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SILICON MALLEE

Dr Ronald Grill, Managing Director, Technology Management Pty Ltd, explains how the city of Adelaide has come to be considered the home of Australia's high technology electronics industry.

The name 'Silicon Valley' was applied to the Santa Clara Valley — the area south of San Francisco from San Mateo to San Jose — by technology journalist Don Hoefler in 1971. Many 'Silicon Place' names have since emerged, including Silicon Alley (New York City); Silicon Forest (Portland, Oregon); Silicon Beach (Santa Monica, California); Silicon Roundabout (East London); Silicon Fen (Cambridge, UK); and Silicon Welly (Wellington, New Zealand).

Mallee is an Australian Aboriginal word for the region around Adelaide with its original cover of low, scrubby eucalyptus 'mallee' vegetation. Because of its geographic location and the productive and resourceful electronics industry in Adelaide, this region has been named 'Silicon Mallee'.

To the wider community electronics typically means television sets, microwave ovens and mobile phones. These and most other consumer electronics products are not made by the Adelaide electronics industry; they are mass-produced overseas to standard designs and in large volumes.

The high technology electronics industry (HTEI) in Adelaide designs and produces relatively small volumes of complex, intellectual property-based electronic products and systems for commercial, industrial and government customers in sectors including avionics, biotechnology, environment, defence, medical, research, security, scientific, telecommunications and related applications.

The Adelaide HTEI includes 300 mostly locally owned, small and medium-size firms that design and produce their own products plus a small number of foreign multinational companies, concentrated in the defence electronics sector. Products of the Adelaide HTEI are sold in all Australian states and in more than 130 other countries. Adelaide's productive and resourceful HTEI firms employ 11,000 well-trained and well-paid engineers, scientists, technicians, production and support staff who produce $4 billion annual revenue.

$4 billion is a large number! It is equal to the ex-factory sale price (average of $25,000 each) of all 160,000 passenger cars built in Australia in 2016. This extraordinary revenue feat was achieved in the small and relatively isolated city of Adelaide with just 5.4% of Australia's population. The Adelaide HTEI also has a surprisingly large 40% of Australia's high technology electronics design and manufacturing industry.

Origin

The electronics industry had its origin in Adelaide with the pioneering efforts of two early firms. In the 1920s the Reverend John Flynn OBE proposed a 'Flying Doctor Service' for the people in the sparsely populated Australian outback. This medical lifeline required radio for communications, as most outback properties had no telephone. A mutual acquaintance referred Reverend Flynn to a young Adelaide electrical engineer named Alfred Traeger, who, in

1928, produced a novel two-way radio for outback homesteads to communicate with the new Flying Doctor Service. As most of the homesteads had no electricity, this equipment was powered by a generator fitted with bicycle pedals and cranked by the seated operator. It soon became known as the 'pedal-wireless' and was the beginning of the Traeger Transceivers business.

In the 1930s, while Professor Frederick Terman was mentoring his former students William Hewlett and David Packard at Stanford University, Physics Professor Kerr Grant was mentoring his former students, brothers Edward and Donald Both, at the University of Adelaide. Professor Terman and Professor (later Sir) Kerr Grant independently recognised the combination of engineering knowledge and innovative ability in their former students and encouraged and directly assisted the establishment of businesses to commercialise their students' innovations. The early history of Hewlett Packard is widely reported, from the development of its first product in 1939 — the Model 200A Audio Oscillator — in the Packard family garage. The first Both product in 1932 was not widely reported. It was a revolutionary, portable, battery-operated, direct writing electrocardiograph that overcame the limitation of the processing of the trace in the previous photographic recording process. This was the origin of Both Equipment Ltd.[1]

Growth

The Adelaide electronics industry expanded after the opening of the Long Range Weapons Establishment laboratories in the Adelaide suburb of Salisbury in 1947. These joint UK–Australia facilities supported the test of rocket weapons at Woomera, 450 km north of Adelaide with tracking, guidance and telemetry systems.

While the rocket range is no longer in regular use, the Salisbury laboratories have expanded and are now known as the Defence Science and Technology Group (DSTG). This is the Australian Government's principal defence research establishment with high-level expertise in communication, computing, surveillance, control systems and defence-related technologies. This facility houses more than 1000 engineers, scientists, technical and support staff. Electronics has been and continues to be the principal technology employed and researched at these laboratories.

The DSTG is Australia's major source of science and technology that is embedded in defence systems engineered and produced in Adelaide by specialist defence contractor firms, including BAE Systems, SAAB, Raytheon, Boeing and Lockheed. The continuous operation of the DSTG research facilities and the associated defence contractor firms has been a major influence on the development of the cluster of Adelaide HTEI businesses — first as a creator of innovative technologies for military, commercial, industrial and

scientific applications, and second as a critically important training facility and a place for collaboration of electronic engineers, scientists and technicians.

The rigorous research methodologies and technology standards of DSTG provide a source of tacit knowledge which flows into and greatly benefits the local electronics industry. The defence budget varies and in downturns many former DSTG employees have moved on to employment in the defence or non-defence electronics industry. Several collaborative professional relationships developed by staff at DSTG and contractor firms have evolved into entrepreneurial start-up businesses in the defence and non-defence HTEI sectors in Adelaide. Many of these now established firms produce multimillion-dollar revenues and now employ many hundreds of staff in Adelaide. DSTG has thus provided the electronics industry in Adelaide with the services of a "surrogate university".[2]

Electronics has another dimension beyond the design and manufacture of overtly electronic products and systems. Electronics is also a critically important 'enabling technology' in all 'Knowledge Age' sectors and is employed to sense, monitor, measure, store and process data and to control external systems. Examples of Adelaide-designed and -built products that are critically 'enabled' by electronics include Ellex ophthalmic surgical lasers, ATRAD atmospheric radar systems and Redarc automotive products. Government statistical data classifies these respectively as 'medical', 'scientific' and 'automotive' products, so the electronics is not identified and the value of the electronics is unreported and unseen by our community and governments.

Clusters

Over several decades, the firms in the Adelaide HTEI have evolved through self-organisation into a collaborative and productive cluster. This same endogenous process applied in the evolution of the widely reported HTEI clusters in Silicon Valley California, Texas and Cambridge. Adelaide shares two critically important characteristics with these three exemplar clusters. All four of these areas are (a) small in comparison with their major national populations and (b) isolated economically and socially from their major national populations. Small city size and short commute times facilitate more frequent face-to-face interaction

that develops trust. Small city size also assists people in cluster firms to know a high proportion of the people in their industry. This contrasts with large cities where their HTEI firms are widely scattered, thus limiting face-to-face interaction and collaboration.

Isolation from major populations encourages collaboration with trusted local peers in preference to distant and lesser known potential collaborators. A sustainable competitive advantage develops in locally managed assets including knowledge, relationships and motivations "that distant rivals cannot match".[3] Cluster participants also understand that they must "play by the rules" in a small community.[4]

Cluster performance is measured by the level of 'firm-to-firm interdependence'. In the Adelaide HTEI, 43% of firms have interdependent technology-based relationships with local cluster firms, while in Sydney — with its large size and scattered HTEI firms — this factor is measured at 13%.[5]

Productivity

The Adelaide HTEI is the region's leading Knowledge Age industry and its annual productivity is $343,600 per employee — more than three times the $113,600 productivity of the remaining South Australian manufacturing industry, which is predominantly based on traditional 'Industrial Age' processes and products.

The higher HTEI productivity which yields premium returns on its Knowledge Age products is a direct return on the controlled intellectual property (IP) that is inherent in the design and the manufacturing processes and is embedded in the delivered HTEI product. Conversely, Industrial Age goods are produced using design and manufacturing knowledge that is widely available, so no significant premium can be achieved over and above the recovery of labour, material and overhead costs and a modest margin.

Research

The premium returns achieved from their IP-based products allows the Adelaide HTEI firms to invest strongly in research and development (R&D), which underpins their market leadership and profitability. Adelaide HTEI firms invest an average of 4.9% of annual revenue in R&D[6] and many of these firms invest more than double that amount. Across all Australian manufacturing industry, the level of investment on R&D rarely exceeds 1% of revenue.[7]

Recognition

This industry sells its products on a 'business-to-business' or 'business-to-government' basis, does not sell by retail and does not advertise in public media. Government statistics do not adequately record the value of the HTEI. Therefore, our community and governments cannot identify the HTEI or quantify its value to our regional economy.

Transition

Our regional economy is in transition from its past dependence on Industrial Age manufacturing to our logical future as an education, research and Knowledge Age industry region. The high technology design and manufacturing knowledge and resources of the Adelaide electronics industry are a critical requirement in this transition.

Promotion

The ongoing restructure and personnel changes in the executive branch of government and the recent election of a new government provide an opportunity for the electronics industry to engage with and inform people in new positions. All businesses in our industry can join with this industry association to promote the industry's value and participate in the transition of our region and our Knowledge Age future.

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SHORT CIRCUITS

ELECTRONEX EXPO MOVING TO MCEC IN 2019

Following the 2018 edition of Electronex – The Electronics Design & Assembly Expo and Conference, held from 5–6 September at Rosehill Gardens, Sydney, the show organisers have announced that the 2019 expo will be held in the new extension of the Melbourne Convention and Exhibition Centre.

The expo alternates annually between Sydney and Melbourne, and at the last Melbourne event in 2017, more than 80% of visitors indicated that they would prefer to see future events held at the MCEC. 2018's Sydney show was meanwhile judged an outstanding success, with around 1000 trade visitors and delegates attending the two-day event.

"The move to this state-of-the-art venue will take the show to the next level and allow for more exhibition space, following the sellout of the two previous Melbourne shows at Melbourne Park Function Centre," Australasian Exhibition and Events (AEE) said. "Next year's show will also feature more companies with advanced manufacturing solutions, which are an integral part of the electronics manufacturing sector."

Electronex was first held in 2010 and has grown to become an esteemed exhibition for electronics manufacturing and assembly in Australia. Reflecting the growth of high-tech niche manufacturing in Australia, at the recent Sydney expo more than 45% of the trade visitors said they had not previously attended Electronex. The event attracts a dedicated audience of engineers and senior decision-makers, with 80% of the visitors saying they had not attended any other major manufacturing expos in the past 12 months.

Over 90 companies were represented on stands, with many exhibitors featuring new products at the expo. Exhibitors reported that it was one of the most successful exhibitions they had attended, with a quality audience of high-level decision-makers seeking new products and new innovations and solutions or their business. 90% of visitors indicated that they had met companies they were not previously aware of and 85% discovered new products or services they were not aware of, reinforcing the important role of exhibitions and face-to-face contact in today's digital world.

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

For details about exhibiting at Electronex in 2019, contact AEE on 03 9676 2133 or email info@auexhibitions.com.au.
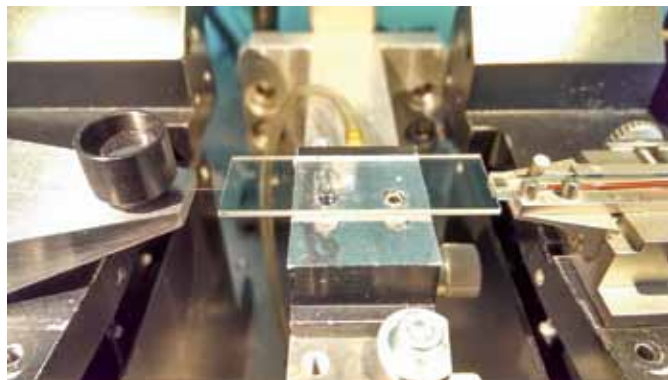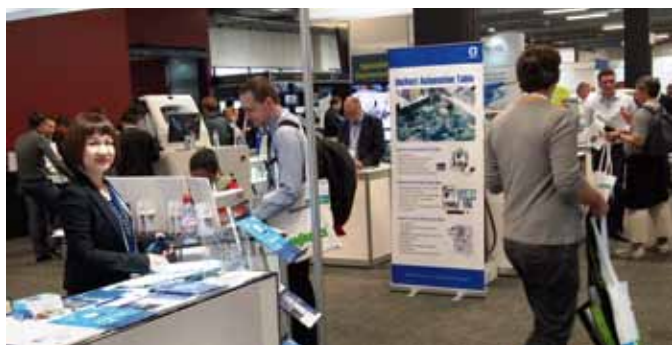
ULTRATHIN OPTICAL FIBRE TRANSMITS 1.2 PETABITS PER SECOND

Scientists have developed an ultrathin optical fibre, as fine as a human hair, that can transmit 1.2 petabits of data per second — 12 million times quicker than the fastest nbn connection.

Internet data use is increasing exponentially, due to developments such as on-demand streaming and artificial intelligence, and fast approaching the limits of existing communications networks. Research into new types of optical fibre that can transmit ultralarge volumes of data have to date resulted in thick fibres that are vulnerable to damage from bending and pulling.

Now, scientists from Hokkaido University and electrical equipment manufacturer Fujikura have developed a 4-core, 3-mode fibre that is almost the same width as existing standard optical fibres but can transmit 12 times as much data per second. Its narrower diameter means it is less prone to damage and can easily be cabled and connected using existing equipment.

Combined with a coupler developed by the Macquarie University Photonics Research Centre, and a transmission system developed by Japan's National Institute of Information and Communications Technology (NICT), the fibre has undergone a dramatic improvement in speed that gives it the ability to smoothly accommodate traffic for big data and 5G services. It could therefore be used for transmitting data between data centres, metropolitan networks or undersea communications cables.

"The world's insatiable demand for data means that we are approaching a 'capacity crunch' and need to find new ways to transport ever-larger volumes," said Dr Simon Gross from the Macquarie Photonics Research Centre.

"This technology promises a solution to the bottleneck created by existing optical fibres. For the first time, we have created a realistic and usable-sized fibre which is resilient and can transport huge amounts of data.

"It also represents a big cost saving over installing the 12 standard optical fibres you would need to transport the same volume of data."

Image: Multiplexer being tested with fibres coupled from the left and right.

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TECHNOLOGIES

SHORT CIRCUITS

POWER CONSUMPTION SUBSTANTIALLY CUT FOR IoT SENSORS

Researchers from the National University of Singapore (NUS) have invented a low-cost 'battery-less' wake-up timer — in the form of an on-chip circuit — that significantly reduces the power consumption of silicon chips for Internet of Things (IoT) sensor nodes, bringing it down to true picoWatt range — one billion times lower than a smart watch.

IoT sensor nodes are individual miniaturised systems containing one or more sensors, as well as circuits for data processing, wireless communication and power management. To keep power consumption low, they are kept in sleep mode most of the time, and wake-up timers are used to trigger the sensors to carry out a task. As they are turned on most of the time, wake-up timers set the minimum power consumption of IoT sensor nodes. They also play a fundamental role in reducing the average power consumption of systems-on-chip.

The NUS team, led by Associate Professor Massimo Alioto, collaborated with Associate Professor Paolo Crovetti from Italy's Politecnico di Torino to reduce the power consumption of wake-up timers embedded in IoT sensor nodes, which in many cases require decades of battery lifetime. Presented at the 2018 Symposia on VLSI Technology and Circuits in Hawaii, the team's timer is claimed to cut the power consumption of rarely active IoT sensor nodes by 1000 times.

"As an element of uniqueness, our wake-up timer does not need any additional circuitry — as opposed to conventional technologies, which require peripheral circuits consuming at least 1000 times more power (eg, voltage regulators)," said Assoc Prof Alioto. This ability to operate without any voltage regulator is due to the timer's reduced sensitivity to supply voltage, thus suppressing the additional power that is conventionally consumed by such peripheral always-on circuits.

"Under typical office lighting, our novel wake-up timer can be powered by a very small on-chip solar cell that has a diameter similar to that of a strand human hair," Assoc Prof Alioto added. "It can also be sustained by a millimetre-scale battery for decades."

The wake-up timer can continue operations even when battery is not available and under very scarce ambient power, as demonstrated by a miniaturised on-chip solar cell exposed to moonlight. It can also achieve slow and infrequent wake-up using a very small on-chip capacitor (half a picoFarad), helping to significantly reduce silicon manufacturing costs due to the small area (40 µm on each side) required.

The team is currently working on various low-cost, easy-to-integrate, energy-autonomous silicon systems with power consumption ranging from picoWatts to sub-nanoWatts. These critical sub-systems will make future battery-less sensors a reality, with the end goal of building a complete battery-less system-on-chip.

"We have demonstrated silicon chips with substantially lower power that will define the profile of next-generation IoT nodes," said team member Dr Orazio Aiello, a Visiting Research Fellow at NUS. "This will contribute towards realising the ultimate vision of inexpensive, millimetre-scale and, eventually, battery-less sensor nodes."
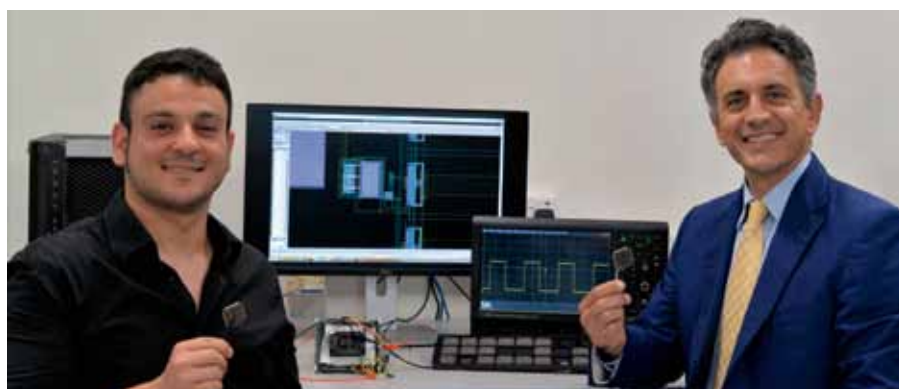
CHEAPER, MORE EFFICIENT PEROVSKITE SOLAR CELLS

European scientists have synthesised a molecule that could assist with selective layer formation in perovskite solar cells. Described in the journal *Advanced Energy Materials*, the molecule assembles itself into a monolayer which can cover a variety of surfaces and can function as a hole-transporting material in a perovskite solar cell.

Perovskite-based solar cells are at the forefront of emerging photovoltaics, already competing in efficiency against well-established solar technologies used in solar panels around the world. An important step towards mass production of this new generation of solar cells is the development of efficient selective contact layers that would be compatible with the deposition of perovskite layers on various substrates.

Spin coating and vapour deposition are the two main methods which are currently being used for the formation of the layers in perovskite solar cells. Spin coating involves dripping liquid solution on spinning surfaces, but during the process large quantities of the material are lost. Vapour deposition, meanwhile, needs high temperatures and complex vacuum technologies, and not all molecules are suitable for evaporating.

The molecule, synthesised by the KTU chemists, assembles itself into a monolayer which can cover a variety of surfaces and can function as a hole-transporting material in a perovskite solar cell.

Now, chemists from Lithuania's Kaunas University of Technology (KTU) have synthesised a molecule that assembles itself into a monolayer and can evenly cover any oxide surface — including the textured surfaces of the silicon solar cells used in tandem architectures.

"It's not polymer, but smaller molecules, and the monolayer formed from them is very thin," said Ernestas Kasparavičius, a PhD student at KTU. "This, and the fact that the monolayer is being formed through dipping the surface into the solution, makes this method much cheaper than the existing alternatives. Also, the synthesis of our compound is a much shorter process than that of the polymer usually used in production of perovskite solar cells."

The synthesised material was subsequently tested by physicists at Helmholtz-Zentrum Berlin (HZB), headed by Dr Steve Albrecht in collaboration with KTU doctoral student Artiom Magomedov. Together, they successfully used the material as a hole-transporting layer in perovskite solar cells.

"In our laboratory in Kaunas, we studied use of the self-organising molecules to form the electrode layer as thin as 1–2 nm, evenly covering all the surface," Magomedov said. "During my internship in Berlin I was able to apply our material and to produce a first functioning solar element with just a monolayer-thick selective contact."

The self-assembling monolayer technique not only results in low material consumption, but also high efficiency — the element's power conversion efficiency was close to 18%, which is exceptionally high for a new technology. Also, when the monolayer is used as a hole-transporting layer in perovskite cells, no additives are needed to improve the performance of the cells. This could significantly improve the lifespan of the elements.

Since this approach to perovskite solar cells has never been considered before and can potentially play a role in industrial processes, the researchers have filed a patent application on the molecule and its use. The KTU scientists are also synthesising new materials for monolayer formation, with the first tests of the optimised materials at HZB resulting in solar cells with greater than 21% efficiency.

DESIGN DEVELOPED FOR ALUMINIUM-ION BATTERIES

Scientists from the US, Australia and South Korea have demonstrated a strategy for designing active materials for rechargeable aluminium-ion batteries, bringing us one step closer to making the science behind the technology work.

While lithium-ion batteries have enjoyed remarkable success powering mobile electronic devices, in renewable energy applications they are fraught by limited cycle life, safety concerns and relatively high costs. Aluminium-ion batteries have thus been seen as ideal contenders for this space, given aluminium is the third most abundant element in the Earth's crust behind oxygen and silicon. It also has the one of the highest theoretical volumetric capacities on account of its multiple redox states.

"Developing batteries using aluminium has received a lot of expectation for delivering high energy to price ratios," said Dr Dong Jun Kim, formerly of Northwestern University and now based at UNSW. But up until now, finding appropriate host electrodes for insertion of complex aluminium ions had been a fundamental challenge.

"We found a novel way to design rechargeable aluminium batteries by employing a redox-active macrocyclic compound as the active material," Dr Kim said. In other words, he and his team managed to use a large organic chemical compound as the part of the battery that stores energy, something that previously had researchers stumped.

"We believe the research discussed in the article opens up a new approach to designing aluminium-ion batteries that could be of interest to scientists investigating next-generation electrochemical energy storage," Dr Kim said.

Dr Kim said the results of the study, published in the journal *Nature Energy*, showed "promising battery performances"; however, he stressed that it is early days and improvement will be required in every aspect of the technology. He will therefore continue to research aluminium-ion batteries while examining the potential of using other elements.

"I look forward to further research on utilising redox-active organic molecules for multivalent-ion intercalation batteries such as aluminium, magnesium, zinc and calcium," Dr Kim said.

SWITCHING REGULATOR POWER MODULES

RECOM's latest power modules are designed to increase the power density of DOSA-packaged DC/DC converters. The RPM modules feature efficiency up to 99%, enabling a low-profile package suitable for applications where space is critical.

The power modules are said to offer one of the highest power densities in a DOSA footprint on the market with a profile of only 3.75 mm. They provide 1, 2, 3 or even 6 A in the same-sized package for scalability.

The 6 A module has at least 50% higher power density than its peers on the market, due to its IC and a novel multilayer PCB layout. It is thermally optimised to pull the heat away from the board — so without derating it delivers over 48 W/cm^3 at up to 90°C. With a ground plane in the PCB together with the metal housing, six-sided shielding ensures good EMC performance.

The power modules have been designed, tested and manufactured all in Europe. With input and output capacitors already included, the series operates without the need for additional components. They are SMD with a land grid array package.

To facilitate rapid testing, RECOM has also developed evaluation boards so that customers will be able to quickly and easily test the modules.

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www.recom-power.com

PRINTED CIRCUIT BOARDS

IMP Electronics Solutions sources high-quality printed circuit boards (PCBs) direct from the factories that manufacture them. With flexible and rigid-flex options available, customers can be supplied with anything from low-volume, quick-turn prototypes to medium- and high-volume production runs.

IMP Electronics Solutions also offers an extensive PCB prototype service, ranging from single-layer to 10-layer. The company offers two types of service for each of the layer counts and can provide a comprehensive PCB flyer showcasing the usable areas, various services and extras available.

As an alternative to traditional wiring options, flex-circuits (FPCs) are intended to provide a lighter, cleaner and neater appearance along with the capability of assuming 3D configurations. Advantages of flex-circuits are said to include improved connection, simplified assembly, reduced reworking and troubleshooting time, improved component appearance and one-way-only fit, resulting in fewer wiring errors during installation and servicing.

IMP Electronics Solutions Pty Ltd
www.imppc.com.au

THREE-PHASE POWER QUALITY ANALYSER

The Elspec G4500 is a power quality analyser that utilises the PQZIP algorithm, enabling the user to continuously measure, store and analyse waveform signals regardless of their size. The device complies with standards for aggregations, time clock uncertainty, flagging and transient influence quantities. It is available to rent from TechRentals.

The unit measures and records 5000 power parameters continuously at resolutions of ½ cycles, 10/12 cycles and 150/180 cycles. The instrument features I/O ports, a web-based interface, Wi-Fi, and voltage and current inputs.

The product is IEC6100-4-40 Class A compliant and features a plug-and-play probe interface for automatic detection of probes and clamps; a configurable report module for the creation of the user's own report templates; and an external battery (2 h life) that allows for continuous recording in the event of a power loss.

TechRentals
www.techrentals.com.au

INTEGRATED DEVELOPMENT ENVIRONMENT

Digi-Key Electronics introduces the DK IoT Studio — an integrated development environment (IDE) that aims to provide a simple way for developers and providers to create IoT solutions. The studio allows users to go from idea to prototype in minutes without writing any code.

The tool, developed in partnership with Atmosphere IoT, has an intuitive user interface along with drag-and-drop functionality. Simply dragging sensors, processors and other library elements and dropping them onto the design panel allows the user to make connections and start collecting data and sending it to a mobile device or the cloud. The product also generates the embedded code (firmware) as well as the web and mobile application code.

The initial release of the DK IoT Studio will feature Espressif's ESP32 and NXP's Rapid IoT Kit, with additional supplier platforms being added quarterly. Other notable benefits of the tool include: the ability to create and import/export designs for shareable/customisable projects; utilisation of Amazon Web Services (AWS); and integration of data into a third-party application, data warehouse or cloud platform.

The goal of the design tool is to offer a seamless path from the creation of an IoT solution to field deployment. The tool is paired with access to Digi-Key's inventory of electronic components.

Digi-Key Electronics
www.digikey.com

WATER-RESISTANT AA BATTERY HOLDERS

Keystone Electronics has met the increasing demands for water-resistant AA battery holders with its latest covered plastic battery holders.

The self-contained battery holders can be placed on or off a board, between components or cards, or anywhere within a case or piece of equipment as space allows. In addition to portability, the devices also feature coil spring contacts to compensate for variations in battery length and to securely hold batteries in place, ensuring positive, low contact-resistance connections.

Engineered with a sealing gasket to provide a watertight compartment for AA batteries, the self-contained enclosures are IP65 rated for water, dust and other harsh environments. Manufactured for increased durability from moulded ABS, the contacts are nickel-plated spring steel.

The waterproof battery holders are available in configurations to accommodate two, three or four AA cells. They include 6″-long, 26 AWG pre-tinned wire leads for simplified installation and a built-in, sealed on/off switch for additional product security.

NPA Pty Ltd
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MEDTECH SECURITY

AND THE ROLE OF BATTERY MANUFACTURERS

The medical technology (medtech) sector is in a vulnerable state, with an unprecedented number of cyber attacks in recent years targeting critical medical equipment in hospitals. Neil Oliver, Technical Marketing Manager at professional battery manufacturer Accutronics, explains how battery manufacturers can play a role in improving the safety and security of medical devices.

A t the start of 2016, the US Food and Drug Administration (FDA) drafted guidance for securing medical devices, recommending that "medical device manufacturers address all risks, including cybersecurity risk". Yet these proposed guidelines only go some way to solving the issue of medtech security and do not cover hardware security. Medical original equipment manufacturers (OEMs) therefore have an opportunity to reassess their approach to device security.

Hardware hacking

Cybersecurity is certainly a big issue for health care, but it is not the only aspect of medical security that practitioners must consider. When medical OEMs are designing their devices, it is critical they keep in mind the safety of the physical device itself.

One of the biggest issues facing devices across all industries is that of hardware hacking, which is when a counterfeit or grey market component or peripheral is used in a device and undermines its integrity. This ranges from a USB memory stick in a hospital computer carrying malware or even a counterfeit battery being used in a device, resulting in unexpected and abrupt power failure.

While some of these hardware hacks are the direct result of third parties with malicious intent, many are unintentionally caused by device manufacturers or end users. For example, a health trust or hospital might be under financial constraint and choose to buy a grey market or unbranded battery to power its device rather than buy the part specified by the OEM. While this initially reduces costs, these fake batteries are not certified by the OEM and are most likely of inferior quality, increasing the incompatibility, the risk of sudden device failure or even a safety-related incident.

It is for this reason that recent calls to consider security during design stages offer OEMs an opportunity. While the FDA guidelines are currently recommendations and not legally binding, responsible OEMs will abide by them and pay close attention to a device's security — both cyber and physical — at each stage of the product development life cycle (PDLC).

For example, an OEM might want to consider algorithmic security to ensure that only a battery which has been certified by the OEM can be used in the medical device. This would require consulting with a medical battery manufacturer early in the PDLC.

Algorithmic security is essentially software encryption. The certified battery is programmed with a key which is known only to the battery manufacturer and the medical device OEM. The medical device issues a random challenge to the battery and requires it to respond immediately with an answer based on calculations determined by its internal key. The device performs the same calculations and checks to see if the answers are identical.

If the battery is unable to provide a correct response then the device determines that the battery is suspect and performs whatever action has been predetermined by the OEM, which can vary from shutting down, allowing discharge but not charge or alerting the OEM of the infringement for the purposes of voiding warranty.

cells within the available volume. This means that the energy density and subsequent battery longevity of the medical device is not optimised.

Given a constrained space, it is tempting for some battery integrators, driven by the OEM, to squeeze cells into the available space. While this may work for cylindrical and prismatic cells that are housed in metal cases, the same cannot be said for pouch cells, which have only a thin metallised polyester material to contain and protect the inner electrodes.

Any excess force, bending or locally applied pressure can result in an internal short circuit which can have serious consequences for safety. Cases for pouch cells should also be designed with excess volume to allow for cell swelling which naturally occurs as the battery is cycled.

Smart batteries

With the rise of smart medical devices, OEMs are looking to their batteries to provide smart functionality which can improve safety, reliability and performance. A smart battery plays an active role in device power management, working alongside a smart charger and host device.

A smart battery monitors its state of charge and only requests charging when it is required. The appropriate charging voltage and current are broadcast to the smart charger, which responds accordingly.

This method means that a single charger can be used to charge many different types of battery without the need for the charger to be preprogrammed to accommodate them. It also allows for chemistry independence where batteries of different types, from different manufacturers and with different charge requirements can be used in a single system.

A smart battery can provide users with highly accurate runtime information. Whereas the fuel gauge accuracy on a mobile phone is less important, in a medical device it is critical that the battery can accurately report this information so medical professionals can make informed decisions about battery charging and replacement. A properly configured smart battery will account for many factors, including the age of the battery, the temperature, previous discharge history and the discharge rate to provide a fuel gauge accuracy of up to 1%.

In order to maximise stored battery energy, smart batteries have various power modes. They can send themselves to sleep when not communicating with a device and are often shipped in a shutdown mode, maximising shelf life.

As safety is paramount, smart batteries protect themselves from abnormal charging and discharging. Each series cell in a lithium-ion smart battery is protected against overdischarge and overcharge while the battery is also protected against overcurrent, short-circuit and overtemperature. In addition to a primary method of protection (temporarily opening a charge or discharge FET), many smart batteries also include a one-time operated logic fuse which can be blown by the battery if it detects a serious fault condition.

With the wearable medical device market expected to reach US$4.6 billion by 2020 and the FDA expected to push for legal guidelines on medtech security, OEMs must consider battery safety and security as a high priority. Batteries are now being used to power critical medical devices that can make the difference between life and death, so OEMs must treat them with the seriousness they deserve.

Accutronics
www.accutronics.co.uk

Safety of medical devices

Smart medical devices are also increasingly used as monitors for patients' vital statistics. For example, a wearable patch was recently invented that regularly records patient vitals, such as heart rate, temperature and movements.

This means that doctors do not need to go from bed to bed to take note of the vitals and can instead monitor them from a central location. However, doctors will come to rely on the device as a reliable source for patient information, meaning they will make serious treatment decisions based on them.

As a consequence, not only must the security of these devices be considered to avoid hackers obtaining sensitive information, but also the safety and reliability of them, to ensure that these critical devices do not fail.

Design considerations

To mitigate the risks of a critical medical device failing, it is essential that OEMs work with battery manufacturers early in the design process. With new devices, OEMs often have unrealistic expectations for the longevity of the battery, both in terms of stored energy and cycle life, and they can fail to provide adequate volume for the battery which is required to meet the runtime requirements of the device.

All too often, OEMs will turn to a battery manufacturer with a predetermined slot for the battery. However, it is often then difficult for battery integrators to tessellate commercially available

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'TWISTED LIGHT'
COULD ENABLE 100x FASTER INTERNET SPEEDS

Researchers at RMIT University have unlocked a way to carry more data, and process it quicker, than the fibre optics of today — potentially allowing for internet speeds 100 times faster than what we're used to.

Currently, optical fibres carry information on pulses of light, at the speed of light — but the way the light is encoded at one end and processed at the other affects data speeds. Fibre-optic communications like those used in the national broadband network use only a fraction of light's actual capacity by carrying data on the colour spectrum, while new broadband technologies seek to use the oscillation, or shape, of light waves to encode data — increasing bandwidth by making use of the light we cannot see.

Now, researchers at RMIT's Laboratory of Artificial Intelligence Nanophotonics (LAIN) have built a nanophotonic device that encodes more data and processes it much faster than conventional fibre optics. Described in the journal *Nature Communications*, the technology carries data on light waves that have been twisted into a spiral to increase their capacity — known as light in a state of orbital angular momentum, or OAM.

"Present-day optical communications are heading towards a 'capacity crunch' as they fail to keep up with the ever-increasing demands of big data," said Dr Haoran Ren, co-lead author of the paper.

"What we've managed to do is accurately transmit data via light at its highest capacity in a way that will allow us to massively increase our bandwidth."

In 2016, the LAIN team published a disruptive research paper in the journal *Science* describing how they'd managed to decode a small range of this twisted light on a nanophotonic chip. But technology to detect a wide range of OAM light for optical communications was still not viable, until now.

"Our miniature OAM nanoelectronic detector is designed to separate different OAM light states in a continuous order and to decode the information carried by twisted light," Dr Ren said.

"To do this previously would require a machine the size of a table, which is completely impractical for telecommunications. By using ultrathin topological nanosheets measuring a fraction of a millimetre, our invention does this job better and fits on the end of an optical fibre."

Professor Min Gu, LAIN Director and Associate Deputy Vice-Chancellor for Research Innovation and Entrepreneurship at RMIT, said the materials used in the device are compatible with silicon-based materials use in most technology, making it easy to scale up for industry applications.

"Our OAM nanoelectronic detector is like an eye that can 'see' information carried by twisted light and decode it to be understood by electronics," he said. "This technology's high performance, low cost and tiny size makes it a viable application for the next generation of broadband optical communications.

"It fits the scale of existing fibre technology and could be applied to increase the bandwidth, or potentially the processing speed, of that fibre by over 100 times within the next couple of years. This easy scalability and the massive impact it will have on telecommunications is what's so exciting."

Prof Gu said the detector can also be used to receive quantum information sent via twisting light, meaning it could have applications in a whole range of cutting-edge quantum communications and quantum computing research.

"Our nanoelectronic device will unlock the full potential of twisted light for future optical and quantum communications," he said.

A Plug-In Makes WAGO Controllers IoT-Ready

Open. Easy. Industrial IoT Champion with MQTT Protocol

Record, digitize and link data profitably - this is the core concept behind Industry 4.0. A simple configuration transforms the WAGO PFC100 and PFC200 Controllers into IoT controllers that transmit data from the field level to the cloud, where data can be aggregated and analysed. This creates true added value for your company - be it for increasing the efficiency of in-house production, implementing energy management in buildings or developing further end customer services. Existing systems also become IoT ready, giving them long-term viability. The WAGO PFC family of controllers thus forms the basis for a sustainable corporate world.

In just a few simple steps, both WAGO PFC100 and PFC200 Controllers can be transformed into an IoT device by installing a firmware upgrade and programming an IEC application with the corresponding library. Status information such as Run/Stop, connection status, device information and variables defined in the IEC program can be transmitted to the cloud and visualized. The customer can decide whether the controller sends data to Microsoft Azure, Amazon Web Services or IBM Bluemix. Links to third-party solutions will also be feasible thanks to the standardised MQTT protocol. Data is transmitted as JSON files and the link encrypted with TLS.

MQTT **MQTT**
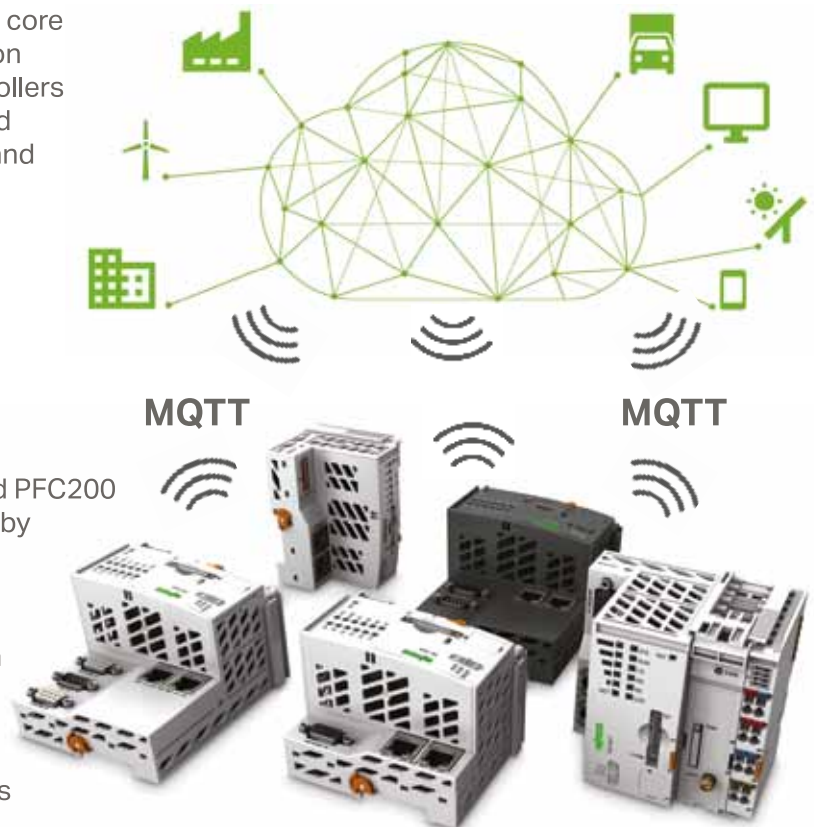
PFC100 & PFC200 Controllers
750 Series

Increase the Reliability of your Critical System

WAGO Uninterruptible Power Supply (UPS) Solution

Consisting of a 24 V UPS charger and controller with one or more connected batteries, WAGO's Uninterruptable Power Supply reliably powers an application for several hours. Be confident in your system with reliable and consistent supply; independent of fluctuations in mains supply, is guaranteed.

WHY WAGO?

→ **Slim charging and control units:** Save control cabinet space

→ **Battery control technology for predictive maintenance:** Extending battery life

→ **Visualisation and Configuration:** Display and RS-232 interface

240VAC / 24VDC 5A UPS
Item No. 787-1675

sales.anz@wago.com | (03) 8791 6300 | www.wago.com.au

4G INTELLIGENT MULTIFUNCTION CONTROLLER

The GTP-541M, from ICP DAS, is an industrial smart 4G remote terminal device, backward compatible with the 2G/3G frequency band. Depending on the user's needs, the intelligent multifunction controller can be used with different software interfaces.

The 4G remote terminal equipment transmits input/output signals to the remote management platform through LTE/WCDMA/GPRS. The local I/O data can also be stored in the micro SD card, to become a remote data logger.

ICP also provides related software support in order to facilitate the quick establishment of monitoring programs by users. This range of software includes VxServer, Virtual COM software such as VxComm. In addition, in order to meet different application requirements, users can switch the product to different functions such as ModBusSMS, DIOSMS and RMV through SD card replacement firmware.

The controller's powerful features are designed to reduce user development time, making it suitable for IoT applications.

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

THERMAL IMAGING CAMERA

The FLIR T640 thermal imaging camera delivers high performance thermal imaging with a 5 MP visual camera, a large 4.3″ touchscreen LCD display and autofocus. The camera is capable of 8x continuous zoom and captures images in 640 x 480 thermal resolution, which ensures highly detailed measurements from long range. It is available to rent from TechRentals.

The product is able to take high temperature readings, with a range of -40 to 2000°C and accuracy of ±2°C or ±2%. Automatic location data is added to every image from the built-in GPS/compass. Data and images are able to be quickly shared to Apple and Android smart devices via the FLIR Tools app.

The camera's ergonomic design includes an optical block that can rotate 120° for easy targeting and auto-orientation to ensure the screen is always easy to read. The large screen features a colour viewfinder for bright conditions and on-screen sketching. It is also capable of taking measurements from 10 different spots simultaneously, periodic image storage (time lapse) and the ability to create instant PDF reports directly from the camera.

TechRentals
www.techrentals.com.au

MODE-CHANGING MEMS ACCELEROMETER

The STMicroelectronics IIS2DLPC 3-axis MEMS accelerometer can change operating mode on the fly, from ultralow power to high resolution. The sensor can provide continuous contextual awareness to wake the host system when action is required and take its measurements before returning to ultralow-power operation.

With this extra flexibility, users can build long-lasting battery-powered industrial sensor nodes or medical devices, tamperproof smart meters and smart power-saving or motion-activated functions. In addition, the opportunity for low power consumption enables smart accessories for industrial machinery or robotics to be created as convenient, battery-powered add-on modules that require minimal integration effort.

A choice of four reduced-power modes lets users optimise power consumption in wide-ranging application scenarios. Low noise, down to 90 $\mu g/\sqrt{Hz}$ in high-resolution mode, permits proper measurement. Additional features give users extra control over power consumption, including easy-to-use one-shot data conversion and a 32-level FIFO for storing batched data to reduce CPU intervention. An integrated temperature sensor and built-in self-test capability are also provided.

Especially suited to industrial applications, the product is specified over an extended temperature range from -40 to +85°C.

STMicroelectronics Pty Ltd
www.st.com

HOW TO POWER WEARABLES

WITHOUT SACRIFICING ENERGY DENSITY

There is a new technology gripping the markets of the future — wearable technology.

Wearables are portable systems that contain sensors to collect measurement data from our bodies. Powering these sensors without wires calls for pliable batteries that can adapt to the specific material and deliver the power the system requires. Microbatteries developed by the Fraunhofer Institute for Reliability and Microintegration IZM provide the technical foundation for this new technology trend.

In medicine, wearables are used to collect data without disturbing patients as they go about their daily business — to record long-term ECGs, for instance. Since the sensors are light, flexible and concealed in clothing, this is a convenient way to monitor a patient's heartbeat. The technology also has more everyday applications — for example, fitness bands that measure joggers' pulses while out running.

How to power these smart accessories poses a significant technical challenge. There are the technical considerations — durability and energy density — but also material requirements such as weight, flexibility and size, and these must be successfully combined. This is where Fraunhofer IZM comes in: experts at the institute have developed a prototype for a smart wristband that, quite literally, collects data firsthand.

The silicone band's technical piece de resistance is its three green batteries. Boasting a capacity of 300 mAh, these batteries are what supply the wristband with power. They can store energy of 1.1 Wh and lose less than 3% of their charging capacity per year.

With these parameters the new prototype has a much higher capacity than smart bands available so far, enabling it to supply even demanding portable electronics with energy. The available capacity is actually sufficient to empower a conventional smart watch at no runtime loss. With these sorts of stats, the prototype beats established products such as smart watches, in which the battery is only built into the watch casing and not in the strap.

Success through segmentation

According to Robert Hahn, a researcher in Fraunhofer IZM's department for RF & Smart Sensor Systems, segmentation is the recipe for success. "If you make a battery extremely pliable, it will have very poor energy density — so it's much better to adopt a segmented approach," he said.

Instead of making the batteries extremely pliable at the cost of energy density and reliability, the institute turned its focus to designing very small and powerful batteries and optimised mounting technology. The batteries are pliable in between segments. In other words, the smart band is flexible while retaining a lot more power than other smart wristbands available on the market.

Customer-tailored solutions

In its development of batteries for wearables, Fraunhofer IZM combines new approaches and years of experience with a customer-tailored development process. As explained by Hahn, "We work with companies to develop the right battery for them."

The team consults closely with customers to draw up the energy requirements. They carefully adapt parameters such as shape, size, voltage, capacity and power and combine them to form a power supply concept. The team also carries out customer-specific tests.

Smart plaster to measure sweat

In 2018, the institute began work on a new wearable technology: the smart plaster. Together with Swiss sensor manufacturer Xsensio, this EU-sponsored project aims to develop a plaster that can

Microbattery with metal foil laminated housing. Image© Fraunhofer IZM

Millimetre-sized lithium-ion batteries with interdigital electrodes. Image© Fraunhofer IZM, Volker Mai

Mechanically flexible microbattery strip made from segmented battery cells. Image© Fraunhofer IZM

directly measure and analyse the patient's sweat. This can then be used to draw conclusions about the patient's general state of health. In any case, having a convenient, real-time analysis tool is a useful way to track and monitor healing processes.

Fraunhofer IZM is responsible for developing the design concept and energy supply system for the sweat measurement sensors. The plan is to integrate sensors that are extremely flat, light and flexible. One idea, for instance, would be an encapsulation system made out of aluminium composite foil. The researchers also need to ensure they select materials that are inexpensive and easy to dispose of — after all, a plaster is a disposable product.

Conclusion

For over 25 years, Fraunhofer IZM has been one the world's leading institutes for applied research and the development and system integration of robust and reliable electronics. Cooperating with industry and academia, the institute is overcoming the challenges associated with wearable technology. And with the sector expected to reach a market value of €72 billion by 2020, we can expect Fraunhofer IZM's early successes to produce big returns.

Fraunhofer IZM
https://www.izm.fraunhofer.de/en.html

FMAC NEO: 3-PHASE MAINS FILTER

SCHURTER launches its single-stage filter family FMAC NEO.

Especially compact with high performance, the new filter series is ideally suited for use in today's more portable industrial machines, designed to occupy less floor space in manufacturing plants. A wide temperature range extends its capabilities for use in many critical applications.

Three-phase control cabinets, in particular, can have space constraints. SCHURTER addresses this problem with a completely new filter design, which is much more compact than older generations. The new, almost cubed design makes optimum use of available space in the cabinet housing. Designed with the highest quality components, the filter attenuation remains very high relative to its more compact dimensions.

The new filter family is also suitable for use in devices subjected to high EMC loads such as energy converters or motor drives. Typical applications include converters for photovoltaics, battery storage or charging stations for electric vehicles. These new high-performance type filters are also the better choice for modern day frequency inverters used for motor control.

The FMAC NEO filter series has screw terminals for safe and reliable wire terminations. A full metal flange guarantees a good earth ground connection upon screw mounting to the chassis. The standard versions can be used over a wide temperature range from -40°C to 100°C.

The filters are designed for currents from 16 A to 230 A at an ambient temperature of 50°C. They are ENEC and cURus

Description:
• Terminals for three phases and ground
• One stage
• Very high attenuation
• Industrial or low leakage current versions

Unique selling proposition:
• Compact design with small footprint
• Single-stage filter for high efficiency
• Lightweight design
• Wide temperature range

Applications:
• Voltage rating 520 VAC for worldwide acceptance
• Protection against interference voltage from the mains
• Especially designed for industrial applications such as frequency converters, stepper motor drives, UPS systems and inverters
• Suitable for use in equipment according to IEC/UL 60950

approved and recommended for applications up to 520 VAC. The standard versions are designed for industrial applications with leakage currents <13 mA. Special versions for leakage-critical applications of <3 mA are also available.

The completely redesigned models of the FMAC NEO family are the ideal replacement for all types of SCHURTER legacy FMAC filters. The FMAC NEO offers the same high performance with significantly smaller dimensions and weight.

SCHURTER (S) PTE LTD
www.schurter.com

⬛.SCHURTER
ELECTRONIC COMPONENTS

PANEL INDICATOR LEDs

Combining features such as ingress protection (IP67) and sunlight readability with good performance, Marl's range of high-performance panel indicator LEDs has been specifically designed for installation in all categories of climatic and hazardous environments, providing high-intensity indication for long durations in demanding applications.

Using a standard industrial mounting of 8.1 mm with a nickel-plated brass housing, the 537 series is suitable for high-vibration and external industrial applications.

Featuring a coloured diffused lens offering a wide viewing angle, internal resistor and bipolar circuitry (suitable for AC or low-voltage DC in any orientation), the series offers status panel indication in tough industrial environments. It is available in a range of LED colour and voltage options.

Aerospace & Defence Products
www.aerospacedefenceproducts.com.au
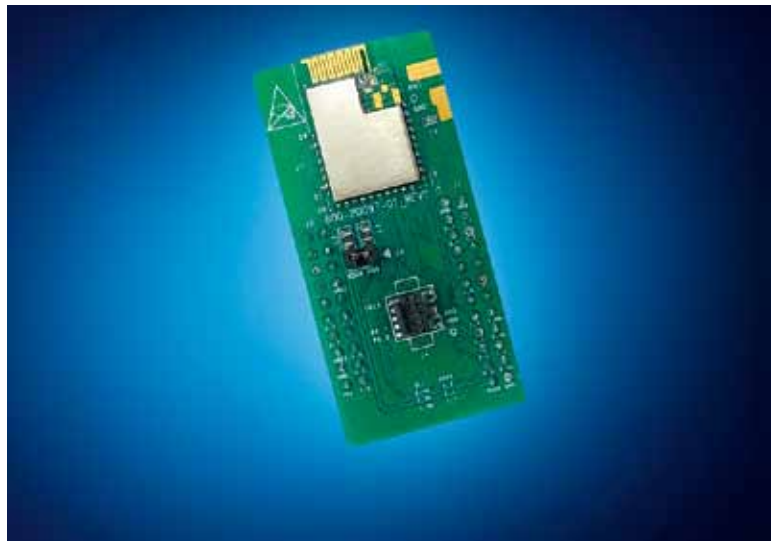
WICED BLUETOOTH MODULES

Cypress Semiconductor has released its fully integrated Bluetooth Smart Ready EZ-BT and Bluetooth Low Energy (BLE) EZ-BLE Wireless Internet Connectivity for Embedded Devices (WICED) modules, with the aim of simplifying the design and development of Internet of Things (IoT) devices, home automation, medical devices and industrial applications.

The modules feature an onboard crystal oscillator, flash memory, passive components and a Cypress CYW207xx system-on-chip (SoC) with a 32-bit Arm Cortex-M3 processor. The low-power devices support pulse-width modulation (PWM) and analog-to-digital conversion (ADC) as well as UART, SPI and I²C serial communication. The EZ-BT module also includes a PCM/I²S audio interface and 512 KB of serial flash memory. The EZ-BLE module is available in a version with 128 KB of flash and 60 KB SRAM memory for over-the-air updates and self-sufficient operation.

The EZ-BT module includes a royalty-free Bluetooth stack compatible with Bluetooth 5.0, while the EZ-BLE modules ship with a royalty-free BLE stack compatible with Bluetooth 4.1. The EZ-BLE modules offer pre-programmed EZ-Serial firmware platform for immediate, easy-to-use BLE connectivity.

The modules are supported by Cypress's WICED Studio software development kit (SDK), combining Wi-Fi and Bluetooth into a single integrated development environment (IDE). The IDE allows for the rapid configuration, development and programming of Bluetooth applications.
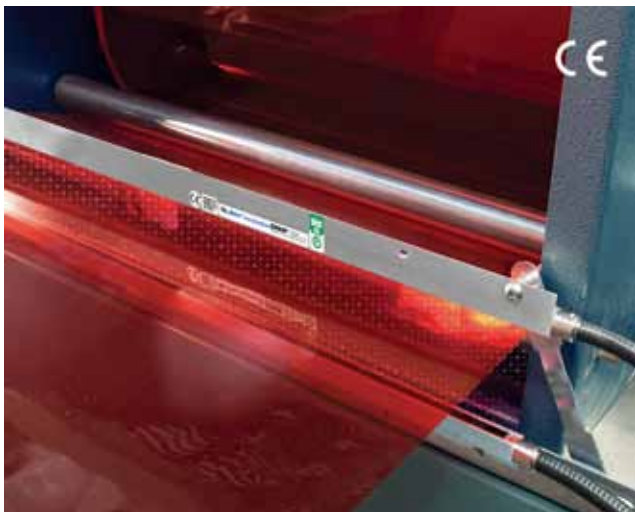
Mouser Electronics
www.mouser.com

ANTISTATIC IONISING BAR

EXAIR's Gen4 Ionizing Bar is designed to eliminate static electricity 25% better than the company's previous models by eliminating larger static charges, faster. It has improved range and is effective when mounted up to 102 mm from a charged surface. It eliminates static on plastics, webs, sheet stock and other product surfaces where tearing, jamming or hazardous shocks are a problem.

Gen4 products have undergone independent laboratory tests to certify they meet the rigorous safety, health and environmental standards of the USA, European Union and Canada that are required to attain the CE and UL marks. They are also RoHS compliant. Design features include a metal-armoured, high-voltage cable to protect against abrasion and cuts, integrated ground connection and electromagnetic shielding.

The product is compact and has an integrated mounting flange, which allows it to fit in the confined spaces of machinery where a static charge is generated. A high concentration of positive and negative ions produces fast static decay, neutralising surfaces which are causing production, quality or safety problems.

The product line is offered 76 to 2743 mm lengths. The electrical ion source is shockless and there is no radioactive element. A selectable voltage power supply has been specially designed to operate Gen4 products.

Applications include surface cleaning, neutralising plastics, bag opening, printing machinery, packaging operations and elimination of painful static electricity shocks.

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

WIRELESS ETHERNET GATEWAY

Wireless data transmission is now commonplace in machinery and equipment applications. WAGO's Wireless Ethernet Gateway, which meets the IP65 degree of protection and has an internal directional antenna, is suitable for harsh industrial environments.

In addition to the standard current WLAN standards, it also allows communication via Bluetooth 4.0. Integrated access point functionality makes it possible to set up a WLAN or Bluetooth network. The gateway can be easily configured with a button on the device or via web server.

Main features include WLAN 802.11 a/b/g/d/e/i/h and Bluetooth 4.0 with robust communication and high data throughout; a high degree of IP65 protection for direct on-machine use; and access point functionality to build a network of up to seven clients. An additional version with an external antenna can be used in a control cabinet or with a poor radio connection.

WAGO Pty Ltd
www.wago.com.au

COMMON-MODE CHOKES

Coilcraft's 1812CAN Series common-mode chokes provide noise suppression on CAN (1 Mbps) or CAN FD (5 Mbps) data lines in automotive and industrial automation applications.

CAN common-mode chokes are the most commonly used filter component to attenuate common-mode noise at the CAN bus (controller area network) transceiver's output. The series can also be used for the FlexRay automotive bus system.

Measuring 4.95 x 3.18 x 3 mm, the low-profile series is offered with inductance values from 11 to 100 μH to filter a broad range of common-mode noise frequencies with high attenuation. It offers up to 60% lower DCR than other CAN bus chokes, according to the company, resulting in lower losses on differential signal lines.

The series is qualified to AEC-Q200 Grade 1 standards (-40 to +125°C ambient), making it suitable for automotive and other harsh environment applications. It features RoHS-compliant, silver-palladium-platinum-glass frit terminations and offers a maximum reflow temperature of 260°C.

TRI Components Pty Ltd
www.tricomponents.com.au

INDUSTRIAL IoT SERVERS

ICP DAS's UA-5200 series of IIoT (Industrial IoT) communications servers now includes the UA-5231M-4GE and UA-5231M-4GC, which have metal cases and can support 4G LTE in a multitude of countries. The built-in OPC UA Server, MQTT Broker and Client functions meet the requirements of connecting MES, ERP, SCADA and cloud services.

The UA series can access I/O modules and controllers in the field via communication interfaces such as Ethernet, RS232 and RS485, or through protocols like Modbus TCP/RTU/ASCII. The products support the cloud service platform 'IFTTT', able to connect with over 500 web apps.

The logic control 'If This Then That' allows users to receive firsthand notification messages through the most commonly used mobile apps when an event is triggered. The series also connects IT to OT and integrates all the devices as well as web-based apps into the cloud, allowing managers to improve production performance and enhance their factory competitiveness for Industrial IoT.

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

ENCLOSURES

OKW's PROTEC enclosures have a modern and attractive square design with soft contours. As a result, the wall-mount and table-top housings are useful for modern electronics applications, both indoors and outdoors.

The enclosures have an inclination angle of 20°, which is considered ergonomically suitable for operating terminals and for reading off data. They can be ordered in three sizes, with dimensions of 140 x 140 x 76 mm, 180 x 180 x 92 mm and 220 x 220 x 108 mm, and are also available in three different versions.

Version I features a deep recessed interface area at the rear of the enclosure for the installation and protection of connectors, interfaces, switches and cables. Version II features a snap-on cover for flush covering of the recessed interface area. Version III has a deep cover for the recessed interface area, which is fitted by screws. The deep cover provides additional internal space for the electronics, cabling and connections.

A recessed operating area for integrating membrane keyboards, operating elements and touch systems has been provided in the square top cover. The top cover is screwed to the bottom part at the back with stainless steel Torx screws, and the entire screwed connection is thus hidden from view. The range of accessories for the enclosure series includes matching sheet aluminium holders, which allows hidden, secure wall mounting.

The series is made of high-quality V0 material in off-white. The electronics compartment can be sealed up to protection class IP65 by means of an accessory sealing kit — this is particularly useful for tough applications, eg, in the smart factory/IIoT, central control units, surveillance systems and access and security controls in industrial environments or outdoors. The series can also be used in many other sectors, such as data acquisition systems, data systems engineering, measuring and control engineering as well as medical technology and health care.

The enclosures can also be modified according to the user's individual requirements, eg, with printing, mechanical machining for interfaces/displays, painting, EMC coating on the inner side of the enclosure and more.

ROLEC OKW Australia New Zealand P/L
www.okw.com.au

DEVELOPMENT KIT FOR WIRELESS POWER TRANSFER

Würth Elektronik and Infineon Technologies have jointly released a development system for wireless power transfer, the 760308EMP-WPT-200W. The development kit includes a power supply unit, a transmitter and a receiver unit.

The transmitter side consists of a full bridge and a resonance circuit. This is formed from the series connection of the WPT coil and the resonance capacitors. As a result of the phase shift between the voltage and current in the resonance circuit, the system works in ZVS (zero voltage switching) mode. This leads to high system efficiency.

A synchronous rectifier is used on the receiver side with downstream filtering and screening. In addition, amplitude modulation (AM) of the alternating field between the transmitter and receiver allows any data to be sent from the receiver side to the transmitter side.

The product serves to develop applications outside the Qi standard up to a power of 200 W. Options include sensors and a display board to test scenarios for data acquisition, forwarding and display.

The currents in the resonance circuit are sinusoidal, which ensures good EMC performance, and the circuit can be scaled from 10 W up to several kW. By changing the switching frequency, the output voltage changes and data can be transmitted from the receiver to the transmitter.

Possible fields of application include Industry 4.0, IoT or medical technology. Wherever there are harsh environments with any cable and connector openings in enclosures which should be avoided, such as in the case of wireless battery charging, it may be expedient to convey status messages.

Wurth Electronics Australia Pty
www.we-online.com

what's next

'Talking' buildings monitor themselves

An Australian company is rolling out wireless technology across the country that allows buildings to monitor themselves and report problems autonomously — and even talk to your smartphone.

Known as EMIoT and developed by UNSW, the wireless platform relies on LED exit signs as the backbone of a low-power meshed network that covers 99.9% of a building — even reaching underground car parks, pump systems and air conditioning. Emergency lighting manufacturer WBS Technology, which is commercialising the technology, has installed it in more than 10 apartment complexes — the latest being at Castle Hill in the north-west of Sydney.

"All you need is to install the emergency lights, and they all automatically connect to each other, and that creates the network," said Dr Wen Hu, from UNSW's School of Computer Science and Engineering. "The emergency lights can then be networked with other devices via various wireless technologies, including Bluetooth, which allows them to be controlled locally with a smartphone or via the internet from anywhere in the world."

Each exit sign or emergency light acts as a node in the network, passing information back and forth across a building. Once operating, other devices can be connected to the network — ventilation and pumping systems, security cameras and sensors, access doors to common areas and halls — allowing all of them to be controlled and monitored remotely.

The collaboration between UNSW and WBS began under UNSW's TechConnect incubator program. This led to an Australian Research Council Linkage project between the two, culminating in an Innovation Connections Grant.

Dr Wen Hu checking one of the hallway lights meshed into the smart building network. Image credit: Quentin Jones/UNSW.

Originally, WBS approached UNSW about creating a network of emergency lights using Zigbee, a low-power, low-data-rate, close-proximity wireless network used by medical devices. However, emergency lights can often be in out-of-the-way places where communications are unreliable. So Dr Hu and his colleagues worked on developing a meshed network of different communications technologies that could work seamlessly and provide a reliable network across a plethora of locations.

They eventually hit on a meshed combination of LoRa used by wireless sensors for healthcare monitoring: 6LoWPAN, a new internet protocol for small devices; and RPL, an experimental network protocol for point-to-point communications where stability and low data rates are an issue. They created a gateway that bridges the different technologies with cellular telecommunications networks, allowing it all to connect to computer servers in the cloud. They then added Bluetooth to provide localised control via smartphones.

WBS is now using the technology to transform itself into an entirely new business, offering what it calls 'sensors as a service'. For a fixed monthly fee, the company provides a network of emergency and other lights that monitor themselves, react to their surroundings and to remote commands, and can have other devices added to the same network.

At the retrofitted apartment building in Castle Hill, lights in the underground carpark dim when there's no movement and brighten when there is, as do lights in hallways and common areas. If a light fitting fails, building managers know which one and how long it has been inoperative.

As the network expands, energy usage and the status of heating and cooling could be tracked, flow gauges could report back on water usage and identify leaks, ventilation and pumping systems could be monitored remotely and hot water systems could be checked for faults. Even residents trapped in an underground carpark would be able to communicate with building managers via an app.

"We're actually creating a smart building ecosystem," said Luke Gibbeson of WBS. "There's 14 buildings in this apartment complex, and we've installed a networked emergency lighting solution throughout them without any cabling and with no supporting network infrastructure.

"Our communications gateway looks like a standard exit sign, which relays other emergency lights communication to the cloud and acts like a normal exit sign — so it's a plug-and-play system. You can install in a new building or retrofit into an older one, like this one. As more IoT devices are installed, they can be added to the network, and all managed remotely via a cloud-based service or locally through a smartphone app."

INTEGRATED QUANTUM CHIP OPERATIONS ARE NOW POSSIBLE

Two fundamental quantum techniques have been combined by Australian researchers in an integrated silicon chip, confirming the promise of using silicon for quantum computing.

Quantum computers that are capable of solving complex problems, like drug design or machine learning, will require millions of quantum bits — or qubits — connected in an integrated way and designed to correct errors that inevitably occur in fragile quantum systems. Now, a UNSW-led research team has experimentally realised a crucial combination of these capabilities on a silicon chip.

The team is led by Professor Andrew Dzurak, a program leader at the Centre of Excellence for Quantum Computation and Communication Technology (CQC2T) and Director of the NSW node of the Australian National Fabrication Facility. He and his colleagues have demonstrated an integrated silicon qubit platform that combines both single-spin addressability — the ability to 'write' information on a single spin qubit without disturbing its neighbours — and a qubit 'read-out' process that will be vital for quantum error correction.

In 2017, Prof Dzurak and colleagues published a design for a novel chip architecture that could allow quantum calculations to be performed using silicon CMOS (complementary metal-oxide-semiconductor) components — the basis of all modern computer chips. In their new study, published in the journal *Nature Communications*, the team combine two fundamental quantum techniques, confirming the promise of their approach.

Prof Dzurak's team had previously shown that an integrated silicon qubit platform can operate with single-spin addressability — the ability to rotate a single spin without disturbing its neighbours. They have now combined this with a special type of quantum readout process known as Pauli spin blockade, a key requirement for quantum error correcting codes that will be necessary to ensure accuracy in large spin-based quantum computers. This new combination of qubit readout and control techniques is a central feature of their quantum chip design.

"We've demonstrated the ability to do Pauli spin readout in our silicon qubit device but, for the first time, we've also combined it with spin resonance to control the spin," said Prof Dzurak.

"This is an important milestone for us on the path to performing quantum error correction with spin qubits, which is going to be essential for any universal quantum computer."

The lead author on the study is Michael Fogarty, who performed the experiments as part of his PhD research. According to Fogarty, "Quantum error correction is a key requirement in creating large-scale useful quantum computing because all qubits are fragile, and you need to correct for errors as they crop up… [This] creates significant overhead in the number of physical qubits you need in order to make the system work."

"By using silicon CMOS technology we have the ideal platform to scale to the millions of qubits we will need, and our recent results provide us with the tools to achieve spin qubit error correction in the near future," Prof Dzurak added.

"It's another confirmation that we're on the right track. And it also shows that the architecture we've developed at UNSW has, so far, shown no roadblocks to the development of a working quantum computer chip — and, what's more, one that can be manufactured using well-established industry processes and components."

Working in silicon is important not just because the element is cheap and abundant, but because it has been at the heart of the global computer industry for almost 60 years. The properties of silicon are well understood and chips containing billions of conventional transistors are routinely manufactured in big production facilities.

In 2015, Prof Dzurak's team realised quantum logic calculations in a real silicon device with the creation of a two-qubit logic gate — the central building block of a quantum computer. Prof Mark Hoffman, UNSW's Dean of Engineering, said, "Those were the first baby steps, the first demonstrations of how to turn this radical quantum computing concept into a practical device using components that underpin all modern computing.

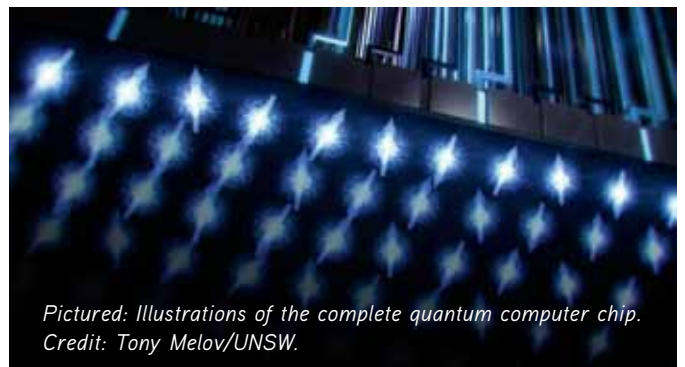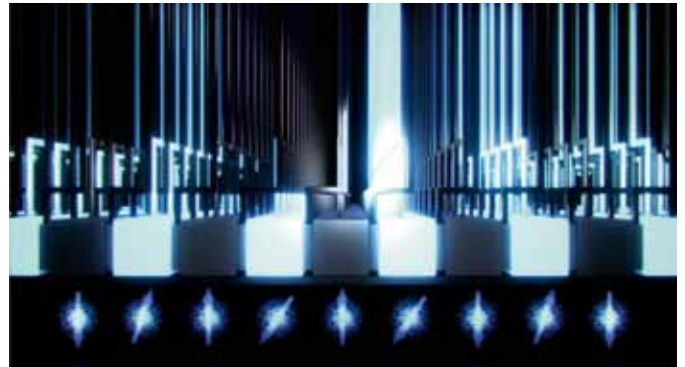"Our team now has a blueprint for scaling that up dramatically.

"We've been testing elements of this design in the lab, with very positive results. We just need to keep building on that — which

is still a hell of a challenge, but the groundwork is there, and it's very encouraging."

In 2017, a consortium of Australian governments, industry and universities established Australia's first quantum computing company to commercialise CQC2T's intellectual property. Operating out of new laboratories at UNSW, Silicon Quantum Computing (SQC) has the target of producing a 10-qubit demonstration device in silicon by 2022, as the forerunner to creating a silicon-based quantum computer.

In May 2018, Australian Prime Minister Malcolm Turnbull and French President Emmanuel Macron announced the signing of a memorandum of understanding (MoU) addressing a new collaboration between SQC and the French research and development organisation Commissariat à l'energie atomique et aux energies alternatives (CEA), bringing together French and Australian efforts to develop a quantum computer.

The MoU outlined plans to form a joint venture in silicon-CMOS quantum computing technology to accelerate and focus technology development, as well as to capture commercialisation opportunities. The proposed JV would bring together Prof Dzurak's team with a team led by Dr Maud Vinet from CEA, who are experts in advanced CMOS manufacturing technology, and who have also recently demonstrated a silicon qubit made using their industrial-scale prototyping facility in Grenoble.

Pictured: Illustrations of the complete quantum computer chip.
Credit: Tony Melov/UNSW.

MULTISENSOR KIT

Dialog Semiconductor's SmartBond Multi-Sensor Kit is a complete multisensor node solution that enables engineers to develop multiple applications on the same hardware and support different use cases through firmware.

The small and low-power wireless sensor kit is built on Dialog's DA14585 SmartBond system-on-chip (SoC) and integrates TDK InvenSense motion sensors and Bosch Sensortec environmental sensors for 15 degrees of freedom (DOF) in Internet of Things (IoT) applications. It combines Bluetooth 5 wireless communications and an Arm Cortex-M0 processor with an accelerometer, gyroscope, magnetometer and environmental sensors in an effort to help reduce development time, enable rapid proof of concept and accelerate time to market.

The kit offers flexibility across hardware and software that includes extensive cloud support, ranging from IFTTT for the creation of simple applets to the creation of advanced workflows for data analytics supporting cloud agents from all major platforms. Through cloud connectivity, engineers can incorporate visualisation of historic data with data analytics, remote sensor management, Alexa voice command support, alert notifications, cloud-based actuator control and more into their projects.

It is supported by Dialog's software suite, which includes application software running on the DA14585, cloud gateway software for Raspberry Pi hardware, web applications and mobile applications for Android and iOS. Sensor data collected by the onboard DA14585 can be processed locally by Dialog's SmartFusion software to enable data transmission with minimal interference and low power consumption prior to transmission to a smartphone or Bluetooth-enabled Raspberry Pi gateway to the cloud.

Mouser Electronics
www.mouser.com

RACK-MOUNTING AND DESKTOP ENCLOSURES

Hammond Electronics has introduced 4U high versions and added extended 559 mm depths to all heights of its RM family of 1–4U 19″ rack-mounting and desktop enclosures. 1–3U half-width versions are also available.

The all-aluminium construction consists of a heavy-duty extruded frame with removable vented or plain top and bottom covers. 19″ units are supplied with rack-mounting angles; both 19″ and half-width variants come complete with self-adhesive rubber feet for when the enclosure is to be used as a desktop unit.

The front and rear panels are removable and interchangeable; their flat design makes machining and printing a simple process. Front panel handles are optionally available to assist with insertion and removal of the 19″ units from a cabinet. Adjustable rear panel mounting angles are also available as an accessory for the 457 and 559 mm-deep units to give greater support for heavy components.

Four heights and five depths are available. The half-width units are available in depths of 108 and 203 mm and 1–3U heights. 1–4U full-width 19″ units are available in depths of 203, 330, 457 and 559 mm.

The standard finish is durable black powder coat paint. Custom finishes, modified and silk-screened front and rear panels, and other variants to meet customer specifications can be supplied through Hammond's in-house modification service. The series is shipped flat-packed to protect against damage in transit.

Hammond Electronics Pty Ltd
www.hammondmfg.com

MICROCONTROLLERS

STMicroelectronics' STM32G0 series of microcontrollers (MCUs) targets entry-level applications that require energy efficiency, functionality, security and value in a small footprint.

Flexible packaging and memory options enable designers to do more within less space. A power-distribution architecture reduces external power and ground connections to just a single pair of pins, allowing more of the package pins to be allocated for user connectivity.

In addition, ST is making large memory densities available in small low-pin-count packages. On top of this, the series features power-saving innovations that trim consumption close to that of specialised ultralow-power devices.

To provide robust security for today's connected devices, the series introduces a variety of hardware-based features including memory protection to support secure boot. Some devices in the series add to these features an AES-256 hardware cryptographic accelerator with a true random number generator (TRNG) to aid encryption.

Another valuable feature that anticipates a growing need is support for the latest USB Type-C specifications that allow easy, high-speed connectivity and battery charging, including Power Delivery version 3.0.

The series is based on the Arm Cortex-M0+ core, which is conceived to deliver sharp performance within a tight power budget. It targets fast-evolving products in the connected world, including smartphones, smart kitchen equipment and appliances, air conditioning, consumer or industrial motor controls, advanced user interfaces, IoT devices, rechargeable connected devices, drones, lighting systems and more.

STMicroelectronics Pty Ltd
www.st.com

AUTOMATIC DIRECTION-FINDING ANTENNA

Narda Safety Test Solutions has developed an automatic direction-finding antenna (ADFA) that delivers stable results quickly. Insensitive to reflections, it precisely determines the direction of a detected signal.

When coupled with the powerful SignalShark real-time receiver, the system is suitable for automatic direction-finding of signals in the frequency range from 200 MHz to 2.7 GHz. As well as for cellular network providers and the military, it is primarily aimed at PMR and BOS radio operators with applications that involve safety and security.

At the heart of the product is an array of nine antenna elements around an omnidirectional reference antenna optimally arranged to achieve stable measurement results. The reference antenna allows test engineers to observe the spectrum at the same time as direction-finding. The principle of automatic direction-finding for a single-channel receiver is based on the measurement of the phase difference between antenna elements. The nine antenna elements are measured against the central reference element. The greater the distance between them and the greater the recorded phase difference, the better the bearings.

As well as stationary applications, the antenna can be attached to the roof of a vehicle using a magnetic mount. When connected to the SignalShark, a bearing cycle takes just 1.2 ms and achieves an accuracy of up to 1° RMS (typical). Along with the simple display of the determined direction, the receiver can also overlay a heat map on a stored map. The powerful localisation software on the SignalShark can thus show the most likely location of the interferer directly on the screen during mobile operation, all in real time. A handheld antenna can be used with the receiver to determine the exact location of a signal source over the final few metres, so that the test engineer can enter a previously localised building in order to determine the exact room where the source is located.

Narda Safety Test Solutions GmbH
www.narda-sts.de

SERVER-ON-MODULES FOR AIRCRAFT

Designed for converged edge servers in aircraft, congatec's COM Express Type 7 server-on-modules are suitable for content delivery applications, seatback screens and passengers' mobile devices, as well as for predictive maintenance and other big data applications, video surveillance and cloud-based flight data recordings.

The platforms are also suitable for augmented reality applications in aviation to optimise the navigational capabilities in low-visibility areas, and are further applicable in AI-based virtual assistants for improving pilot productivity and efficiency as well as enhancing passengers' flight experience. They enable engineers to tailor the performance of their virtualised aircraft edge servers to the given needs and to simply and efficiently scale the core performance in closed-loop engineering cycles by swapping modules.

The server-on-modules help to solve obsolescence issues, as the standardised modules can easily be upgraded in the design. Additionally, the densely packed robust modules help to optimise the SWaP-C demands of modern airborne applications due to their compact, lightweight and efficient footprint.
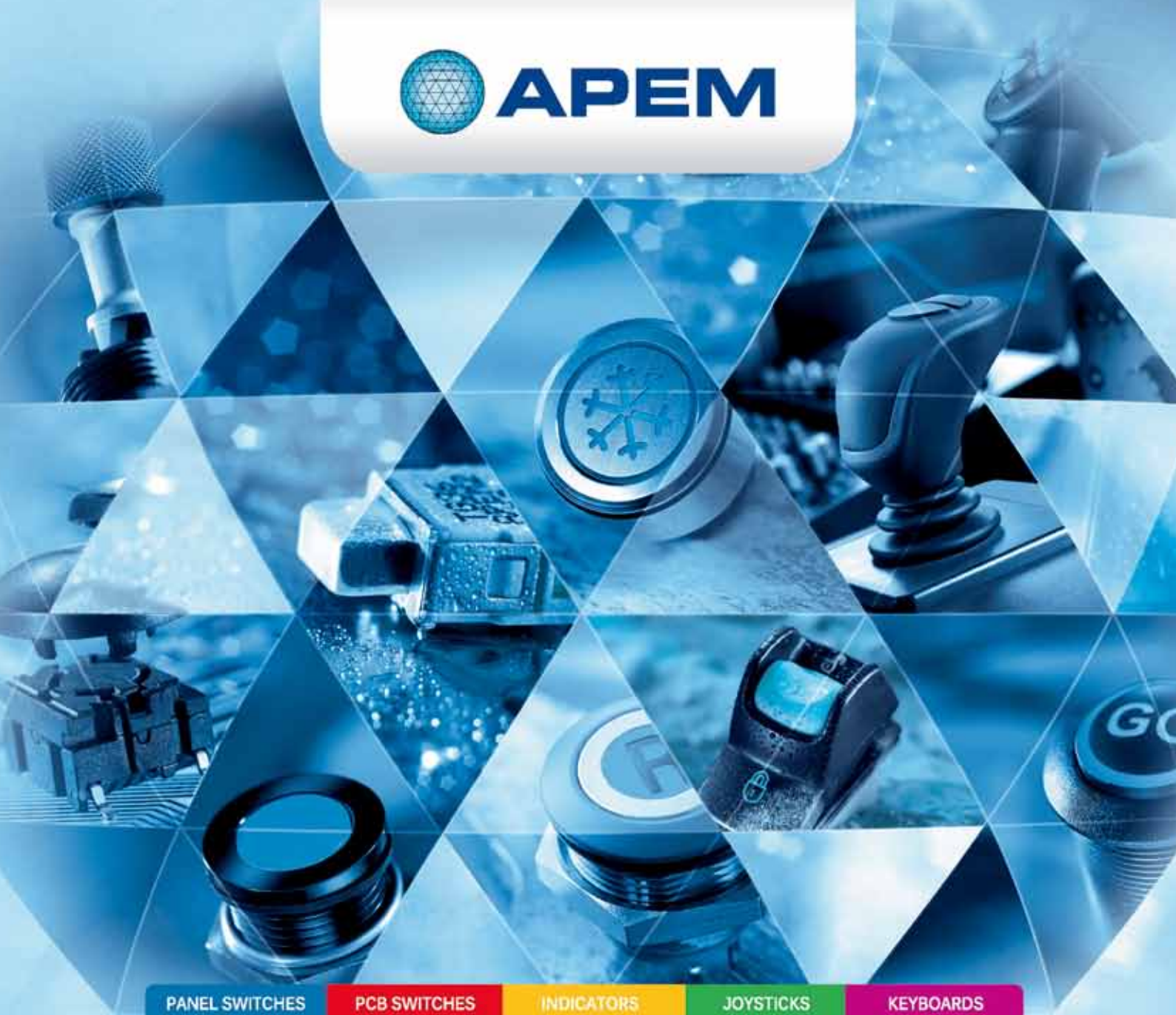
The edge server platforms for aircraft are based on the com express type 7 server-on-module standard specified by the PICMG and are equipped with Intel Atom, Pentium and Xeon processors. They meet all requirements for operating in harsh airborne environments, including support of the extended temperature ranges as well as high shock and vibration resistance. Providing optional coating for humidity resistance, they are qualified to meet extended environmental standards.

Congatec Australia Pty Ltd
www.congatec.com

FANLESS BOX PC

SINTRONES' ABOX-5200 fanless box computer is designed for a variety of demanding environments and applications in surveillance and field control systems.

With the high performance of Intel Coffee Lake 8th Gen technology, the PC can effectively support autonomous vehicles, factory automation and number plate recognition. It can be adapted to various industrial requirements, including connected smart patrol, smart factories, police cars, automatic number plate recognition and artificial intelligence.

The computer is powered by an Intel 8th Gen Core i7/i5/i3 CPU with 10x GbE/3x COM/3x DP/4x USB 3.0/9–48 V AI GPU computing. It can provide high computing performance for graphics processing by harnessing the power of its GPU. It was engineered using dual hot swappable SATA Storage RAID 0,1,5.

The fanless box computer can continuously process deep learning AI operations and support end-to-end deep learning solutions which play a vital role for automation solutions and autonomous vehicles. The principle is to focus the high performance on processing numerous data streams in and from sensors, including cameras and radars.

The device has 10x GbE LAN (optional for 8x PoE), 8x GPI, 4x GPO and 3x RS232/422/485 and 9–48 VDC input, and a wide range operating temperature of -40 to 70°C that can be employed in extreme weather conditions.

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

DUAL-CHANNEL ARBITRARY WAVEFORM GENERATORS

Teledyne LeCroy has released the Model T3AWG3252 and Model T3AWG3352 high-definition, high-performance arbitrary waveform generators consisting of two channels, 16-bit vertical resolution, 6 Vpp (optional 12 Vpp) max output voltage (50Ω), 128 Mpts/ch memory (optional 1 Gpts/ch), a maximum sampling rate of 1.2 GS/s and a sinewave frequency output of 250 MHz and 350 MHz respectively.

The products offer an arbitrary function, arbitrary waveform and digital pattern generator and 16384 waveform sequencer as well as the capability of rise and fall times of less than 1.1 ns.

The baseline hardware voltage offset capability provides the ability to generate a ±24 or 48 V output voltage window (50Ω into high impedance with high-voltage option). The disruptive and innovative architecture enables the AWG to generate/add 8-channel digital patterns and to operate all models in true arbitrary (variable clock) mode or direct digital synthesis (DDS) mode.

Scientific Devices Australia
www.scientific-devices.com.au

OCT IMAGING SYSTEMS

Thorlabs has expanded its Telesto OCT line to include two complete imaging systems that offer polarisation-sensitive detection: the TEL210PSC2 and TEL220P-SC2. The polarisation-sensitive spectral-domain OCT systems enable reproducible and robust 2D and 3D imaging and analysis of polarising samples.

The systems are available in both long-range (TEL210PS) and general-purpose (TEL220PS — 5.5 μm axial resolution) variants. In addition, the user can switch between different A-scan rate presets (ranging from 5–76 kHz) to achieve an optimal balance between sensitivity and imaging speed. The polarisation-sensitive detection and evaluation package allows for the analysis of parameters such as retardation, optic axis and the degree of polarisation uniformity.

All Thorlabs OCT systems are shipped with a high-performance computer preinstalled with ThorImage OCT 5.1 image acquisition software as well as a user-programmable Thorlabs OCT software development kit (SDK). To allow for custom data analysis, the user also has access to the raw data.

The user can choose to purchase a complete, preconfigured system, which includes a scanner with dedicated imaging objective, scanner stand and sample manipulation stage, or to opt for a user-configurable solution where the customer chooses from a large selection of modular components.

SDR Scientific
www.sdr.com.au

LOW-POWER MICROCONTROLLERS

The Renesas Synergy S1JA microcontrollers (MCUs) feature the 48 MHz Arm Cortex-M23 core and integrate programmable analog and security functions for good sensor signal acquisition and conditioning. The MCUs target low-power IIoT sensor applications such as flow control meters, multisensor systems, headless medical monitors and instrumentation systems, and single-phase electricity meters.

The group includes five MCUs with 256 KB flash memory, 32 KB SRAM memory and a wide operating voltage range of 1.6 to 5.5 V. Each MCU integrates a sensor-biasing unit that supplies power to the external sensor, and a configurable analog fabric that processes complex algorithms to maximise signal conditioning and precise analog measurements. On-chip analog components include a 16-bit analog-to-digital converter (ADC), 24-bit sigma-delta ADC, fast response 12-bit digital-to-analog converter (DAC), rail-to-rail low-offset operational amplifiers and high-speed/low-power comparators.

The MCUs enable analog configurations from basic functions to more complex analog blocks. As a result, embedded designers are able to reduce PCB size by eliminating several external analog components. Access to capacitive touch enable pins allows designers to develop touch-button HMI interfaces, and the memory mirror function enables over-the-air updates with little software overhead.

Ultralow power allows the MCUs to extend battery life for battery-operated portable and battery backup applications; their standby mode consumes a mere 500 nA to enable 20-year battery-operated applications that spend extended periods in sleep mode. In addition, the integrated AES cryptography accelerator, true random number generator (TRNG) and memory protection units provide the fundamental blocks to develop a secure system that connects to the cloud.

Renesas Electronics
www.renesas.com

SIGNAL CONVERSION

WAVELENGTH CONVERSION TECHNOLOGY
BOOSTS TRANSMISSION CAPACITY

Fujitsu Laboratories has developed an ultrahigh-capacity wavelength-division multiplexing system that considerably expands the transmission capacity of optical fibres in optical networks connecting data centres — without the deployment of new transceivers dedicated to new wavelength bands.

In recent years, the use of social networks and streaming video has contributed to exponential increases in the volumes of data handled by data centres. Moreover, many predict that data circulation will grow dramatically in the future with the spread of 5G communications and 8K video technologies. Though data centre operators have already connected multiple data centres with optical networks and use distributed storage for disaster recovery and distributed processing for high-speed processing, they need to expand transmission capacity even further to effectively prepare for the increases in data volume anticipated in the immediate future.

Expanding transmission capacities between data centres can be accomplished by increasing the number of optical fibres; however, additional fees would be assessed based on the number of optical fibres used, presenting a significant cost burden for operators. Another option is the simultaneous use of new wavelength bands outside the C-band — the wavelength band used for optical transmissions defined by ITU-T, the Telecommunication Standardization Sector of the International Telecommunication Union — however, this method would necessitate the separate development of transceivers that could support each band.

Now, Fujitsu Laboratories has developed what is claimed to be the world's first broadband wavelength conversion technology that can batch convert C-band optical signals to new wavelength bands, including the L-band and S-band, for transmission, reconverting them back to the original C-band when received.

First, the C-band optical signal is combined with two pump lights, generating a signal with mixed wavelength. The pump lights change the signal's refractive index of a nonlinear optical medium which the signal passes through and outputs converted signals at a different wavelength. A similar principle is used on the receiver side to return the transmitted optical signal to the C-band.

With this technology, it becomes possible to convert an optical signal to an arbitrary wavelength band efficiently by choosing the wavelengths of two pump lights, based on the chromatic dispersion characteristics of various nonlinear optical media. Additionally, the technology can reduce the noise superimposed on the signal after wavelength conversion by synchronously controlling the pump lights. This means it can simultaneously convert the signal's wavelength efficiently while maximising the quality of the optical signal.

Fujitsu Laboratories used the technology to create a prototype system to convert an optical signal in C-band to L- and S-bands, then multiplexed them for transmission, confirming in principle that the technology could triple available wavelength without the use of transceivers for each new wavelength band. Transmissions using an even greater variety of different bands thus become possible, allowing data centre operators to use existing equipment as is to raise the efficiency of optical fibre utilisation and thereby expand transmission capacity from 2–10 times as needed.

This promises to eliminate the kind of network bottlenecks that could pose challenges for high-volume users that need to store, back up or perform parallel analysis on large volumes of data distributed between multiple data centres. This includes cases that many expect to increase dramatically in the near future, such as transfers of unstructured data including 8K video material and device log information connected through 5G networks. In addition, data centre operators can immediately make use of new C-band transceivers that will be developed going forward in wavelength bands outside the C-band.

Fujitsu Laboratories aims to incorporate this technology into a new line-up of the Fujitsu Network 1FINITY series of optical transmission systems, in fiscal 2019. In addition, the company is considering extending the technology to data centre operators, contributing to the creation of new business for its customers.

Fujitsu Australia
www.fujitsu.com.au

INDUSTRIAL IoT DEVICE

NetComm has announced an addition to its Industrial IoT portfolio to allow businesses to connect all low-power, low-bandwidth devices to LTE networks.

Low-power devices that only require a limited amount of bandwidth are being introduced by businesses to optimise operations. With the NetComm NTC-100 product, businesses are less dependent on proprietary unlicensed networks in the area to manage and control these devices remotely.

The low-power, low-bandwidth device integrates a dual-technology LTE module using Cat -M1 and NB-IoT technologies to economically track and monitor applications that were traditionally too costly to connect. This is expected to accelerate the uptake of Industrial IoT by providing diverse industry sectors with the chance to connect and manage large fleets of small, low-value assets wherever there is an LTE network available.

Businesses across all industry sectors can now connect devices with the standards developed by 3GPP: Cat-M1 and NB-IoT. Widely available LTE networks support these applications by adding low-bandwidth capabilities to extend range and battery life.

The modem supports Cat -M1 and NB-IoT connections to any device that needs network connectivity, giving businesses a way to remotely manage, control and gather data from their devices. The device also features remote management capabilities to query status information, run diagnostics, troubleshoot and execute commands via SMS.

Built to endure vibration and extreme temperatures in harsh industrial, commercial and automotive environments, the robust device features rugged IP40-rated industrial housing to ensure longevity in harsh remote and isolated climates. The remote management allows for a wide range of automation and monitoring features to avoid unnecessary truck rolls.

NetComm Wireless Limited
www.netcommwireless.com.au

SINGLE-BOARD COMPUTER

The Raspberry Pi 3 Model A+ includes the latest features and capabilities to a compact form factor. It is accessible to the education, hobbyist and professional markets.

Like the Raspberry Pi 3 Model B+, it boasts a 64-bit quad core Broadcom BCM2837 processor running at 1.4 GHz, adding performance enhancements over the previous model. The board also adds dual-band wireless networking, delivering 2.4 and 5 GHz IEEE 802.11ac wireless LAN and Bluetooth 4.2 with modular compliance certification. This allows the board to be designed into end products with reduced compliance testing, improving time to market for professional developers.

Additional features include: 512 MB LPDDR2 SDRAM; extended 40-pin GPIO header; 1x full size HDMI; MIPI DSI display port; MIPI CSI camera port; 4-pole stereo output and composite video port; H.264, MPEG-4 decode (1080p30); H.264 encode (1080p30); OpenGL ES 1.1, 2.0 graphics; Micro SD format for loading operating system and data storage; 5 V/2.5 A DC via micro USB connector; and 5 V DC via GPIO header.

The board is useful for educators and makers, for whom multiple USBs, Ethernet connectivity and 1 GB of RAM may not be a requirement. It is also suitable for professional use, offering with the same modular compliance certification as the Raspberry Pi 3 Model B+. It has the same mechanical footprint as the Raspberry Pi 1 Model A+ and will be produced until at least January 2023.

element14
au.element14.com

ETHERNET INTERFACE CARD

The G211X Ethernet interface card, from MEN Mikro Elektronik, is a quad Ethernet card based on the PICMG CPCI-S.0 CompactPCI Serial. The four Gigabit Ethernet interfaces on the front panel are accessible via robust, X-coded M12 connectors.

All four interfaces are controlled by an Ethernet controller connected to the backplane via an x4 PCI Express connection. Each interface also supports a data transmission rate of 1 Gbps, even if all four channels are used simultaneously. For better control, two LEDs each indicate the connection and activity status of the interfaces.

The product includes an Intel i82580 Server chipset, with support for eight virtual machines, and features 500 V isolation voltage. It is designed for an extended operating temperature of -40 to +85°C and suitable for use in harsh and mobile environments.

OEM Technology Solutions
www.oem.net.au

RUGGED CARBON FIBRE SERVER

Crystal's RS114PS18 rugged carbon fibre server features high-end computing performance in a 1U chassis, with a depth of 18″, and will fit most rack spaces. An ultralightweight chassis (5.44 to 6.35 kg), providing EMI/EMC protection and shock and vibration resilience, makes the carbon fibre server suitable for airborne, shipboard, land-based and transit case applications.

Other features include: up to 512 GB of memory; easy mounting with Delrin glides or Jonathan rails; versatility with up to six removable drive bays; one expansion slot; and Intel Sandy Bridge, Ivy Bridge, Haswell or Broadwell CPU options.

The product is engineered and tested to withstand challenging environments, meet and exceed military and industrial standards, and provide the latest COTS technologies and benefits, such as availability, upgradability and flexibility.

Metromatics Pty Ltd
www.metromatics.com.au

MULTILINE CAMERAS FOR HIGH-SPEED VISION APPLICATIONS

Teledyne DALSA's cutting-edge multiline CMOS camera, the Linea ML, delivers high-quality images at a maximum line rate of up to 300 kHz in 8k/16k resolutions, using the next-generation CLHS fibre-optic interface. Sequential exposure with independent start and stop integration for each channel allows versatile illumination configurations using the latest LED lighting technologies.

In addition to monochrome/HDR imaging, users are able to capture multifield (brightfield, darkfield and backlit) images in a single scan with pulsed lighting using monochrome models. The units are also able to capture RGB or RGB+NIR images in a single scan with continuous wave lighting using colour or multispectral models.

The CLHS fibre-optic interface provides high-throughput data transmission. Fibre-optic cables offer long cable lengths (up to 300 m), are immune to electromagnetic radiation and are suitable for industrial environments.

The cameras are suitable for demanding vision applications where resolution, throughput and detectability matter, particularly when combined with the Xtium2 CLHS series of high-performance frame grabbers.

Adept Turnkey Solutions
www.adept.net.au

ISOLATED RS-485 MODULE TRANSCEIVER

The MAXM22511 2.5 kV isolated RS-485/RS-422 module transceiver, from Maxim Integrated Products, offers the high efficiency and robustness necessary to support performance in typically noisy industrial environments.

The device is said to simplify and shrink the design of fieldbus communications systems for factory automation, motor control and other Industrial Internet of Things (IIoT) applications. The highly integrated module accomplishes this by eliminating the need for discrete digital isolators, transceivers, transformers and transformer drivers costs. It thus streamlines the design of a compact, robust and efficient fieldbus communications pathway that enables the collection of real-time health and status information from the edge of the digital factory and moves it to the cloud, helping to optimise factory throughput.

The product supports 25 Mbps data rates while providing 60% DC-DC efficiency and ±35 kV electrostatic discharge protection. It is available in a land grid array (LGA) package measuring 9.35 x 11.5 mm.

Avnet Electronics Marketing
www.em.avnetasia.com

QUANTUM DOT FILMS IN DISPLAYS

MAJOR TECHNOLOGY AND MARKET TRENDS

Dr Khasha Ghaffarzadeh, Research Director

This article will focus on some of the key frontiers of short-, medium- and long-term change in quantum dot (QD) films. In particular, we will argue that the transition away from Cd-based QDs will soon be complete; we will show how QD material improvements are translating into total cost reductions and how that is reshaping the market's pricing strategies; and finally we will consider whether film type QDs can continue their supreme reign, or whether relentless innovation soon renders them obsolete.

The primary market of quantum dots (QDs) today, beyond research uses, is in displays. Here, the driver is achieving wide colour gamut displays thanks to the ultranarrowband emission of QDs. This attribute is helping position LCDs as a viable competitor against large-sized, premium-priced, high colour quality OLED displays.

Up to now, the QDs' material characteristics have defined their use case. The QDs have been essentially only integrated into displays as 'remote' phosphors. In one implementation, the QDs are loaded into a resin which is then coated onto a film that is then sandwiched by two barrier (encapsulation) layers. This arrangement is called film-type QD or QD enhancement film (QDEF). In the other implementation, the QDs are put into tubes which are placed at the edge of displays. This is generally called edge optic QDs.

In both cases, QDs re-emit the light from the phosphor-converted backlight LEDs and in doing so narrow the emission spectrum, thus achieving wide colour gamut and thus pushing the display industry further towards the Rec2020 standard. In both cases, remote phosphor integration was adopted because QDs could not tolerate harsher heat or light flux stress conditions which a closer proximity to the light source (LED) would have imposed on them.

The edge optic QD implementation is now essentially obsolete. Its main proponent (QD Vision) lost an IP battle against the market leader (Nanosys), and consequently had to sell its patent portfolio at a bargain price to a leading QD user (Samsung). The film-type QD implementation, however, is continuing its growth.

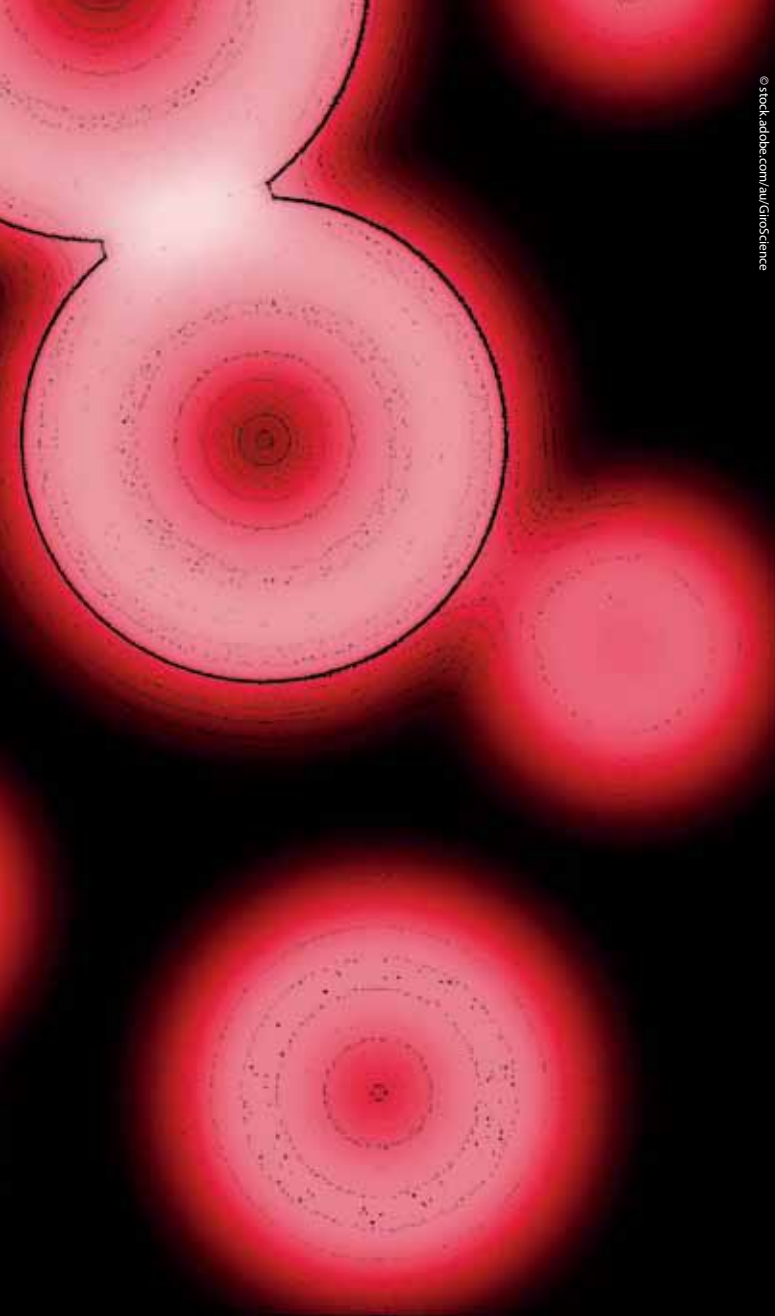## Transition away from Cd-based QDs will soon be complete

Several key trends today characterise the market and technology dynamics of film-type QDs (or QDEFs). Below we will discuss two key trends: transitioning away from Cd-based and reducing implementation cost.

The ban on cadmium (Cd) in Europe has finally been announced for October 2019. Even prior to this announcement, Cd QDs had appeared only as a transitory solution, a technology on borrowed time.

To respond, the industry has been developing InP-based QDs as an alternative to Cd-based ones. In the early days, the performance gap between Cd and InP QD technologies was vast. Now, however, the quantum yield (QY) difference has all but disappeared, while the FWHM gap has also been notably narrowed (note: QY affects efficiency and FWHM affects colour gamut).

The FWHM gap, however, stubbornly persists, with InP QDs today achieving around 40 nm commercially. Pushing it down towards 38 nm commercially (or even 35 nm in the lab) remains a challenge. This is because the emission bandwidth is not just a function of the control of the monodispersity of the QDs during the synthesis, it is also a function of the shape and crystalline structure of the particles.

Despite this continued performance discrepancy, the market transition appears largely complete, with the market share of Cd-based QDs having dropped substantially over time and hovering at around 20% today.

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monodispersity, to achieve excellent shelling process, to minimise built-in stresses and CTE mismatches, and to obtain full ligand surface coverage (more so when ligands are exchanged away from as-grown ones to promote compatibility with a resin, a photoresist or an ink, since this is often a time-consuming process). There is continued progress all around, but often of an incremental nature.

Pricing strategy on the cusp of major change

With cost reduction comes renewed questions about the pricing strategy of QD-enabled display makers. Originally, display makers positioned QD TVs as ultrapremium. This reflected the need to counter the value proposition of the (then) emerging white OLED TVs and also the actual cost of implementation.

Now that the implementation cost has fallen, and is expected to fall further, new pricing options have become viable. Some makers are seizing this opportunity to create a product range covering a spectrum of prices, whereas others are still struggling to maintain the ultrapremium aura with the help of price signals. This latter position, however, increasingly appears untenable in the long term. This long-term pricing trend will also present a challenge to large-sized WOLED unless that too can reduce its production costs.

Overall, we find that film-type implementation will continue its volume (m^2 of displays sold) growth in the short and medium terms. But a major question is whether this trend will last, and if so for how long? This is because alternative implementation approaches are being developed.

The pending decline of film type QDs

We have developed a 10-year technology roadmap and market fore-casts (segmented by QD integration type), assessing how the QD technology will transition from edge optic (now almost obsolete) and film type towards colour filter type, on-chip type and finally emissive type. These emerging approaches have vastly different technology readiness levels as well as requirements and material- and device-level challenges.

These alternative approaches are not limited (vs film type) by value proposition, but by technical challenges. Therefore, as these challenges are overcome, film type QDs will first begin to lose their exclusive control of the QD display market, and will then enter into a decline phase. Indeed, we find that film type will have to share the market first with colour filter type, then with on-chip type (eg, microLED displays), and finally with emissive type (long-term development but ultimate prize).

Innovate or die

These transitions may open the market to newcomers who either came too late or were barred by IP issues. In any case, they con-demn the suppliers and users to continue to invest in R&D so as not to be left behind as these transitions occur. This is exciting because many material improvements are needed: reduce self-absorption, increase air/heat/light stability, improve dispersion and processability in photoresists or inkjets without too much degrada-tion, boost blue absorbance, find optimal device stack and so on.

The IDTechEx report 'Quantum Dot Materials and Technologies 2018–2028: Trends, Markets, Players' provides a detailed assess-ment of all these directions of material improvements and outlines the latest progress. For more, see www.IDTechEx.com/qd.

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Approaches for reducing implementation costs

As with all display components, the pressure to achieve more for less is relentless and perennial. QDs are no exception. In the case of QD films, it means lowering the cost of the entire solution, including QD materials, substrate, coating, barrier, etc.

In fact, the barrier layers are a significant cost contributor. Their cost, however, can be lowered if barrier performance requirements are relaxed, leading to simpler barrier film structures. This, in turn, can only be achieved if QD materials become more air stable.

Progress continues to be made here, with the barrier require-ments appearing to have been relaxed from 1E-4 g/day/m^2 to 1E-3 g/day/m^2 and 1E-2 g/day/m^2, and now even the target of 1E-1 g/day/m^2 seems feasible in the near future.

The QD material cost should also be reduced. One way is to increase the efficiency and the brightness of the QDs, leading to a lower consumption/m^2 for a given output. Another method would be to lower the cost of QD production/kg. This, of course, will stem from greater scale and also from innovation in the synthesis procedure.

As to the latter, companies have explored a low-temperature molecular seeding process, a continuous (vs batch) process in heated microcapillary reactors, a one-pot synthesis process for core-shell (or graded core-shell) structures, and so on. In all cases, however, it remains challenging to balance reaction time and temperature against the need to maintain high size and shape

An RFID tag is modified by cutting out a small part its antenna (silver ribbon) and placing a small push-button switch on it. If several modified tags are mounted on a surface, they can act as a wireless keypad.

HACKING RFID TAGS
TO CREATE IoT DEVICES

Canadian researchers have found a way to hack radio frequency identification (RFID) tags — the ribbons of metal with a tiny chip found in various objects — in a huge step towards mass-manufacturing smart devices that do not use batteries or require charging.

These battery-free objects, which feature an IP address for internet connectivity, are known as Internet of Things (IoT) devices. If an IoT device can operate without a battery, it lowers maintenance costs and allows the device to be placed in areas that are off the grid. Many IoT devices have sensors in them to detect their environment, from a room's ambient temperature and light levels to sound and motion, but one of the biggest challenges is making these devices sustainable and battery-free. Now, researchers from the University of Waterloo have found a way to give RFID tags the ability to sense their environment.

"It's really easy to do," said postdoctoral fellow Ju Wang. "First, you remove the plastic cover from the RFID tag, then cut out a small section of the tag's antenna with scissors, then attach a sensor across the cut bits of the antenna to complete the circuit."

In their stock form, RFID tags provide only identification and location. It's the hack the research team has done — cutting the tag's antenna and placing a sensing device across it — that gives the tag the ability to sense its environment.

To give a tag eyes, the researchers hacked an RFID tag with a phototransistor — a tiny sensor that responds to different levels of light. By exposing the phototransistor to light, it changed the characteristics of the RFID's antenna, which in turn caused a change in the signal going to the reader. They then developed an algorithm on the reader side that monitors change in the tag's signal, which is how it senses light levels.

Among the simplest of hacks is adding a switch to an RFID tag so it can act as a keypad that responds to touch.

"We see this as a good example of a complete software-hardware system for IoT devices," said Professor Omid Abari. "We hacked simple hardware — we cut RFID tags and placed a sensor on them. Then we designed new algorithms and combined the software and hardware to enable new applications and capabilities.

"Our main contribution is showing how simple it is to hack an RFID tag to create an IoT device. It's so easy a novice could do it."

The team's research was presented at the 24th Annual International Conference on Mobile Computing and Networking, held from 29 October–2 November in New Delhi, India.

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