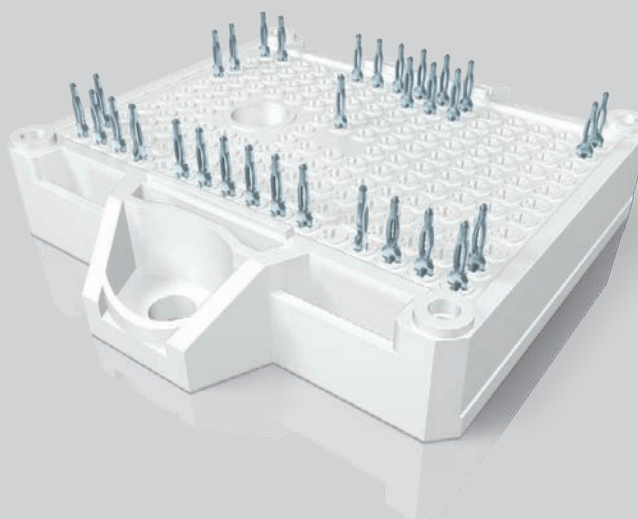
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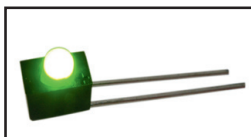




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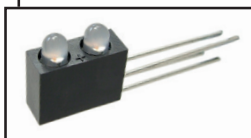
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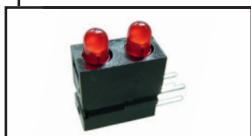
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## AUTOMOTIVE-GRADE GNSS MODULE

u-blox has announced its automotive-grade MAX-M8Q-01A GNSS module. Measuring 9.7 x 10.1 x 2.5 mm, it offers an operating temperature range from -40 to +105°C.

The module is designed to meet the stringent requirements of the automotive market, providing good positioning accuracy even in challenging environments such as urban canyons. Its extended temperature range ensures continuous performance even in harsh environments, eg, when mounted in a car-roof antenna.

Produced in adherence to the u-blox 0 ppm program, which aims to bring down product failure rates to zero and consistently achieve high production quality, the module is delivered with the automotive industry's standard PPAP documentation to ensure compliance with user requirements. The module is said to offer product developers a reduction of design and qualification time and effort, shortening time to market and reducing risks for product development.

**u-blox Singapore Pte Ltd**  
[www.u-blox.com](http://www.u-blox.com)



## DIGITAL STORAGE OSCILLOSCOPE

The Tenma 72-8725 DSO four-channel digital storage oscilloscope offers a user-friendly front panel with clear indications to allow access to all basic functions for easy operation. The scaling and position buttons for all channels are optimally arranged for intuitive operation.

The design is based on the familiar practices of traditional instruments, so users can handle the units without spending considerable time familiarising themselves with operation. For fast adjustment to ease with testing, there is an Auto key to instantly display the appropriate waveform and range position.

The product's dual time base function offers good waveform detail observation and analysis capabilities. The device offers storage of waveforms set-ups and bit maps waveforms and set-ups reproduction.

Users can scroll through the display in scan mode for continuous monitoring of signal variations. By using the XY mode, they can display the waveform and Lissajous figure concurrently. The product also supports plug-and-play USB storage devices for communication with computers.

Other features include: automatic measurement of 24 waveform parameters; built-in FFT; multiple Auto set-ups for extra flexibility; and visual system help messages. The unit has multiple waveform mathematics functions, including add, subtract, multiply and divide. It also has edge, video, pulse, slope and alternate trigger functions.

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# FABRIC-LIKE SUPERCAPACITOR

## CUSTOMISABLE FOR WEARABLE ELECTRONICS

Scientists at Nanyang Technological University, Singapore have created a customisable, fabric-like power source that can be cut, folded or stretched without losing its function, making it suitable for wearable electronics.

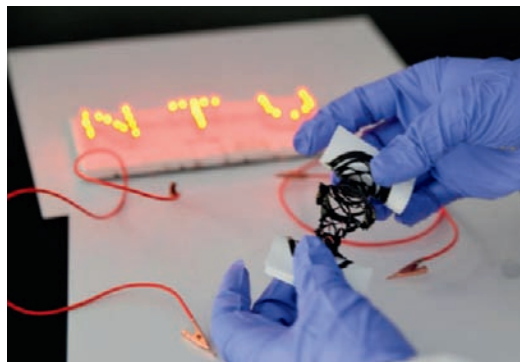
**W**riting in the journal *Advanced Materials*, the team explained that their wearable power source, a supercapacitor, works like a fast-charging battery and can be recharged many times.

Crucially, they have made their supercapacitor customisable or 'editable', meaning its structure and shape can be changed after it is manufactured — while retaining its function as a power source. Existing stretchable supercapacitors are made into predetermined designs and structures, but the new invention can be stretched multidirectionally and is less likely to be mismatched when it is joined up to other electrical components.

"Although some progress has been made on stretchable supercapacitors, traditional stretchable supercapacitors fabricated by predesigning structured electrodes for device assembling still lack the device-level editability and programmability," the researchers wrote. "To adapt to wearable electronics with arbitrary configurations, it is highly desirable to develop editable supercapacitors that can be directly transferred into desirable shapes and stretchability."

The team's supercapacitor is made of strengthened manganese dioxide nanowire composite material. While manganese dioxide is a common material for supercapacitors, the ultralong nanowire structure, strengthened with a network of carbon nanotubes and nanocellulose fibres, allows the electrodes to withstand the associated strains during the customisation process.

When edited into a honeycomb-like structure, the supercapacitor has the ability to store an electrical charge four times higher than most existing stretchable supercapacitors. In addition, when stretched to four times its original length, it maintains nearly 98% of the initial ability to store electrical energy, even after 10,000 stretch-and-release cycles.



*The supercapacitor functions well even when stretched.*  
Image credit: NTU Singapore.

The team's experiments also show that when the editable supercapacitor was paired with a sensor and placed on the human elbow, it performed better than existing stretchable supercapacitors. It was able to provide a stable stream of signals even when the arm was swinging, which were then transmitted wirelessly to external devices — similarly to devices that captures a patient's heart rate.

The researchers believe that the editable supercapacitor could be easily mass-produced as it would rely on existing manufacturing technologies. Production cost will thus be low, estimated at about

AU\$0.12 to produce 1 cm<sup>2</sup> of the material. The team has filed a patent for the technology.

"A reliable and editable supercapacitor is important for development of the wearable electronics industry," said Professor Chen Xiaodong, leader of the research. "It also opens up all sorts of possibilities in the realm of the Internet of Things when wearable electronics can reliably power themselves and connect and communicate with appliances in the home and other environments."

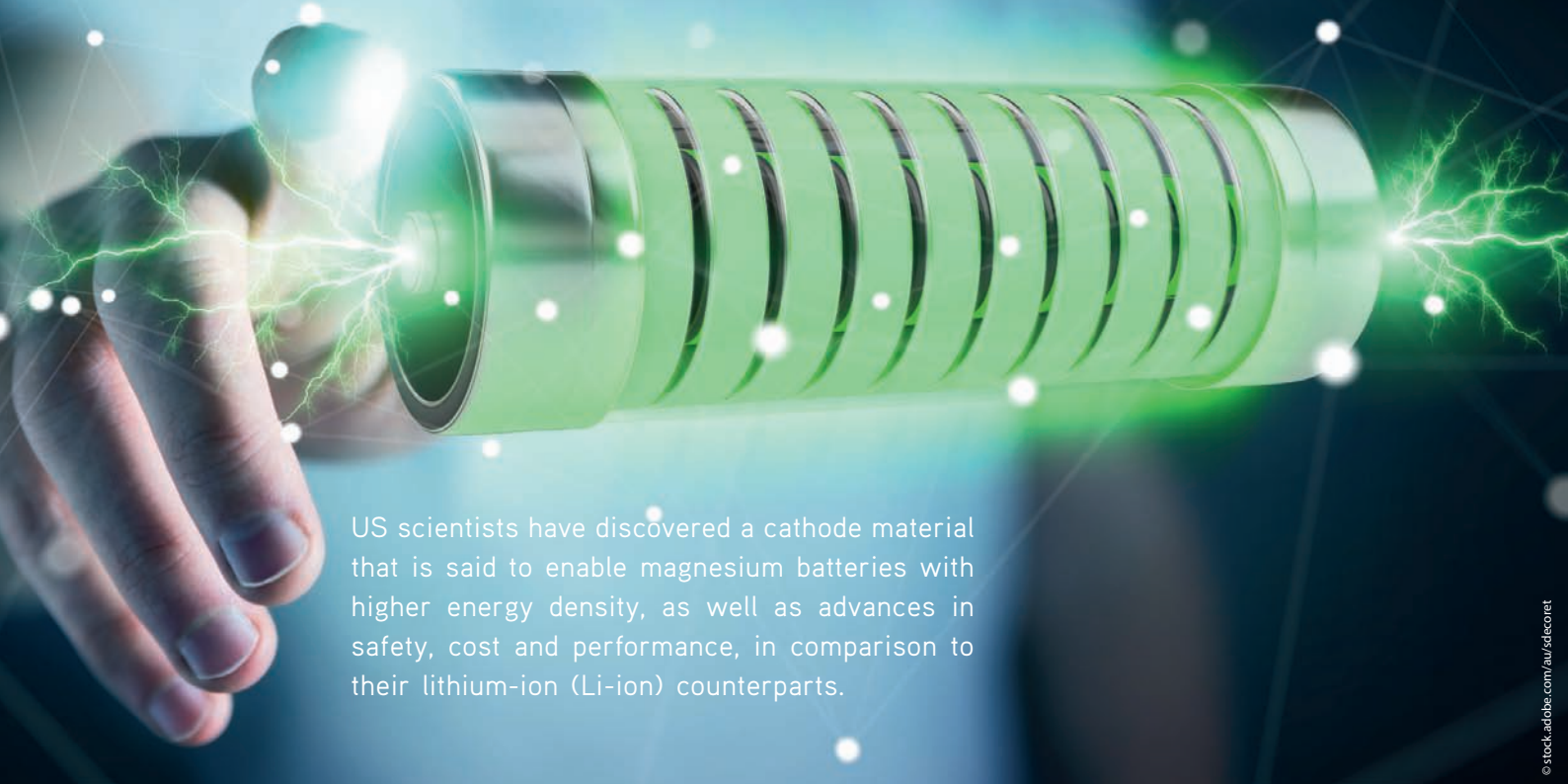
"My own dream is to one day combine our flexible supercapacitors with wearable sensors for health and sports performance diagnostics. With the ability for wearable electronics to power themselves, you could imagine the day when we create a device that could be used to monitor a marathon runner during a race with great sensitivity, detecting signals from both under- and over-exertion."

"Customisable and versatile, these interconnected, fabric-like power sources are able to offer a plug-and-play functionality while maintaining good performance," added Dr Loh Xian Jun, a co-author on the research. "Being highly stretchable, these flexible power sources are promising next-generation 'fabric' energy storage devices that could be integrated into wearable electronics."



# MAGNESIUM BATTERIES

## ARE ONE STEP CLOSER TO REALITY



US scientists have discovered a cathode material that is said to enable magnesium batteries with higher energy density, as well as advances in safety, cost and performance, in comparison to their lithium-ion (Li-ion) counterparts.

The research was led by Professor Sarbajit Banerjee from Texas A&M University, who has spent a number of years trying to better understand ion intercalation — the critical process by which ions like lithium and magnesium move in and out of other materials within intercalation batteries. Together with collaborators at the University of Illinois at Chicago (UIC), the Lawrence Berkeley National Laboratory and Argonne National Laboratory, he developed a battery solution that hinges on a redesigned form of an old Li-ion cathode material — vanadium pentoxide — which his team proved is capable of reversibly inserting magnesium ions.

Using one of the world's most powerful soft X-ray microscopes — the Scanning Transmission X-ray Microscope (STXM) and X-ray Emission beamlines — at the Canadian Light Source in tandem with one of the world's highest resolution aberration-corrected transmission electron microscopes housed at UIC, the researchers were able to observe the unique electronic properties of their novel vanadium pentoxide and directly prove magnesium-ion intercalation into the material, revealing why this new type of vanadium pentoxide is superior to the old version as well as to Li-ion batteries. Their results have been published in the journal *Chem*.

Laptops and mobile phones are two examples of technologies enabled by the lithium-ion battery, which revolutionised energy storage capacity and rechargeability in comparison to its lead-acid and nickel-metal hydride predecessors. But while lithium-ion technology

currently dominates the market, the researchers wrote that “the safety and long-term supply of lithium remain serious concerns”. Not only is lithium's widespread use expected to see it come in increasingly short supply, but there have been recent reports of Li-ion-powered devices having either caught fire or exploded as a result of the fundamental flammability and reactivity of lithium.

“Apart from being much safer for consumer applications, magnesium-ion technology is appealing fundamentally because each magnesium ion gives up two electrons per ion — twice the charge, whereas each lithium ion gives up only one,” said Texas A&M graduate student Justin Andrews, first author on the study. “This means that, all other considerations aside, if you can store as much magnesium in a material as you can store lithium, you immediately almost double the capacity of the battery.”

But for all their perceived advantages — including a higher melting point and higher abundance than lithium, the ability to form smooth surfaces when recharging and the potential to deliver more than a fivefold increase in energy density, according to the researchers — magnesium batteries have been essentially sidelined by a variety of problems. First and foremost is the lack of a suitable cathode, or positive electrode — otherwise known as the part of a battery where the magnesium ions enter during discharge of the battery to power an electronic device and then exit during charging.

"Indeed, the most exciting thing about magnesium ions — namely, that they store twice the charge in battery applications — also forms the basis for the biggest challenge," said UIC chemist Jordi Cabana. "The higher charge of the magnesium ions make them 'stick' much more strongly with surrounding atoms."

In other words, Professor Banerjee said, the magnesium ions get waylaid as they are traversing through the paths within the vanadium pentoxide cathode material. Their sluggish movement is what makes it so difficult to make viable magnesium batteries.

"In many structures, some of these interactions are very favourable, meaning that the magnesium is quite happy to sit and stay a while in those specific sites," Andrews explained. "In our material, the magnesium is 'frustrated' as it moves through the lattice, because it encounters many less-than-optimal environments. In this sense, it is more than happy to just keep moving right along, leading to an improvement in capacity and diffusion."

Seeking to solve this problem, Professor Banerjee said his team "essentially reconfigured the atoms to provide a different pathway for magnesium ions to travel along, thereby obtaining a viable cathode material in which they can readily be inserted and extracted during discharging and charging of the battery".

This rare phenomenon is achieved by limiting the location of the magnesium ions to relatively uncomfortable atomic positions by design, based on the way the vanadium pentoxide is made — a property known as metastability. This metastability helps prevent the magnesium ions from getting trapped within the material and



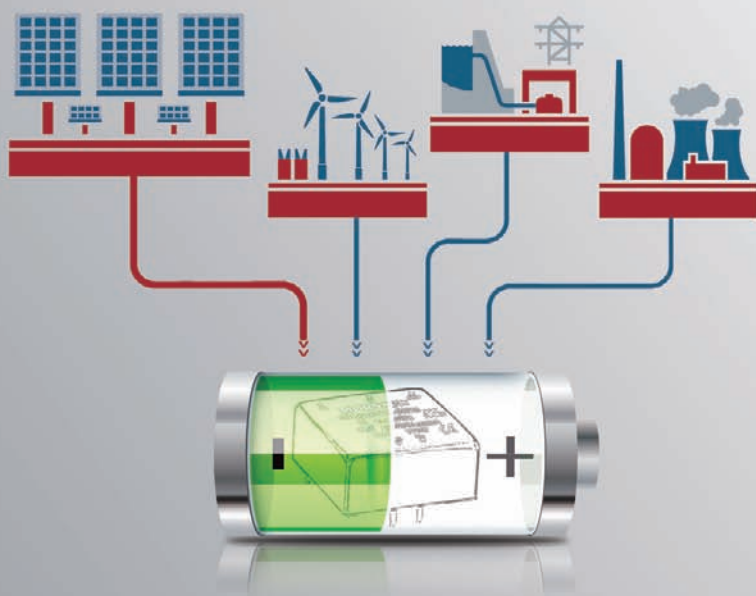
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promotes complete harvesting of their charge-storing capacity with negligible degradation of the material after many charge-recharge cycles.

Andrews said the team's research represents a significant advance towards solving the cathode problem while also highlighting the inherent advantages of using much more imaginative, metastable materials like this new form of vanadium pentoxide. He did, however, admit that there are "still several other fundamental problems to overcome before magnesium batteries become a reality".

"Nevertheless, this work moves magnesium batteries one step closer to reality — namely, a reality where batteries would be less expensive, lighter and safer for allowing for easier adoption to large-area formats necessary for electric vehicles and to store energy generated by solar and wind sources," he said.

## Power Supplies for Energy Storage System



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PLCnext Control is Phoenix Contact's first open control platform product based on PLCnext Technology. The controller combines the robustness and security of a classic PLC with the openness and flexibility of the world of smart devices. With PLCnext Technology, the company is responding to the challenges of the world of IIoT and simplifying existing controller solutions. Automation projects can now be implemented without the limitations of proprietary systems.

As an enhancement to classical IEC 61131-compliant PLC programming, PLCnext Technology makes it possible to program controllers using high-level language, thus ensuring PLC-typical real-time performance and data consistency for high-level languages and model-based code as well. Multiple developers can work independently in different programming languages and with the development tools they prefer. The result is faster application development, according to the company. Open source software and apps can also be incorporated into the system in a flexible way.

The controller is adaptable and open to the application of future technologies. The expanded connectivity provided by open interfaces and a direct cloud connection provide more freedom of choice. In addition to its open design, PLCnext Control's high-performance CPU and large mass storage in a small housing make it a suitable alternative.

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## MULTIBAND CAT 1 LTE MODULE

Gemalto's Cinterion PLS62-W 4G LTE wireless module is an industrial cellular module for global connectivity with multiband LTE Cat 1 and 2G/3G fallback.

Including LTE 700 MHz Band 28, the product is compatible with Telstra's 4GX network and will also work with Optus's 4G Plus network. With 12-band 4G LTE, 7-band 3G UMTS and quad-band GSM/GPRS, the module offers global connectivity for industrial M2M applications.

A powerful Java embedded system offers easy and fast application development, a broad choice of tools, high code re-usability, easy maintenance, on-device debugging, and multithreading programming and program execution. An advanced power management system provides optimised sleep mode to preserve power and extend battery life, while an operating temperature range of -40 to +90°C ensures that the module serves as a rugged design choice for demanding IoT applications.

The PLS62-W module is part of the Cinterion Industrial Plus family, which leverages the latest wireless standards to deliver IoT-optimised data speeds, advanced voice features and multiband capabilities to ensure seamless global coverage. They share a common footprint and are available in local and global variants including 2G, 3G, CDMA, LTE and LTE Advanced.

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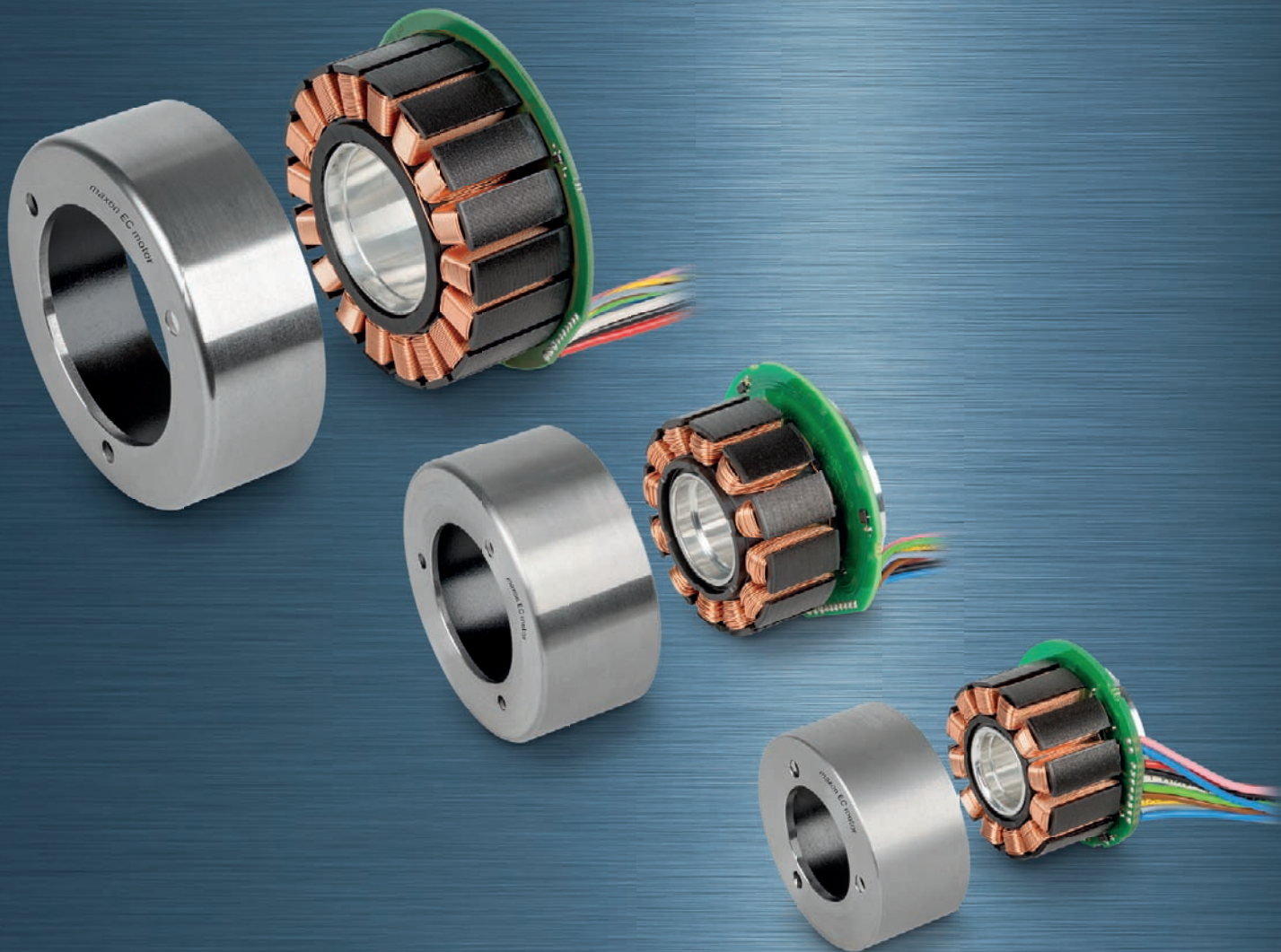
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# ULTRATHIN 'ELASTIC SKIN' DISPLAY FOR HOME HEALTH CARE

Japanese researchers have invented an ultrathin elastic display that can show the moving waveform of an electrocardiogram recorded by an on-skin electrode sensor that fits snugly on the skin. The integrated biomedical sensor system — called 'skin electronics' — can even transmit biometric data to the cloud.



*The soft, flexible skin display is about 1 mm thick. Image credit: 2018 Takao Someya Research Group.*

**T**hanks to advances in semiconductor technology, wearable devices can now monitor health by first measuring vital signs or taking an electrocardiogram, and then transmitting the data wirelessly to a smartphone. The readings or electrocardiogram waveforms can either be displayed on the screen in real time, or sent to the cloud or a memory device.

The new skin electronics system aims to go a step further by enhancing information accessibility for people such as the elderly or the infirm, who tend to have difficulty operating and obtaining data from existing devices and interfaces. It aims to help ease the strain on home healthcare systems in ageing societies through continuous, non-invasive health monitoring and self-care at home.

Developed via a collaboration between The University of Tokyo and Japanese printing company Dai Nippon Printing (DNP), the skin display consists of a 16 x 24 array of micro LEDs and stretchable wiring mounted on a rubber sheet. The integrated system combines a flexible, deformable display with a lightweight sensor composed of a breathable nanomesh electrode and wireless communication module.

"Our skin display exhibits simple graphics with motion," said Professor Takao Someya, leader of the research. "Because it is made from thin and soft materials, it can be deformed freely."

The display is stretchable by as much as 45% of its original length, making it more resistant to the wear and tear of stretching than previous wearable displays. It is built on a novel structure that minimises the stress resulting from stretching on the juncture of hard materials, such as the micro LEDs, and soft materials, like the elastic wiring — a leading cause of damage for other models.

It is also said to be the first stretchable display to achieve good durability and stability in air, with the researchers finding that not a single pixel failed in the matrix-type display while attached snugly onto the skin and continuously subjected to the stretching and contracting motion of the body.

The nanomesh skin sensor, developed as part of an earlier study, can be worn on the skin continuously for a week without causing any inflammation. It had previously been found capable of measuring temperature, pressure and myoelectricity (the electrical properties of muscle), but this study marked the first time it successfully recorded an electrocardiogram and stored it in memory.

The researchers applied tried-and-true methods used in the mass production of electronics — specifically, screen printing the silver wiring and mounting the micro LEDs on the rubber sheet with a chip moulder and solder paste commonly used in manufacturing printed circuit boards. Applying these methods is expected to accelerate the commercialisation of the display and help keep down future production costs, with DNP looking to bring the integrated skin display to market within the next three years.

"The current ageing society requires user-friendly wearable sensors for monitoring patient vitals in order to reduce the burden on patients and family members providing nursing care," said Professor Someya. "Our system could serve as one of the long-awaited solutions to fulfil this need, which will ultimately lead to improving the quality of life for many."



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