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# HALL SENSORS — HOW TO CHECK THEIR OPERATION

Find out how to test popular switches.

In the majority of popular applications, Hall sensors are used as non-contact switches. Systems in SIP3 packages that contain complete circuits for signal conditioning with a two-mode output are mainly used for this function. Therefore, this is not so much a sensor as it is a Hall switch. Operation of such a system can be easily checked if we know the system's type. When we deal with an unidentified element, we should have at least some basic knowledge of how a Hall sensor works in order to be able to check the system's operation. A set of necessary information is provided in this article.

### Hall sensor — basic information

The majority of Hall switches in TO-92 or TO-92UA SIP3 packages feature the following output arrangement: 1 — V<sub>dd</sub> (power supply), 2 — chassis ground, 3 — output. They are numbered in the same way as in the transistor. Things become a bit more complicated when it comes to SMD sensors, because here you can encounter SOT-23, SOT-223, SO-8 or other, special-purpose packages.

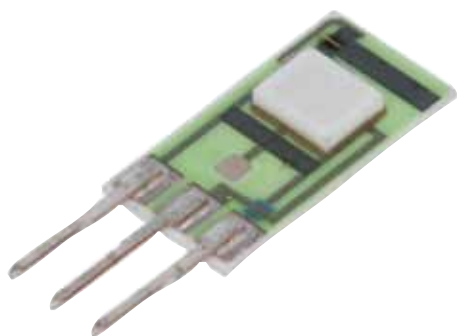
While SOT-23 and SOT-223 packages are well-known from transistors and their pinout corresponds to the arrangement of outputs mentioned above, the same cannot be said about other types of packages. Without access to the Hall sensor documentation or at least the name of its manufacturer, it is hard to determine which terminals are responsible for powering or connecting the sensor interface.

It was integration of a conditioning system, a Schmitt trigger and an output amplifier in a single sensor package that made Hall sensors, which are sometimes called Hall-effect sensors, popular and enabled the application of those systems as magnetic field detectors in the industry. However, when we deal with a two-mode (enabled/disabled) output, we should talk not so much about a Hall sensor as about a Hall switch, although these terms are often confused and mixed not only by users, but also in manufacturers' catalogues.

Hall switches can work in the following modes:

#### **Bipolar Hall sensor**

Magnetic field of proper voltage and north or south polarity is required to



*The SS94A1 Hall sensor, from Honeywell.*



*The SS441A unipolar Hall sensor, from Honeywell.*



*The SS361RT bipolar Hall sensor, from Honeywell.*

change a switch output state. If a sensor is placed in such a field, its output changes its state and maintains it until moved to a field of opposite polarity. It is said that those systems have a latch output.

### **Unipolar positive Hall sensor**

The output of that switch is activated by a properly strong positive magnetic field ('S' pole). The output is deactivated if that field fades (reaches a value that is below the switch-on threshold).

### **Unipolar negative Hall sensor**

The output of that switch is activated by a properly strong negative magnetic field ('N' pole). The output is deactivated if that field fades (reaches a value that is below the switch-on threshold).

## **How to check the operation of a Hall sensor**

In order to check a sensor it is enough to be aware of the Hall effect and have a power supply or a battery and a strong magnet. Firstly, connect the positive polarity voltage to terminal 1, and then connect the negative supply pole to terminal 2. You can estimate value of the supply voltage based on the switch application. Those in miniature packages that are intended for portable devices have a supply voltage of 3 V. The voltage of bigger switches, which are used in the industry, ranges from 5 to 12 V. Unfortunately, this is not a rule and without detailed information from a technical data sheet it should be taken into account that experimenting with supply voltage can lead to damage of a switch system or will not guarantee its sufficient sensitivity.

After applying supply voltage between the free terminal of a Hall sensor and the ground chassis, turn on the voltmeter. Now, bring one of strong magnet's



**IN ORDER TO CHECK A SENSOR IT IS ENOUGH TO BE AWARE OF THE HALL EFFECT AND HAVE A POWER SUPPLY OR A BATTERY AND A STRONG MAGNET.**

poles close to the front of a sensor, keeping it at the right angle. Depending on a switch type, voltage on its output should change rapidly either when the sensor is approached by the 'S' or 'N' pole. In the case of a bipolar switch, this effect can be achieved by bringing close/distancing, rotating (changing the polarity) and bringing close/distancing again of one of magnetic poles. If the voltage change meets our expectations, the switch presumably works properly and is ready to use.

## **Application and installation of a Hall sensor**

After checking the functioning of a Hall-effect sensor, we can proceed to its target application. It is worth following a couple of basic principles.

The output signal from a Hall sensor changes depending on the sine of the angle between the sensor's surface and the resultant vector of the magnetic field intensity. Maximum and minimum signals are reached when the lines of the magnetic field force are perpendicular or parallel to the sensor's surface, respectively. Manufacturers calibrate sensors in perfect conditions, so in real applications potential errors that result from the angle of installation of a Hall switch system with respect to the lines of the magnetic field force should be taken into account.

It is also important to choose a Hall switch that is compatible with the magnet or vice versa. In certain applications, for

example while setting the position of a spinning object, it may happen that the output signal is already available when the magnet is only approaching the system's casing, and not when it is precisely under the casing.

Even though modern Hall sensors work in a very wide temperature range, it can still have a strong impact on their parameters. It is therefore worth paying attention to the temperature range of the environment in which a Hall switch will be used when choosing it for a given application.

It is also beneficial to notice the limitation of the load's amperage. Not every Hall switch is suitable for switching on a transmitter or a signalling light. Some have a low output load that is suitable for powering a CMOS or TTL system input. It should be remembered that the load current directly affects the temperature of the switch structure and hence its sensitivity parameter.

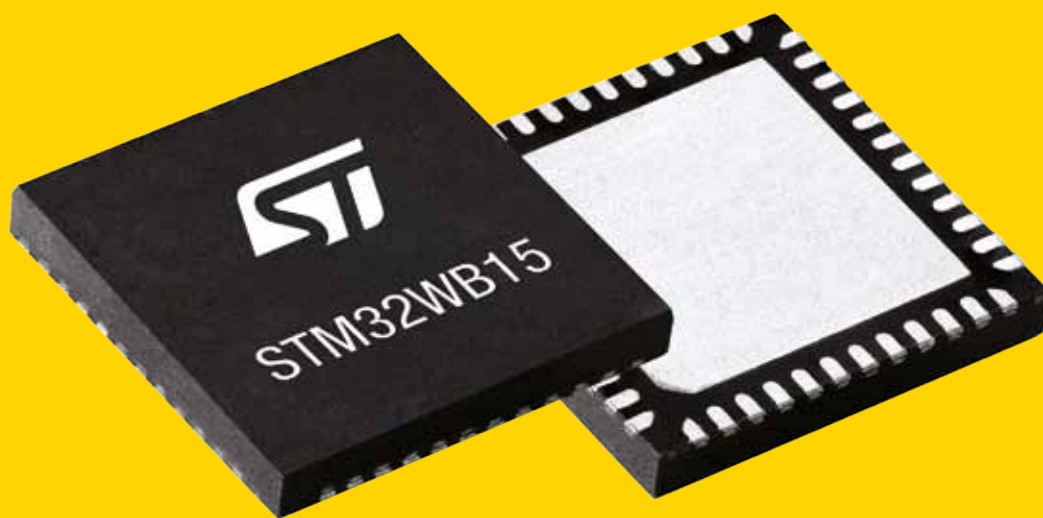
Selection of packages and their types should be application-specific. The TO-92 package of a Hall sensor is rather fragile and easy to damage. It is also easy to disconnect the delicate terminals. That is why while installing a switch system in your application, especially on a long cable, proper security of its terminals should be ensured, for example, by means of soldering the switch on a PCB or attaching the cable to the cover in a proper way.

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## ORGANIC SEMICONDUCTORS HARNESS WASTE HEAT FOR ELECTRICITY

An international research team, led by the King Abdullah University of Science and Technology (KAUST), has developed electron-transporting, n-type organic semiconductors that could help generate electricity from waste heat released by industrial processes and homes.

Thermoelectric generators that can convert temperature changes or gradients into electricity are highly suitable for harnessing waste heat. At the heart of thermoelectric generators are two electronically different materials, an n-type semiconductor and a hole-transporting (or p-type) semiconductor, which are joined at their ends to form a circuit. The conversion efficiency of the generators depends on both types of semiconductor delivering optimal performance.

Organic thermoelectric materials have recently emerged as easier to process and less toxic than their cheaper and more abundant conventional inorganic counterparts. These new materials also present lower thermal conductivity, but their thermoelectric performance remains inadequate. Typically, doped n-type organic semiconductors are not stable in ambient conditions and display lower electrical conductivities than their p-type equivalents, which have been widely investigated.

"One important challenge is to find n-type organic materials with comparable performance to the best p-type semiconductors," said KAUST research scientist Hu Chen, who led the new study within the research group of Iain McCulloch.

The team devised a systematic approach to synthesise air-stable doped n-type organic semiconductors with high thermoelectric performance. The monomers comprised cyclic amides, or lactams, fused with naphthalene and anthracene cores, generating rigid conjugated polymers by a non-toxic metal-free acid-catalysed polymerisation.

"There is no rotational freedom along the backbone, which reduces energetic disorder and subsequently enhances electrical conductivity," McCulloch said.

In this design, the electron withdrawing lactam groups produced a highly electron-deficient backbone, stabilising the polymer under ambient conditions. Additionally, smaller cores led to larger electron affinity and, consequently, better thermoelectric performance in the polymers. Chen explained that larger cores have a lower density of electron withdrawing groups, which cumulatively decrease the electron affinity.

Described in the *Journal of the American Chemical Society*, the air-stable polymers are believed to have good commercial potential. The team is now planning to develop scalable processes to allow these materials to be integrated into thermoelectric generators.



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## NANOCARBON MATERIAL MADE FROM CRAB SHELLS



As the demand for electronic devices continues to grow, so too does the strain on the finite resources used in their production, such as metals and fossil fuels. In an effort to provide renewable alternatives, researchers from Osaka University have developed a nanocarbon material for electronics applications made from chitin derived from crab shells, with their results published in the *Journal of Materials Chemistry C*.

Nanocarbon materials show significant promise for use in electronic devices. In particular, those with porous three-dimensional (3D) structures provide efficient networks for the transport of charge as well as electrolytes and reactants. The flow through these networks can be further improved by the addition of imperfections — known as defects — in the form of different atoms, such as nitrogen.

Efforts to use both synthetic polymers and biomass to prepare 3D porous nanocarbon with defects have led to effective sensing, energy storage and electrocatalysis materials. However, many of these are made from non-renewable resources or require multiple steps to prepare the network and introduce the defects.

The Osaka researchers have now developed 3D porous defective nanocarbon materials through the simple pyrolysis — or thermal decomposition — of chitin nanofibre paper. Chitin is a biopolymer that is the major component of crustacean shells. Because the structure of chitin contains nitrogen atoms, it acts as its own source of defects and no doping steps are required.

"We were able to control various properties of the final nanocarbon materials by pyrolysing the chitin nanofibre paper at different temperatures," said study first author Luting Zhu. "The pore structure, specific surface area and electrical resistivity all varied with the pyrolysis temperature, providing us with a useful means of tuning the material for specific applications."

The pyrolysed chitin nanofibre papers were successfully used as photosensors, exhibiting lower resistance when exposed to light. They were also shown to be effective supercapacitor electrodes (electrical components that can store electric charge in an electric field), with higher specific capacitance than many other nanocarbon materials reported to date, indicating their potential for use in energy storage.

"In order to translate laboratory findings into products that make a significant impact in the real world, it is important to streamline processes, which is why we are excited about our simple pyrolysis treatment," said corresponding author Hiroataka Koga. "Furthermore, our successful use of a renewable resource that is generally considered a waste product demonstrates the viability of sustainable electronics."

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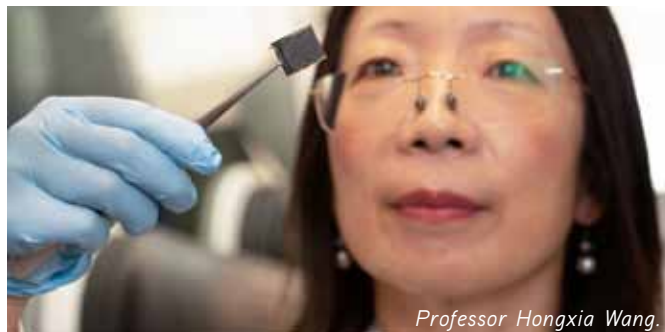
## HUMAN HAIR CAN BOOST PEROVSKITE SOLAR CELL PERFORMANCE

Researchers from the Queensland University of Technology (QUT) have used carbon dots, created from human hair waste sourced from a Brisbane barbershop, to create a kind of 'armour' to improve the performance of cutting-edge solar technology, with their results published in the *Journal of Materials Chemistry A*.

Perovskite solar cells, a relatively new photovoltaic (PV) technology, are seen as the best PV candidate to deliver low-cost, highly efficient solar electricity in coming years. They are as effective at power conversion efficiency as the current commercially available monocrystalline silicon solar cells, and as they are flexible, they could be used in scenarios such as solar-powered clothing, backpacks that charge your devices on the go, and even tents that could serve as standalone power sources. The challenge for researchers in this area is to make the technology cheaper and more stable.

Last year, QUT Associate Professor Prashant Sonar led a research team that turned hair scraps into carbon nanodots by breaking down the hairs and then burning them at 240°C. In that study, the researchers showed the carbon dots could be turned into flexible displays that could be used in future smart devices.

The latest study saw QUT Professor Hongxia Wang's research team, working with Prof Sonar's group, use the carbon nanodots on perovskite solar cells out of curiosity. Prof Wang's team had previously found that nanostructured carbon materials could be used to improve a cell's performance; after adding a solution of carbon dots into the process of making the perovskites, they found the carbon dots forming a wave-like perovskite layer where the perovskite crystals are surrounded by the carbon dots.



Professor Hongxia Wang.

"It creates a kind of protective layer, a kind of armour," Prof Wang said.

"It protects the perovskite material from moisture or other environmental factors, which can cause damage to the materials."

The study found that perovskite solar cells covered with the carbon dots had a higher power conversion efficiency and a greater stability than perovskite cells without the carbon dots. This is a major breakthrough for Prof Wang, who has been working with perovskite cells since they were invented about a decade ago, with the primary objective of developing cost-effective, stable PV materials and devices.

"Our final target is to make solar electricity cheaper, easier to access, longer lasting and to make PV devices lightweight because current solar cells are very heavy," Prof Wang said.

"The big challenges in the area of perovskite solar cells are solving stability of the device to be able to operate for 20 years or longer and the development of a manufacturing method that is suitable for large-scale production."

## CALCIUM ELECTROLYTE COULD BE USED FOR BATTERIES

Scientists from Tohoku University have developed a fluorine-free calcium (Ca) electrolyte based on a hydrogen (monocarborane) cluster that could potentially realise rechargeable Ca batteries. The researchers say their new material, achieved by designing the coordination structure of Ca cation with a weakly coordinating anion and mixed solvents, shows markedly improved electrochemical performances such as high conductivity and high electrochemical stabilities.

Current lithium-ion (Li-ion) batteries have some drawbacks: they are approaching their demand limits of theoretical energy density and cost, and lithium is not naturally plentiful. Calcium, on the other hand, is the fifth most abundant element in the Earth's crust and its metal anode has low reduction potential (-2.87 V vs standard hydrogen electrode (SHE)) and volumetric capacities of 2072 mAh cm<sup>-3</sup>, giving it comparable cell voltage and energy density to those of Li. Calcium batteries are therefore cost-effective and possess high battery performance, making them a suitable substitute for Li batteries.

That said, many challenges remain before Ca batteries can be realised due to a lack of suitable electrolytes that possess reductive/oxidative stabilities and high ionic conductivities. Moreover, realising a fluorine-free system is desirable for practical Ca electrolytes because a fluorine-containing electrolyte intrinsically induces CaF<sub>2</sub> formation on the electrode, which hinders Ca diffusion as well as the Ca plating and stripping processes.

The Tohoku University researchers, led by Kazuaki Kisu and Shin-ichi Orimo, utilised the hydrogen cluster anion because of its high reductive and oxidative stability, which allows for a wide potential window and demonstrates excellent stability against metal anodes such as lithium, sodium and magnesium. "A design that incorporates a hydrogen cluster into a Ca electrolyte had not been proposed yet," Kisu said. "We were pleased that this turned out suitable for a Ca battery."

The researchers say their Ca electrolyte, described in the journal *Scientific Reports*, is a major breakthrough for Ca batteries. According to Kisu, "We expect the development of a promising electrolyte candidate based on complex hydrides compatible with Ca batteries will create future opportunities for exploring other related complex hydride compounds such as multivalent electrolytes."



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# THINK POSITIVE:

## THE KEY TO TRANSPARENT ELECTRONICS

A new study led by RMIT University could pave the way to revolutionary, transparent electronics — see-through devices that could potentially be integrated in glass, in flexible displays and in smart contact lenses, bringing to life futuristic devices that seem like the product of science fiction. Their work has been published in the journal *Nature Electronics*.

**F**or several decades, researchers have sought a new class of electronics based on semiconducting oxides, whose optical transparency could enable fully transparent electronics. Oxide-based devices could also find use in power electronics and communication technology, reducing the carbon footprint of our utility networks. RMIT researchers and their collaborators have now introduced ultrathin beta-tellurite to the two-dimensional (2D) semiconducting material family, providing a solution to this decades-long search for a high-mobility, p-type oxide.

“This new, high-mobility, p-type oxide fills a crucial gap in the materials spectrum to enable fast, transparent circuits,” said team leader Dr Torben Daeneke, who led the collaboration

across three nodes of the ARC Centre of Excellence in Future Low-Energy Electronics Technologies (FLEET).

Other key advantages of the long-sought-after oxide-based semiconductors are their stability in air, less-stringent purity requirements, low costs and easy deposition. “In our advance,” said Dr Daeneke, “the missing link was finding the right ‘positive’ approach.”

### Positivity has been lacking

There are two types of semiconducting materials: ‘n-type’ materials have abundant negatively charged electrons, while ‘p-type’ semiconductors possess plenty of positively charged holes. It’s the stacking together of complementary n-type and

*Dr Ali Zavabeti, Patjaree Aukarasereenont and Dr Torben Daeneke with transparent electronics.*



Image credit: RMIT University

p-type materials that enables the creation of electronic devices such as diodes, rectifiers and logic circuits — the materials that serve as the building blocks of every computer and smartphone.

A barrier to oxide devices has been that while many high-performance n-type oxides are known, there is a significant lack of high-quality p-type oxides. However, in 2018 a computational study revealed that beta-tellurite ( $\beta\text{-TeO}_2$ ) could be an attractive p-type oxide candidate, with tellurium's peculiar place in the periodic table meaning it can behave as both a metal and a non-metal, providing its oxide with uniquely useful properties.

"This prediction encouraged our group at RMIT University to explore its properties and applications," said Dr Daeneke, who is a FLEET associate investigator.

### Liquid metal

Dr Daeneke's team demonstrated the isolation of beta-tellurite with a specifically developed synthesis technique that relies on liquid metal chemistry. As explained by co-first author Patjaree Aukarasereenont, a FLEET PhD student at RMIT, "A molten mixture of tellurium (Te) and selenium (Se) is prepared and allowed to roll over a surface.

"Thanks to the oxygen in ambient air, the molten droplet naturally forms a thin surface oxide layer of beta-tellurite. As the liquid droplet is rolled over the surface, this oxide layer sticks to it, depositing atomically thin oxide sheets in its way.

"The process is similar to drawing: you use a glass rod as a pen and the liquid metal is your ink."

While the desirable  $\beta$ -phase of tellurite grows below 300°C, pure tellurium has a high melting point, above 500°C. Therefore, selenium was added to design an alloy that has a lower melting point, making the synthesis possible.

"The ultrathin sheets we obtained are just 1.5 nm thick — corresponding to only few atoms," said co-author Dr Ali Zavabeti. "The material was highly transparent across the visible spectrum, having a bandgap of 3.7 eV, which means that they are essentially invisible to the human eye."

### Up to 100 times faster

To assess the electronic properties of the developed materials, field-effect transistors (FETs) were fabricated. According to Aukarasereenont, "These devices showed characteristic p-type switching as well as a high hole mobility (roughly 140  $\text{cm}^2\text{V}^{-1}\text{s}^{-1}$ ), showing that beta-tellurite is 10 to 100 times faster than existing p-type oxide semiconductors. The excellent on/off ratio (over  $10^6$ ) also attests the material is suitable for power-efficient, fast devices."

Dr Zavabeti added, "The findings close a crucial gap in the electronic material library.

"Having a fast, transparent p-type semiconductor at our disposal has the potential to revolutionise transparent electronics, while also enabling better displays and improved energy-efficient devices."

The team plans to further explore the potential of this novel semiconductor. According to Dr Daeneke, "Our further investigations of this exciting material will explore integration in existing and next-generation consumer electronics."

## Bluetooth badges enable safe distancing for workers

As the COVID-19 pandemic continues on, with unexpected spikes and surges in different regions at different times, electronic components distributor Digi-Key Electronics remains committed to maintaining a safe and clean work environment. The company has thus deployed a robust safe distancing solution for all employees in its product distribution centre (PDC), with more than 2500 active employee badges online in the first two weeks of the deployment.

The Safe Distancing Solution from Option works through a Bluetooth badge sensor that each individual employee is issued. The badges interact wirelessly with one another and feed to a cloud platform, which can maintain contact tracing information and should improve the accuracy and efficiency of necessary quarantine procedures. By deploying the badge sensors to employees potentially working in close contact with others, Digi-Key has been able to better perform contact tracing procedures and reduce the number of employees that need to quarantine when an employee does test positive.

"We selected the badge option with Option because it really offered the best in employee privacy," said Shane Zutz, Vice President of Human Resources for Digi-Key. "It provides the contact tracing needed to mitigate disruptions due to health concerns, without an infringement of privacy, and does not trace anyone beyond our corporate campus."

Beyond offering employee privacy, the Safe Distancing solution was also quick to integrate, and Digi-Key did not have to make any significant investment in the infrastructure. The battery life on the badges is long enough that it won't be seen as too intrusive to ask employees to charge them once a week. Digi-Key also already had plans to implement LoRa (low-power wide-area) technology in the future as part of its 'smart warehouse' initiative, and this

option was one of the few that was based on a LoRa network.

The solution works on a LoRa network that is active within the walls of the Digi-Key campus. The newly built-out LoRa network wirelessly transmits the information to a cloud platform that securely maintains contact records in the event that a contact tracing report needs to be created. The LoRa network also opens up other options for future applications critical to the smart warehouse initiative such as building access, area access, asset tracking and more.

When considering deploying a solution, Digi-Key ran several test cases and realised it was able to significantly cut down on the number of employees quarantining due to a potential

COVID-19 exposure based on CDC guidelines. One scenario reduced the number of people from 23 to four, and another scenario went from 19 down to three. Since the solution is based on contact events between badges, rather than more invasive means like employee interviews, the solution can more accurately report when employees are within six feet of one another for an extended period of time.

Digi-Key worked with value-added distributor and integration partner GetWireless on the deployment and support of the badge devices and gateways. The company is already using visitor-specific badges for the minimal visitors allowed in the building at this time.

"The GetWireless Team is proud to have worked closely with Digi-Key during their trial and rollout of the Option Safe Distancing Solution for the workplace," said GetWireless CEO Brian Taney. "It is exciting to see a large, innovative organisation like Digi-Key leveraging IoT solutions to address real-world issues and, in turn, to gain greater visibility into the wellbeing of their great team."

Option CEO Alain Van den Broeck added, "Digi-Key recognised the strength and flexibility of Option's solution, which rests on two pillars — WMW's cloud-based platform with apps and data registrars and Option's CloudGate IoT gateway with superior wireless LoRaWAN performance — both core building blocks for successful digital transformations in Digi-Key."

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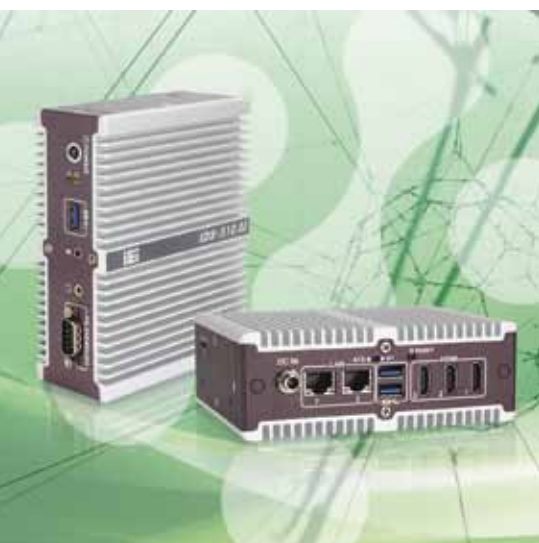
iEi's IDS-310AI fanless, ultracompact, artificial intelligence edge computing system is pre-installed with a Mustang-MPCIE-MX2 AI accelerator card, which includes two Intel Movidius Myriad X VPUs, to provide a flexible deep learning solution.

The IDS-310AI's triple HDMI display support, coupled with VPUs, aids in running AI fast and is suitable for low-power-consumption applications such as surveillance, retail, digital signage and transportation. With the advantage of power efficiency and high performance to dedicated deep neural networks (DNN) topologies, it can be implemented in an AI edge computing device to reduce total power usage, providing longer duty time for the rechargeable edge computing equipment.

Space limitation is one of the constraints commonly seen in today's industrial environments. Under tight restrictions, the IDS-310AI not only provides a palm-sized design to meet the space requirements, it also comes with adequate basic I/O interfaces suitable for various applications.

Other features include: Intel Celeron J3455 1.5 GHz (up to 2.3 GHz, quad-core, TDP 10 W); two GbE LAN ports; triple USB 3.2 Gen1; and an M.2 A-key slot for expansion.

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Crystal Group RIA (Rugged Intelligence and Autonomy) is a real-time embedded computer that combines good compute power, data-handling capabilities and storage in a compact, rugged unit capable of withstanding harsh environmental conditions, including potholes, collisions and extreme temperatures that are likely to cause traditional systems to fail.

Specifically designed for unmanned and autonomous driving vehicles, the turnkey solution is suitable for both military and commercial/industrial applications. With the ability to reduce development time and streamline systems integration, it can be used to accelerate innovation and conquer complexity in artificial intelligence (AI), automation, autonomous vehicles (AVs), advanced driver-assistance systems (ADAS), machine learning, sensor fusion, unmanned platforms and many other high-tech projects.

Features include: 10–32 VDC input power; lightweight aluminium construction (13.6–18.1 kg); up to 2 TB DDR4 of memory; up to three GPUs supported; Intel Xeon Scalable processors; open loop cooling system kits available; versatility, with two removable 15 mm drives or three removable 9.5 mm drives; expandability, with up to six PCI-E slots; and liquid cooling to maximise compute density.

**Metromatics Pty Ltd**  
[www.metromatics.com.au](http://www.metromatics.com.au)



## PoE TO USB-C ADAPTER

Microchip Technology has announced a PoE to USB-C adapter with the highest power capability that converts both power and data while offering up to 60 W USB output power via an Ethernet cable supported by PoE infrastructure.

The adapter (part number PD-USB-DP60) can accept up to 90 W of PoE and convert it to 60 W output over USB-C that will power most cameras, laptops, tablets and other devices using USB-C for input power. This adapter simplifies installation by reducing dependency on AC infrastructure. Without the dependency of an AC outlet, there is no longer a range limitation of 3 m and power can be delivered over 100 m. The adapter also enhances the remote power management capabilities of the USB-C power device. The remote power reset capability, provided by the PoE source, allows power cycling via web interface or Simple Network Management Protocol (SNMP) to reset the device, rather than having to manually unplug and restart at the location of the equipment.

The adapter can connect to a variety of PoE sources with various standards deployed. It supports newer IEEE 802.3af/at/bt standards as well as legacy PoE standards.

Having the capability of converting 90 W input to 60 W output enables devices requiring higher power charging to make use of PoE that could not have done so before. The adapter can be paired with Microchip's single-port and multi-port (up to 24) PoE injectors/midspans and switches that comply with IEEE 802.3af/at/bt industry standards and provide up to 90 W power per port. If a lower power is needed to power the USB-C device, IEEE802.3af (15.4W) or IEEE802.3at (30W) PoE sources can be used.

**Microchip Technology Hong Kong**  
[www.microchip.com](http://www.microchip.com)

DC/DC

# RED40W RED60W

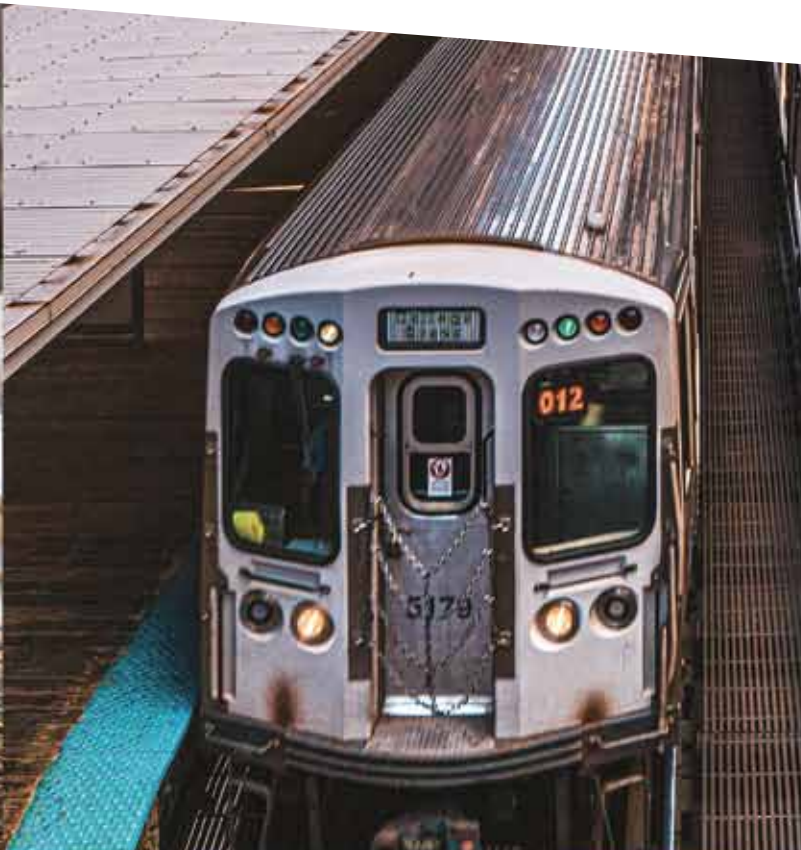
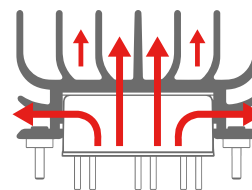
4:1 Wide Input Range

- No Minimum Load Required
- 3000VDC Isolation
- 6 Sided Continuous Shield
- UL62368-1, EN62368-1, & IEC62368-1
- EN50155 And EN45545-2 Railway Standard



## Diverse Cooling Solutions

Dedicated heat sink protects power electronic equipment in the most demanding environments.



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# CONNECTED DEVICES:

## FOUR CYBERSECURITY PREDICTIONS FOR 2021

In 2020, organisations in all industries, across the globe, changed forever. These changes will alter the risk surface for every organisation in 2021 and beyond, forcing them to adopt new technologies and security strategies to keep pace, according to Forescout.

While the benefits of connected devices such as IT, operational technology (OT), Internet of Things (IoT), Industrial Internet of Things (IIoT) and the Internet of Medical Things (IoMT) can't be denied, they are also creating additional challenges from a security point of view because they have vulnerabilities in their underlying transmission Control Protocol/Internet Protocol (TCP/IP) stacks. These are the basic connectivity software components used in every connected device. While a vulnerability in a single device will only affect that device, vulnerabilities in the TCP/IP stack can affect thousands or even millions of devices across many vendors and manufacturers.

"Organisations will be attacked through these devices in 2021," said Rohan Langdon, Country Manager, Australia, New Zealand and Japan, Forescout. "These attacks will potentially prevent organisations in the healthcare industry, for example, deliver[ing] patient care at a critical time. The risk of an attack will continue to rise as more devices are added to networks. What's more, supply chain vulnerabilities will force organisations to rethink their cybersecurity strategies entirely and adopt segmentation and zero trust principles, as maintaining good cybersecurity hygiene with patching IoT and OT devices becomes difficult or impossible.

"While 2020 saw the revelation of the weakness of these underlying TCP/IP stack components with disclosures like Ripple20, 2021 is the year these vulnerabilities will be exploited."

### Forescout's four key cybersecurity predictions for 2021

#### Prediction #1

In 2020, the pandemic took a toll on supply chain systems, leaving people without toilet paper, cleaning products and other essential items. As a result, 2021 will drive a new wave of investment in automation technology. A side effect of an increasingly automated supply chain will be that organisations will have to think about how they also apply automation to cybersecurity to ensure these new systems are protected. While it may not yet be a deciding factor in what automation technology is chosen, cybersecurity will have to be a key piece of the overall automation strategy for organisations in every industry.

In addition, the need to adapt security strategies for supply chain systems will come to a critical juncture in 2021 as the world moves to manufacture and distribute vaccines for COVID-19. This process will require many components and critical infrastructure systems to be safely and securely operating across factories, manufacturing, pharmaceuticals, distribution and health care.



THERE NEEDS TO BE INCREASED VISIBILITY INTO WHAT COMPONENTS MAKE UP EACH CONNECTED DEVICE INSIDE AN ORGANISATION.

### Prediction #2

In 2020, there were disclosures of supply chain vulnerabilities in the underlying TCP/IP stacks, which is the widely used commodity software and hardware underlying many IoT, IT and OT devices. These vulnerabilities are far-reaching, with a single flaw exposing many devices across many manufacturers and showed the underlying foundation of millions of connected devices around the world is inherently insecure. In 2021, we will see at least one attack leveraging this new category of vulnerabilities, highlighting the fact that there needs to be increased visibility into what components make up each connected device inside an organisation, as well as risk mitigation strategies to account for a growing number of vulnerable devices.

### Prediction #3

As the technology matures, 5G-connected devices will see increased adoption across organisations in every industry. While 5G is marketed towards consumers because of the high speed that will be delivered for mobile phone use, many features of 5G promise significant technological advancements for corporate networks. Organisations everywhere will begin to have 5G-connected devices in 2021. This is one of the many steps that will propel us into the next generation of networking, with next-generation technologies replacing local area networks and wide area networks and becoming the new version of Wi-Fi.

### Prediction #4

As remote work extends from being a temporary solution to the pandemic to one that companies embrace long term, the implications of the new work-from-anywhere world will become clear. Home networks contain dozens of connected devices, from Wi-Fi coffee pots, to personal laptops and tablets, to video baby monitors. As the perimeter of the office stretches to also include the home, we will see attackers begin to leverage weak consumer devices for enterprise attacks.

Organisations will need to determine how they will adapt to this new world, now that it has become clear that working remotely is not only possible for many but, in some cases, preferred. This means that zero trust capabilities will be more important than ever as corporate laptops connect to home, coffee shop and hotel networks around the world, mingling corporate devices with riskier ones that are no longer controlled by enterprise cybersecurity teams.

"2020 made clear that it is almost impossible to accurately predict what the future will look like," Langdon said. "Despite this, some things are most certainly predictable. Cybersecurity threats are on the rise, with attackers looking for new entry points for attack and high-target areas to cause maximum impact. Cybersecurity teams and leaders must be prepared with the appropriate strategies and technologies to address this in 2021 and beyond."

Forescout Technologies, Inc.  
www.forescout.com



## Design Faster

### Simplifying Motor Control with dsPIC33 DSCs, Tools and Reference Designs

As brushless electric motors proliferate across a growing range of applications, developers need products and tools that minimize development time and design complexity while reducing board size, system cost and energy consumption. Microchip is expanding its motor control offering with a new cost-effective dsPIC33C digital signal controller (DSC) family that is supported by design tools, development hardware and reference designs.

The dsPIC33C DSCs, with their high analog integration, simplify motor control system design while reducing development and bill of materials costs in automotive, industrial, medical and consumer applications. Our newly enhanced support ecosystem includes the motorBench® Development Suite, a Low-Voltage Motor Control (LVMC) Development Board and a Refrigerator Compressor Reference Design that helps you get your designs done faster.



#### Contact Information

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microchip.com/WNIE-MotorControl

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## WIRELESS MICROCONTROLLERS

STMicroelectronics has extended its STM32WB Bluetooth LE microcontroller (MCU) offering with devices that combine entry-level features with extra power savings for long-lasting performance.

The dual-core STM32WB15 and STM32WB10 Value Line pair an

Arm Cortex-M4 processor to run the main application and a Cortex-M0+ to handle Bluetooth 5.2 connectivity, enabling real-time performance from each. The radio stage has a 102 dBm link budget to enable connection over long distances and integrates balun circuitry to save board space and reduce the bill of materials.

With an ultrapower-saving mode that allows the radio to remain operational, and carefully tailored peripherals and memory, the devices are suited to power-conscious embedded applications including wearables, beacons, smart circuit breakers, trackers, IoT endpoints and equipment for industrial automation.

The software development kit (SDK) for each MCU includes standardised radio protocol stacks and openness to proprietary protocols. A set of security mechanisms enables safe software updates for brand protection and device integrity, with proprietary code read-out protection (PCROP) to guard intellectual property.

The addition of the latest devices means the STM32WB series scales across package variants, offering options including extended GPIOs and pin-to-pin compatibility between similar packages of the portfolio. Users can easily migrate designs between devices to take advantage of different features and memory densities, leveraging pin-compatibility across packages.

The development ecosystem includes STM32Cube certified radio stacks that support various profiles, software expansion packs and sample code; the STM32CubeMX configurator and initialisation code generator; the STM32CubeIDE development environment; a powerful STM32CubeMonitor-RF evaluation tool; and associated Nucleo hardware tools.

**STMicroelectronics Pty Ltd**

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

## PUSH-BUTTON AND SECURITY COVER

APEM has released the WP series push-button with high-performance momentary switch, for interfaces that must be easily identifiable.

The push-button is designed to increase visibility of critical functions with its extra-large activation surface. It comes with a large-format, personalised laser marking and an anodised 25 mm-diameter bearing area that can be tinted in blue, black, green or red. The waterproof device is IP67 and IP69K rated, making it suitable for harsh applications such as outdoor or military.

Also available is the WPG series security cover for specific metal security guard requirements to prevent any unwanted activation, especially when the button is positioned in outdoor applications. There are three types of switch guards and eight colours available.

**Control Devices Australia**

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



## TOUCH MONITORS

The IDP-3100 series bezel-less touch monitors (available in 15" and 21.5") are designed to empower a multitude of automation, retail, industrial and kiosk applications. They deliver a backlight lifetime of 50,000 h and good display performance within a compact, contemporary design.

To address issues caused by direct sunlight — screen cracking, hazing and yellowing — the monitors are equipped with a UV-resistant touch solution for outdoor applications. The base unit supports the integration of customised brightness enhancements, optical bonding and/or surface treatments (such as anti-glare/reflective/fingerprint/microbial treatments).

The IDP-3100 monitors leverage DeviceOn/Display software to enable remote monitoring, status visualisation and real-time management. The software supports brightness and colour adjustments, screen on/off timer functions and group management. The backlight lifespan monitoring and warning reminders help ease maintenance and optimise display performance remotely.

Featuring an industrial-grade design and IP65-rated front panel to protect against water and dust ingress, the IDP-3100 monitors are suitable for a range of industrial applications. The touchscreen supports easy cleaning and maintenance in high usage applications where hygiene is important. The monitors leverage a HDMI signal interface for integration within embedded boards and systems and can support both panel and VESA mounting to ease deployment in diverse applications and environments.

**Advantech Australia Pty Ltd**

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



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# STRUCTURAL BATTERY

## COULD ENABLE 'MASSLESS' ENERGY STORAGE

Swedish researchers have produced a structural battery that is claimed to perform 10 times better than all previous versions.

Containing carbon fibre that serves simultaneously as an electrode, conductor and load-bearing material, the battery is said to pave the way for essentially 'massless' energy storage in vehicles and other technology. It has been described in the journal *Advanced Energy & Sustainability Research*.

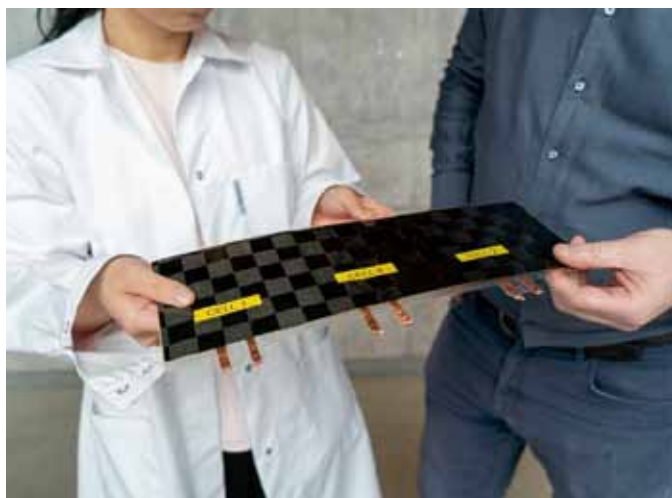
The batteries in today's electric cars constitute a large part of the vehicles' weight, without fulfilling any load-bearing function. A structural battery, on the other hand, is one that works as both a power source and as part of the structure — for example, in a car body. This is termed 'massless' energy storage, because in essence the battery's weight vanishes when it becomes part of the load-bearing structure. Calculations show that this type of multifunctional battery could greatly reduce the weight of an electric vehicle.

The development of structural batteries at Chalmers University of Technology has proceeded through many years of research, including previous discoveries involving certain types of carbon fibre. In addition to being stiff and strong, they also have a good ability to store electrical energy chemically. But while the first attempt to make a structural battery was made as early as 2007,

it has so far proven difficult to manufacture batteries with both good electrical and mechanical properties.

Now Chalmers researchers, in collaboration with KTH Royal Institute of Technology, have presented a structural battery with properties claimed to far exceed anything yet seen in terms of electrical energy storage, stiffness and strength — including multifunctional performance that is 10 times higher than previous structural battery prototypes.

The structural battery uses carbon fibre as a negative electrode and a lithium iron phosphate-coated aluminium foil as the positive electrode. The carbon fibre acts as a host for the lithium and thus stores the energy. Since the carbon fibre also conducts electrons, the need for copper and silver conductors is also avoided — reducing the weight even further. Both the carbon fibre and the aluminium foil contribute to the mechanical properties of the structural battery. The two electrode materials are kept separated by a fibreglass fabric in a structural electrolyte matrix. The task of the electrolyte is to transport the lithium ions between the two electrodes of the battery, but also to transfer mechanical loads between carbon fibres and other parts.



The battery has an energy density of 24 Wh/kg, meaning approximately 20% capacity compared to comparable lithium-ion batteries currently available. But since the weight of the vehicles can be greatly reduced, less energy will be required to drive an electric car, for example, and lower energy density also results in increased safety. And with a stiffness of 25 GPa, the structural battery can compete with many other commonly used construction materials.

"Previous attempts to make structural batteries have resulted in cells with either good mechanical properties or good electrical properties," said Chalmers Professor Leif Asp, leader of the project. "But here, using carbon fibre, we have succeeded in designing a structural battery with both competitive energy storage capacity and rigidity."

Despite their success, the researchers did not choose the battery materials to try and break records — rather, they wanted to investigate and understand the effects of material architecture and separator thickness. Now a new project, financed by the Swedish National Space Agency, is underway, where the performance of the structural battery will be increased yet further. The aluminium foil will be replaced with carbon fibre as a load-bearing material in the positive electrode, providing both increased stiffness and energy density. The fibreglass separator will be replaced with an ultrathin variant, which will give a much greater effect — as well as faster charging cycles. The new project is expected to be completed within two years.

Prof Asp, who is leading this project too, estimates that such a battery could reach an energy density of 75 Wh/kg and a stiffness of 75 GPa. This would make the battery about as strong as aluminium, but with a comparatively much lower weight.

"The next-generation structural battery has fantastic potential," Prof Asp said. "If you look at consumer technology, it could be quite possible within a few years to manufacture smartphones, laptops or electric bicycles that weigh half as much as today and are much more compact."

And in the longer term, it is absolutely conceivable that electric cars, electric planes and satellites will be designed with and powered by structural batteries.

"We are really only limited by our imaginations here," Prof Asp said. "We have received a lot of attention from many different types of companies in connection with the publication of our scientific articles in the field. There is understandably a great amount of interest in these lightweight, multifunctional materials."

## THERMAL CIRCUIT BREAKER

SCHURTER's TA36 thermal circuit breaker is an improved version of the TA35, which has been re-designed with a modern and contemporary look in a variety of colours to suit various applications — from industrial and medical equipment to consumer goods.



The product offers both the function of an appliance switch and thermal overcurrent protection. It is a particularly versatile series of miniature circuit breakers, with a high UL rating of 277 VAC for rated currents ranging from 0.05 to 20 A, available in a 1- or 2-pole version.

The switches are designed for efficient snap-in mounting and are equipped with plug-in connections (Quick-Connect). They come in a wide variety of options and colour combinations, customisable to suit the application — with three flange colours, five types of switch markings and seven trendy rocker colours.

**SCHURTER (S) PTE LTD**

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

## SYRINGE BARRELS

Nordson EFD has introduced the largest sized syringe barrel in its Optimum dispensing components line. The 70 cc syringe barrel holds more assembly fluids, such as adhesives, epoxies, sealants and solder pastes, than the other sizes including 3, 5, 10, 30 and 55 cc. It is suitable for electronic applications such as underfill, potting and conformal coating. The barrel should therefore last longer on the production line, causing fewer changeovers and reducing downtime for manufacturers.

The 70 cc fluid reservoir is available in the company's clear Optimum resin for general-purpose applications and UV-blocking amber resin for light-sensitive assembly fluids. The barrel's consistent internal diameter maintains the proper seal with the piston for consistent dispensing results. It features the same ZeroDraft walls as other Optimum syringe barrels.

All syringe barrels are manufactured in Nordson EFD's silicone-free facilities and certified for industrial use.

**Nordson Australia Pty Ltd**

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





## DIGITAL I/O CARD

The M2p.7515-x4 from Spectrum Instrumentation offers a way to generate and acquire fast digital signals using a half-length PCIe card that measures just 168 x 107 mm in size. The tiny form factor means that it can be inserted into almost any desktop PC, turning it into a powerful tool for applications such as logic analysis or pattern generation.

The digital I/O card features 32 parallel channels that can be clocked at speeds up to 125 MHz. When set for digital acquisition, the channels offer 3.3 and 5 V TTL compatibility, making them suitable for use with a range of digital signals. In generation mode, the cards typically deliver output levels of 0.2 V for low states and 2.8 V for high states into high impedance.

Designed for versatility, the cards come with 1 GB of onboard memory and a variety of different acquisition and replay modes. When generating patterns, the cards can operate in Single-shot, Multiple Replay (Burst), Gated Replay, Sequence and FIFO modes, making it possible to generate almost any signal pattern. It's even possible to load new data to the onboard memory while replaying previously stored signals. The ability of the cards to use FIFO streaming, with a top transfer speed over the PCIe bus of 700 MBps, enables users to generate constantly changing digital patterns for long periods of time.

When acquiring digital signals, the cards support Single-shot, Multiple Recording, Gated Sampling and FIFO modes. Combining the different modes with the onboard memory makes it easy to capture and monitor long and complex digital signal patterns. To ensure timing precision, the cards feature a flexible internal clock design with an onboard reference that's said to be accurate to better than 1 ppm. If required, they also support the use of a direct external clock or an external clock reference.

The product is fully programmable and comes with drivers for Windows and Linux operating systems, as well as programming examples for C++, LabVIEW, MATLAB, Visual Basic.NET, Python and other programming languages. If a turnkey solution is required, Spectrum offers its own control software that allows signal generation, acquisition, display, processing, storage and reporting.

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**IOLITEs**  
IOLITE DAQ system is also available in standalone rugged aluminium chassis compatible with SIRIUS data acquisition instruments. The IOLITEs chassis provides 8 slots for IOLITE input and output slices to be installed.



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## INTERNAL CELLULAR ANTENNAS

The Revie Flex series of internal cellular antennas, from Laird Connectivity, are flexible, peel-and-stick, frequency-optimised antennas for cellular networks and Narrowband Internet of Things (NB-IoT) applications. The series gives design engineers the flexibility to customise the cellular spectrum for their passive component needs.

The Revie Flex 600 is a powerful, full-spectrum antenna that supports the 600–6000 MHz frequency range as well as global 5G and legacy cellular networks. Measuring 130 x 30 mm, the antennas are optimised for use when mounted via the supplied adhesive backing. The high-efficiency antennas are said to ensure easy manufacturer certification and ongoing connections for high data throughput in a variety of integration environments.

The Revie Flex 700 is an ultracompact, 96 mm antenna for 5G devices, supporting frequencies between 698 and 6000 MHz. The efficient, adhesive and flexible PCB antenna can be embedded and mounted to any plastic housing and features omnidirectional pattern coverage optimised for 5G, NB-IoT and LTE-M/CAT-M devices.

The base Revie Flex covers 698–875 MHz and 1710–2500 MHz and is built specifically to support LTE-M, Cat M1 and NB-IoT.

The cellular antennas are ground plane-independent, customisable, frequency-optimised solutions for wireless data transfer across global cellular network providers.

**Mouser Electronics**  
[au.mouser.com](http://au.mouser.com)

## MODULAR POWER SUPPLIES

Rapid advances in the electronics industry require a comprehensive power supply and flexible portfolio to support user needs. MEAN WELL offers modular power supplies to support the need for low-volume and custom-power requirements in medical and industrial markets.

The company's NMP650 and NMP1K2 series of modular power supplies allow users to set and modify output voltage, current, wattage, power, temperature and more according to their demands. The series are equipped with intelligent control functions, such as remote power on and off, overtemperature warning and a DC OK signal that provides for remote control and monitoring applications. The fan speed is automatically adjusted through its internal temperature detection function for thermal performance.

Suitable applications include medical equipment such as MRI, CT and PET scanners, test or measurement systems, and laser equipment.

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



## NO-TOUCH INFRARED SENSOR SWITCH

The ACS-20B-MRTU No-

touch Infrared Sensor Switch, from ICP DAS, can be used to open a door using palm induction, which makes it more convenient when entering or exiting a room or building. The inductive distance and the delay time for door opening are adjustable and have red and blue indicator lights to show the status of the switch. As people enter and exit the door using the switch, a time stamp recording the action can be simultaneously logged.

The switch includes an RS-485 interface and provides Modbus RTU communication, which can remotely enable/disable the switch and get the induction time records by the access control system. It is not only used for the access control system but also helps control other electronic devices. While it is triggered in toggle mode the first time, the switch outputs ON signal, and next time outputs OFF signal.

The switch can be used with electric doors to prevent issues related to the spread of infectious bacteria via touch. It can be used in medical institutions, retail stores, the food industry, industrial plants and offices to provide a more sanitary environment.

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



## LIGHTNING AND SURGE PROTECTION DEVICES

The protection of sensitive electronic equipment against the harmful effects of lightning and surges is becoming more important as system complexities increase. Each critical area, from the incoming AC

mains and distribution boards to final circuits and individual devices, can be protected using Weidmüller's VARITECTOR range of surge protection devices.

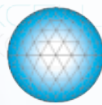
The VARITECTOR PU AC family of mains surge protection devices provides Class II surge protection. It has an  $I_{max}$  of 50 kA (8/20  $\mu$ S) and complies with IEC/EN 61643-11 as well as AS/NZS 1768: 2011. Available in 1 ph, 1 ph+N, 3 ph and 3 ph+N formats, all MEN-connected domestic, commercial and industrial Class II installations can be protected.

To ensure sensitive equipment is protected over time, the VARITECTOR PU AC green flag indicator changes to red as the device nears its end-of-life signalling. Remote signalling is an option advising a replacement cartridge is required. For further protection, versions are available with an additional yellow warning flag to indicate the partial end of life. This can be advantageous in areas of critical infrastructure where the need to always maintain protection is necessary.

The replaceable plug-in cartridges are securely held in place with a positive locking lever. A high level of protection is afforded by a typical Up of 1500 V.

**Weidmuller Pty Ltd**  
[www.weidmuller.com.au](http://www.weidmuller.com.au)

## TRENDING



**APEM**  
an IDEC company

## PRODUCTS

### RT HANDLE FOR XD SERIES JOYSTICK

**>> JUST IN**



The new addition to APEM's product range, the multi-function RT handle is exclusively designed for the APEM XD series Joystick and for vehicle applications requiring right hand operation. The RT handle features both front and rear facing configuration plates that allows the user to easily reach for all forward facing functions with just their thumb. This ergonomic control grip offers a wide selection of push buttons and hall-effect thumbwheel combinations to be incorporated into the one handle. The handle provides up to four axis of proportional control and 10 momentary switching functions. Provides IP67 above panel sealing. Ideal for Off-highway vehicles and Industrial machinery.

### WP AND WPG SERIES PUSH BUTTON AND SWITCH COVER

APEM has designed a high-performance switch for interface solutions that must be easily identifiable. The WP series push button increases visibility of your critical functions with its extra-large activation surface. The WP series also has a special metal security cover to prevent unwanted activation especially when the button is installed outdoors. Developed for Military or Outdoor applications and is able to endure extreme conditions. Available in 8 colours.



### FNR SERIES ROCKER SWITCH



The FNR series is specially designed for easy forward and reverse control with an excellent tactile feel. This rocker switch is extremely well sealed making it suitable for demanding environments, especially on an all-in-one joystick control. Comes with a 20 mm diameter, embedded LED resistors and can be easily mounted and installed on a control lever. FNR rocker switch operates with ease, comfortability and precision, even with high repetition use. Backlighting options also available in 5 colours.

### Q25 AND Q30 SERIES LED INDICATORS

APEM has released the new Q25 and Q30 series to their range of LED indicators. Both are constructed using a PCB with 6 SMT LED chips and has triple redundancy for failsafe circuits. A moulded Fresnel lens scatters the LED light to give that all-round illumination. Features include 12 to 24V AC/DC, IP67 and IP69K above panel sealing and stainless steel 316L chamfered bezel. Suitable for Food & Beverage, Off-highway vehicles, Oil & Gas and Security applications.



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# SMART SOLAR HARVESTER

INSPIRED BY A MAGNIFYING GLASS



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Researchers from Nanyang Technological University, Singapore (NTU Singapore) have designed a 'smart' device to harvest daylight and relay it to underground spaces, reducing the need to draw on traditional energy sources for lighting. Their innovation has been reported in the journal *Solar Energy*.



In Singapore, authorities are looking at the feasibility of digging deeper underground to create new space for infrastructure, storage and utilities. Demand for round-the-clock underground lighting is therefore expected to rise in the future.

To develop a daylight harvesting device that can sustainably meet this need, the NTU team drew inspiration from the magnifying glass, which can be used to focus sunlight into one point. They used an off-the-shelf acrylic ball, a single plastic optical fibre — a type of cable that carries a beam of light from one end to another — and computer chip-assisted motors.

## Automatic positioning to harvest maximum sunlight

The device sits above ground and, just like the lens of a magnifying glass, the acrylic ball acts as the solar concentrator, enabling parallel rays of sunlight to form a sharp focus at its opposite side. The focused sunlight is then collected into one end of a

fibre cable and transported along it to the end that is deployed underground. Light is then emitted via the end of the fibre cable directly. At the same time, small motors — assisted by computer chips — automatically adjust the position of the fibre's collecting end, to optimise the amount of sunlight that can be received and transported as the sun moves across the sky.

To guarantee the device's automatic positioning capability, pairs of sensors that measure light brightness are also placed around the sunlight collecting end of the fibre cable. Whenever the sensors detect inconsistencies in the light measurements, the small motors automatically activate to adjust the cable's position until the values on the sensors are the same. This indicates that the fibre is catching the maximum amount of sunlight possible.

During rain or overcast skies when there is inadequate sunlight to be collected and transported underground, an LED bulb powered by electricity, installed right next to the emitting end of the fibre

cable, will automatically light up. This ensures that the device can illuminate underground spaces throughout the day without interruption.

The device overcomes several limitations of current solar harvesting technology. In conventional solar concentrators, large, curved mirrors are moved by heavy-duty motors to align the mirror dish to the sun. The components in those systems are also exposed to environmental factors like moisture, increasing maintenance requirements. The NTU device, however, is designed to use the round shape of the acrylic ball, ridding the system of heavy-duty motors to align with the sun, and making it compact.

The researchers' prototype weighs 10 kg and has a total height of 50 cm. To protect the acrylic ball from environmental conditions (ultraviolet light, dust, etc), the researchers also built a 3 mm-thick, transparent dome-shaped cover using polycarbonate.

"Our innovation comprises commercially available off-the-shelf materials, making it potentially very easy to fabricate at scale," said Assistant Professor Yoo Seongwoo, lead author of the study. "Due to space constraints in densely populated cities, we have intentionally designed the daylight harvesting system to be lightweight and compact. This would make it convenient for our device to be incorporated into existing infrastructure in the urban environment."

The NTU team believes the device is suited to mounting as a conventional lamp post above ground. This would enable the innovation to be used in two ways: a device to harvest sunlight in the

day to light up underground spaces and a streetlamp to illuminate above ground at night using electricity.

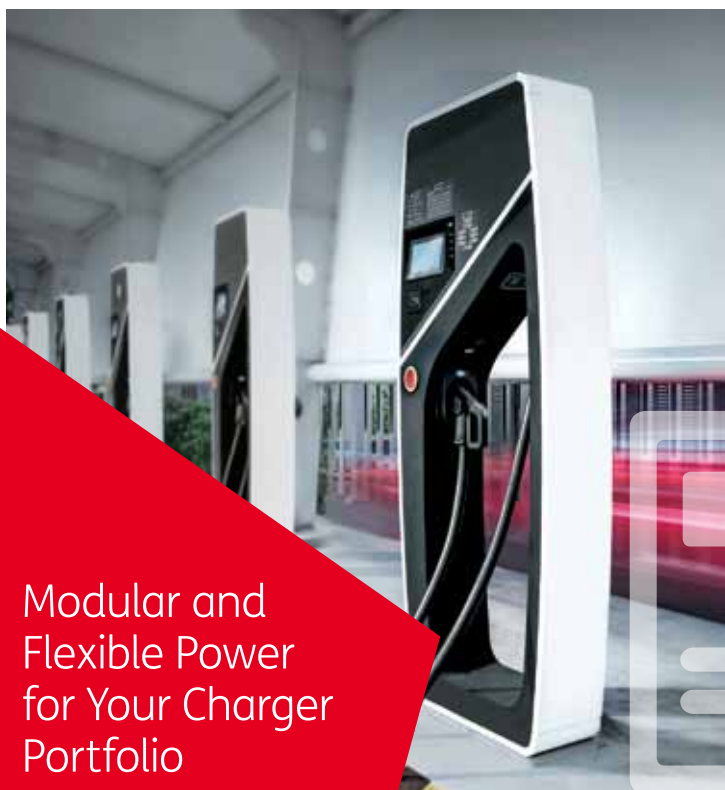
### Performs better than LED bulbs

In experiments in a pitch-black storeroom (to simulate an underground environment), the NTU researchers found the device's luminous efficacy — the measure of how well a light source produces visible light using 1 W of electrical power — to be at 230 lm/W. This far exceeds those recorded by commercially available LED bulbs, which have a typical output of 90 lm/W. The quality of the light output of the smart device is also comparable with current commercially available daylight harvesting systems, which are far more costly.

"The luminous efficacy of our low-cost device proves that it is well suited for low-level lighting applications, like car parks, lifts and underground walkways in dense cities," said Dr Charu Goel, first author of the study. "It is also easily scalable. Since the light-capturing capacity of the ball lens is proportional to its size, we can customise the device to a desired output optical power by replacing it with a bigger or smaller ball."

Serving as industry collaborator on the study is Technolite, a Singapore-based design focused agency specialising in lighting. Moving forward, the lighting company is exploring ways to potentially incorporate the smart device or its related concepts into its industrial projects for improved efficiency and sustainability.

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## SURFACE MOUNT FUSE

SCHURTER's UMT-H surface mount ceramic fuse family now includes 40 and 50 A current ratings with a breaking capacity rating of 500 A at 125 VAC/72 VDC. The series provides robust overcurrent and short circuit protection performance in a package size of 5.3 x 16 mm.

The series was originally developed to provide a smaller alternative to through-hole mounted 5 x 20 mm cartridge fuses often used for primary circuit protection. The range has since grown to include 26 rated currents from 160 mA to 50 A. Rated voltage is maximum 277 VAC/250 VDC, with an interrupt capacity rating of 1500 A for current ratings up to 6.3 A. The Time-Lag T characteristic withstands high inrush and pulse currents.

The series has evolved to include higher current ratings to meet more markets for secondary protection in battery-powered applications. Areas of application are widespread, from motors to emerging applications such as those reliant on energy accumulators and everything in between. The fuse is useful for many applications in energy, data, medical, industrial control and automotive to name a few. It is also impermeable to conformal coatings, and thus a suitable candidate for use in ATEX and IECEx rated devices for hazardous environments.

A variety of breaking capacity measurements are performed on the product at specific solder trace widths. The admissible ambient temperature range is -55 to +125°C. Large solder pads are added for optimal heat dissipation.

The fuse is designed according to IEC 60127-7 and UL 248-14 and carries VDE and cURus approvals. IEC, MIL-STD 202 and AEC-Q200 tests apply.

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## 150 AND 300 W DC/DC CONVERTERS

The WAF series is a compact and ruggedised range of DC/DC converters from Helios Power Solutions, available in 150 and 300 W output power for harsh industrial environments.

The series features ultrawide input range voltages: the WAF150 offers 9 to 36 V, 18 to 75 V and 43 V to 160 VDC; and the WAF300 offers either 18 to 75 V or 43 to 160 VDC. Both 150 and 300 W versions are available in five single outputs of 12, 15, 24, 28 or 48 VDC.

Features include an operating temperature range of -40 to +100°C ambient; remote ON/OFF; OCP, OVP and OTP protection; and adjustable output voltage.

The WAF series convection/conduction-cooled package construction makes it suitable for extreme environmental and electrically demanding applications. The fully enclosed and encapsulated converters comply with the stringent requirements for Railway EN50155 standard, vibration MIL-STD-810F and UL 62368-1 approval.

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

## RUGGED CONNECTORS

Fischer Connectors has extended its flagship series of ultrarugged and harsh-environment connectors with the release of the Fischer UltiMate 80, a field-ready connector offering high levels of functionality and ruggedness; and the standard Fischer UltiMate connector, now available in size 15 with various pin layouts of up to 27 signal and power contacts.

The rugged, compact and lightweight Fischer UltiMate series connectors are used to ruggedise technology for field operations in extreme environments. The connectors' resin-sealed contact block offers robust sealing (up to IP68/IP69 even unmated, gastight, CBRN decontamination), high shock and vibration resistance, as well as high cable resistance in terms of traction. Environmentally sealed to resist extreme shocks and vibrations, the durable connectors are suitable for interconnect devices, equipment, hubs and embedded electronic systems where weight matters, for example in defence and security, industrial, instrumentation, marine and underwater, as well as robotics and unmanned vehicles.

Intermateable with other NATO STANAG 4695 connectors, the field-ready Fischer UltiMate 80 connector comes in two layouts featuring six or seven signal and power contacts (size 08) with up to AWG 22. It offers an ultrarugged, lightweight and IP68-sealed connectivity solution for any harsh environment, especially for defence and security applications and soldier modernisation programs. Its design is compliant with MIL-STD-810 and MIL-STD-202. The connector comes as a pre-cabled plug, and a pre-cabled and/or panel receptacle.

The Fischer UltiMate connector in size 15 meets special power and high-speed data requirements for further design and technology developments with various contact layouts (two, four, eight, 4+12 or 27 signal and power contacts).

**Electus Distribution**  
[www.electusdistribution.com.au](http://www.electusdistribution.com.au)





## SERIAL COMMUNICATION MODULE

Acromag's AP513 serial communication module, an AcroPack rugged I/O module based on the PCI Express mini card (mPCIe) standard, provides four individually isolated RS232 serial ports on a compact 30 x 70 mm board. Each port is isolated to 250 V from digital circuitry and 100 V from the other three ports. The isolation protects equipment and signal integrity in electrically noisy environments with potential for high common mode voltages, harmful transient signals and ground loops.

Designed for COTS applications, the mPCIe mezzanine modules deliver a SWaP-optimised solution for military, aerospace and industrial systems, performing functions including data collection, control, testing and simulations. A variety of carrier cards are available to host a mix of up to four AcroPack I/O modules on PCI Express, VPX, CompactPCI-Serial or other small form factor computer platforms.

A number of features are available to help simplify configuration and improve performance. Software configuration helps users quickly set baud rates, character sizes, stop bits and parity. For efficient data processing, each serial port is equipped with 256 B FIFO buffers on the transmit and receive lines; consequently, CPU interaction is minimised. Programmable triggers, extensive handshake support, interrupt controls and a 16550-compatible UART provide additional flexibility.

Carrier cards for rack-mount, field-deployable, industrial chassis, desktop and small mezzanine computing platforms let users combine up to four I/O function modules on one computer board. Software tools support embedded applications running on Linux, Windows or VxWorks operating systems.

**Metromatics Pty Ltd**  
[www.metromatics.com.au](http://www.metromatics.com.au)

## COMe MINI TYPE 10 MODULE

Advantech's SOM-7583 is an innovative COMe mini Type 10 module featuring the latest 11th Gen Intel Core processors with up to four cores Core i7. It supports a wide range power input (8.5 to 20 V) and extended temperature SKU (-40 to 85°C), making it suitable for a multitude of applications in harsh environments.

The device integrates with LPDDR4X 4266 Mt/s IBEC RAM, up to 16 GB and onboard NVMe SSD, which achieves a 10-fold increase in the sequential reading and writing speed compared to eMMC 5.1. It supports multiple I/O and displays and is designed to enable low-latency networking performance in factory automation applications via 2.5 GbE LAN with TSN. This should improve the precision of data synchronisation over the network and minimise jitter to reduce latency during real-time device communication.

The SOM-7583 facilitates AI acceleration with the Intel Deep Learning Boost engine, VNNI, which is designed to improve efficiency and increase inferencing performance. It is useful for applications that require powerful computing in a compact design, such as aerospace, defence, industrial control and transportation.

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

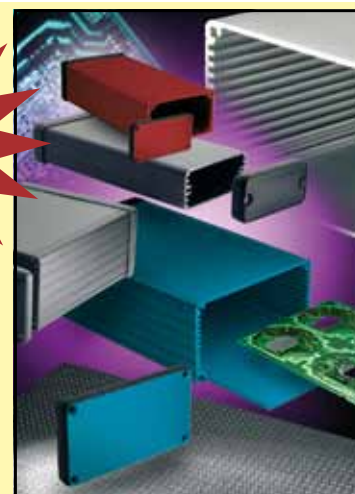


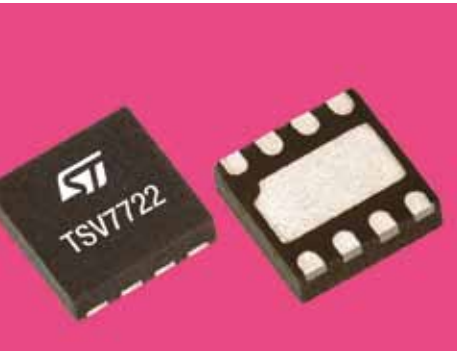
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## OPERATIONAL AMPLIFIER

The STMicroelectronics TSV7722 precision high-bandwidth operational amplifier, with gain-bandwidth of 22 MHz and slew rate of 11 V/ $\mu$ s, is suitable for high-speed signal conditioning and current measurement in power-conversion circuits and optical sensors.

The maximum input-offset voltage of 200  $\mu$ V (typical 50  $\mu$ V at 25°C) and low input-voltage noise density of 7 nV/ $\sqrt{\text{Hz}}$  permit precise low-side current measurements. In addition, the typical input bias current of 2 pA enables photodiode-current measurement in optical-sensing applications such as smoke detectors. Unity-gain stable, and fully specified on a load of 47 pF, the device can be used as an input buffer for analog-to-digital converters (ADCs).

With an operating-voltage range of 1.8–5.5 V, the product can be powered from the same supply as low-voltage CMOS components, such as a microcontroller, or from a deeply discharged battery. Moreover, its precision parameters and stability over temperature are said to simplify circuit design as there is no need for precision resistors or trimming after assembly.

By providing responsive current measurements for power-conversion systems, the product can enhance energy efficiency in applications such as automotive smart mobility, solar panels, telecom infrastructure and computer servers.

**STMicroelectronics Pty Ltd**  
[www.st.com](http://www.st.com)

## SMART GRID GATEWAYS

HMS Networks has expanded its Ixxat SG-gateway series for the networking of energy components. Two multi-I/O versions allow traditional I/O-sensors as well as sensors or devices in Wi-Fi networks to be connected to energy systems using IEC 61850 and IEC 60870. Users benefit from direct and seamless access to sensor data from the control room, as well as IIoT capabilities for monitoring, maintenance and forecasting purposes.



The gateways enable device manufacturers, system integrators, energy suppliers and network operators to get instant status information into the control room through direct access to plant data from various sources. This enables efficient system operation and fast reactions to network disturbances, as well as remote monitoring and maintenance of devices and systems. The compact gateways are especially suitable for retrofitting plants and digitalisation of substations, and are used in many areas of energy automation, eg, in power plants and at large energy consumers.

Due to a wide range of supported interfaces and protocols, the products remove the need for installing several separate gateways, such as fieldbus gateways, sensor gateways, IoT gateways and firewalls. Adding to the existing support for IEC 61850, IEC 60870, EtherNet/IP, Profinet, MQTT and 4G, the two latest gateways feature multi-I/O and Wi-Fi capabilities (WLAN according to IEEE 802.11 a/b/g/n). With this, traditional as well as wireless sensors can be easily connected to control rooms and cloud systems. Besides RS232/485 and Ethernet, eight digital I/Os (24 VDC) and eight analog inputs (0–20 mA or 0–10 V) are available for direct sensor connection, all switchable via software.

Example applications are temperature monitoring of high-voltage lines via Wi-Fi using Modbus TCP, pressure and density measurement of cooling liquids using Modbus RTU, and room temperature or humidity measurement in buildings using analog or digital I/O.

**Global M2M**  
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## ELECTRON BEAM METAL AM MACHINE

Using technology from a high-performance electron microscope and an electron beam lithography system for semiconductor manufacturing, JEOL has developed the JAM-5200EBM electron beam metal AM machine with high power, high density and high speed. It is suitable for use in the fields that require a high level of quality, such as aerospace, industrial power and medical.

Featuring a long cathode life of over 1500 h, the product is designed to reduce downtime for cathode replacement and improve productivity. There is also no need for helium gas to prevent scattering of powder, as the company's e-Shield powder dispersal prevention system avoids the scattering phenomenon.

The helium-free environment means parts be manufactured in a clean space and the surface of the cathode should be less susceptible to damage, allowing the electron beam to remain stable. As a result, the manufacturing quality can be maintained until the end of the cathode's lifetime.

The company has developed technology that allows for automatic adjustment of the focus and distortion of the electron beam; thus, both high quality and high reproducibility in manufacturing can be achieved. Users can check the status of manufacturing and system by via a remote monitoring system 24 hours a day, 365 days a year.

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[www.jeol.co.jp/au/](http://www.jeol.co.jp/au/)



## CUSTOM CABINET COOLERS FOR ELECTRICAL ENCLOSURES

EXAIR's Cabinet Cooler systems can be used to purge and cool electrical control panels. They convert an ordinary supply of compressed air to cold,  $-7^{\circ}\text{C}$  air, without refrigerants. The cold air is circulated through the enclosure to eliminate heat damage and control shutdown. For dirty and dusty environments, a Non-Hazardous Purge option will create a positive pressure inside the cabinet to keep dirt and debris from entering the user's control panel.

The systems can be customised to provide cooling within electrical enclosures in NEMA 12, NEMA 4, NEMA 4X and hazardous location environments. These customisations include specific Btu/h values from 275–5600 Btu/h, adaptations for high-temperature environments

up to  $93^{\circ}\text{C}$  and a selection of materials, including aluminium, Type 303SS and 316SS, to combat corrosive environments. Additional customisations include settings to maintain a specific cabinet temperature, special coatings, high-temperature materials, special cold air distribution kits and more.

The compact cabinet coolers can be installed in minutes through a standard electrical knockout hole. An optional thermostat control minimises compressed air use. There are no moving parts to wear out and no maintenance is required.

Applications include cooling PLCs, microprocessors, variable frequency drives, industrial computers and robotics. All systems are UL Listed and CE compliant.

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## Creating the 'world's most powerful' AI-capable supercomputer

The Swiss National Supercomputing Centre (CSCS), Hewlett Packard Enterprise (HPE) and NVIDIA have announced that they are creating what is expected to be the world's most powerful AI-capable supercomputer.

Planned to come online in 2023, the 'Alps' system infrastructure will replace CSCS's existing Piz Daint supercomputer and serve as a general-purpose system open to the broad community of researchers in Switzerland and the rest of the world. It is expected to enable breakthrough research on a wide range of fields, including climate and weather, materials sciences, astrophysics, computational fluid dynamics, life sciences, molecular dynamics, quantum chemistry and particle physics, as well as domains like economics and social sciences.

Alps will be built by HPE based on the HPE Cray EX supercomputer product line, which is a next-generation high-performance computing (HPC) architecture designed from the ground up to efficiently harness insights from vast, ever-increasing amounts of complex data. It features the HPE Cray software stack for a software-defined supercomputing experience as well as the NVIDIA HGX supercomputing platform, including NVIDIA GPUs, the NVIDIA HPC SDK and the recently announced Arm-based NVIDIA Grace CPU.

Taking advantage of the tight coupling between NVIDIA CPUs and GPUs, Alps will be able to train GPT-3, one of the world's largest natural language processing models, in only two days — seven times

faster than NVIDIA's 2.8-AI exaflops Selene supercomputer, currently recognised as the world's leading supercomputer for AI by MLPerf.

CSCS users will be able to apply this AI performance to a wide range of emerging scientific research that can benefit from natural language understanding. This includes, for example, analysing and understanding massive amounts of knowledge available in scientific papers and generating new molecules for drug discovery.

"We are not simply procuring a new computer," said Thomas Schulthess, a computational physicist at ETH Zurich and Director of CSCS. "For enabling scientific

breakthroughs, we are retrofitting our computer centre in several expansion phases to a service-oriented research infrastructure.

"Alps will use the HPE Cray EX supercomputing infrastructure based on a cloud-native software architecture to implement a software-defined research infrastructure, as well as NVIDIA's novel Grace CPU, to converge AI technologies and classic supercomputing in one single, powerful data centre infrastructure."

"HPE has had a longstanding collaboration with the Swiss National Supercomputing Centre (CSCS) in advancing high-performance computing (HPC) technologies to accelerate a range of scientific research," said HPE President Antonio Neri. "We are honoured to continue this journey by designing a powerful new system that furthers CSCS's mission. Armed with this incredible tool, CSCS is equipped to harness new insights from its data that drive breakthroughs in advancing our world."

"Today's monumental scientific challenges demand a new kind of supercomputer to fuel discovery," concluded Jensen Huang, founder and CEO of NVIDIA. "Taking advantage of our new Grace CPU designed for giant-scale AI and HPC, CSCS and NVIDIA are joining together to blaze a new trail — building a world-class, Arm-based supercomputing infrastructure that will let leading scientists apply the power of AI to do world-changing research."



Artist's rendering of Alps, a powerful AI-capable supercomputer.



## DUAL THERMAL CAMERA DRONE PAYLOAD

The FLIR Vue TZ20 is a high-resolution, dual thermal sensor gimbal purpose-built for the DJI Matrice 200 Series and Matrice 300 airframes. Featuring both a narrow-field-of-view and a wide-field-of-view 640 x 512 resolution FLIR Boson thermal camera module, the product offers situational awareness with a 20x digital thermal zoom capability, to help public safety drone pilots from police, fire, and search and rescue teams, as well as industrial and critical infrastructure inspectors, complete missions both near and far.

IP44 rated to provide operability in poor weather conditions and weighing 640 g in total, the device includes a wide-angle Boson with a 95° field of view and a narrow-angle Boson with a 19° field of view. FLIR developed the product with the DJI Payload Software Development Kit (PSDK) and DJI Skyport 2.0 platform, offering simplified, plug-and-play operation through the DJI Pilot Software. Payload functions include thermal video streaming, video recording and still-image capture with 20x zoom, enabling operators to conduct missions at safe distances while capturing the thermal data and detail required.

**FLIR Systems Australia Pty Ltd**  
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## PROGRAMMABLE POWER MANAGEMENT ICs

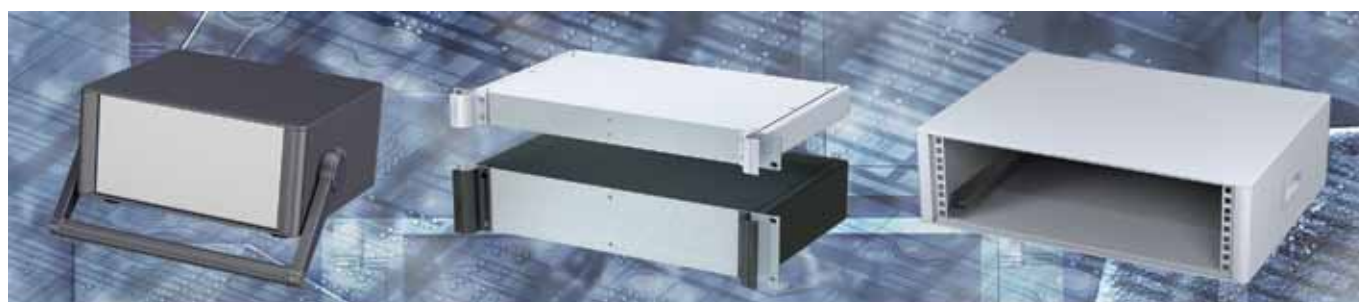
Qorvo has released the ACT88329 and ACT88321 multi-time programmable constant-on-time (COT) power management ICs (PMICs). Both PMICs, from the ActiveCiPS line of products, are optimised for high performance and compact form-factor designs.

The PMICs are said to accelerate time to market by delivering design flexibility for multiple applications, from SSD cards, computer vision (such as security cameras) and routers to home control, voice-assisted devices and low-power mobile uses such as LPDDR5. The same base part can be used to support different end products simply by changing the PMIC configuration without special software or firmware. Manufacturers can debug their design and change settings in real time without changing external components.

The PMICs integrate five voltage rails, a sequencer and seven configurable general-purpose IOs (GPIOs) in a small 2.18 x 2.58 mm 30-ball WLCSP package. The GPIOs support two-level input voltage monitoring and can be configured for different features and purposes like interrupt, reset, external enable and sleep/deep sleep modes. The ACOT control mode provides high performance at low output voltage.

Each PMIC includes three DC/DC step down converters using integrated power FETs and two low-dropout regulators (LDOs). All are highly configurable via the I<sup>2</sup>C interface. They support output voltage as low as 0.5 V for low-output applications like LPDDR5.

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# OPTICAL FIBRE COULD BOOST SUPERCONDUCTING QUANTUM COMPUTERS

The secret to building superconducting quantum computers with massive processing power may be an ordinary telecommunications technology, as physicists at the US National Institute of Standards and Technology (NIST) have measured and controlled a superconducting quantum bit (qubit) using light-conducting optical fibre instead of metal electrical wires.

**D**escribed in the journal *Nature*, the new method paves the way to packing a million qubits into a quantum computer rather than just a few thousand.

Superconducting circuits are a leading technology for making quantum computers because they are reliable and easily mass produced. But these circuits must operate at cryogenic temperatures, and schemes for wiring them to room-temperature electronics are complex and prone to overheating the qubits. A universal quantum computer, capable of solving any type of problem, is expected to need about 1 million qubits. Conventional cryostats — supercold dilution refrigerators — with metal wiring can only support thousands at the most.

Optical fibre, the backbone of telecommunications networks, has a glass or plastic core that can carry a high volume of light signals without conducting heat. But superconducting quantum computers use microwave pulses to store and process information, so the light needs to be converted precisely to microwaves.



*NIST physicists measured and controlled a superconducting qubit using light-conducting fibre (indicated by white arrow) instead of metal electrical cables like the 14 shown here inside a cryostat.*

To solve this problem, NIST researchers combined the fibre with a few other standard components that convert, convey and measure light at the level of single particles, or photons, which could then be easily converted into microwaves. The system worked as well as metal wiring and maintained the qubit's fragile quantum states.

"I think this advance will have high impact because it combines two totally different technologies — photonics and superconducting qubits — to solve a very important problem," said NIST physicist John Teufel. "Optical fibre can also carry far more data in a much smaller volume than conventional cable."



**BY APPLYING A CERTAIN MICROWAVE FREQUENCY, RESEARCHERS CAN DRIVE THE QUBIT BETWEEN LOW-ENERGY AND EXCITED STATES**

Normally, researchers generate microwave pulses at room temperature and then deliver them through coaxial metal cables to cryogenically maintained superconducting qubits. The new NIST set-up used an optical fibre instead of metal to guide light signals to cryogenic photodetectors that converted signals back to microwaves and delivered them to the qubit. For experimental comparison purposes, microwaves could be routed to the qubit through either the photonic link or a regular coaxial line.

The 'transmon' qubit used in the fibre experiment was a device known as a Josephson junction embedded in a three-dimensional reservoir or cavity. This junction consists of two superconducting metals separated by an insulator. Under certain conditions an electrical current can cross the junction and may oscillate back and forth. By applying a certain microwave frequency, researchers can drive the qubit between low-energy and excited states (1 or 0 in digital computing). These states are based on the number of Cooper pairs — bound pairs of electrons with opposite properties — that have 'tunnelled' across the junction.

The NIST team conducted two types of experiments, using the photonic link to generate microwave pulses that either measured or controlled the quantum state of the qubit. The method is based on two relationships: the frequency at which

microwaves naturally bounce back and forth in the cavity, called the resonance frequency, depends on the qubit state, and the frequency at which the qubit switches states depends on the number of photons in the cavity.

The researchers generally started the experiments with a microwave generator. To control the qubit's quantum state, devices called electro-optic modulators converted microwaves to higher optical frequencies. These light signals streamed through optical fibre from room temperature to 4 kelvins (-269°C) down to 20 millikelvins (-273°C), where they landed in high-speed semiconductor photodetectors, which converted the light signals back to microwaves that were then sent to the quantum circuit.

In these experiments, researchers sent signals to the qubit at its natural resonance frequency, to put it into the desired quantum state. The qubit oscillated between its ground and excited states when there was adequate laser power. To measure the qubit's state, researchers used an infrared laser to launch light at a specific power level through the modulators, fibre and photodetectors to measure the cavity's resonance frequency.

Researchers first started the qubit oscillating, with the laser power suppressed, and then used the photonic link to send a weak microwave pulse to the cavity. The cavity frequency accurately indicated the qubit's state 98% of the time — the same accuracy as obtained using the regular coaxial line.

The researchers envision a quantum processor in which light in optical fibres transmits signals to and from the qubits, with each fibre having the capacity to carry thousands of signals to and from the qubit.



## LDO REGULATORS

Toshiba Electronic Devices & Storage has launched the TCR5RG series of 45 LDO regulators, all housed in thin and compact WCSP4F packages that measure 0.645 x 0.645 mm. The LDO regulators' high ripple rejection ratio of 100 dB (typ) brings power stabilisation to DC power lines for mobile devices, such as wearables.

The regulators' high ripple rejection ratio has been achieved by combining a wide-gap circuit, a low-pass filter that allows only extremely low frequencies to pass, and a low-noise, high-speed operational amplifier. They also feature low output voltage noise and high output voltage accuracy. Together, these features enable the regulators to contribute to the stabilisation of power lines.

The line-up includes 45 products with a maximum output current of 500 mA and output voltages in the range of 0.9 to 5 V, allowing users to select the output voltage best suited to their application. The LDO regulators are suitable for power line applications in cameras and small devices such as smartphones and wearables requiring high-density mounting.

**Toshiba (Australia) Pty Ltd**  
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## RIBBON CABLES

Würth Elektronik is expanding its range of cables, offering flexible flat ribbon cables in various designs under the product name WR-FFC (Flat Flexible Cable). To allow even more flexibility in use, the company now offers pre-folded ribbon cables. Accordion-style folding means the cables should take up less space — this allows flexible use of the cables for different distances, thus simplifying storage in development and production.

WR-FFC Folded is available in 0.5 and 1 mm pitches, each in three variable lengths: 120 to 200, 165 to 350 and 280 to 500 mm. The user can choose between FFC Type 1 with the contacts on the same side and FFC Type 2 with the contacts on the opposite sides. There are 20- to 50-pin versions available in 0.5 mm pitch and 10- to 30-pin versions in 1 mm pitch.

**Würth Electronics Australia Pty**  
www.we-online.com





## PREFABRICATED INTERFACES

HARTING's Han S connectors enable users to build energy storage systems on the basis of battery modules, and have been specifically designed for front-mounting energy storage systems. In order to shorten installation times and reduce the amount of wiring required onsite, the company is offering the interfaces in combination with fully prefabricated cable assemblies tailored to the respective application.

The assemblies are the Han S 200 CA-c-b/r 25<sup>2</sup>, CA-c-b/r 35<sup>2</sup> and CA-c-b/r 50 mm<sup>2</sup>, and are available with cable lengths of 20, 30, 40 and 50 cm. They are suitable for temperatures ranging between -50 and +120°C. The fabrication material is halogen free as well as ozone resistant. The voltage limits are 1.8 kV (25 mm<sup>2</sup>)–3 kV (50 mm<sup>2</sup>) AC and 2.7 (25 mm<sup>2</sup>)–4.5 kV (50 mm<sup>2</sup>) DC. The assemblies meet various standards, including EN 45545-2 and NF F 16-101. The connector's design meets all technical requirements, including the UL 4128 standard for stationary energy storage systems.

The single-pin connector is suitable for front-mounting drawers on energy storage devices and can transmit rated currents of up to 200 A at 1500 V. It offers safe installation, with finger-protected contacts with various types of connection (M8 bolts or busbars), and permits users to visually check the locking status. In addition, the product is vibration-proof and comes in two different colours: red and black. It features a mechanical coding system that makes it impossible to incorrectly connect the polarity, making the connector suitable for connecting large numbers of battery modules.

**HARTING Pty Ltd**

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

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## ELECTRICALLY CONDUCTIVE ADHESIVE FILMS

Creative Materials introduces its series of isotropic and anisotropic B-stage electrically conductive adhesive films. Both series are available in sheets and as custom preforms to user-specified geometries.

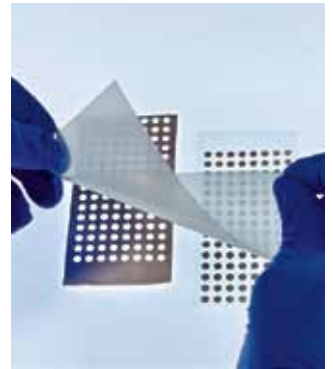
125-22-F is an isotropically conductive series of films available in standard thicknesses of 1–5 mm; other thicknesses can be requested. 126-37-F is an anisotropically conductive series of films and is recommended for use at 1 or 2 mm thicknesses. Another version of 126-37-F accommodates atypical bond-line thicknesses and contact pitches. All of these films and preforms are supplied on an easy-to-remove release liner.

The products offer good thermal stability and high temperature properties to 162°C, electrical conductivity, chemical resistance when fully cured, adhesion to a wide variety of high-energy surfaces, minimal flow during bonding and curing, and low CTE. Cure temperatures as low as 100°C can be used.

Both products are typically used in conductive splicing of ribbon cables, PTF circuits, electrical attachment of surface-mounted devices and assembly of electrical and electronic components. The anisotropic product is used when shorts between closely spaced contacts is a concern.

**Creative Materials Inc**

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



## 32-BIT AUTOMOTIVE MICROCONTROLLER

Nuvoton Technology has launched the NuMicro NUC131U, a 32-bit microcontroller for automotive applications. The product is qualified by AEC-Q100 Grade 2 and features a built-in Controller Area Network (CAN) 2.0 B interface. Its high performance and high immunity make it suitable for automotive body control, automotive CAN modules, on-vehicle diagnostic systems (OBD), dashboard control and automotive lighting applications.

The series features an Arm Cortex-M0 core running up to 50 MHz, 68 KB Flash, 8 KB SRAM and 4 KB LDROM to support CAN boot loader update operating voltage from 2.5 to 5.5 V. It has an operating temperature from -40 to +105°C. It is equipped with a rich set of peripherals including six sets of UART, two sets of I<sup>2</sup>C, one set of SPI and 24 channels of 100 MHz PWM to drive the stepping motor or HVAC compressor. A 12-bit ADC provides up to 800 kSPS to sense voltage, current or temperature sensors for automotive applications to reduce the number of external peripheral components and the form factor of the end product.

The series is available in LQFP48 (7 x 7 mm) and LQFP64 (7 x 7 mm) packages. Multiple IDEs are supported, including the Keil MDK Nuvoton Edition, IAR EWARM and NuEclipse; the Keil MDK Nuvoton Edition (for NuMicro Cortex-M0 family) and NuEclipse are free to use. Easy-to-use software development tools including PinView and PinConfig are available to speed up the time to market.

**Arrow Electronics Australia Pty Ltd**

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

# INVESTING IN ADHESIVES

## WHY ROI IS MORE THAN JUST THE PAYBACK PERIOD

One of the major considerations when specifying an adhesive is how quickly it will deliver return on investment (ROI) — a metric that is affected by a variety of tangible and intangible factors. Matthew Baseley, Technical Sales Executive at adhesives specialist Intertronics, explains the considerations that determine return on investment (ROI) in an adhesives process.

If you've ever tried to source an adhesive for your application, you probably realised quickly that there is no universally perfect adhesive. Everything from the substrates you're bonding, operating temperature and humidity, to the exposure of the assembly to solvents, weather and mechanical stress, will influence your choice of adhesive.

It is worth understanding that the adhesive choice will only be one component of the full bonding process — which includes surface preparation, adhesive mixing, application and dispensing, curing and QA — and that it is in this entire process that you are investing. It is important to take a holistic view; for example, application and curing equipment costs, and efficiency of method, are factors that will affect an ROI calculation and so allow comparison to other options.

We think of ROI as a measure of how fast we get our money back after making an investment. For a bonding process, an investment in equipment can be justified by improvements in the method, or savings in resources like labour, energy or space. However, there are many hidden, intangible benefits that come with suitable investment — ones that go beyond the headline ROI figure.

### Determining ROI

There is always a compromise to be made in adhesive specification, and that is often between ultimate adhesive functionality and optimal bonding process. The very best bond strength may come from an adhesive with a complicated preparation requirement and an extensive cure time; but that may not be suitable for the proposed production volumes or speed of manufacture. Sometimes this dilemma stems from over-specifying the adhesive requirements, which limits material choice and so can add cost. Factoring in adhesive 'processability' can ultimately deliver a faster ROI, without compromising on quality.

For example, while the upfront cost of UV light-curing equipment may be higher than a process using an adhesive that cures

at room temperature over time, the increased throughput achieved with on-demand curing — seconds, rather than minutes or hours — may well offer a much shorter payback period.

In fact, when a UV light cure systems technology is looked at as an integral part of a full production process — across inventory, dispensing, curing and quality assurance — it can lead to an average of 30% savings in overall process costs.

### Precision offers payback

While not necessary for small batch adhesive assembly operations where manual mixing and application are deemed sufficient, the accuracy and repeatability possible using robotic dispensing or automated adhesive mixing lowers process variability and can be compelling even in moderate volume applications. By reducing human error and increasing precision, you can lower scrappage rates and material waste. The labour cost element is often reduced, as operators are reallocated to more productive work (possibly with upskilling). Adhesive dispensing robots are available for surprisingly modest costs, and factoring all the advantages of automation usually results in a quick ROI.

It's important to note that the collective improvement in all these areas — from throughput and standardisation to quality and yield — has an impact on the business that goes well beyond the tangible measurables. It is ultimately the imperceptible improvement in your brand and reputation that leaves a lasting impact in the mind of your customer.

Thinking about the return on investment for a new bonding application or improvement of an existing one involves a comprehensive consideration of the entire process. A higher initial investment can lead to a faster ROI. In addition, investing in a robust, reliable and repeatable process can have a lasting, intangible impact on your brand.

Intertronics  
[www.intertronics.co.uk/](http://www.intertronics.co.uk/)

# RESEARCHERS 'PAINT' MARIE CURIE IN A SEMICONDUCTOR LAYER

*Perovskite  
portrait of Marie  
Sklodowska Curie.*

Imagine that you could paint a canvas by making the canvas itself change to a different colour instead of brushing paint on it.

That is exactly what Lukas Helmbrecht and his colleagues at Amsterdam research institute AMOLF are doing, thanks to a new technique called ion exchange lithography — which takes on the fundamental challenge of patterning semiconductor materials with different properties in a single film. This patterning is essential for the development of next-generation (opto) electronic functional components such as LEDs or solar cells.

The concept of the technique is to use a reactive 'ink' that can be painted or printed on an equally reactive 'canvas', after which a perovskite semiconductor forms by means of ion exchange. As a proof of principle, the researchers used the technique to airbrush a portrait of Marie Curie in a perovskite semiconductor layer, with the results described in the journal *Advanced Materials*.

Perovskite is a highly promising semiconductor material used to produce items such as LEDs and solar cells. Helmbrecht and colleagues found a way of converting a layer of lead carbonate (the canvas) into a perovskite, simply by 'painting' on it with a solution of methylammonium bromide. The latter undergoes a chemical reaction with the lead carbonate to form a green-emitting perovskite. Using a solution of a different substance as the ink allows you to paint a blue- or red-emitting perovskite next to this, or to airbrush or print a pattern.

A wide range of variations in the composition of the perovskites is possible by choosing different inks, and the patterns can be created very accurately: drops of ink just a few micrometres in size also yield dots just a few micrometres in size. This means the ink does not run.

"The challenge of this research was developing the chemical reaction and the conditions: the quantity of ink, the pressure and the properties of the canvas," said Helmbrecht. "None of these was known, and the process does not work if they are not exactly right."

Helmbrecht said ion exchange lithography is fundamentally different from existing techniques for depositing perovskite layers, noting, "All traditional techniques result in different layers of different perovskites. Our method results in one single layer that consists of different types of perovskite."

In addition, perovskites are usually quite sensitive to the treatments used in traditional methods, such as etching or rinsing, which can damage the perovskite. With ion exchange lithography, such treatments are no longer needed, and cleanrooms or other special conditions are no longer required.

"We have developed a far simpler method for applying a pattern of different perovskite semiconductors next to each other on a chip or LED," Helmbrecht said.

The researchers have already demonstrated the utility of ion exchange lithography by using the technique to produce a working LED, which Helmbrecht said has proven the principle. Different groups within AMOLF will now start using the technique to create other applications.



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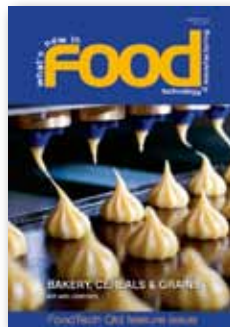
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