November/December 2020 Vol.40 No.3
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# what's new in electronics

## NVIDIA® Jetson AGX Xavier™ Edge AI Platform

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Backplane Systems Technology

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## COVER STORY


Backplane Systems Technology presents Neousys's NRU Series of NVIDIA Jetson AGX Xavier system-on-module (SOM) edge AI platforms, offering 11 TFLOPS FP16 or 22 TOPS INT8 GPU computing power and withstanding operating temperatures from -25 to +70°C. The series offers a solution for emerging edge AI applications by providing a rugged, compact fanless platform consuming only 30 W while offering equivalent GPU performances to a mainstream 120 W GPU. It is therefore suitable for autonomous machines, robotics, predictive maintenance, security and smart city applications.

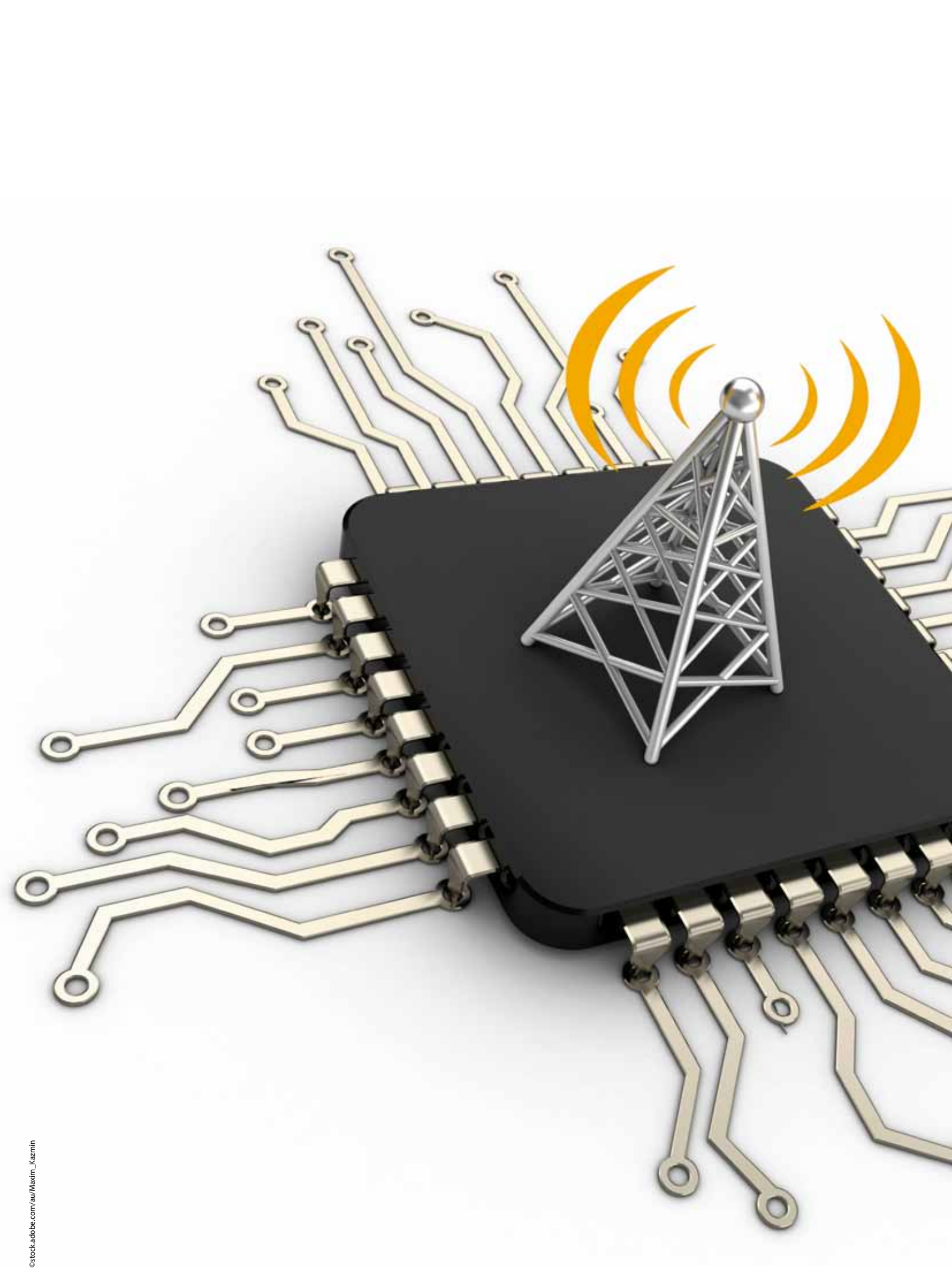
The series features one isolated CAN bus for in-vehicle applications, one RS-232 for GPS PPS input for cross-platform synchronisation, plus isolated digital IOs for connecting sensors and actuators. In addition to the onboard 32 GB eMMC memory on the Xavier module, an NVMe socket is available for fast read/write performance and a mini-PCIe socket for Wi-Fi or 4G connectivity.

The NRU-120S Series integrates four 802.3at Gigabit PoE+ screw-lock ports for IP and industrial cameras, allowing a wide range of NVIDIA AI tools to be utilised and support modern deep learning frameworks. It incorporates two front-accessible, hot-swappable 2.5″ SSD bays for easy replacement and data access.

The NRU-110V Series supports eight GMSL automotive cameras via FAKRA Z connectors ensuring AI applications can obtain high-quality images in a range of lighting conditions, from rainy to sunny days and black nights. With 10 GB Ethernet data transmission and the onboard trigger system, the series can simultaneously capture images from all eight GMSL cameras within millisecond channel-to-channel skew.

The NRU Series offers an 8–35 V wide-range DC input with built-in ignition power control. The efficient power design and compact form factor make it a suitable computing edge AI solution for both stationary and mobile applications.

*Backplane Systems Technology Pty Ltd*
*www.backplane.com.au*



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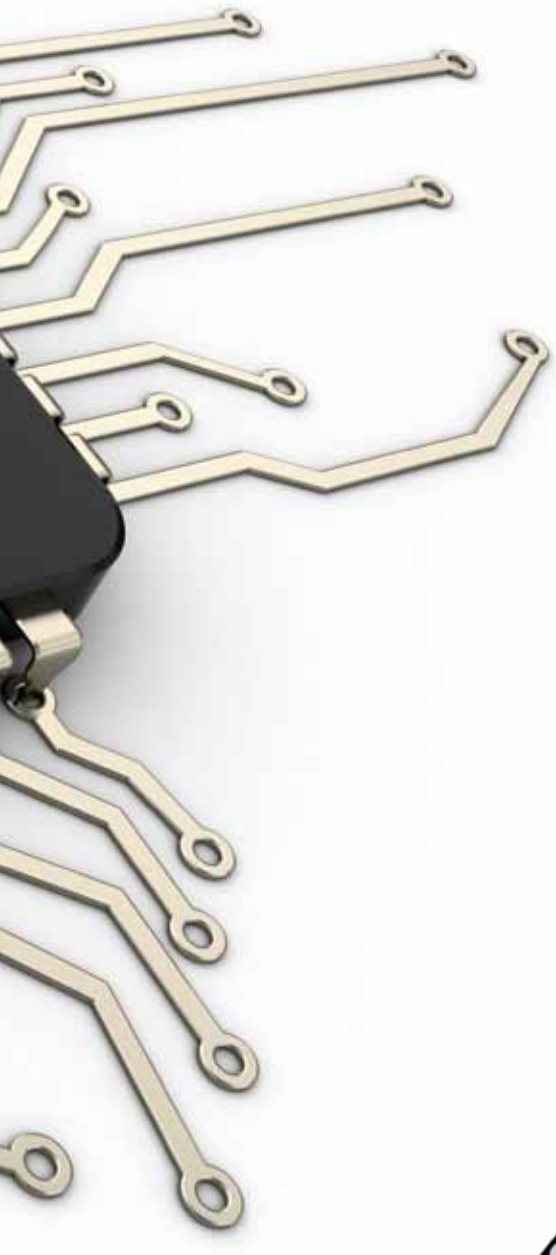
# DESIGNING WIRELESS DEVICES FOR IoT AND REMOTE APPLICATIONS

## SIX FACTORS FOR A SUCCESSFUL WIRELESS DESIGN

*Geoff Schulteis**



COVID-19 has not stopped the evolution of wireless technologies and it has not slowed the trend towards greater numbers of wireless devices.

The use and the breadth of applications for smart wireless continues to grow as new devices appear for smart building control, small trackers, Bluetooth consumer devices and smart applications in industry. Automotive is set to be a large future market for RF and wireless devices, as the next generations of electric and autonomous vehicles need smart safety and control.

There's a trend towards devices becoming smaller as well, which poses an interesting challenge for the designer — how to squeeze all of the components onto a smaller circuit board. Every wireless device needs an antenna, so this article looks at some of the factors that add up to make a successful integration of an antenna into a wireless design.

### Select the right antenna

Choosing the most suitable antenna is crucial in achieving the highest levels of performance. The antenna needs to suit the application and form factor of the design. The smallest antennas will be SMD, or chip, antennas, which are tiny and are directly mounted on a PCB. However, for certain designs, an external, terminal antenna may perform better. Alternatively, a flexible printed circuit (FPC) can be a good solution if space is tight on the PCB. Selecting the right antenna will allow it to excel in performance within the design. This is the first step to a great wireless design.

Figure 1 shows three forms of antenna — SMD, FPC and the terminal antenna used on the exterior of the device. Note: these are not to scale!

Bear in mind that the performance values for antennas in the manufacturers' datasheets are based on readings taken in the perfect conditions of a test chamber. When the design reaches the real world, the antenna will probably perform slightly different, as the RF signals react to real-life surroundings.

### Optimal location

The antenna's position in relation to its surrounding components makes a great difference, so the next step is to consider the position of the antenna on the PCB and how it relates to the other components close by. Antennas are different to other components in this respect, and simply popping an antenna in, later on in the design, will not generally allow the antenna to achieve its potential performance.

It is normally recommended to place the antenna on the corner of a PCB, or in some cases in a position on one of the long edges. Each individual antenna has its own guidelines for optimal placement, so refer to the manufacturer's datasheet, which will specify the ideal position for the antenna. The antenna should be kept away from metal parts and noisy components such as LCD data lines or charging circuits.


*Figure 1.*

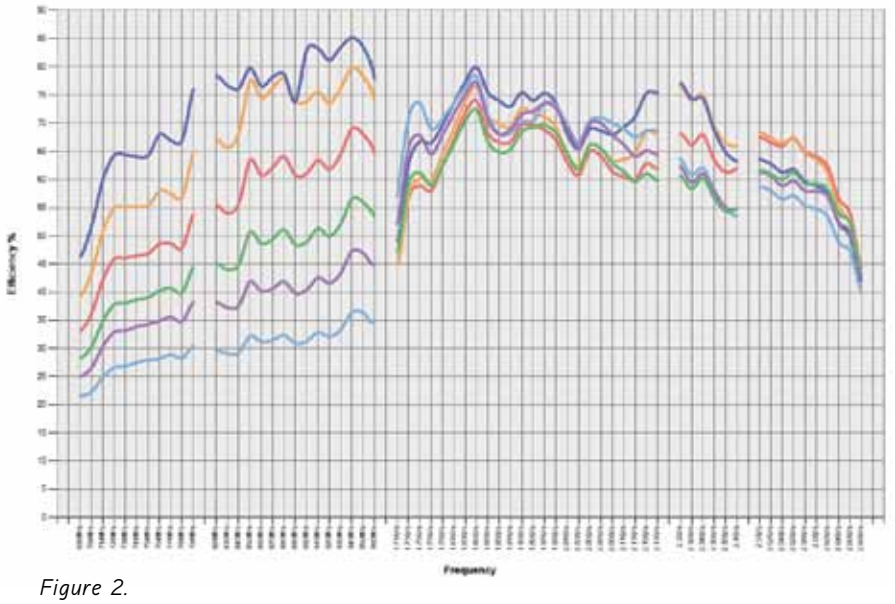


*Figure 2.*

The size of the device may also be a factor, because if the device is very small it will be more difficult to allocate a suitable space for an SMD antenna. The FPC antenna may be a useful alternative if this is the case as it need not be positioned on the PCB; it may be inserted against the outer casing for the design.

## Allow for the ground plane

Most SMD antennas use a ground plane to radiate a signal; that is to say, they use a small area of PCB to bounce their signals against. The length of the required ground plane is directly related to the lowest frequency where the antenna is operating.

With an embedded antenna, resonance occurs at whole number multiples, or fractions of the wavelength, although a half-wave is the shortest optimal resonant length of an antenna. However, you can get around this limitation, since a quarter-wave monopole antenna can radiate against a ground plane, acting as a monopole, which then acts as the missing half of a half-wave dipole. Quarter-wave monopoles are by far the most popular antennas used in portable wireless devices.

A full-wave 916 MHz antenna is ~327 mm long. This is clearly not achievable as an embedded antenna in a small device. A quarter-wave version would now be down to 87.2 mm. Coiled up across multiple layers in a small surface mount chip antenna is how this is achieved. The other radiator, your host PCB ground plane, must be a single length of this size or greater for lower frequencies. It is important that the ground plane should be at least one quarter wavelength of the antenna's lowest frequency, or its efficiency will be seriously compromised.

Figure 2 shows how antenna efficiency is impacted at the lower bands but has very little effect at the higher bands.

It is not recommended to sacrifice space for the ground plane, particularly for devices in the sub-1 GHz frequencies which are the most susceptible to efficiency losses, even with ground plane sizes that are just slightly minimal. Some devices connect to larger devices such as OBD2 dongles or connect to a harness to supply power. This extra connection can take the place of the PCB ground plane but should have several ground wires running through the bundle for optimal antenna performance. Where space of the ground plane is severely limited, it may be worth considering the FPC antenna.

## Battery longevity and antenna performance

For battery-operated devices, power is a critical factor — because the device must not consume too much power. There is a simple rule of thumb in RF: the more data a device is to communicate, the more power it will consume. This means that devices with lower data rates will use far less power.

Where the data transfer is relatively small, for example with the Narrowband IoT LPWAN networks, the antenna will use less power and the batteries could deliver as many as 10 years of operational life.

Remember that the voltage and performance of a battery can affect antenna performance. For example, an unstable current or fluctuations in voltage might lead to distortion, or even a complete loss of signal if the voltage should become too low. Alkaline or lithium single-use batteries are often preferable because of their voltage stability.

If it is important for the device to have a long battery life, take great care with the RF integration. A good board layout will allow the antenna to perform more efficiently by reducing the time needed to transmit and receive data. Transmitting and receiving data consumes power, so a more efficient design, where data can be processed faster, will help to extend the life of the battery.

## Enclosure material

Many of the devices for IoT and remote-controlled applications will be for devices that are going to be installed and left in situ for long periods, maybe years. They can be connected and almost forgotten about. This means that the enclosure should be manufactured from a durable material that will last. Metal enclosures or glass-filled plastics are not antenna friendly and should always be avoided if possible.

## Test, reconfigure and test again

After paying careful attention to the antenna throughout the design process, the next step will be to test the device at the prototyping stage to be sure that the antenna works optimally. With the right testing equipment, it is possible to test devices along the same performance parameters that carriers themselves use during network approval testing. These include parameters such as:

- Total radiated power (TRP) — testing the overall power efficiency of the antenna.
- Total isotropic sensitivity (TIS) — testing the overall receive signal chain from the antenna to the radio.
- Specific absorption rate (SAR) — this will test the absorption of materials nearby the antenna, including casing materials, and human skin if a handheld device.
- Radiated spurious emissions (RSE) — this will test to see if the device is only broadcasting at intended frequencies.

These parameters provide a fairly comprehensive overview of the overall efficiency of the antenna. It is important to test, reconfigure and then test the device again, to be sure of gaining network certification.

**Geoff Schulteis is a Senior Antenna Applications Engineer with Antenova. Geoff has more than 20 years of experience in designing, integrating and testing antennas.*

*Antenova Limited*
*www.antenova.com*

# NEW STM32H7

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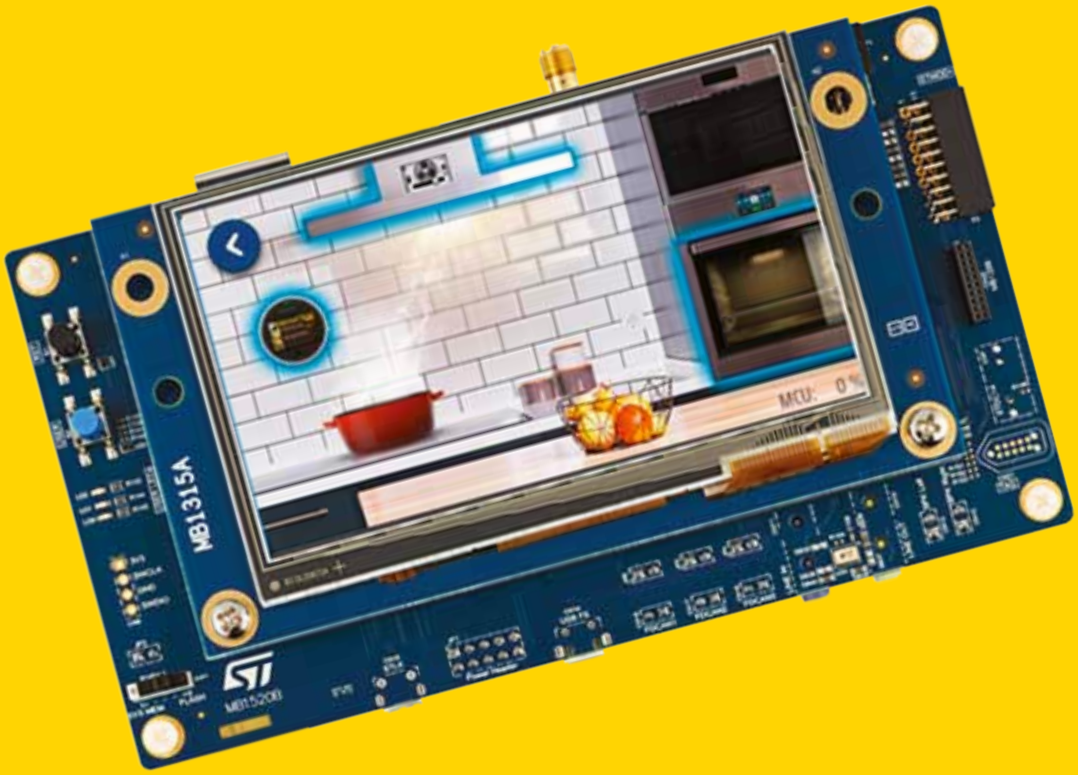


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what's next

# Low-pressure over-moulding solution gets the green light

Ampcontrol's lighting division, Burn Brite, recently commissioned Tarapath to provide a complete turnkey low-pressure over-moulding solution for the company's new Intrinsically Safe LED light, designed for hazardous area mining and tunnelling applications. Ampcontrol needed to bring the process in-house to enable flexible manufacturing; hence the requirement was for production equipment, production tooling for four over-moulded products, along with material as an ongoing consumable.

The IS LED light, being a product in demanding environments, needed to achieve a high IP rating as the primary concern; at the same time, a level of professionalism in appearance needed to be achieved. There was also a very demanding schedule, so time was of the essence. Other potential manufacturing techniques were ruled out. Complicated plastic injection moulded enclosures with gaskets and seals required long lead times, and simpler techniques such as heatshrink boots and y-connections did not offer the look befitting the product.

## Equipment

Tarapath recognised the need for companies in the cable assembly space to have a piece of low-pressure moulding equipment which dealt specifically with the challenges of manufacturing at times complex and intricate cable assemblies and harnesses. There may be assemblies with multiple branches, varied lengths and varied connector terminations. Overcoming these handling issues was important to deliver a solution that enabled flexibility yet ensured a practical and, most importantly, safe machine.

The Beta 300 2T WIDE incorporated an enlarged work area to deal with cumbersome cables, along with an adjustable light curtain area so long cables could exit the work area to a dolly or similar, additional fixing points for custom fixtures where needed, and additional clamping force to deal with larger parts, all integrated with custom programming for complete safety. This machine was the ideal fit for Ampcontrol's requirements for a medium-volume, high-flexibility manufacturing set-up.

## Product design and tooling

The in-house design team for Burn Brite products worked closely with Tarapath to reach the final designs for their over-moulded products. A grommet, connector over-mouldings for male and female amphenol connectors and a 2-to-1 splice over-moulding were all required for the project.

A combination of designing for function as well as a dynamic, angular aesthetic came together in the products, creating a cohesion between each item that would be unachievable with off-the-shelf back shells and/or heatshrink boots.

Choosing low-pressure moulding over assemblies of injection moulded parts and gasketing arrangements meant reduced costs initially, as well as reduced lead times. The one-step process of over-moulding also removes multiple potential assembly steps. This suited the new Burn Brite IS LED light, as a high inventory of parts was undesirable.

## Material

Tarapath was able to have its standard material, in this case PA 641, colour matched to the Burn Brite cables. The blue cables, indicative of intrinsic safety, were reaffirmed with the over-mouldings matching.

## Turnkey solution

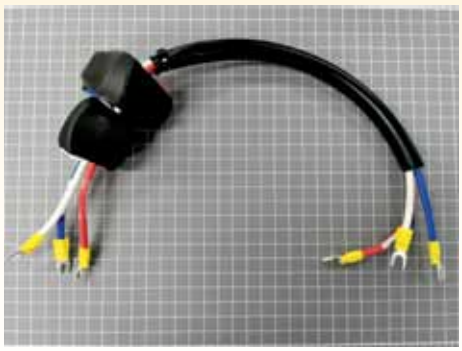
Although normal conditions were challenged, with the COVID-19 pandemic being an obstacle to getting the complete project completed in time, all timelines were met. Ampcontrol was able to have its Burn Brite IS LED light certified as required, get equipment and tooling onsite and begin production, which is now ongoing.

*Tarapath Pty Ltd*
*www.tarapath.com.au*

# Our capabilities

## CNC Machining
## UV Colour Printing
## Enclosure Customisation

**Cable Assembly** *** **Box Build** *** **System Assembly**



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ampec TECHNOLOGIES

## FLEXIBLE FILM CAN CHANGE COLOUR LIKE A CHAMELEON


Chameleons can famously change their colour to camouflage themselves, communicate and regulate their temperature — a trait that scientists have been attempting to replicate for use in stealth technologies, anti-counterfeiting measures and electronic displays. Now, researchers from Sichuan University have developed a flexible film that changes colour in response to stretching, pressure or humidity.

By tensing or relaxing their skin, chameleons can change the way light reflects from guanine crystals under the surface, producing what's known as structural coloration. These structural colours are different from the pigments that give many other creatures their hues. Scientists have mimicked the crystalline nanostructures of chameleon skin in various colour-changing materials, but they're either difficult to produce or they rely on non-renewable petroleum resources. In contrast, cellulose nanocrystals are a renewable material that can self-assemble into a film with iridescent structural colours; however, the films are typically fragile and, unlike chameleon skin, can't be stretched without breaking.

Fei Song, Yu-Zhong Wang and colleagues wanted to develop a highly flexible film made of cellulose nanocrystals that changes colour when stretched. They reported their results in the journal *ACS Applied Materials & Interfaces*.

To increase the flexibility of cellulose nanocrystals, the researchers added a polymer called PEGDA and used UV light to crosslink it to the rod-shaped nanocrystals, producing films with bright iridescent colours ranging from blue to red, depending on the PEGDA amount. The films were both strong and flexible, stretching up to 39% of their original length before breaking.

During stretching, the colour of one film gradually changed from red to green, and then changed back when relaxed. According to the researchers, this is the first time that stretching- and relaxing-induced, reversible structural colour changes that are brilliant and visible to the naked eye have been realised for cellulose nanocrystal materials. The film also changed colour with pressure and humidity, allowing the team to show or hide writing made by an inkless pen.

The new bio-based smart skin could find applications in strain sensing, encryption and anti-counterfeiting measures, the researchers say.

## BLUGLASS RECEIVES FEDERAL GRANT FOR LASER MANUFACTURING

Australian semiconductor and electronic technology manufacturer BluGlass has been awarded a co-funding grant by the Australian Government's Advanced Manufacturing Growth Centre (AMGC) to establish a high-throughput, laser diode foundry business onshore in Australia.

The matched funding grant of $250,000 was awarded to assist with the development and commercialisation of BluGlass's remote plasma chemical vapour deposition (RPCVD) technology. This technology will deliver large-size commercial wafers that are critical in the manufacture of lasers and light-emitting diodes (LEDs) as well as semiconductor manufacturing platforms and chips.

BluGlass's high-density, large-scale plasma source is being designed to produce ultraprecision uniformity for the deposition of semiconductor devices, lasers and next-generation LEDs. The distributed plasma source design will deliver a scalable and uniform platform suitable for large

industrial machines, accommodating multiple 8″ wafers. In addition, the project focuses on a new plasma source for the company's BLG-300 system to upgrade its capability to uniform deposition on a single 12″ wafer or multiple 4″ wafers.

"This AMGC co-funding grant will assist in the development of a number of new competitive edges for commercialisation of our RPCVD technology," said BluGlass Chief Technology Officer Dr Ian Mann. "The new design will support scalability on virtually any MOCVD platform in the industry and be capable of hybrid (both MOCVD and RPCVD) growth in a single deposition chamber, enabling the advantages of each growth technique for the first time in a single platform."

BluGlass will collaborate with several industry partners and organisations on the successful delivery of the project, including with the Division of Space Plasma, Power and Propulsion (SP3) at the Australian National University on plasma source design, simulation and testing; AKELA Laser on laser diodes device packaging and testing; and Objective3D on metal 3D design, test and rapid prototyping of critical plasma source components.

It is anticipated that the successful project will help grow the company's revenues to $40–75 million by FY 2025.

## QR CODE RECEIVES IEEE MILESTONE AWARD

It's played a key role in helping businesses to open up safely during COVID-19, and now the ubiquitous QR Code has received an IEEE Milestone award from the Institute of Electrical and Electronics Engineers (IEEE).

Since 1983 the IEEE Milestone award has recognised historic achievements that have contributed to the development of society and industry in the electric and electronic fields, with over 200 achievements now considered IEEE Milestones. The QR Code was recognised for helping to improve the manufacturing and management of companies around the world and for gaining ubiquity worldwide as a critical information-sharing tool in a variety of applications, such as electronic payments.

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Based on the concept of being easy to read and capable of handling large amounts of information, QR Codes can handle 200 times more information than barcodes and transmit information at high speed. It was created in 1994 by DENSO WAVE (a part of DENSO at the time), with the company soon making the code widely accessible to the public and focusing on dissemination activities.

In the latter half of the 1990s, the QR Code began to be used as an inexpensive and safe technology in manufacturing processes, such as quality checking, product shipments and inventory management. Since then, the technology's use has expanded to other fields in different industries, such as food and pharmaceuticals. In the first half of the 2000s its use expanded into everyday life, along with the spread of mobile phones equipped with cameras. In recent years it has been used for electronic ticketing, payment and, of course, registration of personal details.

Even over 25 years after its development, DENSO WAVE continues to develop the functions of the QR Code. The company has developed 'SQRC', which can store two types of data (public and private) in a single code, and 'Frame QR', which achieves a balance between free design and security. The company plans to develop these products in fields such as anti-counterfeit products and mobile ticket generation.

Both DENSO and DENSO WAVE plan to continue helping to solve social issues utilising the technologies they have developed.

new PRODUCTS

## EPOXY ADHESIVES

Creative Materials has introduced its 128-32 series of anisotropically conductive B-stageable silver-filled epoxy adhesives, which can be applied by screen-printing, dipping and syringe dispensing. The products feature good adhesion to a variety of metallic contact pad compositions, as well as other substrates.

Applications for the series include conductive splicing of ribbon cables, electrical attachment of surface-mounted devices and bonding of flex circuits to PC boards and electroluminescent panels. The series is especially useful for preventing shorts in applications where closely spaced contacts are of concern.

The 128-32 series offers good thermal stability, fast cure at low temperatures, snap cure at high temperatures and a long working time. The 128-32-F series is a B-stageable film version of the product, with the 128-32FP variant designed to feature a finer pitch than traditional anisotropic conductive materials. Other products in the series can provide custom versions specific to the target pad size and pitch.

**Creative Materials Inc**
www.creativematerials.com

## WALL-MOUNTED ENCLOSURES

OKW Gehäusesysteme presents the SMART-PANEL range of wall-mounted enclosures. The elegant square or rectangular design fits seamlessly into modern residential/commercial and industrial environments. The enclosures are suitable for the convenient control and monitoring of the entire building technology.

Due to their attractive design, SMART-PANELS adapt themselves optimally to their surroundings. Wired control/operating centres or radio-connected devices in the smart home, applications in the IIoT, access controls, monitoring devices, data acquisition systems, medical technology and much more are conceivable. The product is available from stock in two sizes.

The square version, measuring 84 x 84 mm, is prepared for concealed installation on standard flush-mounted/cavity wall boxes with a max installation opening of 61 mm. The rectangular version (155 x 84 mm) is prepared for concealed installation on simple flush-mounted boxes up to a max installation opening of 61 mm, double flush-mounted boxes and larger installation boxes up to a max height of 145 mm and width of 74 mm.

Both versions are manufactured from high-quality ASA+PC-FR (UL 94 V-0) in the colour traffic white (RAL 9016). The bottom part of the enclosure is highly polished and the top part has a fine surface texture with a recessed control area for membrane keyboards, display/operating elements and touch displays. Assembly is via a snap-in function without screws. The enclosure ranges have an IP40 protection class, sufficient for indoor applications.

Accessories include a tool for opening the enclosures, hardboard plates to protect the electronic components and a glass panel, eg, for display applications. The product has a flat, recessed surface at one end for USB or Mini-USB connectors. A variety of modifications can be implemented on request, including cut-outs for operating/display elements and interfaces, printing, labelling, EMC aluminium vapour plating, special colours/materials, decor foils, etc.

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## MOTION CONTROLLERS FOR HIGH-LEVEL AUTOMATION

Faulhaber motion controllers offer decentralised intelligence and the capacity for real-time communication with high-level process control. This flexibility can be used for applications where control of a DC-micromotor needs to be easily integrated into an automation environment.

The company's intelligent controller technology and high-performance drive technology have been combined in a compact drive system (MC3). Standardised connections and interface variants include RS232, CANopen and EtherCAT. There are three device variants available.

The motion controllers MC 5005 and MC 5010 are designed for OEM integration into a system or devices. An optional motherboard allows multi-axis applications.

The motion controllers MC 5005 and MC 5010, with housing and plug connectors, are designed for use in switch cabinets or inside devices.

The MCS motion control system, which functions as a servomotor with robust design (IP54), is preconfigured and ready for use directly in the automation environment.

All three versions use the same technology and offer the same interface options, the same operating philosophy and the same functionality.

**ERNTEC Pty Ltd**
www.erntec.net

## SMARC MODULE

The SMARC 2.1 SOM-2532 features the latest generation Intel Elkhart Lake processor. It supports multiple I/O and displays including two GbE LAN supporting TSN PHY, three independent 4K displays, two USB 3.1 Gen 2 (10 Gbps) and a SATA Gen3. With its high processing power and diverse I/O, the product is suitable for an array of uses including industrial control, transportation, automation and medical applications.

The SOM-2532 features onboard UFS2.0, dual GbE LAN with TSN PHY, two CAN FD and three independent displays up to 4K. With an increased data payload size and CAN-FD protocol, the device is designed to enhance security and to utilise TSN PHY to improve device communication accuracy. It should also improve the precision of data synchronisation over the network and minimise jitter to reduce latency during real-time device communication.

Equipped with dual LAN, the SOM-2532 is designed to improve cybersecurity in industrial automation applications. Users can connect multiple systems or batch firmware updates using WISE-PaaS/OTA via an internal LAN to protect important data. They can also conduct external communication via another independent LAN in diverse usage conditions.

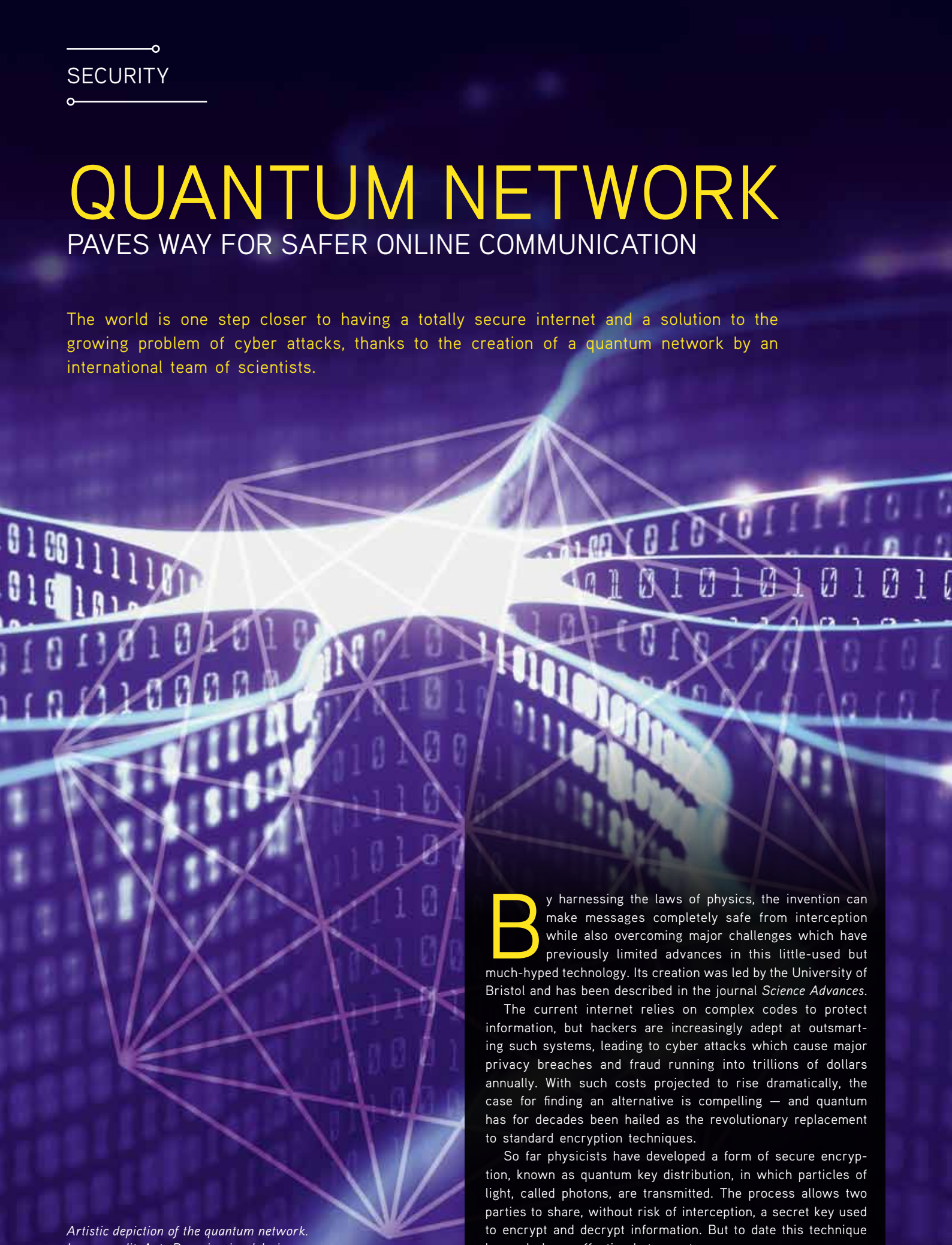
The product has a wide operating temperature from -40 to 85°C, enabling use in harsh operating conditions. It also utilises FUSA to reduce dangers caused by machine malfunction. These features make the device a safe option for portable devices and industrial applications.

**Advantech Australia Pty Ltd**
www.advantech.net.au

# QUANTUM NETWORK

## PAVES WAY FOR SAFER ONLINE COMMUNICATION

The world is one step closer to having a totally secure internet and a solution to the growing problem of cyber attacks, thanks to the creation of a quantum network by an international team of scientists.

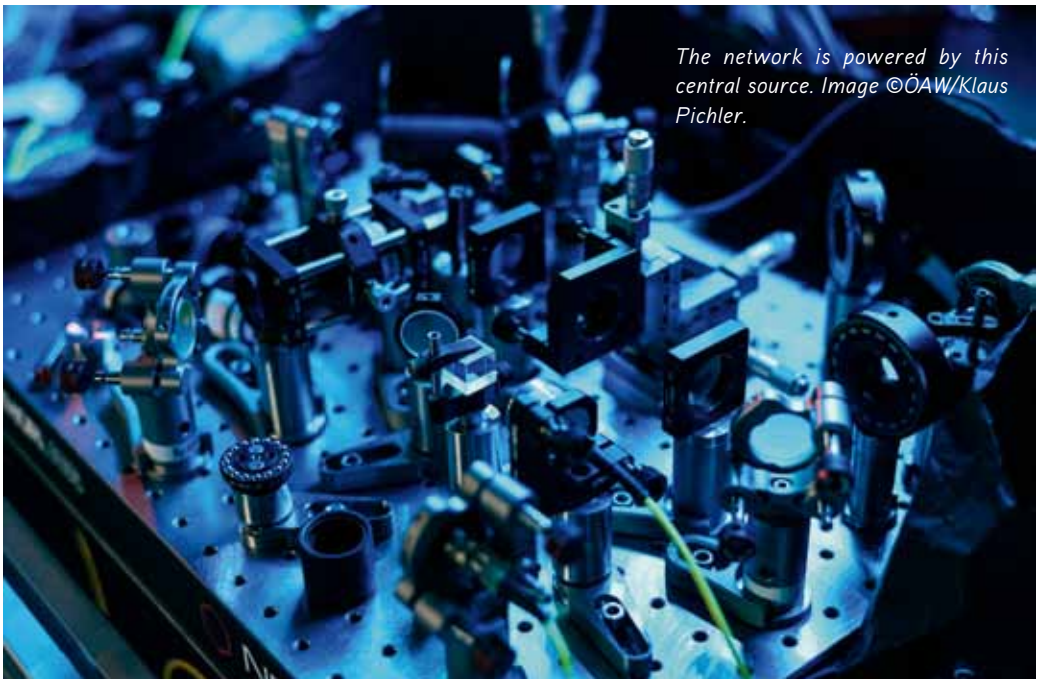


*Artistic depiction of the quantum network. Image credit: Anta Bucevic, visual designer.*

By harnessing the laws of physics, the invention can make messages completely safe from interception while also overcoming major challenges which have previously limited advances in this little-used but much-hyped technology. Its creation was led by the University of Bristol and has been described in the journal *Science Advances*.

The current internet relies on complex codes to protect information, but hackers are increasingly adept at outsmarting such systems, leading to cyber attacks which cause major privacy breaches and fraud running into trillions of dollars annually. With such costs projected to rise dramatically, the case for finding an alternative is compelling — and quantum has for decades been hailed as the revolutionary replacement to standard encryption techniques.

So far physicists have developed a form of secure encryption, known as quantum key distribution, in which particles of light, called photons, are transmitted. The process allows two parties to share, without risk of interception, a secret key used to encrypt and decrypt information. But to date this technique has only been effective between two users.



*The network is powered by this central source. Image ©ÖAW/Klaus Pichler.*

"Until now, efforts to expand the network have involved vast infrastructure and a system which requires the creation of another transmitter and receiver for every additional user," said Dr Siddarth Joshi, who headed the new project at the University of Bristol's Quantum Engineering Technology (QET) Labs. "Sharing messages in this way, known as trusted nodes, is just not good enough because it uses so much extra hardware which could leak and would no longer be totally secure."

The international team's quantum technique applies a principle called entanglement, which Albert Einstein described as "spooky action at a distance". It exploits the power of two different particles placed in separate locations, potentially thousands of kilometres apart, to simultaneously mimic each other. This process is said to present far greater opportunities for quantum computers, sensors and information processing.

"Instead of having to replicate the whole communication system, this latest methodology, called multiplexing, splits the light particles, emitted by a single system, so they can be received by multiple users efficiently," Dr Joshi said.

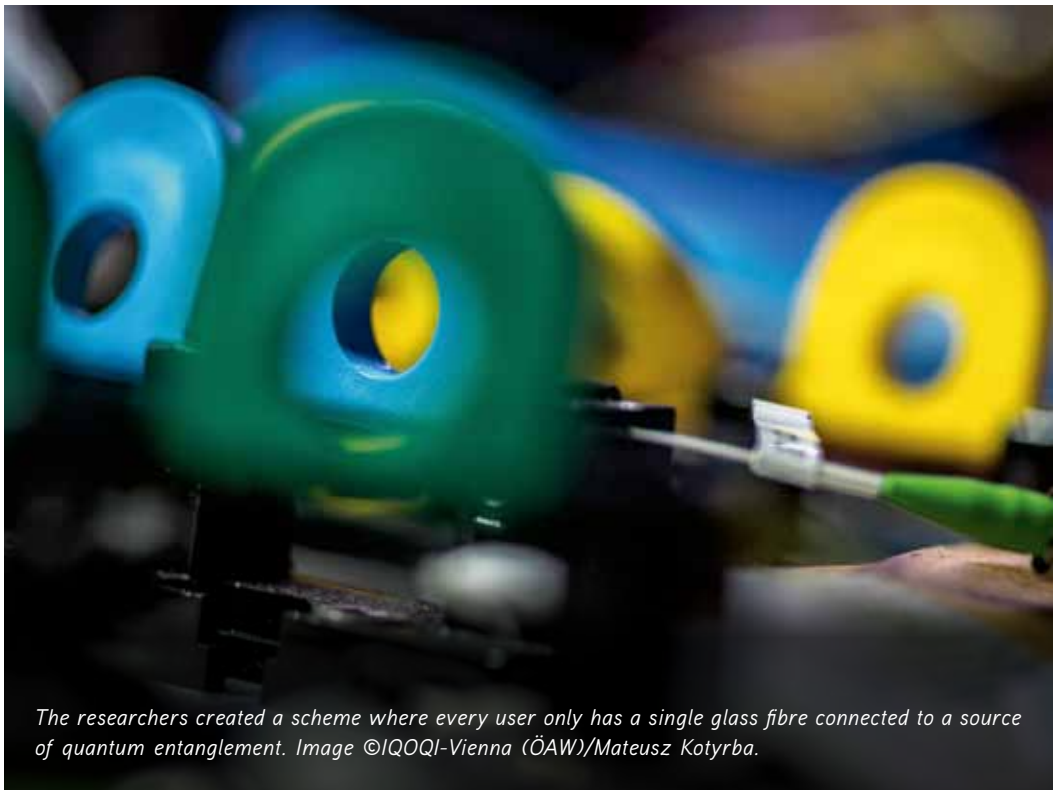
The team created a network for eight users using just eight receiver boxes, whereas the former method would need the number of users multiplied many times — in this case, amounting to 56 boxes. As the user numbers grow, the logistics become increasingly unviable — for instance, 100 users would take 9900 receiver boxes.

To demonstrate its functionality across distance, the receiver boxes were connected to optical fibres via different locations across Bristol and the ability to transmit messages via quantum communication was tested using the city's existing optical fibre network.

"Besides being completely secure, the beauty of this new technique is its streamline agility, which requires minimal hardware because it integrates with existing technology," Dr Joshi said. The system also features traffic management, delivering better network control which allows, for instance, certain users to be prioritised with a faster connection.

Whereas previous quantum systems have taken years to build, at a cost of millions or even billions of pounds, this network was created within months for less than £300,000. The financial advantages grow as the network expands, so while 100 users on previous quantum systems might cost in the region of £5 billion, Dr Joshi believes multiplexing technology could slash that to around £4.5 million, further expanding the potential applications.

"With these economies of scale, the prospect of a quantum internet for universal usage is much less far-fetched," Dr Joshi said. "We have proved the concept and, by further refining our multiplexing methods to optimise and share resources in the network, we could be looking at serving not just hundreds or thousands, but potentially millions of users in the not-too-distant future.



*The researchers created a scheme where every user only has a single glass fibre connected to a source of quantum entanglement. Image ©IQOQI-Vienna (ÖAW)/Mateusz Kotyrba.*

"Until now, building a quantum network has entailed huge cost, time and resource, as well as often compromising on its security — which defeats the whole purpose.

"Our solution is scalable, relatively cheap and, most important of all, impregnable. That means it's an exciting game changer and paves the way for much more rapid development and widespread rollout of this technology."

new PRODUCTS

## FANLESS DIN-RAIL EMBEDDED SYSTEM

iEi's DRPC-230-ULT5 DIN-rail embedded system is a fanless system that has a Whiskey Lake Core i5-8365UE processor pre-installed and supports 2 x DDR4 2400 Hz SO-DIMM up to 32 GB (pre-installed 8 GB), with one lockable HDMI port and one display port for dual display.

The embedded system supports a 2.5″ SATA HDD with a data transfer rate of up to 6 Gbps. Four RS-232/422/485 serial ports and six USB 3.2 Gen 2 ports enable simplified connectivity to a variety of external peripheral devices.

The product is designed to achieve AI inference and PoE applications through its expansion feature. The system is compatible with IEI's accelerator cards (Mustang-V100-MX8, Mustang-V100-MX4) and PoE cards (GPOE-4P, GPOE-2P).

For PoE cards, the embedded system has 60 W of internal power reserved. The product can expand I/O through the second layer; where its modularised flexibility can best fit users' preferences.

**ICP Electronics Australia Pty Ltd**
www.icp-australia.com.au

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## NETWORK PROCESSOR

STMicroelectronics has unveiled the BlueNRG-2N Bluetooth 5.0-certified network processor, lowering power consumption and adding support for the latest Bluetooth features that increase data throughput and enhance privacy and security.

The network coprocessor comes pre-programmed, ready for connecting to a host controller to provide Bluetooth connectivity. Designed to simplify product manufacture, the co-processor also enables scaling of the performance, features and cost of the host system independently. Designers of products such as smart medical wearables, PC peripherals, remote controls, lighting, industrial and home automation can thus optimise their choice of microcontroller (MCU) to meet specific model requirements.

Bluetooth enhancements include support for data length extension, which accelerates over-the-air (OTA) firmware updates by as much as 2.5 times and raises data transfers to 700 Kbps at the application level. In addition, with support for Bluetooth LE Privacy 1.2, the product changes address frequently without host-processor involvement to prevent unwanted tracking with minimal impact on system power consumption.

The processor is programmed with a digitally signed Bluetooth LE stack, designed to save manufacturing costs while still allowing the flexibility to upgrade OTA. Built-in image authentication technology enhances cybersecurity by always checking the stack before starting to allow only signed firmware images to run.

Power consumption is lower compared with previous BlueNRG generations, with low transmit and receive current and drawing just 900 nA in shutdown mode with the BLE stack running. At the same time, the device maintains robust radio performance, with +8 dBm programmable RF output power and up to a 96 dB link budget.

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

## PIEZOELECTRIC PSE SWITCH WITH CABLE

The use of switches in wet room and pool/spa facilities requires not only the right choice of switch technology, it can often demand unusually long cables. SCHURTER addresses the demand for this requirement with the installation-ready piezoelectric PSE with cable.

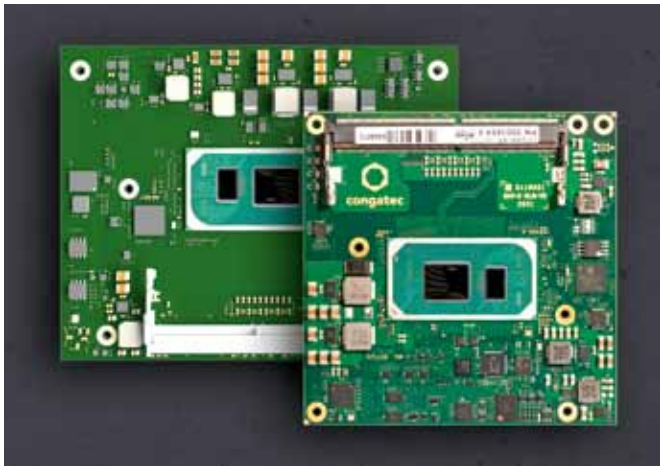
The pre-assembled polyurethane cable is potted, offering flexibility and high IP protection during installation. Waterproof from switch surface to connection, the cable is 15 m in length and installation of the switch is simple by means of a nut.

The housings of the factory-assembled piezoelectric PSE family are made of stainless steel 1.4462, which is characterised by its high resistance to corrosion essential in areas with high humidity. The PSE switches offer a long service life (20 million actuations) where the hermetically sealed housings are resistant to chlorinated liquids and common pool chemicals. Other features include a ring illumination with a total of seven possible display colours, and the supply voltage has a range of 5–28 VDC and maintains constant brightness.

The PSE with cable is suitable for use in any sanitary application, even though it was originally developed for spa and pool builders. Other applications include medical technology, food processing or other similar industrial applications.

**SCHURTER (S) PTE LTD**
www.schurter.sg

## COMPUTER-ON-MODULES



congatec has announced 12 computer-on-modules in parallel with the launch of the 11th Gen Intel Core processors. Based on the low-power, high-density Tiger Lake SoCs, the modules offer high CPU and GPU performance, along with PCIe Gen4 and USB4 support.

The congatec COM-HPC and COM Express computer-on-modules should accelerate performance-hungry, fanless edge applications in harsh industrial and embedded environments. Typical edge computing tasks include industrial and tactile IoT, machine vision and situational awareness, real-time control and collaborative robotics, as well as real-time edge analytics and artificial intelligence (AI) with inference workloads enabled to run across all four CPU cores, or on up to 96 graphics execution units of the Intel Iris Xᵉ graphics.

Product performance has nearly tripled compared to predecessor modules based on 8th Gen Intel Core processor technology, according to the company. This opens up opportunities in the graphics-intensive medical imaging and immersive digital signage sectors as well as in the industrial machine vision and AI-based public safety sectors, where capturing and analysing several video streams in real time is critical for object recognition.

For demanding IoT applications like collaborative robotics, autonomous vehicles, AI or contactless retail markets, congatec's 11th Gen Intel Core processor-based modules take advantage of the 'total compute' capabilities of the CPU and GPU. In combination with Intel Time Coordinated Computing technologies, extensive virtualisation and in-band error correction, the platforms help minimise jitter and are suitable for meeting the demands of critical real-time computing applications.

**Congatec Australia Pty Ltd**
www.congatec.com

new PRODUCTS

## WIRELESS POWER RECEIVER

Renesas Electronics has introduced the P9415-R wireless power receiver with WattShare technology. The 15 W wireless power receiver enables smartphones, power banks and portable industrial and medical equipment to wirelessly charge other mobile devices and accessories that also have wireless charging capabilities. It features up to 5 W of transmit power capability in transmitter/receiver (TRx) mode and can receive up to 15 W on Qi transmitters, enabling quick and convenient mobile device charging on the go.

Based on Renesas's WattShare technology, the device combines receiver and transmitter capabilities, allowing smartphones, smartwatches, truly wireless ear buds and other devices to be wirelessly charged simply by placing them on top of a smartphone or other industrial and medical portable devices. In WattShare TRx mode, the unit enables these mobile devices to change the power flow direction and deliver up to 5 W of power to charge other devices. The same wireless power coil and P9415 circuitry can be used to both receive and transmit power wirelessly.


Other features include: MTP non-volatile memory for easy firmware and device function updates; GUI support offering flexibility for user customisation; UVLO as low as 2.7 V for increased charging area and fast connections; IOUT sensing accuracy for foreign object detection capabilities; bidirectional communications to support proprietary authentication with encryption; and X-Y alignment circuitry for receiver/transmitter device alignment.

**Renesas Electronics**
www.renesas.com


## 5G ANTENNA

Antenova's Lepida SR4L054 is a wideband antenna in SMD form, designed to achieve high efficiency and performance right across the spectrum from 600 to 3800 MHz. The 5G antenna operates right across the cellular bands B71 (617–698 MHz), LTE 700, GSM850, GSM900, DCS1800, PCS1900, WCDMA2100, B40 (2300–2400 MHz), B7 (2500–2690 MHz) and B78 (3300–3800MHz).

The linear polarised antenna has been designed to ensure good coplanarity, as well as easy integration into a wireless design. It was built for demanding applications in 5G, 4G and LTE, where antenna performance makes a difference. It is particularly suitable for wireless devices in the automotive sector, aerospace and UAV, smart metering applications, remote control and 5G routers.

**Antenova Limited**
www.antenova.com

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## DISTRIBUTED MODULAR 2-PORT VNA FAMILY

Anritsu introduces the ShockLine ME7868A family of modular 2-port vector network analysers (VNAs), which can conduct full vector S-parameter measurements over wide distances of up to 100 m.

Consisting of two MS46131A 1-port VNAs with the PhaseLync synchronisation option hardware and accessories, the ME7868A VNA uses the MS46131As as portable VNA ports to directly connect to the device under test (DUT). Delivering vector transmission measurements over long lengths, the VNAs offer multiple advantages compared to traditional solutions that use 2-port VNAs with high dynamic range and require long phase-stable microwave cables to reach the DUT.

Available in 8, 20 and 43.5 GHz frequency models, the series supports multiple existing and emerging commercial and military applications, including high-frequency 5G. As a modular-port-based VNA, the ME7868A eliminates the need for long port cables to measure transmission over distance for applications such as outdoor antenna range testing, over-the-air (OTA) chamber installations, large vehicle (aircraft, ship) electromagnetic characterisation (shielding, RF propagation) and long-distance cable insertion loss measurements.

PhaseLync technology enables two MS46131A 1-port VNAs to phase synchronise with each other over a distance of up to 100 m. PhaseLync improves dynamic range and measurement stability of s-parameter measurements by eliminating the need for long cables with conventional benchtop VNAs. The result is greater operational efficiencies when measuring transmission over distance.

Lightweight and compact, the two MS46131A 1-port VNAs that comprise the ME7868A are USB controlled via an external PC running ShockLine software. Engineers can easily configure and control MS46131A VNAs from a single PC to conveniently match port count to test set-up requirements. Data is more secure as all measurement results are stored on the PC, rather than the VNA, making the solution suitable for confidential testing environments. Analysis and documentation are also simplified, as there is no need to transfer data off the onboard instrument memory.

**Anritsu Pty Ltd**
www.anritsu.com


## INTELLIGENT FACE MASK AND BODY TEMPERATURE DETECTION

IBASE's VINO2100 is an intelligent face mask and body temperature detection system powered by Intel OpenVINO-based iVINO AI recognition software. It is an all-in-one platform featuring a 7th Gen Intel Core i7-7600U processor and a 21.5″ IPS LCD touch panel with IP65 front-panel waterproof protection. It uses a high-precision thermal camera for body temperature measurements ranging from 35 to 42°C, with precision of ±0.3°C.

The real-time automated system features face mask recognition with over 90% accuracy at 50 ms speed, and can be used to intercept people not wearing a face mask and who fail a body temperature test. It supports sound/light alarm and access gate control for one-by-one walkthrough inspection. Unlike handheld thermometers that need an individual to take a person's body temperature, the product provides non-contact and efficient temperature checks and facial mask detection to allow or deny the entry of people in buildings and event venues. The face mask detection function can be disabled if not required.

With artificial intelligence (AI) technology, the device does not require human observation or intervention to assist frontline workers to perform epidemic prevention and control. Measuring 537.8 x 329.26 x 71.95 mm, the fanless system has 8 GB of DDR4 memory and 64 GB SSD storage. A desktop mounting stand and the high-precision thermal camera are optional in the package.

**Backplane Systems Technology Pty Ltd**
www.backplane.com.au

new PRODUCTS

## OUTDOOR FIBRE-OPTIC CONNECTOR

HUBER+SUHNER has launched the Q-ODC-2 Mini — said to be its smallest ever outdoor fibre-optic connector — to enable more flexible and higher capacity deployments of wireless infrastructure in industrial and communication applications.

Featuring a compact design, the product reduces dimensions by 50% and weight by 40% when compared to HUBER+SUHNER's Q-ODC-2 outdoor connector. These smaller proportions should allow wireless infrastructure providers to access new locations and add more capacity to the network, reducing the cost per bit. The device also overcomes the challenge of high system sensitivity, opening up areas of application for fibre optics in industries such as wind energy, railway and shipbuilding.

The connector is waterproof, dust-proof and corrosion resistant and provides safety for outdoor installations. It features a robust push-pull coupling mechanism and an extension connector for cable chaining, making the product fast and easy to install. It is suitable for complex applications with high data rates as network providers look to meet the demand for more capacity at a low cost per bit.

**Huber+Suhner Aust Pty Ltd**
www.hubersuhner.com

## RELATIVE HUMIDITY SENSORS

TE Connectivity's HTU31 devices are surface mount relative humidity sensors with a temperature output. The compact sensors are suitable for harsh environments, including in industrial, automotive and medical applications.

The relative humidity sensors offer fast response times, precision measurement and low hysteresis, even when exposed to extreme-temperature and -humidity environments. The sensors have an operating temperature range of -40 to +125°C with a typical accuracy of ±0.2°C. Measuring relative humidity from 0 to 100%, the sensors offer resolution to 0.01 and an accuracy of ±2%.

The sensors feature an operating voltage range of 3.3 to 5.5 V and maintain an active current consumption of just 450 μA, with sleep modes down to 0.05 μA. They are qualified according to AEC Q100 Grade 1 standards and are housed in a compact, 6-pin DFN package measuring 2.5 x 2.5 x 0.9 mm. In addition to harsh environment performance, the sensors are also suitable for applications such as HVAC, home appliances, respiratory devices and environmental monitoring solutions.

**Mouser Electronics**
au.mouser.com

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## MIXED SIGNAL OSCILLOSCOPE

Tektronix has announced the 6 Series B Mixed Signal Oscilloscope (MSO), extending the performance threshold of the company's mainstream oscilloscopes portfolio to 10 GHz and 50 GS/s. Developed to meet the demand for high-speed data movement and processing in embedded designs, the MSO offers high signal fidelity with 12-bit ADCs and up to eight FlexChannel inputs, enabling users to confidently analyse and debug embedded systems while enjoying ease of use.

The MSO allows manufacturers to bring cutting-edge and high-performance products to industrial, medical, consumer and computer markets. The instrument is poised for higher-speed embedded designs, demanding mixed-signal design troubleshooting and accelerating serial bus speeds. It is also effective for diverse applications in semiconductors, power integrity, automotive, defence, aerospace, research and more.

With up to 10 GHz of fully upgradable bandwidth and up to 50 GS/s sample rate, users have visibility of signals in high-performance designs. The instrument delivers good signal fidelity, contributing less than 51.1 μV of noise at 1 mV/div and 1 GHz and less than 1.39 mV of noise at 50 mV/div and 10 GHz. It is said to be the first oscilloscope with bandwidth of more than 2 GHz to offer four, six or eight channels. Each FlexChannel input can be converted into eight digital channels using a TLP058 Logic Probe for added visibility.

The MSO offers a range of options to streamline protocol decoding, compliance testing for serial standards, jitter analysis and power analysis. Built-in digital down converters (DDCs) behind every channel enable multichannel spectrum analysis, and spectrum measurements are synchronised with time domain waveforms to enable correlation between RF and time events.

The MSO's responsive 15.6″ HD capacitive pinch-zoom-swipe touch display provides an intuitive drag-and-drop, object-oriented user interface. It is capable of switching between Windows 10 and closed operating systems, without loss of performance. A removable SSD, along with optional security licences, enables use of the oscilloscope in secure environments by minimising cybersecurity threats. The TekVPI probe interface, known for versatility and ease of use, communicates seamlessly with a wide range of probes to simplify set-up and reduce errors.

**Vicom Australia Pty Ltd**
www.vicom.com.au

# PREVENTA XPS UNIVERSAL OFFERED BY SCHNEIDER ELECTRIC

*Bolting safety switches.*

*Key-operated safety switches.*

*Safety limit switches.*

*Magnetic safety switches.*

Preventa XPS Universal is a new generation of safety modules from **Schneider Electric**. The modules implement the management of single safety functions in potentially dangerous applications of simple and medium complexity. These devices offer greater simplicity and innovative, user-friendly functions ensuring adequate protection of the operator and the machine itself.

The main advantage of the **XPS Universal** series is that it does not require complicated fieldbus technology to exchange messages when working with PLC controllers. Communication takes place via a straight wire in a point-to-point connection between the semiconductor output of the module and the digital input of the PLC controller. It is possible to send up to 40 different messages, conveying among other things the cause of the failure and the upcoming test cycles, which significantly reduces machine shutdown time. This is possible by using pulse coding and function block decoding that must be integrated into the driver program. **Schneider Electric** has a public library of function blocks for programming systems for the most popular drivers on the market.

The next advantage of the new series is that each module can be adapted to several different safety functions. The function is selected by means of rotary switches located on the front of the module. The functions available, among others, are: emergency stop, anti-valent contacts, protection switch, magnetic switch, safety proximity sensor, PNP sensor, NPN sensor, RFID safety switch, safety curtains, two-hand operation control, mat/edge sensor. This functionality reduces the number of different module types, making it easier to manage the availability of machine spare parts.

**Check out the new Preventa XPS Universal safety modules.**

## GET TO KNOW PREVENTA SERIES PRODUCTS AVAILABLE AT TME

**Schneider Electric's Preventa products** include not only modules but also high-quality sensors and switches, which help to ensure safety when operating the machinery and meet the safety requirements for applications.

**With Preventa it is easy to:**

- automate the shutdown of dangerous machines
- secure dangerous areas
- provide your employees with easy access to stop dangerous machines
  - Bolting safety switches in metal body — series XCSLF and XCSE
  - Bolting safety switches in plastic body — series XCSLE and XCSTE
  - Key-operated safety switches in metal body — series XCSA, XCSB and XCSC
  - Key-operated safety switches — series XCSPA, XCSTA and XCSM
  - Hinge safety switches — series XCSPL, XCSPR and XCSTR
  - Line-operated safety switches — series XY2CJ, XY2CH and XY2CE
  - Safety limit switches — series XCSD, XCSP and XCSM
  - Magnetic safety switches — series XCSDMR, XCSDMC and XCSDMP

***Transfer Multisort Elektronik***
***www.tme.eu***

T M E ®
Electronic Components

## ELECTRONIC FLOW CONTROL

EXAIR's EFC Electronic Flow Control for compressed air is designed to minimise compressed air use on blowoff, drying, cooling, conveying and static elimination operations. It combines a photoelectric sensor with a timing control that limits compressed air use by turning it off when no part is present. With eight programmable on and off modes, the timing control permits easy tuning to the application requirements.

For most companies, the air compressor uses more electricity than any other type of equipment. If not properly controlled, one simple operation using compressed air can easily waste thousands of electricity dollars per year. The EFC is designed to improve efficiency by minimising compressed air use, resulting in reduced compressed air costs. By turning on the air only when a part is present, it provides just enough air to complete a specific task or operation.

The EFC has an easy electrical connection for voltages from 100 to 240 VAC, 50/60Hz. With a sensitivity adjustment and ability to detect objects up to 1 m away, the compact photoelectric sensor has high immunity to noise and inductive loads common to industrial environments. The polycarbonate enclosure of the EFC is suitable for use in a wide range of applications, including those located in wet environments.

**Compressed Air Australia Pty Ltd**
www.caasafety.com.au

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## LOAD CELL

FUTEK's LSB205 is a miniature force sensor featuring good performance, high quality and durability in a small footprint.

The load cell includes an integrated IEEE1451.4 TEDs chip, which should reduce errors during the simple set-up process. It also connects directly to electronics and auto-scales to FUTEK instruments.

A PT-1000 temperature sensor enables support for real-time temperature compensation, making the product usable in different environments, and the detachable 7-pin FUTEK aerospace-grade cable connector allows for quick cable disconnect and helps separate the sensor from cable damage.

Powerful, durable, versatile and full of useful features, the miniature load cell is suitable for any application that requires a creative sensor solution with a small footprint.

**Metromatics Pty Ltd**
www.metromatics.com.au

## SMART MANAGED SWITCHES

D-Link A/NZ has launched the DGS-1520 Series of smart managed switches: the DGS-1520-28, DGS-1520-28MP, DGS-1520-52 and DGS-1520-52MP. With Layer 3 features and support for 10G, the switches are specifically engineered for small-to-medium business and enterprise networks.

The DGS-1520 Series is the successor to the DGS-1510 Series and the first of D-Link's smart managed switches to support 10G Base-T ports for uplinks and stacking. The series includes a range of 28- and 52-port switches with a choice of 2.5GBASE-T PoE, 10GBASE-T and SFP+ uplink ports. All switches offer four 10 Gbps ports (two SFP+ and two 10GBASE-T), with PoE models additionally offering four 2.5GBASE-T ports.

High-bandwidth uplinks eliminate network bottlenecks and provide low-latency connections to core networks and servers, while multi-Gigabit PoE ports eliminate potential network bottlenecks when connecting to high-bandwidth 802.11ac/ax access points. With zero-touch provisioning, multisite network deployments are simple, and there is no need for onsite IT personnel.

The switches are designed to provide maximum uptime as well as high security, multiple management options and flexible stacking configurations with a powerful 80 Gb stacking bandwidth using fibre, copper or hybrid modes. Additionally, the range is compatible with D-Link's latest DPS-520 PoE redundant power system, which can connect up to 4 non-PoE models of DGS-1520 for a resilient network.

**D-Link Australia Pty Ltd**
www.dlink.com.au

## ANALOG-TO-DIGITAL CONVERTERS

Texas Instruments' ADS7028 and ADS7138 analog-to-digital converters (ADCs) feature eight channels that can be configured in any combination of analog inputs, digital inputs or digital outputs. The multiplexed, successive approximation register (SAR) ADCs provide good performance for applications such as rack servers, AC drive power stage modules, automotive centre information displays and mobile robot CPU boards.

The 12-bit ADCs feature open-drain, push-pull digital outputs for I/O expansion, while the devices' analog watchdog function includes an event counter for transient rejection and programmable thresholds for each channel. They have wide operating ranges of 2.35 to 5.5 V AVDD and 1.65 to 5.5 V DVDD. They also have an internal oscillator for ADC processes, as well as a built-in cyclical redundancy check for power-up configuration and data read/write operations.

The ADS7028 communicates through an SPI-compatible interface with a sampling frequency of 1 MSPS, while the ADS7138 communicates using an I²C-compatible interface capable of operating at a frequency of up to 3.4 MHz. Both ADCs operate in either autonomous or single-shot conversion mode. The ADS7028 ADC also offers a root-mean-square module that computes a 16-bit true RMS output for any analog input, as well as a zero-crossing-detect module that features built-in transient rejection and hysteresis near configurable threshold crossings.

**Mouser Electronics**
au.mouser.com

## MODBUS TCP/ UDP TO RTU/ ASCII GATEWAY


ICP DAS's GW-2200i module is a Modbus TCP/UDP to RTU/ASCII gateway that enables a Modbus TCP/UDP host to communicate with serial Modbus RTU/ASCII devices through an Ethernet network and eliminates the cable length limitation of legacy serial communication devices.

The module can be used to create a pair-connection application (as well as serial-bridge or serial-tunnel application), and can then route data over TCP/IP between two serial Modbus RTU/ASCII devices. This is useful when connecting mainframe computers, servers or other serial devices that use Modbus RTU/ASCII protocols and themselves do not have Ethernet capability.

With multiple isolated RS-232/485/422 ports and two Ethernet ports, the device allows daisy chain connection, which enables flexibility in locating devices and easy installation. The product also adds 3000 VDC isolation and ±4 kV ESD protection component that diverts the potentially damaging charge away from a sensitive circuit to protect the module and equipment from the sudden and momentary electric current.

**ICP Electronics Australia Pty Ltd**
www.icp-australia.com.au

# MEMS AND SENSORS

## FOR AUTONOMOUS AUTOMOTIVE APPLICATIONS

*Lauren Davis*

How will MEMS and sensors enable the evolution of the automotive industry? As part of an industry webinar held in August, STMicroelectronics' Davide Bruno* explained how we're edging closer to a future of fully autonomous vehicles — and how his company is helping to make that happen.

Bruno revealed that the 2019 total available market (TAM) for the automotive industry is in the range of $35 billion, split between traditional automotive core electronics (around 65%), and digitalisation and electrification (35%). With the current speed of new projects, new developments and new technologies, he said this will soon shift to more than 60% allocated to digitalisation and electrification and less than 40% for the traditional automotive core electronics — a shift that will happen in just 3–5 years.

"The traditional automotive model is changing, so many OEMs and Tier 1s are rethinking the way their new cars will serve the consumer," Bruno said. "This opens up a lot of opportunities for ST in terms of products, including sensors.

"In the past, the car was a very static element which consists of wheels, engine and steering, and it was not able to do anything smart. Today, the car can park by itself, understand whether you are crossing the lane or not, and even drive by itself. This is done with sensors. Without sensors, you cannot do these things."

According to Bruno, ST has identified four growth drivers for the use of automotive sensors: shared mobility and access control; road noise cancellation; 5G; and driving assistance. "[But] it is the driving assistance that is really changing the game," he said. "It is not a dream anymore — it is a reality. Everybody is working on this."

Bruno explained that there are several 'levels' of autonomous driving — from no automation (level 0) up to full automation (level 5) — with the addition of sensors moving a car from one level up to the next. ST believes that 33% of the cars produced in 2021 will be at levels 2 (partial automation) and 3 (conditional automation), with level 4 viable by the year 2028 and level 5 by the year 2040.

"To move to level 4 and level 5 … we need more fusion between different subsystems including radar, LiDAR and so on," Bruno said. "The LiDAR system can't work well if there is rain, dust and fog; it only works well to define objects when the weather conditions are good. Major subsystems must coexist together."

Furthermore, he said, "Each sensor must have the capability of post-processing, locally in the sensor system … Instead of sending information without any interpretation or any post-processing to the central unit, we need to have smart sensor processing as much as possible. We believe the future for ADAS (advanced driver-assistance systems) is smart sensors, not just more sensors."

The use of sensors in cars is by no means a new trend, with Bruno revealing that the first wave of sensor adoption began with the airbag in 1974. Indeed, Bruno claimed that we are probably not as good at driving as we like to think, as electronic stability control (ESC) has been standard in cars for many years now.


"The ESC system … corrects our driving mistakes for avoiding accidents, yet we do not even perceive it," he said. And with car makers now also seeking to implement sensors for rollover detection and stabilisation, the packaging of such sensors will be important for ensuring their performance.

"A ceramic package gives us much more stability and better linearity," Bruno said.

Other sensors enable what Bruno calls 'non-safety' applications, including navigation and entertainment. This area is ST's speciality, he said, due to the company's simple, streamlined product portfolio that enables the same devices to cover multiple applications — from key access to detecting wheel vibration.

But how will the company fare in level 5, where we sit inside a vehicle but do not actually drive it? According to Bruno, for this we need a better understanding of a sensor's accuracy, stability and linearity.

"There is not so much difference between a sensor which is an inertial module unit used in a smartphone and the sensor you install in your car to achieve level 5 autonomous driving," he said. "What is important, and what is more challenging, is the accuracy, linearity and stability … At level 5 there is no margin of error, so there is no possibility for mistakes."

How will this be achieved? For manufacturers working to level 3 today, Bruno says they put together several devices and operate them in a way that minimises errors. But this is very expensive and very complex, he said, because software is required to synchronise all the devices' signals and verify all the information.

"So the future clearly is to have one single 6-axis or x-axis system, where x can be four, five or six DOF (degrees of freedom), plus what is called functional safety," Bruno said.

Bruno clarified that when we talk about the cost of sensors, we're talking about the time required for calibration. He gave the example of the aviation industry, with aeroplanes already sitting comfortably at level 4 or 5 of automation.

"To enable this function, you need a system that costs $150,000, which will take one week to be calibrated," he said. "The sensor itself is not so different from a standard sensor. But the calibration means the sensor plus the ASIC, plus all the firmware and the way it is calibrated one by one."

The cost of such a system would obviously have to come down in order to be used in an entry-level car, Bruno said. This is what ST is currently working on, in the form of a device called the ASM330CHH — whose closest competitor costs around $10,000 and requires 1–2 days of calibration.

"This is the challenge, which is to provide affordable sensors for the inertial platform," Bruno said. "This is what we are working on now, not only with our internal team, but also with key experts and leaders on the packaging and defining methodologies for the calibration and testing."

This isn't the company's only foray into autonomous vehicles. ST also has a range of high-sensitivity image sensors that, when combined with the proper processing and systems, could be used to monitor in-cabin alertness based on the driver's facial expressions. So if the driver is noticeably drowsy or distracted, the system could enable driver assistance functions or encourage the driver to pull over and take a rest.

The company is also working in cooperation with LeddarTech on the development of a LiDAR evaluation kit, which will include ST's MEMS mirror-based laser-beam scanning solutions. The kit is being developed to target automotive LiDAR applications for high-speed highway driving, as well as industrial and robotics LiDAR applications, with ST's mirrors acting as actuators that will enable LiDAR systems to be very small and cost-effective. These mirrors are produced using a semiconductor, Bruno said; in a high-volume process that means they end up being very small, reliable and cost-effective.

Bruno concluded by acknowledging that the cars of the future will need more and more sensors. But this does not necessarily mean we need to develop new sensors, as current technologies including the accelerometer, gyroscope and microphone should be sufficient. We just need new ways to use these sensors.

So how will companies such as ST help achieve levels 4 and 5 of automation? According to Bruno, "We need to work with key experts and take specific steps, like the ceramic packaging or enhance the calibration, to develop this system with very solid and robust technology at an affordable cost. The combination of these will speed up the adoption of MEMS in automotive applications."

**Davide Bruno is Head of Marketing and Application for MEMS Analog, MEMS and Sensors Group (AMS), Asia Pacific, STMicroelectronics.*

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

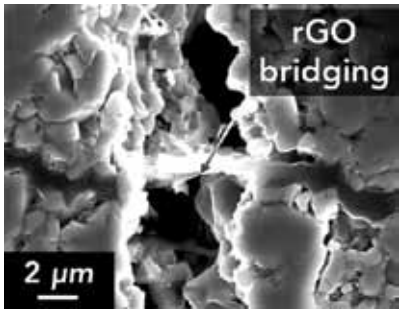
# SOLID CERAMIC ELECTROLYTES GET TOUGH




Brown University researchers have found a way to double the toughness of a ceramic material used to make solid-state lithium-ion batteries. Their strategy, described in the journal *Matter*, could be useful in bringing solid-state batteries to the mass market.

The electrolyte is the barrier between a battery's cathode and anode through which lithium ions flow during charging or discharging. Liquid electrolytes are found in most batteries in use today, but they have some problems. At high currents, tiny filaments of lithium metal can form inside the electrolytes, which cause batteries to short circuit. And since liquid electrolytes are also highly flammable, those shorts can lead to fires.

Solid ceramic electrolytes aren't flammable, and there's evidence that they can prevent the formation of lithium filaments, which could enable batteries to operate at higher currents. However, ceramics are highly brittle materials that can fracture during the manufacturing process and during use. The Brown researchers wanted to see if infusing a ceramic with graphene could increase the material's fracture toughness (a material's ability to withstand cracking without falling apart) while maintaining the electronic properties needed for electrolyte function.




*Graphene (rGO) can help prevent the propagation of cracks in ceramic materials used for battery electrolytes.*

"There's huge interest in replacing the liquid electrolytes in current batteries with ceramic materials because they're safer and can provide higher energy density," said postdoctoral researcher and lead author Christos Athanasiou. "So far, research on solid electrolytes has focused on optimising their chemical properties. With this work, we're focusing on the mechanical properties, in the hope of making them safer and more practical for widespread use."

Athanasiou worked with Brown's Brian Sheldon and Nitin Padture, who for years have used nanomaterials to toughen ceramics for use in the aerospace industry. For this work, the researchers made tiny platelets of graphene oxide, mixed them with powder of a ceramic called LATP and then heated the mixture to form a ceramic–graphene composite.

Mechanical testing of the composite showed a more than two-fold increase in toughness compared to the ceramic alone. "What's happening is that when a crack starts in a material, the graphene platelets essentially hold the broken surfaces together so that more energy is required for the crack to run," Athanasiou said.

Experiments also showed that the graphene didn't interfere with the electrical properties of the material. The key was making sure the right amount of graphene was added to the ceramic. Too little graphene wouldn't achieve the toughening effect; too much would cause the material to become electrically conductive, which is not desired in an electrolyte.

"You want the electrolyte to conduct ions, not electricity," Padture said. "Graphene is a good electrical conductor, so people may think we're shooting ourselves in the foot by putting a conductor in our electrolyte. But if we keep the concentration low enough, we can keep the graphene from conducting, and we still get the structural benefit."

The results suggest that nanocomposites could provide a path forward to making safer solid electrolytes with mechanical properties to be used in everyday applications. The group plans to continue working to improve the material, trying nanomaterials other than graphene and different types of ceramic electrolyte.

"To our knowledge, this is the toughest solid electrolyte that anyone has made to date," Sheldon said. "I think what we've shown is that there's a lot of promise in using these composites in battery applications."

## MICROCONTROLLERS

STMicroelectronics' STM32H723/733, STM32H725/735 and STM32H730 Value-Line MCUs build on the Arm Cortex-M7 core and operate at 550 MHz, said to be the fastest core speed in the market among MCUs that integrate Flash storage on-chip to run deeply embedded applications. The single-core devices are available with up to 1 MB of Flash and designed to bring high-end features such as rich graphics, AI and state-of-the-art cyber-protection to cost-sensitive products.

The devices can interact with off-chip storage while ensuring full execution performance and security. Their benchmark performance figures of 2778 CoreMark and 1177 DMIPS are realised whether working from internal or external memory, aided by features such as the Flexible Memory Controller (FMC) and Octal SPI memory interface. This lets designers tackle memory-hungry applications, such as high-resolution, full-colour graphics and video that demand a large frame buffer, to create products that deliver sophisticated and immersive user experiences.

The MCUs enable small, low-power products to deliver good functionality and performance. This makes them suitable for products that might previously have been unable to incorporate computationally intensive features such as AI, graphics and voice interaction, including home appliances, small medical devices, and industrial sensors and actuators. Several key features deliver advantages in industrial applications, including an integrated switched-mode power supply (SMPS) that overcomes dissipation constraints to allow extended-temperature operation up to 125°C. In addition, fault resilience is provided through error correction (ECC) for all memories.

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

## RUGGED TWIN SERVER

Crystal Group's RS1.532L21X2F rugged twin server delivers good computing performance in extreme and unpredictable environments, which is critical for the successful execution of combat, sonar and electronic warfare applications across all domains — including cyber.

The small, integrated footprint of the unit fits easily into standard rack slots. With good system availability, cooling and shock/vibe resistance, the 1.5U rugged server is ready to perform.

Warfighters achieve dominance with real-time information, which requires failsafe computer hardware that works in any conditions. Crystal Group products are engineered and tested to meet or exceed strict MIL-SPEC standards. In addition, the product's thermal performance utilises custom heatsinking solutions and special air management techniques.

Crystal Group uses the latest COTS technologies for ease and speed of upgrades and reconfigurations, enabling the delivery of customised solutions that can meet the needs of any program. The company has fused the GPU and networking capabilities with the latest Intel Xeon Scalable processors to deliver secure, near-zero latency at the tactical edge.

**Metromatics Pty Ltd**
www.metromatics.com.au

new PRODUCTS

## RJ45 FIELD TERMINATION CONNECTORS

HARTING's RJ Industrial MultiFeature RJ45 connectors have been designed to meet users' requirements for easy installation in the field, due to features such as simple and tool-free assembly as well as a robust metal housing. Integrated blades shorten the individual strands to the correct length when closing the connector, virtually acting as a built-in side cutter. By eliminating such a time-consuming process, assembly should be more than 25% faster.

The series has been designed to meet all the requirements and challenges of a tough operating environment. It features safe Cat 6A performance with IP20 and IP65/67 housing, combined with PoE power supplies IEEE802.3af (PoE 15.4 W)/IEEE802.3at (PoE 25.5 W)/IEEE802.3bt (PoE 100 W) that supply data and power for any device. Other benefits include robust cable fastening; angled connectors with variable cable outlet direction; and suitability for flexible and solid wires from AWG 26 to 22.

**HARTING Pty Ltd**
www.harting.com.au




## FULLY RUGGED TABLET

Getac's next-generation UX10 is a powerful fully rugged tablet that is built to thrive in challenging working environments, such as those found in the public safety, utilities, natural resources and manufacturing industries. Building on the success of the original UX10, the next-generation rugged tablet is designed to deliver improved performance, storage and connectivity in a stylish chassis, while retaining the form factor of its predecessor.

Key features include a 10th Gen Intel Quad-core i5 or i7 processor and PCIe NVMe SSD storage technology, for up to six times faster speeds than SATA SSD, while the latest Intel Wi-Fi 6 AX200 module ensures stable connectivity in dense, congested environments. The product also features enhanced rugged protection, with MIL-STD-810H certification and drop resistance of up to 1.8 m while in tablet mode.

The product is part of the Getac Select program, which combines preconfigured rugged devices, software, accessories and professional services into a series of solutions optimised for individual applications and user groups. One example of this is the UX10-EX, designed to be a field services solution for engineers and technicians in the energy, natural resources and utilities industries. Incorporating intrinsically safe technology, the device meets stringent ATEX/IECEx standards for use in Zone 2/22 hazardous and potentially explosive environments that field professionals encounter on a regular basis. Extensive connectivity options make accessing remote tech support and uploading reports directly from the field fast and efficient, while all-weather functionality means the product can be used in every situation.

**Getac Technology Corp**
www.getac.com/apac

what's next

# Combating COVID-19 with track-and-trace wearables

u-blox, a global provider of leading positioning and wireless communication technologies and services, has announced that its Bluetooth 5 modules are being built into wearable devices that are helping to combat the global COVID-19 pandemic.

Available as either a wristband or a pendant, the TDS-50 has been developed by Florida's Electronic Precepts to present a highly effective track-and-trace solution, with data being directly stored on the device then periodically sent to a web server. In addition, through the social distancing function that is also featured, wearers are given visual and vibrational alerts if another TDS-50 wearer comes within a 2 m distance of them for over 45 seconds. The device can be used anywhere, from schools to businesses or airport settings.

The TDS-50 units needed a compact form factor to make them comfortable for the user to wear. They also had to support ultralow power operation, with the ability to deliver passive scanning (for social distancing purposes) over a period of up to 240 hours. Consequently, the wireless communication module specified had to meet both of these key criteria fully. Given the immediacy of the COVID crisis, it was also crucial that the solution could be brought to market very rapidly — with the constituent RF electronics being quick and simple to incorporate into the design and having all the necessary standards approvals in place.

The u-blox ANNA-B112 proved to have all the attributes needed. With dimensions of just 6.5 x 6.5 x 1.2 mm, the space-saving, integrated and pre-approved system-in-package (SiP) is optimised for situations where a swift turnaround is mandated. It is based on Nordic Semiconductor's nRF52832 chip-level Bluetooth technology, with a 64 MHz Arm Cortex-M4 processing resource plus 512 KB of embedded flash memory. Supporting 1.4 Mbps data rates, it is suited to wearables applications and does not impact heavily on battery reserves.

"u-blox were able to satisfy all our expectations with the ANNA-B112 module, allowing us to bring our track-and-trace device to market within a very short timeframe, while also addressing the stringent space and power constraints that had been set," said Electronic Precepts CEO Jeff Singer. "Over 10,000 TDS-50 units have already been shipped and demand is ramping up every day. We see huge potential for it in schools, businesses and theme parks, as well as within airport environments."

"This collaboration with Electronic Precepts gives us a valuable opportunity to highlight all of the key elements that make u-blox technology so appealing to numerous industry sectors," added Carl Bellanca, Head of Sales for u-blox Americas. "It underlines our ability to provide cutting-edge wireless solutions that have all the necessary processing and data storage capabilities, while also taking up minimal space and drawing only a relatively small amount of power."

*u-blox Singapore Pte Ltd*
*www.u-blox.com*

new PRODUCTS

## MULTICHANNEL AWG AND DIGITISER

Spectrum Instrumentation's hybridNETBOX is an instrumentation platform for applications that require simultaneous signal generation and acquisition. Six models are available offering the choice of two, four or eight pairs of matched AWG and digitiser channels, with output and sampling rates of 40, 80 and 125 MS/s.

With the ability to create and acquire electronic signals at the same time, the product is suitable for measurement systems that need to perform automated closed-loop or stimulus-response type testing. For example, it can reproduce and capture 'echo' signals such as those found in radar, sonar, lidar or ultrasound. With its multichannel capability, the device can test these systems even when arrays of transmitters and receivers are used.

The product is also suited to ATE applications where components and subassemblies need to be tested in a fast and automated way. It can quickly ascertain the functionality and tolerance of DUTs and UUTs (devices or units under test) by exercising them with numerous, easily adjusted, complex signals. This powerful testing process can be deployed in a host of applications like bus testing, MIMO communications, circuit verification, mechatronics and robotics.

The series was created for engineers and scientists that require precise, simultaneous waveform generation and signal acquisition in manual, automated or remotely controlled applications. The portable LXI instrument features hardware and software capabilities that allow all users to match their specific testing requirements as well as speed up their testing processes.

**TRIO Test & Measurement**
www.triotest.com.au



## IoT DATA MANAGEMENT SOFTWARE

Machinechat's JEDI One is an easy-to-use, all-in-one software application for IoT developers and solution architects to provision IoT data collection, visualisation, monitoring and local storage capabilities in minutes, thus accelerating IoT development and deployment.

The majority of today's IoT projects are stalled or delayed due to the complexity of developing custom software applications for each project, with as much as 50% or more of the cost going towards developing custom software to process, store and present IoT data. Machinechat's configurable IoT data management solution enables developers to readily integrate data collection, visualisation and monitoring into their IoT projects in minutes, saving them thousands of hours of custom software development.

The robust IoT software is suitable for engineers, developers and makers building IoT projects.

**Digi-Key Electronics**
www.digikey.com


## INERTIAL MEASUREMENT UNIT

Honeywell's HGuide i200 is a MEMS-based inertial measurement unit (IMU) that serves as a direct replacement for the HG1120, which featured industry standard communication interfaces and wide input voltage range for ease of integration. The i200 utilises inertial sensor technology, providing advanced precision inertial solutions. Offering guidance, control and pointing abilities in harsh environments, the product provides results for land, air or sea.

Despite being an entry-level product, the unit's compact size (1 $cm^3$) and weight (35 g) render it suitable for an array of applications, including agritech, AUVs, communications, industrial equipment, marine, oil and gas, robotics, survey and mapping, stabilised platforms, transportation, UAVs and UGVs. Consistent with other products in Honeywell's IMU suite, the device features nine degrees of freedom (DOF), which means it possesses gyroscopes, accelerometers and magnetometers.

The product also comes with a PC connection board that can convert RS-422 to USB, a USB cable that connects the interface PC connection board to a computer device and the HGuide Data Reader software.

**Supreme Components International (SCI)**
www.supremecomponents.com

# ELECTRONIC IMPLANTS

## COULD RESTORE SIGHT TO THE BLIND

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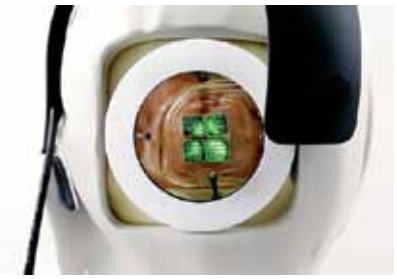
A cortical vision device developed by Monash University researchers could one day help restore sight to the blind, thanks to the use of miniaturised, wireless electronic implants that sit on the surface of the brain.

Many people who are clinically blind have damaged optic nerves, preventing signals from being transmitted from the retina to the 'vision centre' of the brain. The Gennaris bionic vision system — the brainchild of the Monash Vision Group (MVG) — is designed to bypass this damage, making it possible to treat many conditions that currently have treatment limitations.

The system comprises custom-designed headgear with a camera and wireless transmitter, a vision processor unit and software, and a set of 9 x 9 mm tiles that are implanted into the brain. The scene captured by the video camera in the headgear will be sent to the vision processor — similar in size to a smartphone — where it will be processed to extract the most useful information. The processed data will be transmitted wirelessly to complex circuitry within each implanted tile; this will convert the data into a pattern of electrical pulses, which will stimulate the brain via hair-thin microelectrodes.



"Cortical vision prostheses aim to restore visual perception to those who have lost vision by delivering electrical stimulation to the visual cortex — the region of the brain that receives, integrates and processes visual information," said MVG Director Professor Arthur Lowery, who is also principal investigator of the Cortical Frontiers project.

"Our design creates a visual pattern from combinations of up to 172 spots of light (phosphenes) which provides information for the individual to navigate indoor and outdoor environments, and recognise the presence of people and objects around them," he added. Further investigations have shown promise for this technology to deliver improved health outcomes to patients with neurological conditions such as limb paralysis.

The implant was recently trialled on sheep, in one of the first long-term tests of a fully implantable cortical vision prosthesis in the world — with the results published in the *Journal of Neural Engineering*. In preclinical studies, 10 arrays (seven active and three passive) were implanted using a purpose-built insertion system; stimulation was delivered through the seven active devices for up to nine months. Cumulatively, more than 2700 hours of stimulation was performed without any observable adverse health effects.

"The study results indicate that long-term stimulation through wireless arrays can be achieved without induction of widespread tissue damage, nor visible behavioural issues or seizures resulting from the stimulation," said Professor Jeffrey Rosenfeld, lead author of the study.

In June 2019, it was announced that the Cortical Frontiers project would receive more than $1 million under the Australian Government's Medical Research Future Fund (MRFF) Frontier Health and Medical Research program to advance the technology and put forward a detailed plan for future investment. The announcement of the second stage of MRFF funding, due to occur later this year, will support the best one or two applications with millions of dollars in funding across the next five years.

"If successful, the MVG team will look to create a new commercial enterprise focused on providing vision to people with untreatable blindness and movement to the arms of people paralysed by quadriplegia, transforming their health care," said Dr Philip Lewis from the Monash Department of Electrical and Computer Systems Engineering.

Dr Yan Wong, from the Monash Biomedicine Discovery Institute (Monash BDI), added, "The commercialisation of the bionic vision technology also ties in nicely to our plans for exploring further applications beyond vision and spinal cord injury, such as the moderation of epilepsy and depression, brain-controlled prosthetics, and the restoration of other vital senses."

With additional funding, it is hoped that the technology will be produced in Melbourne for distribution globally. Monash BDI's Professor Marcello Rosa said commercial success could see the creation of new export opportunities, highly skilled manufacturing and medical device design jobs, and economic growth for Australia.

"With extra investment, we'll be able to manufacture these cortical implants here in Australia at the scale needed to progress to human trials," Prof Rosa said.

# MANUFACTURING
## IN THE NEW NORMAL

Social distancing, protecting your employees, restarting operations and machines, catching up on supply chain gaps. Just like society as a whole, manufacturers are experiencing a lot of additional challenges they didn't expect, and to top it all many are facing reduced budgets. So how do you navigate the new manufacturing normal?

"Manufacturers are now trying to adapt to the changes in conditions, especially in two major aspects," said Hajime Sugiyama, Industrial IoT Evangelist of Factory Automations Systems Group, Mitsubishi Electric Corporation. "For example, how do you implement social distancing in a factory?"

It's a very interesting question, which has more permutations than most people initially consider. Starting with the individual we can all imagine the use of face guards and masks, and indeed many industries have traditionally used such PPE (personal protection equipment), but this was driven from a hygiene or clean environment standpoint for industries producing such things as food, drugs or even sensitive electronics and semiconductors. But such PPE is not necessarily desirable in all industries. For example, in hot or humid environments the act of wearing a mask may actually increase risks of heat exhaustion, so care must be exercised in truly understanding the worker's environment. Some plant managers are considering using screens between workers, but this is also not a panacea as there potentially can be space and restricted movement issues as well as possible problems around access to emergency devices, such as E-stops, or to reporting and controlling devices — or simply visibility challenges.

"Many manufacturers are focusing on social distancing through shift management," Sugayama said. "For shift management, you need to balance work shifts so that fewer people are working together at the same time to prevent a pandemic situation inside the factory. But this presents a whole new set of challenges."

While balancing shift patterns provides factory managers with a level of operational redundancy — ie, if one shift needs to be suspended due to infection, the second or third shift can continue business as usual after the plant has had a thorough cleaning — it is a natural consequence that fewer people working will naturally lower the productivity.

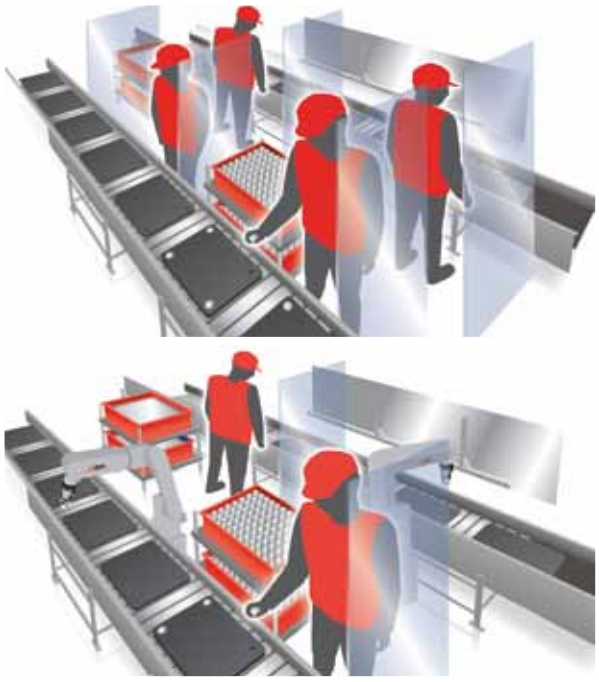
### Let your cobot take the strain

"Building extensive automation solutions takes a great deal of time, budget and planning," Sugiyama said. "And in these times when manufacturers want to get up and running quickly and flexibly, all three resources are likely to be in short supply."

So what's the alternative? One possible solution is the increased use of industrial collaborative robots. Typically these light devices can be quickly deployed, are human-friendly and are flexible enough that they can be quickly trained to do a variety of tasks, without needing extensive robotics expertise. On the whole, they are also quite cost-effective.

"It's clear one solution will not fit all, so flexibility to adopt the right social, 'mechanical' and collaborative solutions will be the norm," Sugayama said.


*Left: As an initial quick fix to social distancing in a factory, individuals could use face guards and masks.*



*Some plant managers are considering using screens between workers, but this is not a panacea as there can be operational limitations (top). One possible solution is the increased use of industrial collaborative robots (bottom).*

## Remote is not just for home workers

An additional area of consideration is remote access. Returning to full operations, restarting processes and lines, often reveals underlying problems that were not previously visible and can create a maintenance nightmare of unquestionable proportions. Remote access is a key benefit, but if the device you are accessing is not intelligent, the value is drastically reduced as the amount of information is restricted. However, if you are lucky enough to be using intelligent automation devices that have some degree of self-determination and extensive diagnostics, then resolving maintenance issues can be accelerated. But aren't all automation devices intelligent?

"While the essential product performance or function may be similar, you would be mistaken if you thought that all products are equal. For example, it is not really true to say 'a drive is a drive, is a drive'," Sugiyama said.

As an example, many users of inverters will be familiar with simple features such as a cooling fan, the significance of which only becomes apparent in times like now. The benefit of a 'smarter' inverter is in being able to diagnose the health of the cooling fan — which in turn helps extend the life of the inverter. In more recent inverter designs there are environmental sensors on the circuit boards to detect effects of corrosive or polluted atmospheres, which are complemented by the merging of communications, intelligence and AI through the inverter hardware and partner software to provide advanced maintenance diagnostics.

"Advances in product technology are not limited to the 'external function' of the device but also in how its operational life is managed, and that means maintenance and performance KPIs — but such know-how cannot remain locked up inside the product and really excels when it can be remotely accessed by maintenance teams," Sugayama explained.

IIoT, Industry 4.0, etc have already been talked about for years, but at their core is the process of communication, extraction of data and subsequent analytics. However, when plant managers consider remote access solutions they often quake in their shoes as they contemplate a large, extensive SCADA system and all its associated paraphernalia. It is true these comprehensive systems are excellent for capturing vast amounts of data, providing alarming and analytics and reviewing historical data, but as mentioned earlier they do take time to correctly plan and install. Other, quicker solutions can be to remotely, but directly, connect to a HMI device on the shop floor to mimic the local screen, or access data over a wireless interface, or as is the more recent trend, to utilise edge controllers.

## So what is the new normal?

"A practical approach is critical," Sugayama explained. "Sometimes the answer is simply a partition screen, other times it is an investment in a cobot, but the watch-words are 'flexibility', 'scalability' and 'results-focused'. So maybe the new normal is actually reminding us to identify what is important."

*Mitsubishi Electric Australia*
*www.mitsubishi-electric.com.au*

# TERAHERTZ CHIP

## EXCEEDS 5G TRANSMISSION SPEEDS

To enable data transmission speeds that surpass 5G standards for telecommunications, scientists from Nanyang Technological University, Singapore (NTU Singapore) and Osaka University have built a new chip using a concept called photonic topological insulators.



The researchers showed that their chip can transmit terahertz (THz) waves resulting in a data rate of 11 Gbps, which is capable of supporting real-time streaming of 4K high-definition video and exceeds the hitherto theoretical limit of 10 Gbps for 5G wireless communications. Their work has been published in the journal *Nature Photonics*.

THz waves are part of the electromagnetic spectrum, in between infrared light waves and microwaves, and have been touted as the next frontier of high-speed wireless communications; however, fundamental challenges need to be tackled before THz waves could be used reliably in telecommunications. Two of the biggest issues are the material defects and transmission error rates found in conventional waveguides such as crystals or hollow cables. These issues were overcome using photonic topological insulators (PTIs), which allows light waves to be conducted on the surface and edges of the insulators — akin to a train following railroads — rather than through the material.

When light travels along PTIs, it can be redirected around sharp corners and its flow will resist being disturbed by material imperfections. By designing a small silicon chip with rows of triangular holes, with small triangles pointing in the opposite direction to larger triangles, light waves become 'topologically protected'. This all-silicon chip demonstrated it could transmit signals error-free while routing THz waves around 10 sharp corners at a rate of 11 Gbps, bypassing any material defects that may have been introduced in the silicon manufacturing process.

NTU's Assoc Prof Ranjan Singh, leader of the project, said this was the first time that PTIs have been realised in the terahertz spectral region, which proves the previously theoretical concept, feasible in real life. The team's discovery could pave the way for more PTI THz interconnects — structures that connect various components in a circuit — to be integrated into wireless communication devices, to give next-generation '6G' communications an unprecedented terabytes-per-second speed (10 to 100 times faster than 5G) in future.

"With the Fourth Industrial Revolution and the rapid adoption of Internet of Things (IoT) equipment, including smart devices, remote cameras and sensors, IoT equipment needs to handle high volumes of data wirelessly, and relies on communication networks to deliver ultra-high speeds and low latency," Assoc Prof Singh said.

"By employing THz technology, it can potentially boost intrachip and interchip communication to support artificial intelligence and cloud-based technologies, such as interconnected self-driving cars, which will need to transmit data quickly to other nearby cars and infrastructure to navigate better and also to avoid accidents."

Assoc Prof Singh believes that by designing and producing a miniaturised platform using current silicon manufacturing processes, the new high-speed THz interconnect chip will be easily integrated into electronic and photonic circuit designs and will help the widespread adoption of THz in future. Areas of potential application will include data centres, IoT devices, massive multicore CPUs (computing chips) and long-range communications, including telecommunications and wireless communication such as Wi-Fi.

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# CHICKEN OR EGG?
# THE BOX OR THE PCB?

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