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As part of EMC Technologies' commitment to provide one-stop compliance testing services to the Australian electronics industry, the company is pleased to introduce the latest ISO 17025 accredited vibration and shock testing services using a state-of-the-art Hottinger Brüel & Kjær (HBK) vibration table.

The HBK Vibration and Shock combo table with a digital switching power amplifier is capable of providing random and sine peak forces. The system has half-sine shock capability and can perform sine on random vibrations. EMC Technologies is now accredited to provide the latest vibration and shock testing to MIL-STD-810, RTCA/DO-160, IEC 60068, AS4428.6, DEF (AUST) 5681, DEF STAN 00-35 and other standards, across the defence, aerospace, automotive, rail, infrastructure, transport and satellite industries.

EMC Technologies did not rest during the Melbourne and Sydney lockdowns. The team at EMC Technologies has been chipping away developing smooth processes to achieve 100% on-time delivery of projects and to minimise customer effort. The company has also purchased a next-generation three-phase regenerative power supply to enhance its EMC testing capabilities for electric vehicles and charging systems.

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JACK CONNECTORS AND THEIR FUTURE IN THE 21ST CENTURY

Almost everyone has heard about jack cables, plugs and sockets, but where exactly are they used?

In everyday life, this type of a connector can be found primarily in audio equipment, but the scope of its applications goes far beyond that. Therefore, it is worth learning more about it in order to learn how to recognise the different types of cables. In addition, we will also try to answer the question of what the future of jack connectors may be.

Different types of jack connectors

Jack plugs were widely used in telephone exchanges in the 20th century. However, it should be noted that later developed standards have gained greater popularity. The main parameters that distinguish the various types of jack plugs are the plug diameter and the number of signal fields/pins/paths.

6.35 mm 'large jack' (1/4")

A jack plug with a diameter of 6.35 mm, known widely as a large jack, is the largest connector of this type that is commercially used. Currently, we find it most often in professional audio equipment, when connecting guitars, microphones or mixers. Due to the common occurrence of interference, the large jack has already been partially replaced by XLR connectors, which are characterised by better parameters.

4.4 mm 'Bantam-type'

Connectors with a diameter of 4.4 mm are popularly known as Bantam-type. They can also be found mainly in professional studio equipment. Interestingly, this type of a connector is still in common use, despite its size. This can be illustrated by the fact that in 2015, Japanese company Nippon DICS developed a five-pin standard called Pentaconn, based on a 4.4 mm jack. The Pentaconn has been received quite warmly in the industry and has since found use in many musical devices.



3.5 mm 'mini jack' (1/8")

The mini jack, a plug with a diameter of 3.5 mm, is undoubtedly the most common type of jack connector. Thanks to it, we can connect various types of audio equipment to our phone, tablet or computer, most often in the form of headphones or speakers.

2.5 mm 'micro jack' (3/32")

The smallest type of jack plug is the so-called micro jack, the diameter of which

is 2.5 mm. This type of a connector can be found in older equipment, as a headphone connector and sometimes as a power connector. Due to its small size, the micro jack is susceptible to all kinds of mechanical damage.

Jack connectors' signal fields — TS vs TRS vs TRRS

Apart from the diameter of the plug itself, jack connectors are also characterised by



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the number of signal fields/pins/paths. Most often, we can find plugs with two, three or four fields. In professional documentation, the number of signal paths is reflected in the initialisms TS, TRS and TRRS. The number of characters always corresponds to the number of pins, and their meaning is: T (tip) in the first field, R (ring) in the middle (there can be several) and S (sleeve) pin, the last one that most often serves the function of a ground pin.

Advantages and disadvantages of jack connectors

Jack connectors, like all other connectors, have some advantages and disadvantages. The main advantage of this type of a plug is the fact that it can be inserted into the socket in any position. This feature, which prevents the plug from being inserted upside down, is the result of the original use of the jack connector in manual telephone exchanges. The most important disadvantage

of the jack is that when connecting the plug, the signal located on its tip (T) may temporarily connect to one of the contacts (R). Unfortunately, this is a consequence of how the jack connector is constructed.

Main applications of jack connectors

As you can imagine, jack sockets and pins are used primarily in audio equipment. Headphones, microphones, speakers, musi-



Bantam-type.



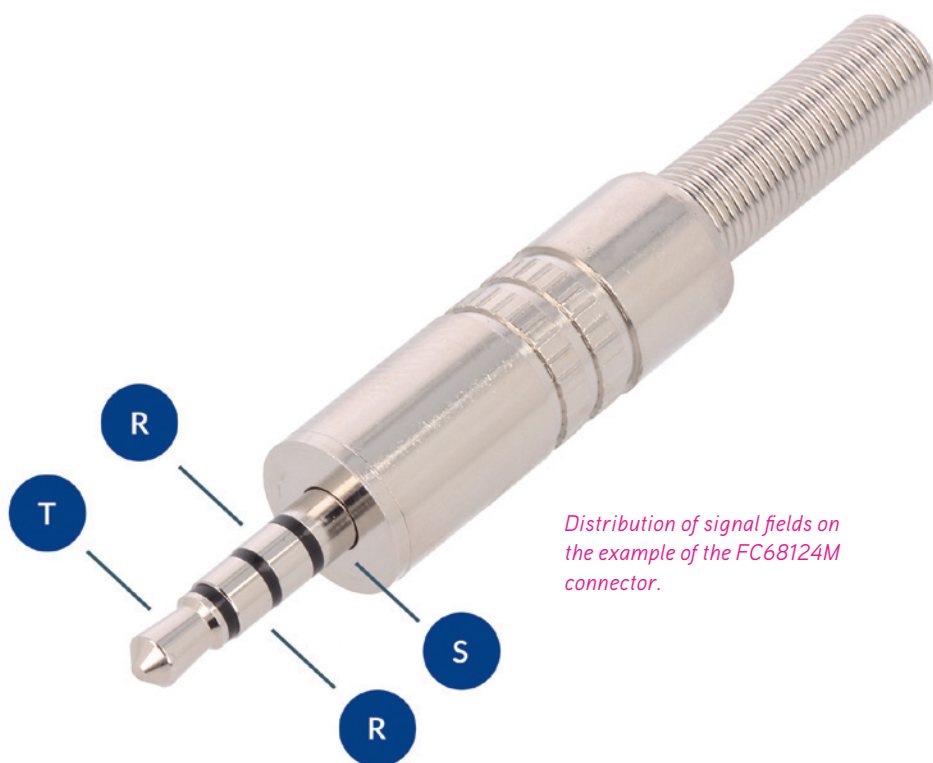
Large jack.



Micro jack.



Mini jack.



cal instruments — all of those are based on this type of cable.

A slightly less common application of jack connectors is in the airline industry. A rather unusual pin with a diameter of 7.2 mm, known as 'NATO pin', is commonly used in military aircraft which are operated by member states of the North Atlantic Treaty Organization. Due to their versatility, jack cables are used in aircraft to connect individual electronic modules.

Jack connectors are also used in TV sets, and these are not only the mini jack outputs used for connecting external headphones, but also a micro jack socket, which is sometimes hidden under the back cover. Many manufacturers place a dedicated service connector on their motherboards in the form of a micro jack socket. It is used for communication with the TV set's motherboard during the production process, so that it is possible to determine, eg, the status of the TV board programming process and the TV mode, and to send certain features to the TV set that enforce certain functions.

Possible future of jack connectors

Nowadays, it may seem that jack connectors are losing their importance and are being replaced by other solutions. This is especially visible in the mobile phone industry. This process was originally initi-

ated by Apple in 2016, and since then many manufacturers have followed it, resigning from the dedicated jack connector in favour of the universal USB-C connector. The pros and cons of this state of affairs deserve a separate article, but the fact is that more and more smartphones are left without a headphone connector.

However, the professional stage and music industry keeps on relying on jack connectors. Additionally, new jack standards, such as Pentaconn, are still being developed.

Thanks to their versatility, jack connectors are also widely used in the industry. The transmitted signals do not necessarily have to be electric sound; they can also be signals of specific communication interfaces, enabling connection between individual modules of machines or devices. Jack connectors are likely to disappear completely from mobile phones, but they will continue to be used in professional audio equipment and industry, as these are areas where miniaturisation has not gone so far, and where upgrading components or entire machines would be exceptionally costly. At the same time, jack connectors are still great for such applications and can be successfully used for many years to come.

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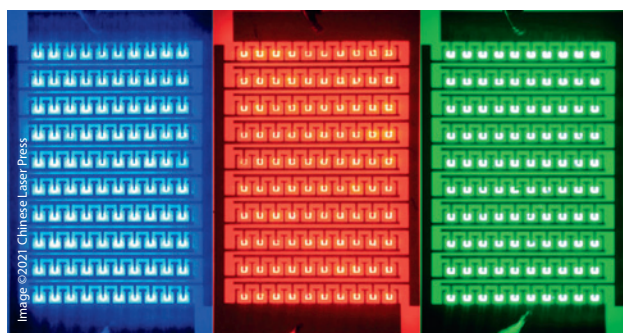
FULL-COLOUR LEDs ON THE MICROSCALE

Micrometre-scale light-emitting diodes (μ LEDs) are the ideal building block for next-generation displays used in head-mounted monitors, mobile phones and televisions because they are bright, respond quickly, offer longevity and consume little energy. Researchers from the King Abdullah University of Science and Technology (KAUST) have now shown that these scaled-down devices can efficiently emit light across the entire visible-light spectrum.

Just as with conventional LED displays, full-colour μ LEDs products will require arrays of blue, green and red light sources. Nitride-based alloys are a group of semiconducting materials that offer one route to achieving this because, with the right chemical mix, they can emit all three colours. However, when nitride devices are reduced in size to micrometre scales, they become very poor emitters of light.

"The main obstacle to reducing the size of the devices is the damage to the sidewalls of the LED structure generated during the fabrication process," said KAUST PhD student Martin Velazquez-Rizo. "Defects provide an electrical path for a leakage current that does not contribute to the light emission." This effect gets worse as the size of the LED shrinks, which has limited the LED size to approximately $400 \times 400 \mu\text{m}$.

Velazquez-Rizo, along with his colleagues Zhe Zhuang, Daisuke Iida and Kazuhiro Ohkawa, have developed bright red indium gallium nitride μ LEDs of just $17 \times 17 \mu\text{m}$. The team used a thoroughly calibrated atom deposition technique to create a 10×10 array of red μ LEDs; the damage to the μ LED sidewalls was then eliminated using a chemical treatment.



"We confirmed with atomic-scale observations that the sidewalls had high crystallinity after the treatment," Velazquez-Rizo said.

As published in the journal *Photonics Research*, the team observed very high output power of 1.76 mW from each square millimetre on the device's surface — a notable improvement on previous devices that reported an output power of less than 1 mW/mm^2 . The team then demonstrated their red μ LEDs with green and blue indium gallium nitride μ LEDs to create a wide colour-range device.

"The next step in our research is to further improve the efficiency of our μ LEDs and decrease their lateral dimensions below $10 \mu\text{m}$," Velazquez-Rizo said.

JAPAN AND FINLAND COLLABORATE ON DEVELOPMENT OF 6G



Japan and Finland have initiated a bilateral partnership, through a collaboration between The University of Tokyo and the University of Oulu, to develop technologies and standards for the sixth generation of wireless communications, commonly known as 6G. Over the next few years, a roadmap for the 6G standard will be created and research into the technological components carried out.

Matti Latva-aho, academy professor at the University of Oulu and Director of Finland's 6G Flagship research program, has been appointed a global research fellow at the University of Tokyo. There he will collaborate with Professor Akihiro Nakao at Tokyo's Graduate School of Engineering, and their team will work to research and develop future 6G technologies and technical standards.

Prof Nakao believes 6G technology could impact society in many different ways, saying it's "not just about higher speeds and faster response".

"The aims of 6G include massive improvement in power efficiency, security based on quantum mechanics, AI-driven network optimisation, integration with satellite networks and more," he said. "For day-to-day life, all this means people will have a more seamless experience communicating with each other, as well as interacting with services and devices."

Some areas of life that could benefit from 6G include health care, where low-power embedded sensors could communicate health data in real time to doctors or expert systems, or even disaster response, as integration with satellite platforms means that if ground-based infrastructure is damaged then essential communication can be maintained.

Profs Latva-aho and Nakao both hope the Japan–Finland collaboration can leverage the best each country has to offer. Both countries have a history of pushing forward the boundaries of communications technology by developing global standards and generating iconic brands such as Nokia.

"As an engineer, the development of technology is of course very exciting, but 6G goes beyond that. Rather than a communications infrastructure, it feels more like a social infrastructure," Prof Nakao said. "We have acquired funding for 10 large-scale national projects, including semiconductor development, augmented reality, satellite communications and more. And we hope to bring the fruits of our research to the university campus, where we can demonstrate the capabilities of 6G firsthand by offering immersive, remote, hands-on lectures before rolling out the technology to the public."

Our capabilities

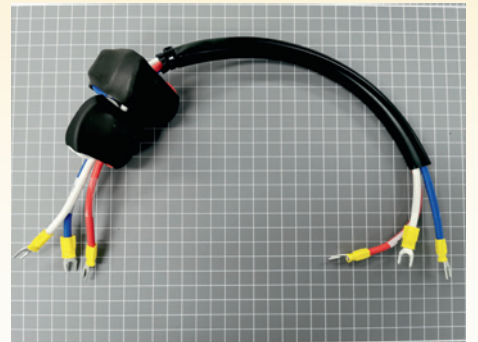
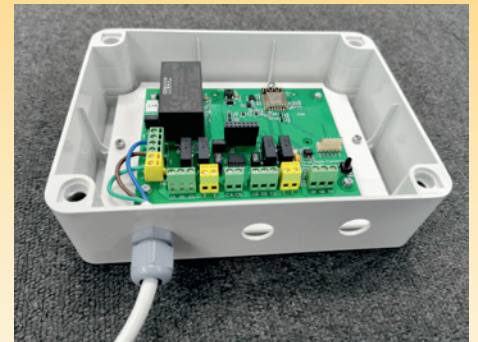
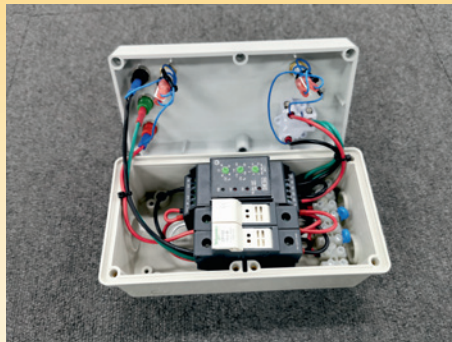
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A SPOONFUL OF SUGAR STABILISES LITHIUM-SULFUR BATTERIES

Australian researchers have managed to stabilise lithium-sulfur battery technology, long touted as the basis for the next generation of batteries, by using a glucose-based additive on the positive electrode — a spoonful of sugar, if you will.

In theory, lithium-sulfur batteries could store 2–5 times more energy than lithium-ion batteries of the same weight. The problem was that in use the electrodes deteriorated rapidly, and the batteries broke down. There were two reasons for this: the positive sulfur electrode suffered from substantial expansion and contraction, weakening it and making it inaccessible to lithium, and the negative lithium electrode became contaminated by sulfur compounds.

Last year, researchers from the Monash Energy Institute demonstrated that they could open the structure of the sulfur electrode to accommodate expansion and make it more accessible to lithium. More recently, they were inspired by a 1988 geochemistry report that describes how sugar-based substances resist degradations in geological sediments by forming strong bonds with sulfides.

By incorporating sugar into the web-like architecture of the electrode, the team successfully stabilised the sulfur, preventing it from moving and blanketing the lithium electrode. Test-cell prototypes have been shown to have a charge-discharge life of at least 1000 cycles, while still holding far more capacity than equivalent lithium-ion batteries, as reported in the journal *Nature Communications*.

“Each charge lasts longer, extending the battery’s life,” said first author and PhD student Yingyi Huang. “And manufacturing the batteries doesn’t require exotic, toxic and expensive materials.”

“In less than a decade, this technology could lead to vehicles including electric buses and trucks that can travel from Melbourne to Sydney without recharging,” added lead author Professor Mainak Majumder, Associate Director of the Monash Energy Institute. “It could also enable innovation in delivery and agricultural drones, where light weight is paramount.”

Dr Mahdokht Shaibani, second author and Monash researcher, noted, “While many of the challenges on the cathode side of the battery have been solved by our team, there is still need for further innovation into the protection of the lithium metal anode to enable large-scale uptake of this promising technology — innovations that may be right around the corner.”



The Monash Energy Institute team includes Mahdokht Shaibani, Mainak Majumder, Matthew Hill and Yingyi Huang.

MODIFIED NANOMATERIAL MAKES SOLAR CELLS MORE EFFICIENT

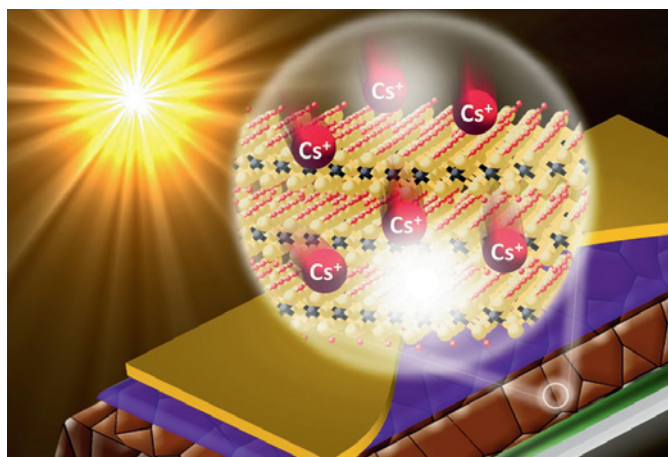


Image courtesy of the study authors under CC BY-NC-ND 4.0

Australian and Swiss researchers have modified a nanomaterial to make perovskite solar cells as efficient as silicon-based cells, without their high cost and complex manufacturing.

The work was led by The University of Queensland’s (UQ) Australian Institute for Bioengineering and Nanotechnology (AIBN) in collaboration with the École polytechnique fédérale de Lausanne (EPFL). UQ’s Professor Joe Shapter said the team’s breakthrough, published in the journal *Cell Reports Physical Science*, addresses an urgent need for alternative environmentally friendly energy sources capable of providing efficient and reliable energy production.

“Silicon-based solar cells remain the dominant first-generation product, making up 90% of the market, but demand was high for cells that could be manufactured without their high prices and complexity,” Prof Shapter said.

“Among the next-generation technologies, perovskite solar cells (PSCs) have attracted enormous attention because of their high efficiency and ease of fabrication.

“But the new generation of solar cells still have some drawbacks, such as poor long-term stability, lead toxicity and high material costs.”

Prof Shapter said his team studied a nanomaterial that showed great promise in overcoming some of the new cell’s drawbacks, and used doping to modify the nanomaterial to enhance the cell’s electrical properties. The researchers found that the efficiency and thermal stability of the doped cells significantly outperformed those that were not doped.

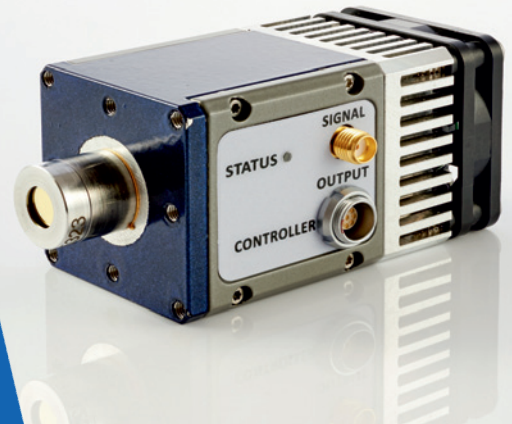
“The PSCs that had doped cells showed a remarkable solar conversion efficiency that exceeded 21%,” Prof Shapter said. In comparison, the average silicon cell efficiency currently sits between 15 and 22%.

Associate Professor Yun Wang from Griffith University contributed modelling to understand the interaction between doped cell layers and materials used in light absorption. He said, “Our results explain how doped cells can greatly improve the energy conversion efficiency and lifetime of solar cells observed from the AIBN experiments.”

Prof Shapter said the team’s research is part of a global push towards advanced and sustainable solar cell technology, and contributes to “intensive efforts to develop various types of solar cells with the aim of realising efficient, stable and low-cost replacements for present silicon-based technology”.

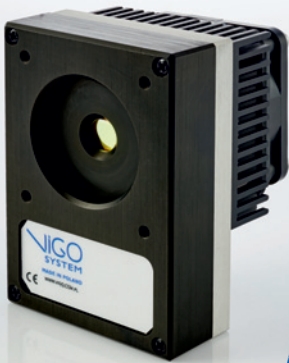


Infrared detectors for specialist and industrial applications



Laboratory infrared detectors

- Optimal wavelength: $6\mu\text{m}$ or $10.6\mu\text{m}$
- Operating frequency: 200MHz or 100MHz
- Sensitive to IR radiation polarisation
- Applications: gas composition analysis, temperature measurement, explosion protection

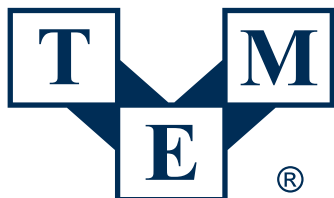


Ultra high speed detection modules

- Optimal wavelength: $10.6\mu\text{m}$
- Suitable for interferometry and telemetry applications
- Applications: communication, dual-comb spectroscopy, 3D scanners

General purpose detectors

- Optimal wavelength: $6\mu\text{m}$ or $10.6\mu\text{m}$
- Operating frequency: 1MHz, 70MHz or 100MHz
- Applications: laser monitoring, beam positioning, gas detection/analysis

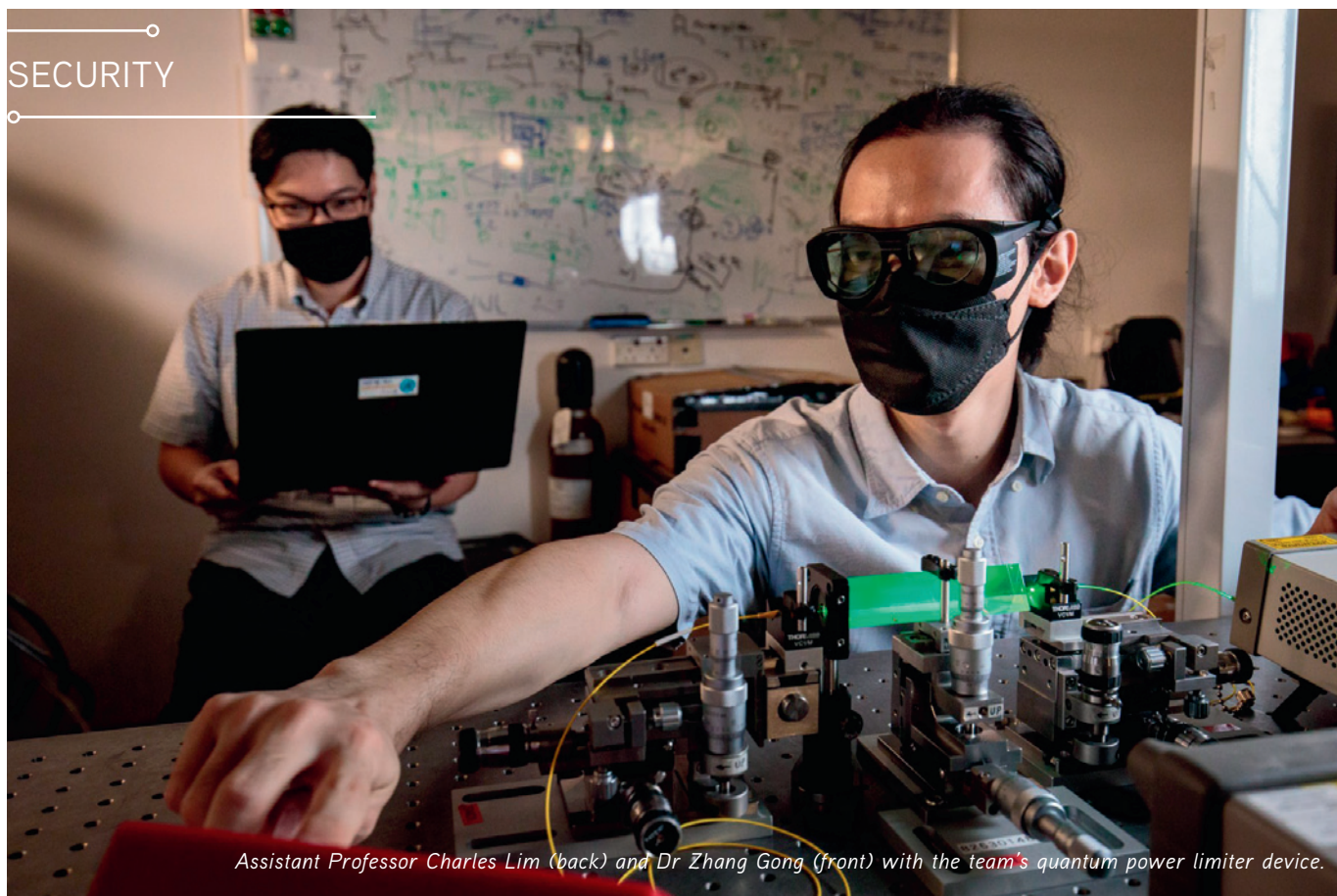


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Assistant Professor Charles Lim (back) and Dr Zhang Gong (front) with the team's quantum power limiter device.

TWO STEPS CLOSER TO ATTACK-PROOF QUANTUM COMMUNICATION

Quantum key distribution (QKD) is a method for secure communication that uses quantum mechanics to encrypt information — but while the security of QKD is unbreakable in principle, vital information could still be stolen by attackers if it is incorrectly implemented.

Researchers from the National University of Singapore (NUS), led by Assistant Professor Charles Lim, have now developed two methods to ensure that QKD communications cannot be attacked in this way.

A futureproof quantum communication protocol

Typically, in QKD, two measurement settings are used — one to generate the key and the other to test the integrity of the channel. The NUS team developed an ultrasecure cryptography protocol in which users can independently test the other party's encryption device by generating a secret key from two randomly chosen key generation settings instead of one. In a paper published in the journal *Nature Communications*, the researchers demonstrated that introducing an extra set of key-generating measurements for the

users makes it harder for attackers to eavesdrop on the exchange of keys, known as a 'side-channel attack'.

"It's a simple variation of the original protocol that started this field, but it can only be tackled now thanks to significant developments in mathematical tools," said Professor Valerio Scarani, a co-author on the study and one of the inventors of this type of method.

Compared to the original 'device-independent' QKD protocol, the new protocol is said to be easier to set up, as well as more tolerant to noise and loss. It is claimed to give users the highest level of security allowable by quantum communications, empowering them to independently verify their own key generation devices. With the team's set-up, all information systems built with 'device-independent' QKD would be free from misconfiguration and mis-implementation.

"Our method allows data to be safe against attackers even if they have unlimited quantum computing power," Asst Prof Lim said. "This approach could lead to a truly secure information system, eliminating all side-channel attacks and allowing end users to monitor its implementation security easily and with confidence."

A quantum power limiter device

Quantum cryptography, in practice, uses optical pulses with very low light intensity to exchange data over untrusted networks. Leveraging quantum effects can securely distribute secret keys, generate truly random numbers and even create banknotes that are mathematically unforgeable.

However, experiments have shown that it is possible to inject bright light pulses into the quantum cryptosystem to break its security. This side-channel attack strategy exploits the way injected bright light is reflected to the outside environment, to reveal the secrets being kept in the quantum cryptosystem.

In a new paper published in the journal *PRX Quantum*, the NUS researchers reported their development of an optical device to address this issue. It is based on thermo-optical defocusing effects to limit the energy of the incoming light. The researchers use the fact that the energy of the bright light changes the refractive index of the transparent plastic material embedded in the device, thus it sends a fraction of the light out of the quantum channel. This enforces a power-limiting threshold.

The power limiter can be seen as an optical equivalent of an electric fuse, except that it is reversible and does not burn when the energy threshold is breached. It is highly cost-effective and can be easily manufactured with off-the-shelf components. It also does not require any power, so it can be easily added to any quantum cryptography system to strengthen its implementation security.

"It is imperative to close the gap between the theory and practice of quantum secure communications if we are to use it for the future quantum internet," Asst Prof Lim said. "We do this holistically — on one hand, we design more practical quantum protocols, and on the other hand, we engineer quantum devices that conform closely with the mathematical models assumed by the protocols. In doing so, we can significantly narrow the gap."

"Rapid advances in quantum computing and algorithmic research mean we can no longer take today's toughest security software for granted. Our two new approaches hold promise to ensuring that the information systems which we use for banking, health and other critical infrastructure and data storage can hold up any potential future attacks."



OPEN-SOURCE BOARD

Red Pitaya's @HOME kit is an easy-to-use remote lab or take-home kit that was created specifically for teachers and students working remotely or at home. All applications are accessible via a web-based user interface and future operating system updates are completely free of charge.

The Red Pitaya STEMlab 125-10, on which the kit is based, is an all-in-one, open-source board that can replace 12 benchtop lab instruments. Features include MATLAB remote control, LabVIEW control, FPGA programming, Jupyter/Python programming, oscilloscope, signal generator, spectrum analyser, LCR meter and more.

The kit offers the versatility and portability to bring lab exercises to remote or at-home settings. Developed in order to provide a hassle-free teaching and learning experience, it is available with free step-by-step teaching examples to make class preparations easier.

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FUSE HOLDERS

Bulgin fuse holders are designed to provide the high level of protection required in today's sophisticated electronic equipment. The fuse accessories hold world safety certifications by UL, VDE, CSA and IMQ. They are manufactured from flame-retardant nylon and polyester, which allows them to operate in a temperature range from -20 to 90°C.

The holders are made to handle 250 VAC and are dedicated to 5 x 20 and 6.3 x 32 mm fuses. Users are also offered a choice of cable-, PCB- and panel-mounted holders, among others.

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VoltServer's Digital Electricity technology is designed to safely transmit up to 2 kW of power across long distances using off-the-shelf data cables. The company's technology has been deployed in hundreds of venues including stadiums, airports, convention centres, office towers, hotels, condominiums, hospitals and indoor gardens, powering 4G, 5G and Wi-Fi wireless communications, LED lighting and IoT applications.

Digital Electricity is a line powering system, which is a means of energising remote equipment from a centralised location over structured copper cable. It runs high-voltage power over lightweight data cable and delivers low current downstream to power loads. It's a natively digital form of electricity transmission that can be considered a third power format in addition to AC and DC.

VoltServer takes conventional electricity and breaks it into small pulses, or 'energy packets'. Each packet is sent to a receiver from a transmitter that contains local, embedded processing. Each energy packet is analysed using a digital signal processing engine to determine that power is being precisely and safely distributed. If a fault is detected, the next energy packet is not sent. Each packet contains only a very small amount of energy, so individually they are not harmful to people, animals, systems or buildings. The receiver converts Digital Electricity back into analog AC or DC to power local loads.

"Imagine a powerful stream of water sent through your plumbing," said VoltServer co-founder and CEO Stephen Eaves. "If a pipe were to burst, the high pressure could injure someone. Instead, break the stream down into millions of droplets. The droplets can be put back together to get the amount of water needed, but each droplet of water is safe. Digital

Electricity is similar by only putting a small amount of energy in packets. Each packet becomes safe, but the total power needs can still be met."

Because of its inherently safe energy-transfer design, the Digital Electricity platform can send power over a distance up to 2 km using off-the-shelf structured copper communications cable and Class 2, low-voltage wiring methods. Similar to Power over Ethernet, this enables VoltServer to transport both digital data and power in a single hybrid cabling infrastructure, which is said to make it easier and more economical to install than conventional 110/220 V electrical systems.

This allows architects, designers and facility managers to quickly and easily configure and reconfigure wireless networks, office floorplans and agricultural grow rooms. Because the platform is natively digital, it provides

insights into energy use with a centralised dashboard. This gives building operators and maintenance staff a granular view of their electric grid to better manage critical loads while eliminating the need for traditional circuit breaker panels.

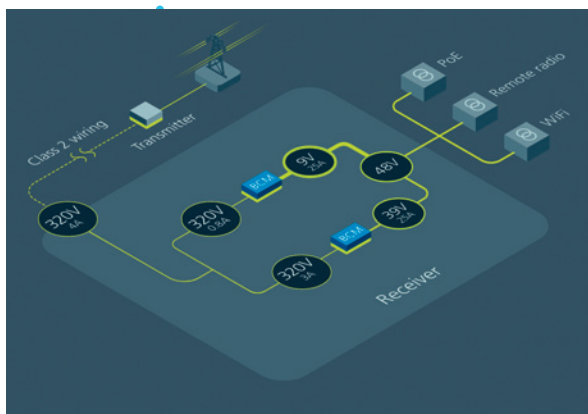
Ruggedised, passively-cooled BCM DC-DC fixed-ratio bus converters from Vicor are designed into the receivers, transforming the higher transmission voltage to a safe low voltage to power the loads. The 97% power efficiency allows cooling without a fan, enabling the receivers to be placed in tight, enclosed spaces that are too small to accommodate cooling fans. This allows the VoltServer platform to operate efficiently with small heat sinks and shrinks the receiver footprint.

"With the Vicor converter, we have 43% less heat loss than a normal converter, and the heat sink size decreases proportionately," said Dan Lowe, VoltServer co-founder and Chief Business Officer. "Our customers include the top three mobile network operators in the US, so the requirements for reliability are extremely demanding."

VoltServer uses the Vicor BCM6123 fixed-ratio bus converter (25 x 61 x 7 mm) in the endpoint receivers to efficiently convert the power packets. Vicor BCMs use a low-noise, high-efficiency Sine Amplitude Converter (SAC) topology that requires little electromagnetic filtration. This further shrinks the power system footprint and simplifies the design while meeting EMI standards.

"With so little electromagnetic filtering needed, we can make the Digital Electricity receiver very compact and mount it pretty much anywhere," Lowe said. "Any other converter would generate more heat. That means that the receiver box would need to be much bigger and would require a lot more cooling — and ultimately would cost a lot more and be more difficult to install."

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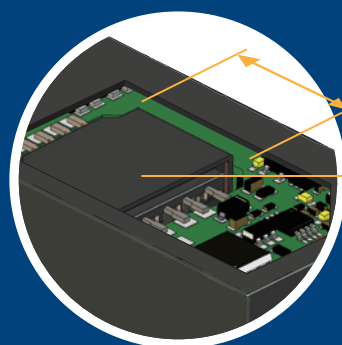
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CONTACTLESS SWITCH

The COVID-19 pandemic has greatly increased the demand for non-contact push-buttons and switches, since the invisible transmission of viruses and bacteria are often through high-contact surfaces. A wide variety of technologies for contactless switching are vying for the attention of developers and buyers, but not all technologies are the same. There are instances, for example, where false signals are picked up by the sensor under certain conditions (eg, splashed water, rain) and this triggers unintentional switching.

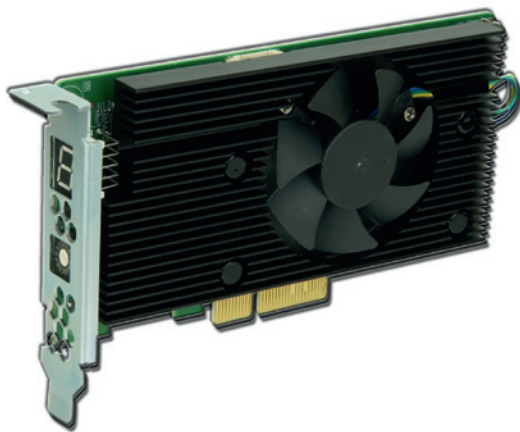
The optical TOF (time-of-flight) technology used in SCHURTER's TTS contactless switch can be programmed with precision and prevent such errors. Detection distance to activate the switch can be programmed at 60 to 0.05 mm, meaning that wiping over when cleaning the switch surface will not trigger and activate the sensor. The advantage of such customisable

detection distance is that the switch can be used as a photoelectric barrier for certain applications.

Housed in stainless steel, visual feedback and status indication are via a bicolour ring illumination (red/green) in the actuator, whose input voltage is between 5 and 28 VDC. Maximum switching voltage is 42 VAC/60 VDC with a maximum current of 100 mA.

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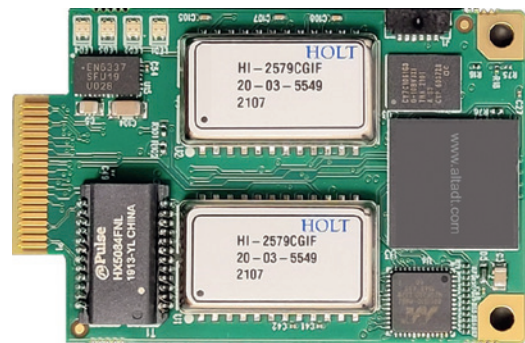
iEi's Mustang-V100-MX4 is a deep learning convolutional neural network acceleration card for speeding up AI inference in a flexible and scalable way. Equipped with Intel Movidius Myriad X vision processing unit (VPU), the PCIe card can be used with an existing system, enabling high-performance computing.

VPUs can run AI quickly and are suited to low power-consumption applications such as surveillance, retail and transportation. With the advantage of power efficiency and high performance to dedicate DNN topologies, they can be implemented in AI edge computing devices to reduce total power usage, providing longer duty time for the rechargeable edge computing equipment.

The accelerator card supports OpenVINO toolkit, which is based on convolutional neural networks (CNN) and extends workloads across Intel hardware, maximising performance. It can optimise pre-trained deep learning models such as Caffe, MXNET and Tensorflow into IR binary file then execute the inference engine across Intel-hardware heterogeneously, such as the CPU, GPU, Intel Movidius Myriad X VPU and FPGA.

ICP Electronics Australia Pty Ltd

www.icp-australia.com.au



EMBEDDED MIL-STD-1553 MEZZANINE BOARD

Alta Data Technologies has released the MEZ-E1553 mini embedded mezzanine board for MIL-STD-1553 networks. The product provides 1-2 dual-redundant 1553A/B/C channels with an Ethernet backplane interface on a 3.6 x 5.6 cm PCB, available in Dual (BC/BM or mRT/BM) or Full Function (BC/mRT/BM) models.

For the company's existing customers, the product can be quickly integrated into their system and utilise the same AltaAPI SDK software as other Alta products, often without recompiling their application. For new customers, the Berkley socket layer means the board will work with almost any operating system. The MEZ-E1553 complements the Mini PCI Express embedded cards (MPCI2-1553) for systems like COM Express.

Alta offers a design reference card with complete schematics, STEP 3D files and break-out cables for bench testing. The user can connect the MEZDEV-E01 board to their development computer via Ethernet and write their application while designing the hardware. Suitable for any rugged, custom requirement, the mezzanine board includes a signal capture (o-scope) capability for troubleshooting 1553 cable issues and cybersecurity signal modelling.

Metromatics Pty Ltd

www.metromatics.com.au

TELECOMS TESTING IN A 5G WORLD

5G-capable devices are well and truly here.



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Partnerships between technology and service providers are emerging, and carriers are covering the nation with their 5G infrastructure. 2021 is the year that 5G has gone from this amazing new unknown thing to mainstream.

5G's high speeds and lower latency technology is actually being put into practice this year in a real way as the country's largest carriers build their 5G networks, capabilities and extend service into metro and regional Australia. 5G-capable smartphones, laptops, and tablets are hitting the market this year, so consumers and business users are getting to experience 5G service for themselves.

While 5G was a consumer play in the beginning, service providers have been prioritizing business use cases this year with the introduction to 5G for business internet services. But it's not just the biggest wireless providers making news. 5G-focused startups are entering the game, from companies offering infrastructure to those making private 5G connections a reality for businesses of all sizes and powering IoT and edge computing.

With the emerging technology comes the upcoming publication of AS/CA S042.5, a new part of the series of Australian standards for cellular customer equipment. Revisions are being made to this series of standards, including revised and more detailed Emergency Service Access requirements for 4G Voice over LTE, 5G Voice over New Radio and Voice over Wi-Fi technologies as well as a new requirement for Advanced Mobile Location supported technologies.

IoT and 5G will have an impact on a vast array of different products and industries including the mining sector, factory automation and road safety, providing fast internet services for home automation and more. It will provide real-time accessibility to those who really need it, bringing the world literally to their fingertips.

As someone once said, "We know that short-term choices carry long-term impacts. That's why we want to ensure our customers address the short-term concerns effectively, while helping them build a robust foundation for the future by ensuring their products are released to market with peace of mind."

Crucially important will be the provision of 5G Voice over NR supported smartphone and smartwatch devices, in delivering a safe and reliable platform for accessing emergency services in times of crisis. Our experienced and qualified team have the expertise to ensure such devices meet all aspects of voice communications over 5G and all other legacy cellular platforms. Choose Comtest's quality expertise to help you provide a safer

world for your consumers in a rapidly changing and evolving technological world.

Modern telecommunications systems are marvels of design and engineering. But nothing is perfect. Consumers expect telecoms products to work flawlessly whether they are purchased on the public market or supplied to businesses.

It's essential that telecom manufacturers and importers have their systems tested to Australian standards to ensure compliance before they go to market. In a world of ever-changing equipment and compliance standards, only Comtest Laboratories offers a complete telecommunications testing service you can rely on.

Comtest leads the way for telecoms testing

Comtest Laboratories is the only telecommunications testing group certified by the National Association of Testing Authorities (NATA) in Australia. This certification is an endorsement of Comtest's proven telecommunications testing experience over more than thirty years. Our experience and expertise in the field allows us to test and assess telecoms systems to ensure they comply with the technical standards they must meet.

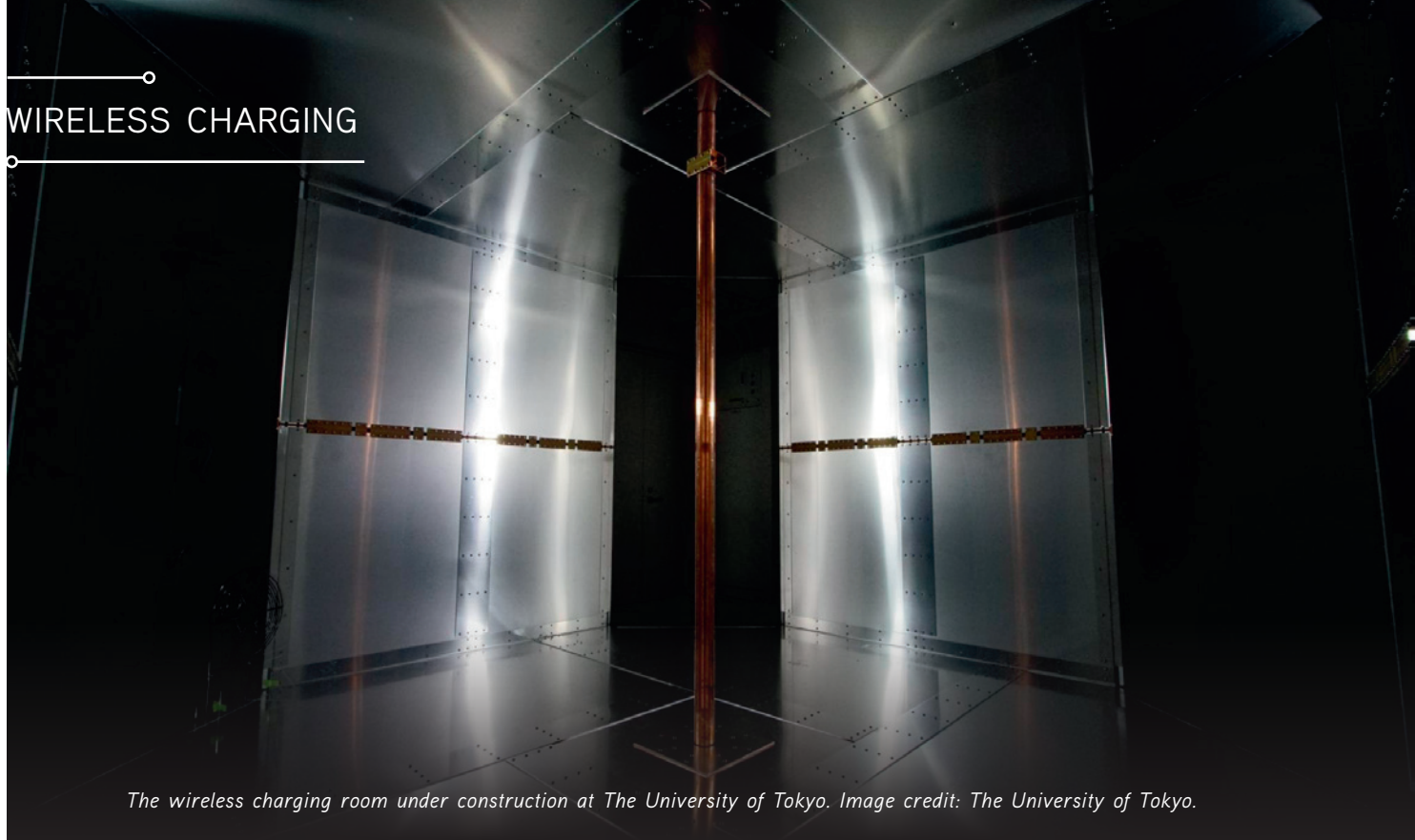
Comtest can complete compliance assessment and certification services for analogue and digital phone systems across the spectrum of consumer and industry technology.

Telecommunications testing is more than just making sure the gear switches on and lights up. To thoroughly test acoustic telecoms gear, Comtest deploys a Head And Torso Simulator (HATS) that uses an artificial ear to make sure the technology being tested operates as it's intended for human senses and is within permissible limits.

This innovative approach is just one example of the lengths Comtest will go to guarantee that your telecoms gear is ready to use. Using high-precision equipment in temperature-regulated laboratories, Comtest will test the efficacy of your products, calibrate electronic equipment and ensure safety to an extraordinary level of accuracy. Our combination of high-quality equipment and deep expertise as Australia's oldest telecommunications testing lab allows us to tackle any telecommunications testing to the highest standards.



Comtest Group
www.comtest.com.au



The wireless charging room under construction at The University of Tokyo. Image credit: The University of Tokyo.

'CHARGING ROOM' POWERS DEVICES WITHOUT WIRES

Researchers at The University of Tokyo (UTokyo) and the University of Michigan (U-M) have developed a system to safely deliver electricity over the air, potentially turning entire buildings into wireless charging zones. Described in the journal *Nature Electronics*, the system can deliver 50 W of power using magnetic fields.

The researchers said their technology is a major improvement over previous attempts at wireless charging systems, which use potentially harmful microwave radiation or require devices to be placed on or near dedicated charging pads. Instead, it uses a conductive surface on room walls and a conductive pole to generate magnetic fields. Devices harness the magnetic field with wire coils, which can be integrated into electronics like mobile phones.

According to study author Professor Alanson Sample, from U-M, the key to making the system work was building a resonant structure that could deliver a room-size magnetic field while confining harmful electric fields, which can heat biological tissues. The team's solution used devices called lumped capacitors; placed in wall cavities, these generate a magnetic field that resonates through the room, while trapping electric fields inside the capacitors themselves. Previous wireless systems were limited to either delivering large amounts of power over a few millimetres or very small amounts of power over long distances.

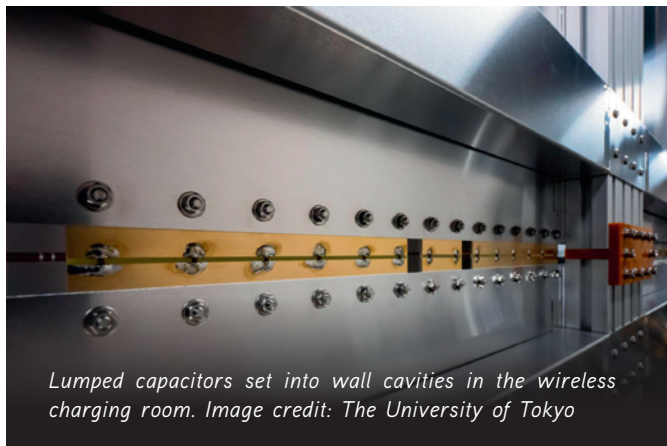
A second hurdle was how to generate a magnetic field that reaches every corner of the room — magnetic fields tend to travel in circular patterns, creating dead spots in a square room. In addition, receivers need to align with the field in a specific way to draw power.

"Drawing power over the air with a coil is a lot like catching butterflies with a net," Prof Sample said. "The trick is to have as many butterflies as possible swirling around the room in as many directions as possible. That way, you'll catch butterflies no matter where your net is or which way it's pointed."

To make that happen, the system generates two separate, 3D magnetic fields. One travels in a circle around the room's central pole, while the other swirls in the corners, travelling between adjacent walls. This approach eliminates dead spots, enabling devices to draw power from anywhere in the space.

The team demonstrated the technology in a purpose-built aluminium test room measuring approximately 3 x 3 m, wirelessly powering lamps, fans and phones that could draw current from anywhere in the room regardless of the placement of people and furniture. The coil receivers needed to be aligned at right angles to the magnetic field to achieve maximum efficiency; however, power delivery efficiency exceeding 37.1% was still achievable anywhere in the room and also while a device was in motion.

Tests with anatomical dummies showed that the system could deliver at least 50 W of power to any location in the room without exceeding US Federal Communications Commission (FCC) guidelines for electromagnetic energy exposure. Prof Sample said it's likely,



Lumped capacitors set into wall cavities in the wireless charging room. Image credit: The University of Tokyo



The finished charging room, located at The University of Tokyo. Image credit: The University of Tokyo.

however, that it will be possible to deliver higher levels of power with further refinement of the system.

Prof Sample added that, further untethering phones and laptops, the technology could also power implanted medical devices and open new possibilities for mobile robotics in homes and manufacturing facilities. The team is also working on implementing the system in spaces that are smaller than room-size; for example, a toolbox that charges tools placed inside it.

"This really ups the power of the ubiquitous computing world — you could put a computer in anything without ever having to worry about charging or plugging in," Prof Sample said. "There are a lot of clinical applications as well; today's heart implants, for example,

require a wire that runs from the pump through the body to an external power supply. This could eliminate that, reducing the risk of infection and improving patients' quality of life."

Furthermore, the system could easily be scaled up to larger structures like factories or warehouses while still meeting existing safety guidelines for exposure to electromagnetic fields. According to corresponding author Takuya Sasatani, from UTokyo, "Something like this would be easiest to implement in new construction, but I think retrofits will be possible as well. Some commercial buildings, for example, already have metal support poles, and it should be possible to spray a conductive surface onto walls, perhaps similar to how textured ceilings are done."



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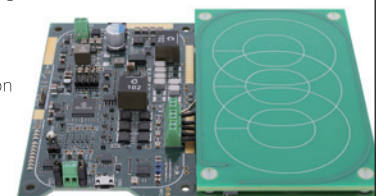
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BRAIDED WIRES

ESPE's textile braided wires, available in a wide range of colours, are characterised by durability and high tensile strength. Braiding provides a protective layer against mechanical damage, providing safety and extending the service life of the cable.

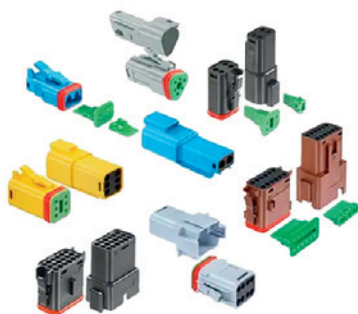
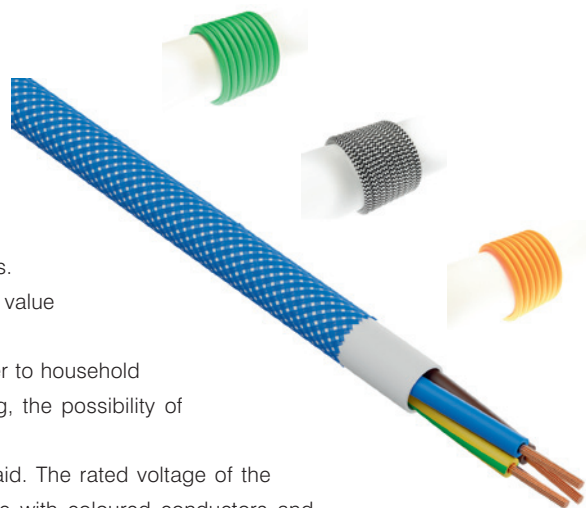
DC (YTL) wires are used in telecommunications systems and control systems. They are suitable for powering LED lighting, eg, in furniture, and their high aesthetic value means they are also used by interior decorators.

H03VV-F/OMY three-core cables (with the protective conductor) may supply power to household appliances and audio/video devices. They are also suitable for lighting fixtures (eg, the possibility of connecting two circuits to a chandelier with an effective, coloured cable).

The products are made of copper wire, double PVC insulation and polyester braid. The rated voltage of the YTL wires is 150 V; in the case of the H03VV-F wires it is 300/300 V. They come with coloured conductors and different colours of braided sleeving. The DC wires measure 2 x 0.5 mm², while the AC wires measure 2 x 0.75 or 3 x 0.75 mm². The operating temperature of all braided cables is 70°C.

Transfer Multisort Elektronik

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SEALED CONNECTOR SYSTEM

TE Connectivity has released the DTXT sealed connector system, part of the company's DEUSTCH connector portfolio. The system uses sealing materials that feature a covalent bond, providing high flexibility, durability and tear resistance for commercial vehicles operating in harsh environments.

The connectors feature an integrated locking system to provide secure mating and electrical connection to the vehicle. The seal covers are made of high-consistency rubber and resist water ingress, protecting the seal from damage during terminal insertion or extraction.

The system is available in a broad range of colours and custom options, enhancing error proofing and removing the need for labelling of wires. The IP69K-rated and J2030 power-wash-tested connectors are compatible with current industry tool standards, eliminating the need for redesigns.

Mouser Electronics

au.mouser.com

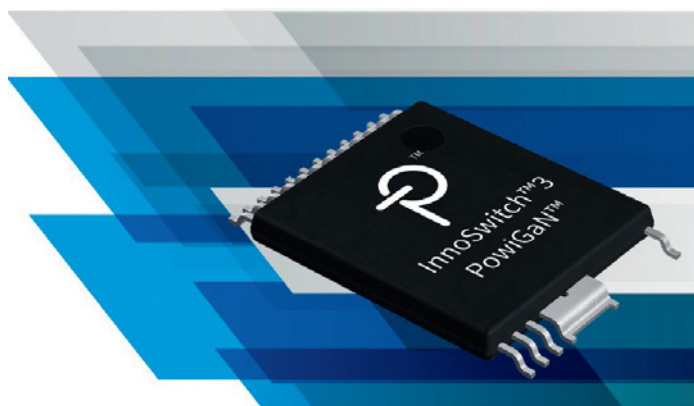
IC FAMILY

Power Integrations' InnoSwitch3 IC family, with PowiGaN technology, is designed to deliver high-impact performance for demanding consumer and industrial applications while simultaneously reducing energy consumption. The IC family incorporates a high-voltage primary-side switch, the primary-side controller, a secondary-side controller for synchronous rectification and FluxLink technology that eliminates the need for an optocoupler.

As more applications increase their reliance on smart devices and power automation, demand for high-efficiency solutions with strong thermal performance is rising and GaN is quickly replacing silicon. PowiGaN is Power Integrations' internally developed technology that allows its ICs to achieve 95% efficiency across the full load range and up to 100 W in enclosed adapter implementations without heatsinks. Claimed to be more efficient, more compact and lighter than silicon alternatives, the technology is suitable for diverse applications.

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The dedicated power system design for a variety of vehicles is E13 and EN50155 certified and can be adapted to an unstable vehicle power source with ease. Optional CAN bus and GPS dead reckoning provide interfaces for real-time vehicle status monitoring and location tracking.

With the addition of a dual 5G networks capability, the product fulfils the need for an ultrafast mobile internet connection through aggregating networks and secondary 5G connection for redundancy in modern transportation, smart production, logistics, manufacturing and automated guided vehicles (AGVs) sectors. The in-vehicle computer can function in tough conditions as it can operate in varying temperatures (-40 to +70°C) and can withstand shock and vibration (MIL-STD-810G certification).

Backplane Systems Technology Pty Ltd

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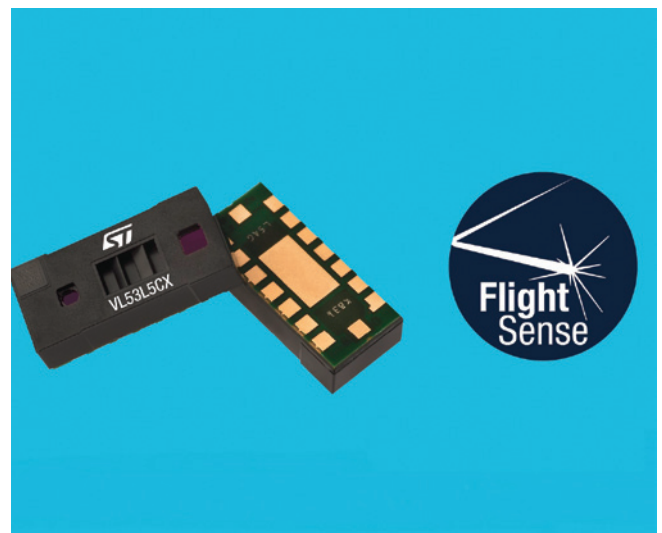
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MULTI-ZONE TIME-OF-FLIGHT SENSOR

STMicroelectronics has announced the VL53L5CX, a FlightSense multi-zone time-of-flight sensor for general-purpose applications that brings sophisticated distance sensing to the full spectrum of consumer and industrial products.

The sensor provides up to 64 sensing zones with multi-target detection, distance measurement up to 4 m in each zone and a wide square-edged field of view with 63° diagonal. The sensor is suited to gesture recognition, complex scene analysis including 3D room mapping for robotics, storage-tank-level monitoring to assist in inventory management, liquid-level control and waste-bin-level monitoring to enable smart refuse collection for enhanced efficiency.

By supporting gesture recognition and automatic human-presence detection, the sensor enables safe, touch-free operation with power saving when used for waking up publicly accessible equipment such as self-service payment terminals, as well as consumer products and domestic appliances. Featuring ST's histogram processing, which reduces the impact of cover-glass crosstalk, the sensor



can be easily integrated and hidden behind various types of front panels. The innovative motion-indicator feature allows the sensor to detect if the target has moved or not.

The number of sensing arrays is programmable and the sensor can provide up to 60 fps in 16-zone (4x4) mode for fast-ranging mode. With simple software configuration to reach high resolution of 8x8 zones, it can also assist keystone correction for video projectors and provide a mini depth-map for augmented reality and virtual reality (AR/VR) applications.

The sensor contains a low-power microcontroller and is capable of autonomous operation for power-saving applications. It comes in a fully integrated 6.4 x 3 x 1.5 mm module that contains an infrared VCSEL (vertical-cavity surface-emission laser) emitter and a receiver with embedded SPADs (single-photon avalanche diodes) and histogram based ToF processing engine.

STMicroelectronics Pty Ltd

www.st.com



DC/DC CONVERTERS FOR RAILWAY AND INDUSTRIAL APPLICATIONS

The RHKW/RHDW series are high-performance DC/DC converters with 3000 VAC reinforced isolation and 4.5 mm clearance/creeping distances for safety-critical applications. The next-generation, board-mountable DC/DC converters have been designed especially for demanding, ruggedised railway and industrial applications.

The series consist of 3–40 W DC/DC converters with single and dual output models in a DIP24 (3–10 W) or 2" x 1" (40 W) package. They have an input range of 36–160 VDC and are equipped with circuits for over/undervoltage protection, as well as over-current, short-circuit and over-temperature protection.

The high-density power converters are realised by using a patented transformer design, which lets the converters perform with an efficiency of up to 90%. The high dielectric strength plastic housing with high-thermal conductivity, comparable with metal casing, performs the isolation between input case output and allows for an operating temperature range of -40 to +105°C.

The converters have been equipped with internal EMI circuits — IEC/EN 55032 Class A and IEC/EN 50121-3-2 — to simplify the design for saving space on PCBs. This series is certified according to IEC/EN/UL 62368-1, EN 50155 and EN 45545-2. Additionally, shock and vibration are compliant with EN 61373 and MIL-STD-810F.

An operating altitude of up to 5000 m, a wide operating ambient temperature and a 36–160 VDC input range make the converters suitable for any safety-critical application where a SELV output is mandatory. Examples are bus voltages of 72, 96 or 110 VDC which need a safety barrier on the secondary side in rolling stocks, in transportation or in harsh industrial environments.

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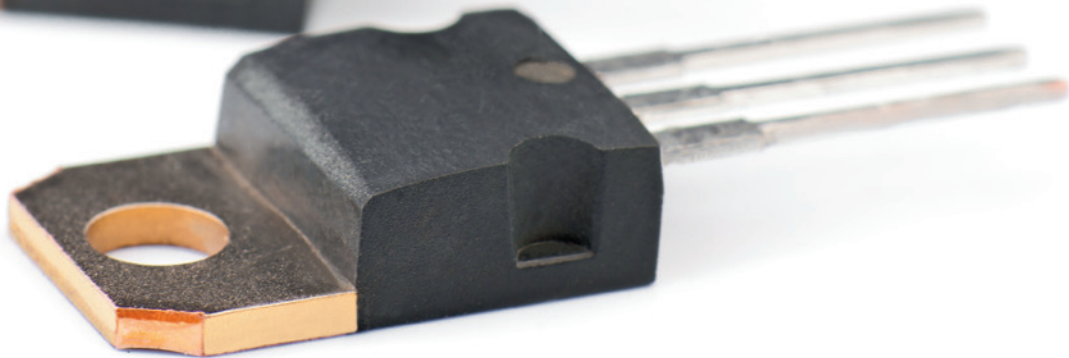
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A SENSITIVE METHOD FOR DETECTING TRANSISTOR DEFECTS

Researchers at the US National Institute of Standards and Technology (NIST) and The Pennsylvania State University have devised and tested a highly sensitive method of detecting and counting defects in transistors — a matter of urgent concern to the semiconductor industry, as such defects limit transistor and circuit performance and can affect product reliability. The team's research has been published in the *Journal of Applied Physics*.

A typical transistor is, for most uses, basically a switch. When it's on, current flows from one side of a semiconductor to the other; switching it off stops the current. Those actions respectively create the binary 1s and 0s of digital information.

Transistor performance critically depends on how reliably a designated amount of current will flow. Defects in the transistor material, such as unwanted 'impurity' regions or broken chemical bonds, interrupt and destabilise the flow. These defects can manifest themselves immediately or over a period of time while the device is operating.

Over many years, scientists have found numerous ways to classify and minimise these effects. But defects become harder to identify as transistor dimensions become almost unimaginably small and switching speeds very high. For some promising semi-

conductor materials in development — such as silicon carbide (SiC) instead of silicon (Si) alone for novel high-energy, high-temperature devices — there has been no simple and straightforward way to characterise defects in detail.

"The method we developed works with both traditional Si and SiC, allowing us for the first time to identify not only the type of defect but the number of them in a given space with a simple DC measurement," said NIST's James Ashton. The research focuses on interactions between the two kinds of electrical charge carriers in a transistor: negatively charged electrons and positively charged 'holes', which are spaces where an electron is missing from the local atomic structure.

When a transistor is functioning correctly, a specific electron current flows along the desired path. If the current encounters a defect, electrons are trapped or displaced, and can then combine

with holes to form an electrically neutral area in a process known as recombination. Each recombination removes an electron from the current. Multiple defects cause current losses that lead to malfunction. The goal is to determine where the defects are, their specific effects and — ideally — the number of them.

"We wanted to provide manufacturers with a way to identify and quantify defects as they are testing different new materials," said study co-author Jason Ryan, also from NIST. "We did that by creating a physics model of a defect-detection technique that has been widely used but poorly understood until now. We then conducted proof-of-principle experiments that confirmed our model."

In a classic metal oxide semiconductor design, a metal electrode called the gate is placed atop a thin insulating silicon dioxide layer. Below that interface is the bulk body of the semiconductor. On one side of the gate is an input terminal, called the source; on the other is an output (drain). Scientists investigate the dynamics of current flow by changing the 'bias' voltages applied to the gate, source and drain, all of which affect how current moves.

In the new work, the NIST and Penn State researchers concentrated on one particular region that is typically only about a billionth of a metre thick and a millionth of a metre long: the boundary, or channel, between the thin oxide layer and the bulk semiconductor body. Ashton explained, "This layer is hugely important because the effect of a voltage on the metal overtop of the oxide of the transistor acts to change how many electrons are within the channel region under the oxide; this region controls the resistance of the device from source to drain."

"The performance of this layer is dependent on how many defects exist. The detection method we investigated was previously unable to determine how many defects were within this layer."

One sensitive method to detect defects in the channel is called electrically detected magnetic resonance (EDMR), which is similar in principle to medical MRI. Particles such as protons and electrons have a quantum property called spin, which makes them act like tiny bar magnets with two opposite magnetic poles. In EDMR, the transistor is irradiated with microwaves at a frequency about four times higher than a microwave oven.

Experimenters apply a magnetic field to the device and gradually vary its strength while measuring the output current.

At exactly the right combination of frequency and field strength, electrons at defects 'flip' — reverse their poles. This causes some to lose enough energy that they recombine with holes at defects in the channel, reducing the current. The channel activity can be hard to measure, however, because of the high volume of 'noise' from recombination in the bulk of the semiconductor.

To focus exclusively on activity in the channel, researchers use a technique called bipolar amplification effect (BAE), which is achieved by arranging the bias voltages applied to the source, gate and drain in a particular configuration. "Because of the biasing we use in BAE and because we measure current levels at the drain," Ashton said, "we can eliminate interference from other things going on in the transistor. We can select just defects that we care about within the channel."

The exact mechanism by which BAE operates was not known until the team developed its model. As explained by co-author Patrick Lenahan, from Penn State, "The only measurement results were qualitative — that is, they could tell the kinds of defects in the channel but not the number."

Before the model of BAE, the scheme was used strictly as a resource for applying voltages and controlling currents for EDMR measurements, which is useful for a more qualitative defect identification. The new model enables BAE as a tool to quantitatively measure the number of defects and to do so with just currents and voltages. The parameter of importance is the interface defect density, which is a number that describes how many defects are within some area of the semiconductor-oxide interface. The BAE model gives researchers a mathematical description of how the BAE current is related to the defect density.

The model, which the researchers tested in a set of proof-of-concept experiments on metal oxide semiconductor transistors, makes quantitative measurements possible. According to Ashton, "Now we can account for the variation in charge carrier distribution throughout the channel region. This opens up the possibilities of what can be measured with a simple electrical measurement."

WATERPROOF GPU COMPUTER WITH M12 CONNECTORS



Backplane Systems Technology presents Neousys's SEMIL-1700GC series, claimed to be one of the world's first IP67-rated waterproof and dustproof inference servers with pre-installed NVIDIA Tesla T4 or Quadro P2200 for demanding environments. It is designed to represent a new level of robustness for rugged edge AI solutions.

Coupled with Intel Xeon E or 9th/ 8th-Gen Core CPU, the system delivers good CPU and GPU performance for advanced edge AI applications in various environmental settings. The series offers -25 to 70°C fanless operation in a rack- or wall-mountable 2U 19" enclosure.

The SEMIL-1700GC series features a sophisticated thermal design to dissipate the heat generated by Tesla T4 or Quadro P2200 GPU for maximum GPU performance in high-temperature environments. It has a corrosion-proof, stainless steel/aluminium chassis with moulded O-rings, plus a patented fusion mechanism design to offer high durability and watertight construction.

The series offers a variety of I/O connectivity, including 802.3at Gigabit PoE+, VGA, USB, COM ports and optional 10G Ethernet, all using M12 connectors for waterproof and rugged connectivity in shock and vibration conditions. Additionally, it features M.2 for NVMe SSD, 2.5" SATA storage accommodation and 8–48 V wide-range DC input with ignition power control, and complies with MIL-STD-810G and EN 50155 standards.

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www.backplane.com.au



CAN/CAN FD TO SINGLE-MODE FIBRE BRIDGE

ICP DAS's I-2533CS-FD is a local CAN/CAN FD (CAN with flexible data-rate) bridge used to establish a connection between two CAN bus systems via a single-mode fibre-optic transmission medium.

To solve the problem between CAN/CAN FD and fibre transmission medium, the bridge is specially designed for converting the electrical CAN/CAN FD bus signal to fibre-optic cables. The product has three other important features.

First, the transmission distance limitation of the CAN bus system will not be affected by the different CAN/CAN FD baud rates. This means that the total CAN/CAN FD bus working distance can be extended. Second, the bus error on one CAN/CAN FD network will not affect the operation of another CAN/CAN FD network. Finally, the two CAN/CAN FD networks can communicate with each other by using different CAN/CAN FD baud rates for high flexibility.

The product is an asset to multiple applications, such as control systems, building automation, factory automation and distributed data acquisition.

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

WI-FI MODULES

Espressif Systems has released the ESP32-S2 MINI Wi-Fi modules, providing engineers with integrated, high-performance, low-power, single-core SoCs in both PCB and IPEX antenna configurations. The generic 802.11 b/g/n Wi-Fi microcontroller modules are suitable for Internet of Things (IoT), wearable electronics and smart home applications.

The modules are designed to offer secure communication, incorporating an Espressif ESP32-S2FH4 Xtensa SoC with a 240 MHz LX7 CPU. Featuring 4 MB external SPI flash and cryptographic accelerators to enhance security performance and protection, the modules also include a low-power co-processor for monitoring the rich set of peripherals, including SPI, I²S, UART, I²C and camera interface, as well as the modules' 43 GPIOs. They operate from -40 to +125°C, making them suitable for a wide range of industrial, consumer and lighting environments.

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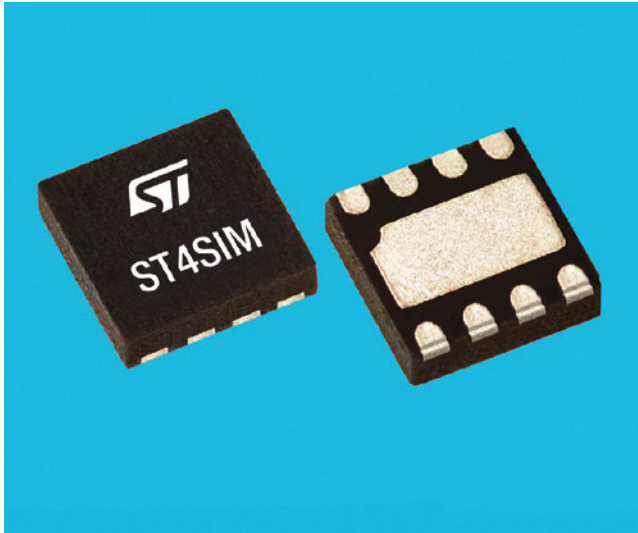
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eSIMs FOR M2M APPLICATIONS

STMicroelectronics has announced mass-market availability of its ST4SIM eSIM (embedded SIM) ICs for machine-to-machine (M2M) applications through e-distribution.

ST's industrial eSIMs provide all the services needed to connect IoT devices to cellular networks. They are suitable for applications such as machinery condition monitoring and predictive maintenance, as well as asset tracking, energy management and connected healthcare devices. In addition, by allowing remote management of the SIM profile in accordance with the GSMA specification, the eSIMs let users change the connectivity provider without having access to the device.



With rich built-in features and access to quality provisioning services, the eSIM family delivers a convenient solution for numerous M2M applications. Mass-market availability lets developers everywhere leverage secure and flexible cellular connectivity in more applications than ever, including independent M2M development, proof-of-concept and prototype projects. Using ST's B-L462E-CELL1 Discovery kit powered by the ST4SIM, the user can also test and evaluate all product features pre-integrated in a complete ecosystem.

The eSIM is certified by GSMA and available in the industry-standard MFF2 5 x 6 mm DFN8 wettable flank package. Other package options are available to order, including the highly miniaturised wafer-level chip-scale package (WLCSP). ST takes care of activation and deployment by arranging for customers to use device-onboarding and service-provisioning platforms provided by ST Authorized Partner Truphone.

STMicroelectronics Pty Ltd

www.st.com

SIGNAL CREATION AND ANALYSIS TOOL

Rohde & Schwarz has collaborated with Cadence Design Systems to develop the R&S VSESIM-VSS signal creation and analysis tool, aimed at simplifying the engineering process from RF design to implementation and enhancing accuracy by using realistic signals for both simulation and testing. It is useful for those in the wireless, automotive, and aerospace and defence industries as well as for manufacturers of active components and systems.

Supporting all major standards such as 5G, the latest Wi-Fi evolutions and more, the joint solution combines signal generation, design simulation and signal analysis to speed up the development process for RF components. As a result, developers and design engineers should benefit from an optimised tool that allows them to address design challenges earlier than before in the development process.

The tool functions as an addition to the Cadence Visual System Simulator (VSS) software for system simulation and modelling, particularly for RF components and RF assemblies used in wireless communications and radar design. The tool is designed to expand the capabilities of the VSS software by adding realistic signals to the workflow. It benefits from two established software tools from Rohde & Schwarz for testing operative circuits, modules and devices: the signal generation capabilities of the R&S WinIQSIM2 simulation software and the signal analysis capabilities of the R&S VSE vector signal explorer software. R&S VSESIM-VSS combines these functions and adds plug-ins for Cadence electronic design automation (EDA) tools.

The data sink plug-in from Rohde & Schwarz provides access to the signal at any point in the design process. The signal can be transferred to a vector signal generator and applied to available hardware, enabling system-level analysis of hybrid hardware/simulated implementations. Another important feature is support of direct digital predistortion (DPD) techniques to verify the effects of linearisation already in the simulation phase of power amplifier development.

Rohde & Schwarz (Australia) Pty Ltd

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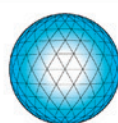


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POWER MANAGEMENT IC WITH BUILT-IN SWITCHING CHARGER

Analog Devices' MAX77659 single-inductor multiple output (SIMO) power management IC (PMIC), complete with an integrated switch-mode buck-boost charger, is designed to charge wearables, hearables and Internet of Things (IoT) devices faster and in less space than other PMICs. The SIMO PMIC delivers over 4 h of play time after a short, 10-min charge and uses a single inductor to power multiple rails, which is said to reduce the bill of materials (BOM) by 60% and shrink total solution size by 50%.

The PMIC integrates a switch-mode buck-boost charger and three independently programmable buck-boost regulators, all sharing a single inductor to minimise total solution size. The regulators extend battery life by operating at 91% efficiency during moderate to heavy load conditions while consuming only 5 μ A of quiescent current during light load conditions. The PMIC supports autonomous headroom control, which reduces heat dissipation by minimising the voltage drop while providing enough headroom to regulate the charging current.

The device is offered in a tiny, 30-bump wafer level package (WLP) that measures 2.55 x 2.37 mm. Use of a single inductor and integration of the charger reduces the bill of materials by 60% for a total solution size of just 22 mm², small enough for the most compact wearable and hearable applications. The PMIC frees up board real estate to pack in additional features such as expanded memory storage, location tracking and vital sensing demanded by today's portable consumer and medical devices.

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PORTABLE SPECTRUM ANALYSERS

Rohde & Schwarz has extended its R&S Spectrum Rider FPH family with the introduction of base models offering measurement frequencies up to 44 GHz.

The analysers combine the functionality of benchtop instruments and the lightweight portability of a handheld instrument, with intuitive features to make high-performance measuring on the go fast and simple. A 44 GHz model has been added to the existing R&S FPH models with measurement frequencies from 5 kHz to 6, 13.6 and 26.5 GHz. In addition, three versions with tracking generators are available with measurement frequencies up to 13.6, 26.5 and 44 GHz.

The analyser delivers solid RF performance for measurements in the field and in the lab, with large buttons and a multi-touch gesture screen that make it easy to operate. The higher frequency models enable the versatile spectrum analyser to perform a broader range of measurement tasks. With high sensitivity of -160 dBm and measurement accuracy of typically 0.5 dB between 10 MHz and 3 GHz, the product offers high RF performance.

The latest models support field applications such as verification of 5G, broadcast, radar, defence and satellite communications links. The 44 GHz model weighs just 3.2 kg and is optimised for mobile use. Its battery lasts up to 4.5 h and the backlit keypad allows users to work in the dark, while the non-reflective display supports a daylight mode for readability in direct sunlight.

The handheld spectrum analyser features a large-format capacitive touchscreen that makes it easy to intuitively adjust settings such as frequency, span and reference level, and to set markers. Large buttons and a practical multifunction wheel facilitate operation with gloves in outdoor environments. The analyser can be remotely controlled via USB, LAN or the R&S MobileView app for iOS or Android.

Rohde & Schwarz (Australia) Pty Ltd

www.rohde-schwarz.com.au



LOW-PROFILE FINGERTIP JOYSTICK

The APEM XS series low-profile fingertip joystick is specifically designed with a height of less than 45 mm above the panel, for easy navigation in small spaces. The less height, the less chance of accidental operation where space is limited on crowded control panels from being accidentally dropped.

The product is IP66 rated for harsh environments, SIL2 capable and has a long operating life of >10 million cycles combined with independent dual sensor output. The joystick is suited to applications including construction, materials handling, robotics and marine.

Control Devices Australia

www.controldevices.com.au



SAFETY AIR GUN

EXAIR's VariBlast Precision Safety Air Gun with Nano Super Air Nozzle provides a focused blast of air capable of handling tough jobs with high levels of strength. The CE-compliant, lightweight air gun employs an engineered variable flow trigger able to produce variable force on a target simply by pulling the trigger. A comfortable full finger trigger and convenient hanger loop are built in to the 1/4" safety air gun. The Nano Super Air Nozzle requires only 8.3 SCFM and is made of Type 316SS or PEEK thermoplastic.

The product is available with a standard 305 or 508 mm extension, which can also be outfitted with an impact-resistant polycarbonate Chip Shield. The air gun body is made of high-impact, glass-reinforced nylon. The airflow that exits the nozzle can't be blocked, leading to safe operation and meeting required OSHA standards 1910.242(b). The air gun produces a quiet 75 dBA noise level, which is well below the limits of the OSHA noise exposure standard 29 CFR 1910.95(a). A variety of other Super Air Nozzles with different force and flow values are available.

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

FPGA MODULES

Acromag's XMC-7AWP and XMC-7KWP modules, with a user-programmable Xilinx Artix-7 or Kintex FPGA, feature write-protected flash memory to secure the configuration files. The modules are suitable for a broad range of applications, such as hardware simulation, communications, signal intelligence, adaptive filtering and image processing. High-speed interfaces are provided for PCIe, 10GbE, LVDS serial and other I/O signals.

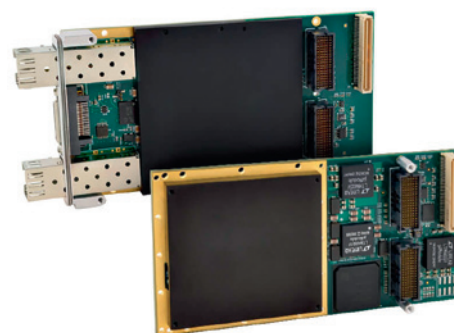
The XMC-7KWP models offer a choice of Kintex-7 FPGAs for 325 or 410k logic cells. Dual SFP+ ports offer support for 10GbE with fibre or copper transceivers. A 36-pin VHDCR connector provides JTAG, USB, global differential clock pairs and LVDS signals to the FPGA. The rear I/O XMC port offers a 4-lane high-speed serial interface and supports SelectIO channels for single-ended or differential I/O. A PMC-style port supports additional SelectIO channels.

The XMC-7AWP models feature a user-configurable Artix-7 FPGA with 200k logic cells. The rear I/O provides an 8-lane high-speed serial interface on the P16 XMC port, with support for 34 single-ended SelectIO or 17 LVDS channels. The P4 port adds another 60 SelectIO or 30 LVDS and global clock lines.

The versatile XMC mezzanine cards plug into host single-board computers or non-intelligent carrier cards for use in PCIe servers, VPX or CompactPCI Serial chassis, and small form factor embedded computers. The air-cooled cards operate across a wide ambient temperature range. Conduction-cooled systems can also be accommodated.

The FPGA mezzanine modules are suitable for high-speed processing of custom algorithms and provide the added security of write-protected configuration flash. Designed for defence and aerospace systems, the COTS modules can be used for algorithmic acceleration, protocol conversion, simulation, HIL test, motor control, and image analysis, as well as sensor fusion applications.

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VITAL SIGNS ANALOG FRONT-END

Analog Devices' MAX86178 triple-system vital signs analog front-end (AFE) enables users to simplify the design of wearable remote patient monitoring (RPM) devices by measuring four vital signs at once.

The single-chip AFE integrates three measurement systems (optical, ECG and bioimpedance) to obtain four common vital signs: electrocardiogram (ECG or EKG), heart rate (ECG or optical PPG), blood oxygen saturation (SpO₂) and respiration rate (using BioZ). It enables synchronised optical PPG and ECG timing for derived health metrics.

Medical device designers are looking to replace office-based health monitoring systems with smaller, lower power, wireless devices worn discreetly and continuously in the home or office. With three clinical-grade subsystems integrated into one IC, the AFE replaces discrete implementations by integrating an optical PPG subsystem to measure heart rate and SpO₂, a single lead ECG sub-system, as well as a biopotential and bioimpedance (BioZ) subsystem to measure respiration rate. It permits small vital signs devices by fitting those multiple functions into a 2.6 x 2.8 mm package.

Next-generation wearable RPMs need to operate at low power to enable smaller batteries or extend battery life for more convenient charging requirements. To enable ultralow-power features, the product provides each subsystem with configurable options to optimise battery life for specific use cases. Suitable for chronic disease management, contagious disease diagnosis and remote monitoring, the AFE enables small body-worn devices that could improve healthcare delivery and keep people out of the hospital.

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STRETCHABLE, SWEAT-POWERED BATTERY

DEVELOPED FOR WEARABLES

Scientists from Nanyang Technological University, Singapore (NTU Singapore) have developed a soft and stretchable battery, measuring 2 x 2 cm and as flat as a small paper bandage, that is powered by human perspiration.

Described in the journal *Science Advances*, the battery was created by printing ink containing silver flakes and hydrophilic poly(urethane-acrylate) (HPUA), which function as the battery electrodes, onto a stretchable textile that can be attached to wearable devices, like watches, wrist bands or arm straps. When the silver flakes come into contact with sweat, its chloride ions and acidity cause the flakes to clump together, increasing their ability to conduct electricity. This chemical reaction also causes an electric current to flow between the electrodes.

When the battery material is stretched, its resistance is further lowered, meaning it can be used when it is exposed to strain, such as when its user is exercising. Furthermore, as the stretchable textile is very absorbent, it retains a lot of sweat, so that the battery remains powered even when the rate of sweating is inconsistent. This is important for consistent functioning as the amount of human sweat secreted is variable and depends on the area of the body it is in, the environmental conditions and the time of day.

Another advantage is that, unlike conventional batteries, the battery does not contain heavy metals or toxic chemicals. As noted by Dr Lyu Jian, who is the co-first author of the study, "Conventional batteries are cheaper and more common than ever, but they are

often built using unsustainable materials which are harmful to the environment. They are also potentially harmful in wearable devices, where a broken battery could spill toxic fluids onto human skin. Our device could provide a real opportunity to do away with those toxic materials entirely."

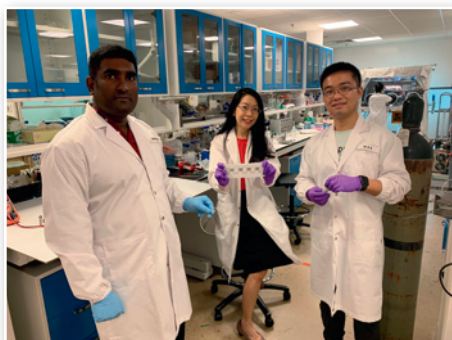
To demonstrate its potential use when it becomes incorporated in wearable biosensors and other electronic devices, the team of scientists tested their device with artificial human sweat. In a separate trial, the team reported that an individual wearing the battery around their wrist and cycling on a stationary bicycle for 30 min was able to generate a voltage of 4.2 V and output power of 3.9 mW that was sufficient to power a commercial temperature sensor device and send the data continuously to a smartphone via Bluetooth.

"Our device could be more durable than current technology, as we showed it could withstand strain from a wearer's daily activities and repeated exposure to stress or sweat," said study leader Professor Lee Pooi See, Dean of NTU Graduate College.

"The slim size of our battery also solves two problems in wearable tech: traditional button batteries are a problem for achieving the sort of sleek aesthetics that are attractive to consumers, while thinner batteries reduce the item's ability to carry enough charge to last throughout the day."

A patent application for the sweat-powered battery has been filed through NTU's enterprise and innovation company, NTUitive. The researchers now plan to further explore the effects of other components of human sweat and how factors such as body heat may affect the performance of the battery.

"Our technology heralds a previously unreachable milestone in the design of wearable devices," Prof Lee said. "By capitalising on a ubiquitous product — perspiration — we could be looking at a more environmentally friendly way of powering wearable devices that does not rely on conventional batteries. It is a near-guaranteed source of energy produced by our bodies. We expect the battery to be capable of powering all sorts of wearable devices."



NTU School of Materials Science & Engineering (MSE) Senior Research Fellow Dr Gurunathan Thangavel, materials scientist and Dean of NTU Graduate College Professor Lee Pooi See, and MSE Research Fellow Dr Lyu Jian. Image credit: NTU Singapore.

PEROVSKITE NANOCRYSTALS STABILISED FOR LEDs

Light-emitting diodes (LEDs) are known for their ability to run efficiently, give off little heat and last for a long time. Researchers have now created stable perovskite nanocrystals for more efficient and longer-lived LEDs, with their results published in the journal *Nature Photonics*.

Perovskites are a class of material that share a particular crystalline structure giving them light-absorbing and light-emitting properties that are useful in a range of energy-efficient applications, including solar cells and various kinds of detectors. Perovskite nanocrystals have been prime candidates as a new LED material, but previous attempts to create nanocrystal LEDs were thwarted by the nanocrystals degrading back to the unwanted bulk phase, losing their advantages and undermining their potential as practical LEDs. Bulk materials consist of billions of atoms; materials such as perovskites in the nano phase are made of groupings of just a few to a few thousand atoms, and thus behave differently.

Researchers from the US Department of Energy's Argonne National Laboratory, Brookhaven National Laboratory, Los Alamos National Laboratory and SLAC National Accelerator Laboratory, along with Academia Sinica in Taiwan, stabilised the nanocrystals by fabricating them within the matrix of a porous structure called a metal-organic framework (MOF), like tennis balls caught in a chain-link fence. They used lead nodes in the framework as the metal precursor and halide salts as the organic material. The solution of halide salts contains methylammonium bromide, which reacts with lead in the framework to assemble nanocrystals around the lead core trapped in the matrix. The matrix keeps the nanocrystals separated, so they don't interact and degrade.

The team's method is based on a solution coating approach, far less expensive than the vacuum processing used to create the inorganic LEDs in wide use today. The MOF-stabilised LEDs can be fabricated to create bright red, blue and green light, along with varying shades of each.

"Our photophysical studies show that this approach allows us to enhance the brightness and stability of the light-emitting nanocrystals substantially," said Xuedan Ma of Argonne National Laboratory.

"The intriguing concept of combining perovskite nanocrystal in MOF had been demonstrated in powder form, but this is the first time we successfully integrated it as the emission layer in an LED," added Hsinhan Tsai, a former postdoc fellow at Los Alamos.

Based on earth-abundant materials and fabricated at room temperature, the LEDs could one day enable lower cost TVs and consumer electronics, as well as better gamma-ray imaging devices and even self-powered X-ray detectors with applications in medicine, security scanning and scientific research. In durability tests, the material performed well under ultraviolet radiation, in heat and in an electrical field without degrading and losing its light-detecting and light-emitting efficiency — a key condition for practical applications such as TVs and radiation detectors.

"In this work, we demonstrated for the first time that perovskite nanocrystals stabilised in a MOF will create bright, stable LEDs in a range of colours," corresponding author Wanyi Nie, from Los Alamos. "Metal-halide perovskite nanocrystals offer a continuously tuneable optical bandgap covering almost all the visible spectrum, meaning we can create different colours, improved colour purity and high photoluminescence quantum yield."

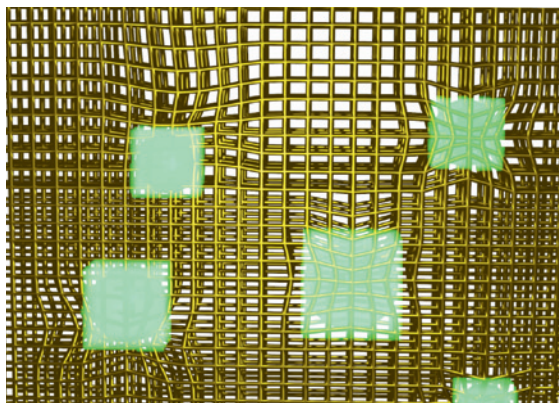


Image credit: Los Alamos National Laboratory.

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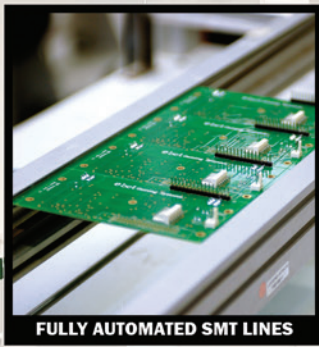
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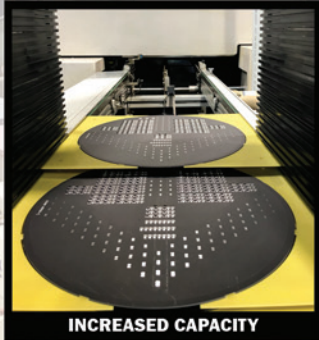
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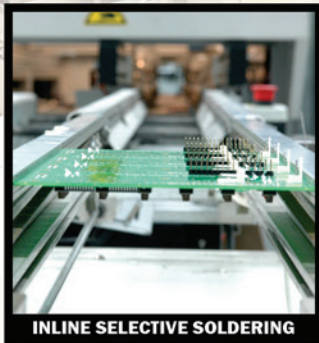
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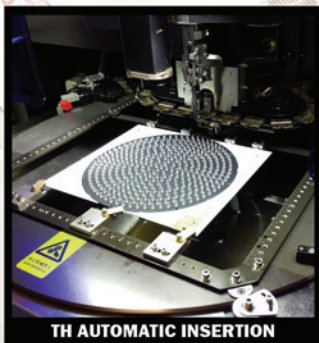
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- Standards & compliance testing

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