what's **new** in
electronics

**Stronger, stiffer, and ESD resistant Onyx
variant for industrial applications**

Markforged

COVER STORY

CONTENTS

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Onyx ESD is a strong, stiff and ESD-resistant micro carbon fibre filled nylon composite base material for industrial applications, designed by additive manufacturing company Markforged.

With a flexural strength of 83 MPa and a surface resistance of 10^5 to $10^7\Omega$, the material has been developed to be static-dissipative, as tested under ANSI/ESD STM11.11. This results in an ESD-safe rating under most other testing standards, including ASTM D257, MIL-STD-1686C and MIL-HDBK-263B. It is also reinforceable with continuous fibres to achieve up to 10x strength compared to existing ESD-safe plastics.

Onyx ESD is claimed to be the most advanced polymer the company has ever developed. It has been precision-engineered to possess a tight range of surface resistance — meeting the ESD-safe requirements of the most stringent manufacturers — while offering the same benefits as Markforged Onyx.

In fact, Onyx ESD is claimed to be stronger and stiffer than Onyx while featuring similar mechanical properties and surface finish. This makes it suitable for tooling, jigs and fixtures that must be ESD-safe and for parts that cause processing difficulties when charge builds up. Some examples include assembly fixtures, test fixtures, custom hand tools, enclosures, component trays, and robotic end-of-arm grippers.

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2021 TOP TECHNOLOGY PREDICTIONS IN POWER ELECTRONICS

START ▶

2021

GaN technology is moving from early adoption to mainstream acceptance.

As 2020 comes to a close, we will undoubtedly look back on the past 12 months as a time in which disruption was the hallmark. Amid the unprecedented socioeconomic upheaval brought about by COVID-19, organisations have had to pivot and strategise, adapt and change in new ways — in a far more agile manner than at any time in history.

2021 will be the year when companies must double down on digitally driven experiences, operational excellence, products, supply chains and ecosystems — not just to rapidly advance, but even in some cases to survive. The measurement of their success will be dependent on how well they harness advanced technologies to jump to the next growth curve in their respective industries. In previous years, organisations chose to be comfortably silently as an early adopter, hesitant to be viewed in the public domain as forward-looking and innovative.

In the past year, GaN Systems demonstrated market leadership with innovative power system design applications that removed the limitations of legacy silicon by using GaN technology to design the near future of lighter, smaller, lower cost and more efficient power systems. Those companies who embraced GaN did so as early adopters. In 2021, the perceived risk factors will shift — from not adopting GaN technology, to the risk of being left behind.

GaN Systems is more convinced than ever that silicon has reached its limitations in solving critical power systems challenges. GaN (gallium nitride) transistors are the clear and undisputed solution for driving more robust growth and product innovation in the electronics industry. Major companies are designing and shipping products with GaN today. In 2021, we will see significantly increased demand for and adoption of GaN-powered products across multiple markets — especially in consumer products and industrial power supplies. The high reliability of GaN power transistors and their ability to bring economic advantage to many applications will be ever more common over the next 12 months — and beyond.

Prediction 1: Chargers and adapters

2020 was the year of the GaN charger. The aftermarket saw more than 100 new models of chargers and adapters in the market for phones, tablets and handheld gaming devices. Looking ahead to 2021, this will be the year of GaN chargers from OEMs, along with the rise of multiport adapters. GaN chargers are moving from a once niche position to the mainstream standard, while also being positioned to deliver on future evolving customer needs with advances in device design, performance, energy efficiency and power requirements.

In 2021, GaN chargers will move from an aftermarket offering to in-the-box. Last year, the best way to purchase a small GaN charger was as an aftermarket purchase at a major big box or online retailer. Many of these chargers only delivered a slight 30% decrease in size. As these aftermarket GaN solutions become common, consumer expectations about the out-of-the box experience will change. Laptop, PC and phone manufacturers will respond to this market pressure with chargers that deliver the required higher and faster charging power levels in a smaller, modern device — shipped in-the-box.

New smart home applications and experiences enabled by the marriage of advances in voice and facial recognition, AI and even biometrics will be found in the next generation of smart speakers, sensors and devices. Attaching these increasingly intelligent and often invisible devices to power will become even more challenging. More efficient and smaller GaN-based chargers will be the ideal way to meet the higher power, energy efficiency and size flexibility design needs of these smart home enablers in 2021 and beyond.

In industrial markets, devices such as portable test equipment, handheld scanners, mobile displays, robots, and medical and supply chain applications — the next generation of power chargers — will need to respond to the growing demands of the industrial marketplace that parallel those of today's forward-looking consumers. In increasingly automated factories and warehouses, demand will be high in

2021 for higher power and faster charging in compact universal chargers to support their higher power applications.

Prediction 2: Consumer audio

Audio is a sizeable market with multiple segments — from audiophiles and prosumers to premium automotive systems and smart speakers. Yet in all segments there are two commonalities — power matters and sound quality matters. By the end of 2021, we foresee that a significant number of the world's noteworthy brands in the audio market will have GaN audio amplifiers and companion power supplies.

High-quality audio in a compact form factor is now a 'must have' across all segments from pro audio, home audio and portable audio. Class-D audio systems with GaN are smaller, lighter and provide the superior sound quality both the enterprise and consumer markets are demanding. In 2021, design engineers will use GaN transistors to solve challenges around power delivery in a small form factor with a compact amplifier. Demand for high-quality audio is fuelling the growth of the Class-D audio amplifier market, which is expected to reach $4.92 billion by 2026 from $2.49 billion in 2018 according to Allied Market Research. Additionally, near-perfect switching wave-forms demonstrate a virtually transparent replication of the audio output.

With GaN, the companion SMPS design is very efficient and operates without heatsinks. These features will allow audio design engineers to create premium audio products at shorter time to market and at an affordable price. With advancements in the semiconductor technology, including the use of GaN, Class-D amplifiers are now being used in more audio applications including home theatres, high-power smart speakers, pro touring amplifiers, portable party speakers, automotive, marine and power sports.

Prediction 3: Data centres

According to Gartner, one of the leading analyst research firms, end-user data centre infrastructure spending worldwide will increase 6% to $200 billion in 2021, after a pandemic-driven decline in 2020. COVID-19 was responsible for putting a hold on 60% of planned construction projects in 2020, which was directly tied to a 10.3% dip in data centre spending. Likewise, due to the pandemic, the global economy remains on its way to its 'digital destiny' as most products and services are now based on a digital delivery model or require digital augmentation to remain competitive.

IN INCREASINGLY AUTOMATED FACTORIES AND WAREHOUSES, DEMAND WILL BE HIGH IN 2021 FOR HIGHER POWER AND FASTER CHARGING IN COMPACT UNIVERSAL CHARGERS

The European Union's 2023 regulatory policies focusing on data centre infrastructure as related to power supply and energy efficiency requirements will have a significant impact on the future of build-outs for data centres. Over the next year, GaN's major impact will be centred on enabling new levels of power and data density in data centres, moving beyond incremental increases in energy efficiency.

The data centre ecosystem will continue to evolve and become even more critical for organisations. Infrastructure efficiency has been a huge concern for many organisations. While 2020 was the year of significant increase in GaN power supply design efforts, we predict that 2021 will focus on actual implementation of GaN in data centres.

In 2021, data centre operators will need increased power density inside their physical data centre infrastructure. Smaller power supplies using GaN technology allow for more storage and memory to be added into the same rack space allowing for data centre capacity growth without actually having to build more data centres.

Prediction 4: Automotive

Advances in power systems with GaN technology and battery technology are driving significant OEM and Tier 1 supplier adoption for EVs and addressing past concerns around range anxiety and car purchase price. The story of GaN in EVs will shift to become more of a narrative about enhanced performance and new capabilities for vehicle designs.

2021 will see rapidly accelerated R&D with GaN as a result of 2020 COVID-19-related shutdowns in global labs. Companies are eager to move ahead with R&D initiatives, specifically those addressing smaller and more power dense systems that can be paired with

advances in battery technology systems to deliver more holistic design choices.

Traditionally, automotive manufacturers have been conservative in their adoption of new technology. In 2021, governments and the public will continue to demand EVs with price and range similar to today's ICE vehicles. Manufacturers will benefit from embracing GaN's proven and noteworthy reliability and cost-efficiency in delivering their designs for these vehicles.

GaN: shifting from early adoption to market acceptance

In 2020, the conversation around GaN technology began to shift — from a focus on early adopters and risk to one of proven reliability and market acceptance. This is the result of products with GaN semiconductors finding success in consumer markets with power adapters and audio, renewed and re-energised work with GaN technology in EV design labs, new EU policy standards around energy efficiency in data centres that only GaN technology can effectively address when combined with power density expectations, and important industry accomplishments in product reliability.

2021 will be the year that GaN technology further demonstrates that it has successfully shifted from early adoption by claiming a substantial and publicly visible foothold in power-reliant markets as diverse as automotive, data centres and consumer electronics. For companies in these market segments, the perceived risk factors will shift — from not adopting GaN technology, to the risk of being left behind.

GaN Systems
https://gansystems.com/

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New LP devices extend multi-protocol BLE, Zigbee & Thread wireless MCUs

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SHORT CIRCUITS

SELF-CHARGING BATTERIES MADE FROM PRINTABLE INK

Strategic Elements subsidiary Australian Advanced Materials is developing a self-charging battery technology through a collaboration with UNSW and CSIRO. The company's battery cells can create electricity from humidity in the air or skin surface to self-charge themselves within minutes; no manual charging or wired power is required.

The batteries should have strong competitive advantages over lithium-based batteries, which suffer from issues with weight, flammability and the need for a constant power supply to recharge. They are being created with a printable ink, developed by integrating the company's Nanocube Memory Ink technology with an advanced graphene oxide material.
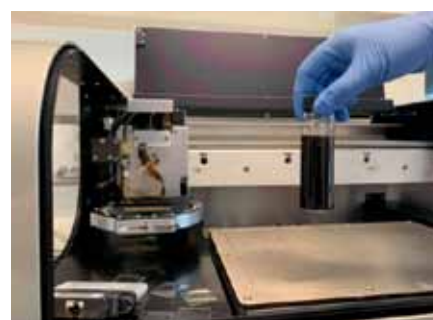
Nanocube Memory Ink is a transparent ink containing billions of nanometre-scale particles that, when printed onto a surface and assembled with electrodes, operate as computer memory. Graphene oxide is meanwhile formed by the oxidation of graphite, which is cheap and readily available, and is dispersible in water and other solvents. Benefiting from exceptional physicochemical properties, graphene-based materials are able to harvest energy from external factors such as moisture and heat.

Early-stage work at UNSW has seen the fabrication of over 100 battery cells by coating graphene oxide ink onto glass. These battery cells are just 10–20 µm thick — thinner than a human hair — and around 1 cm². With the ability to self-charge in approximately three minutes using water vapour in the air, each cell has been able to generate more than 0.7 V of power, with the goal for connected cells to be able to generate 3.7 V. Further development goals include reducing battery cell size whilst increasing current output at lower humidity levels.

"Early-stage results are extremely promising as we apply years of experience and intellectual property in electronic inks into the development of a battery ink that generates electricity from the environment," said Strategic Elements Managing Director Charles Murphy.

The batteries should be particularly suitable for use in Internet of Things (IoT) devices, where there is a growing need for thin and flexible batteries. The global IoT battery market is estimated to grow from US$9.2 billion in 2020 to US%15.9 billion in 2025 — a CAGR of 11.6% — driven by technological advancements and the adoption of IoT devices such as wearables, smart meters, sensors and home automation products.

SELF-REPAIRING FILM MADE OF GELATIN

Sometimes, dropping your smartphone can cause superficial cracks to appear; other times, the device can stop working altogether because fractures develop in the material that stores data. Now, Taiwanese researchers have made an environmentally friendly, gelatin-based film that can repair itself multiple times and still maintain the electronic signals needed to access a device's data. Described in the journal *ACS Applied Polymer Materials*, the material could be used someday in smart electronics and health-monitoring devices.

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Self-repairing films for smart devices already exist, but most only work a single time and some are made with potentially harmful agents that curtail their use in biomedical applications. Researchers have tried incorporating gelatin in electronic devices because it is transparent, readily available and safe; in tests, however, damaged gelatin film was not restored quickly. Yu-Chi Chang and colleagues at Taiwan's National Cheng Kung University wanted to see if they could make a repeatedly self-healing gelatin-based film that would mend cracks in minutes and preserve electrical functionality.

The researchers mixed gelatin and glucose to create a flexible film that they sandwiched between conductive material to simulate an electronic device. After bending the simulated electronic device, the team saw breaks in the gelatin-glucose film disappear within 3 hours at room temperature and within 10 minutes when warmed to 60°C. Gelatin without glucose did not self-repair under the same conditions.

The glucose-based gelatin also transferred an electrical signal following multiple rounds of damage and repair, with an unexpected improvement to the film's electrical performance. The experiments show that glucose and gelatin probably form reversible and interlocking imide bonds during the healing process.

The new film could help maintain the durability of touchscreen and flexible display devices, advanced robotics and assisted health technologies, the researchers say.

Our capabilities

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UV Colour Printing
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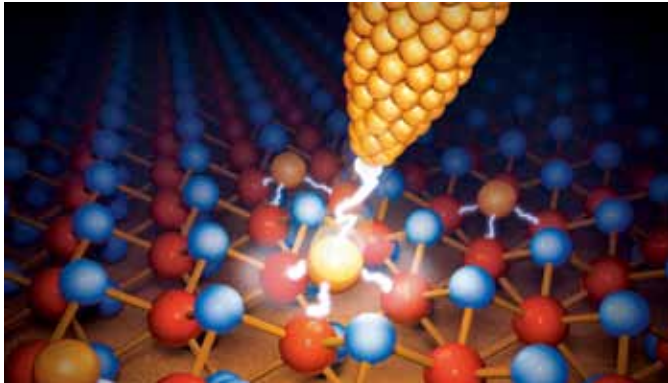

Cable Assembly *** Box Build *** System Assembly

ampec
TECHNOLOGIES

SHORT CIRCUITS

TINY MEMORY DEVICE SHRINKS EVEN FURTHER IN SIZE

Engineers at The University of Texas at Austin (UT Austin) have created what they claim is the smallest memory device yet — and in the process realised the physics dynamic that unlocks the dense memory storage capabilities of these tiny devices. The new device falls under the category of memristors, a popular area of memory research centred around electrical components with the ability to modify resistance between two terminals without a need for a third terminal in the middle known as the gate. That means they can be smaller than today's memory devices and boast more storage capacity.

Two years ago, the UT Austin team created what was then the thinnest memory storage device ever recorded — dubbed an 'atomristor' — with a single atomic layer of thickness. But shrinking a memory device is not just about making it thinner, it's also building it with a smaller cross-sectional area. Now the researchers have shrunk the cross-section area down to just a single square nanometre, publishing their breakthrough in the journal *Nature Nanotechnology*.

"The scientific Holy Grail for scaling is going down to a level where a single atom controls the memory function, and this is what we accomplished in the new study," said UT Austin's Professor Deji Akinwande. The new memristor also promises capacity of about 25 terabits per square centimetre — 100 times higher memory density per layer compared with commercially available flash memory devices.

Getting a handle on the physics that pack dense memory storage capability into these devices enabled the ability to make them much smaller. Defects, or holes in the material, provide the key to unlocking the high-density memory storage capability.

"When a single additional metal atom goes into that nanoscale hole and fills it, it confers some of its conductivity into the material, and this leads to a change or memory effect," Prof Akinwande said. Though the researchers used molybdenum disulfide (MoS_2) as the primary nanomaterial in their study, they think the discovery could apply to hundreds of related atomically thin materials.

With smaller processors, you can make more compact computers and phones. Shrinking down chips also decreases their energy demands and increases capacity, which means faster, smarter devices that take less power to operate.

"The results obtained in this work pave the way for developing future generation applications ... such as ultradense storage, neuromorphic computing systems, radiofrequency communication systems and more," said Pani Varanasi, Program Manager for the US Army Research Office, which funded the research.

SYDNEY QUANTUM ACADEMY TO GROW CITY'S QUANTUM INDUSTRY

The newly formed Sydney Quantum Academy — a partnership between Macquarie University, UNSW Sydney, The University of Sydney and the University of Technology Sydney — has been tasked by the NSW Government with creating thousands of well-paid, high-tech jobs building on the city's quantum strengths.

Officially launching the Academy, NSW Minister for Jobs, Investment, Tourism and Western Sydney Stuart Ayres said the state government is investing heavily in the infrastructure required to build a world-class technology precinct, including investing in support networks for emerging technologies. Sydney is already home to a burgeoning quantum tech industry, with start-ups like Q-CTRL, government-backed enterprises like Silicon Quantum Computing and global tech giants like Microsoft.

"The Academy will keep us at the forefront of quantum technology by developing the future employers, entrepreneurs and the workforce required to sustain the industry's growth," Ayres said.

Sydney Quantum Academy's newly appointed CEO, Professor Peter Turner, predicts that quantum technologies will fundamentally change areas like computation and sensing, and help to solve problems that cannot be solved with classical information technology. He said the Academy plans to grow the talent pipeline through education and training programs, industry partnerships and internships.

"The Academy's unique model means we have the ability and the infrastructure to deliver work-ready graduates and leaders who can help translate quantum research into real-life applications," Prof Turner said. "We need to boost the talent pipeline and anticipate what skills will be required for the future. We can only do this by working closely with industry in Australia and beyond."

Cathy Foley, CSIRO's Chief Scientist and Australia's incoming Chief Scientist, said Sydney will play a central role in developing the nation's quantum technology sector. "The investment by the NSW Government in the Sydney Quantum Academy is a great example of the steps that are needed to create and accelerate a quantum ecosystem that will allow the whole of Australia to come together behind an industry that will create jobs and prosperity," she said.

ULTRA WIDE 12:1 INPUT RANGE
DC/DC CONVERTER

QAE40U/ QAE60U/ QAE100U
40W, 60W and 100W Output Power

► 9-75, 14-160VDC Input Range

► 5, 12, 15, 24, 28, 48, 53 VDC Output Voltage

► High Efficiency Up To 92%

► Up to 3000 VAC I/O-isolation Voltage

► Enhanced Hold-up Function for Supply Interruption and Change-over

► Programable Input Under-voltage Lockout

► EN 50155 and EN 61373 Approval for Railway Applications

► Qualification for Fire Behavior according to EN 45545-2

► Standard 1/4 Brick Package

HAE150U/ HAE200U
150W and 100W Output Power

► 16-160VDC Input Range

► 5, 12, 15, 24, 28, 48, 53 VDC Output Voltage

► High Efficiency Up To 93%

► Up to 3000 VAC I/O-isolation Voltage

► Enhanced Hold-up Function for Supply Interruption and Change-over

► Programable Input Under-voltage Lockout

► Pulse Output for Active Inrush Limit Circuit

► EN 50155 and EN 61373 Approval for Railway Applications

► Qualification for Fire Behavior according to EN 45545-2

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LOOP-POWERED PANEL METERS

Acromag's Vertu VPM2000 loop-powered 1/8 DIN digital panel meters provide a convenient and informative display of any 4–20 mA signal. A dual-line display shows the process value on the top line and the units or a tag on the bottom line. Alternatively, the user can display the input in one scale on the top line (eg, height) and another scale on the bottom (eg, volume). A bar graph option indicates the percentage the value represents.

All models include a digital input and two open collector outputs. For signal isolator and alarm trip applications, model options add two solid-state relays or 4–20 mA analog output. The digital input enables remote reset or triggering of alarms. Open collector outputs are useful for alarm indication or pulse output. Relays support alarm activation, on/off control and pump alternation functions.

Installation is simplified as the meters acquire power from the 4–20 mA loop and therefore require no separate power source. A low voltage drop adds little burden to the loop. The NEMA 4X IP65 panel, conformal-coated PCBs, wide temperature operation and a backlit LCD enable use in most environments. Intrinsically safe and non-incendive versions allow installation in hazardous areas.

Set-up is fast and easy using the front panel buttons or the free configuration software. A micro USB cable connects the meter to a PC and provides power for software-based programming and saving the file. The push-buttons also serve as programmable function keys to change displays, reset min/max readings, acknowledge alarms and more.

Metromatics Pty Ltd
www.metromatics.com.au

IoT DATA MANAGEMENT SOFTWARE

Machinechat's JEDI One is an all-in-one software application enabling IoT developers and solution architects to provision IoT data collection, visualisation, monitoring and local storage capabilities in minutes. Offered as a single binary software application that is installed on-premise, JEDI One for BeagleBone is a ready-to-use IoT software solution for the BeagleBone platform that enables developers and their customers to have complete control over their data, along with a set of data management tools.

One of the key challenges for any engineer, maker or student is the time and effort it takes to develop an infrastructure for data collection, transformation, monitoring and visualisation software for their IoT project. With JEDI One software, these steps can be done quickly, while using minimal resources on the BeagleBone platform. This allows developers to easily add robust data functions into their IoT projects.

Digi-Key Electronics
www.digikey.com

ATX MOTHERBOARD

IBASE's MB997 motherboard is designed for 9th Gen Intel Core i7/i5/i3 and Xeon processors. The Intel C246/Q370/H310-based motherboard is suitable for diverse applications, such as industrial automation, AI integrated systems and smart retail systems.

The board supports up to seven expansion slots including 1x PCI-E(x16), 1x PCI-E(x8)/Gen3.0, 1x PCI-E(x4), 2x PCI-E(x1) and 2x PCI, as well as 6x USB3.1, 2x USB 2.0, 2x SATA 3.0 and 6x COM ports. It can handle up to 128 GB DDR4 memory across four slots and support three independent outputs (HDMI 2.0a, DVI-D and DisplayPort) with 4K resolution each.

The board includes features such as TPM 2.0 hardware-based security to ensure platform integrity, iSMART 4.0 technology that enables power saving, power on/off, power resumption, and NVMe and CNVi interfaces that bring various performance improvements.

The industrial motherboard comes with strict revision control, modification control and long-term support. Operating systems supported are Win10 IoT Enterprise and Linux Ubuntu.

The ATX motherboard delivers high-performance computing for demanding industrial applications while providing connectivity, expansion and functionality to meet user requirements.

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

DEVICE SERVER

ICP DAS's DS-2200i is a serial-to-Ethernet device server that is designed to add Ethernet and internet connectivity to any RS-232/422/485 devices and to eliminate the cable length limitation of legacy serial communication. It can be easily used for the remote control of serial devices through an Ethernet network.

By using the VxComm Driver/Utility, the product's built-in COM port can be virtualised to a standard PC COM port in Windows. Most serial devices do not have network ports; the server makes those devices able to connect to the network. Therefore, serial devices can be accessed or monitored transparently over the internet/Ethernet without software modification.

With two Ethernet ports, the server allows daisy chain connection, which enables flexibility in locating devices for easy installation. It also features 3000 VDC isolation and ±4 kV ESD protection, which diverts the potentially damaging charge away from a sensitive circuit to protect the module and equipment from the sudden and momentary electric current.

The VxComm Driver/Utility supports 32- and 64-bit Windows 10/8/7/2008/2003/XP. The virtual COM works transparently and is protocol independent, enabling integration with the user's current central computer.

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

Compact, Powerful MCUs

PIC18-Q41 Family for Improved Sensor Interface Designs

The PIC18-Q41 family of microcontrollers (MCUs) combines sophisticated analog peripherals and powerful Core Independent Peripherals (CIPs) for small, high-performance data acquisition and sensor-interfacing applications. Available in small 14- and 20- pin packages, these MCUs are equipped with an operational amplifier, a 12-bit Analog-to-Digital Converter with Computation, and 8-bit Digital-to-Analog Converters providing a high level of analog integration for amplification, filtering and signal conditioning. With our comprehensive development tool suite, you can easily configure peripherals and functions, generate application code and simulate analog circuits prior to hardware prototyping to reduce your development time and speed your time to market.

PIC18-Q41 MCUs are well suited for IoT edge nodes, medical, wearables, LED lighting, home automation, automotive and industrial process control.

Key Features
- Up to 64 KB Flash program memory, up to 4 KB data SRAM, 512B data EEPROM
- Small-footprint packages for sensor interface applications
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MICROCHIP

IoT STILL STRONG IN DIFFICULT TIMES

Joseph Zulick*

There are many business areas that are struggling currently, but the Internet of Things and Industrial Internet of Things are not included in this stress. If your concerns are around the risks of COVID-19 and the proximity of your co-workers, then you needn't worry about the benefits of IoT and IIoT.

The strength of IoT and IIoT is being able to obtain data at a distance. We now have an even greater way to connect our information over further distances. Under the current business trends, we are trying to be more creative. This means we take the systems we used to have and now try to make them fit into our rapidly changing need for information.

One year ago, manufacturers were contemplating how they were going to weave IIoT into their fabric of information and their existing IT systems. Fast forward and we are now adapting to Zoom meetings, working from home and getting the answers we used to have by walking into a plant floor or running a report in the office.

Access is one of the biggest issues. How do we securely allow for remoting into the servers, and who can gain what system access? This can be a difficult situation because it's very likely that what one person feels they need to access may not be what the IT department and supervisor deem necessary.

You need to determine who needs what and when. Can they openly access the IoT information that gets fed into reporting software or processors? Can you use firewalls that are time-locked out, much like the safes in the movies that can't be opened until morning once they're locked? Once you determine who is authorised and who needs the information, you can look at the next phase. But how?

How do the users need the information? Let's use a simple example of a sensor that tracks the machine running or not running. Once that sensor feeds the information into the accumulation device or control through a gateway, it will be populated and push the information up to the cloud. Now the software that reads the sensor time on and off will put this into a register or location from which your other cloud programs will pull the information. You may have an OEE program that uses this information to produce a report on OEE or efficiency. This is a high-level report that may combine this information with downtime information that the maintenance department can use to do preventive repairs.

The uptime may combine with the data for the jobs to help managers in production to determine if they will meet their demands or may be used to let them know they will have to run overtime.

The above examples are departments or people that use this information, but there are many programs that will also need to pull this information. ERP (enterprise resource planning) and MRP (material requirements planning) systems will pull the same information and the register data to determine if the manufacturer has adequate supplies of raw materials and if the in-process work can be completed.

Other programs, such as maintenance programs that plan for preventive care using hours of runtime as a parameter, need to use these registers as well. The sharing of data with people and programs is a very important part of IoT.

We know accessibility and sharing are crucial to the value of IoT, but what else? Feedback. Once we have received the information,
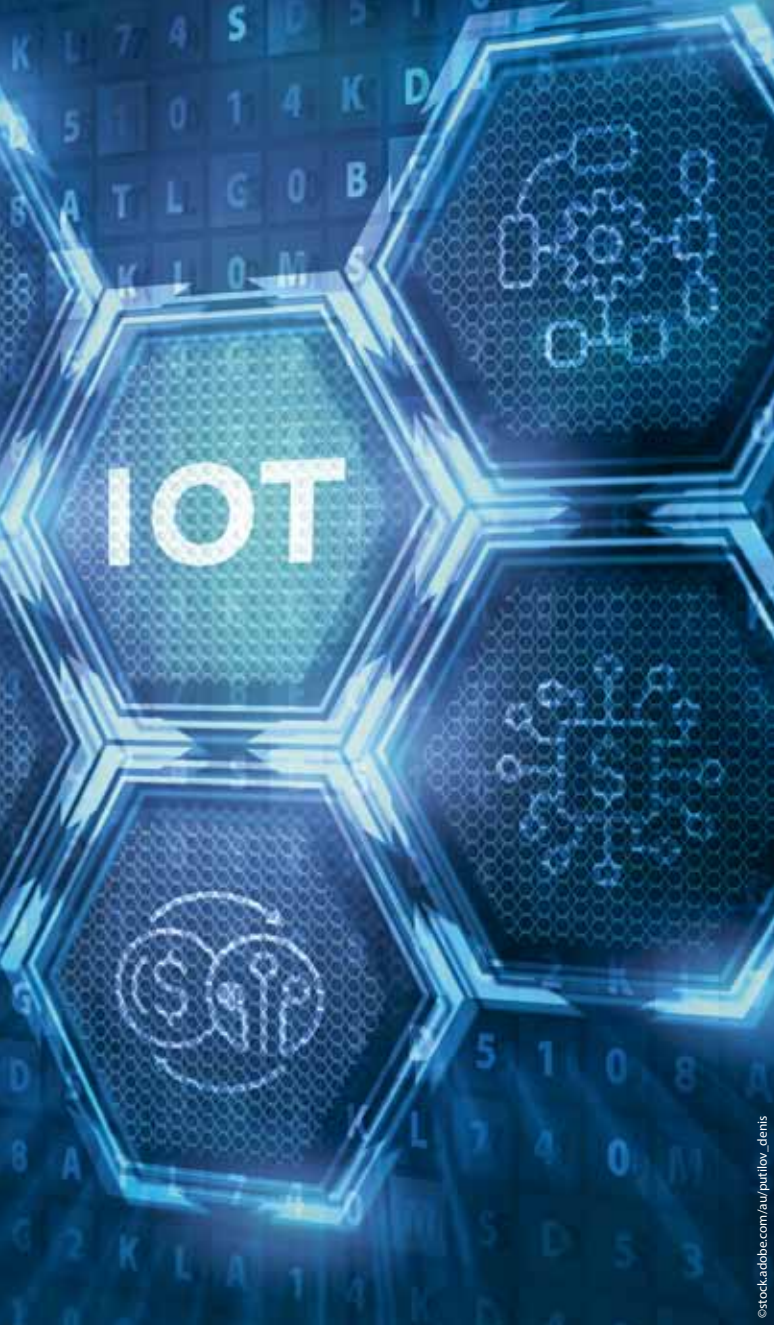
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we need to take the data and adjust the parameters. Many of today's sensors have adjustability; they have a sensitivity curve that can be adjusted and calibrated, based on environment or even chemical make-up. Many times, when we think about sensors and actuators we think about the ones we are most familiar with, but there are many types that can monitor chemicals, gases and position. In some of these sensors they need to have a manual adjustment or in many current sensors they have an electrical adjustment. The feedback gives you better control over the accuracy of the sensor and makes it more responsive.

Feedback also provides information back to smart controllers which are able to take data profiles and customise sensors to the job or application. Many sensors now are using a combination approach. Using optical sensors in conjunction with accelerometers gives a great range of motion to track position.[1] Other sensors use depth, optical and acoustical sensors to work in synchronisation for inputting on the Microsoft computer using their Kinect system.

Programming sensors and tracking their function gives you a far better result. The details of each sensor can be modified, and the status of the sensor can be tracked and compared against historical benchmarks.

One issue that comes up in sensors is that the closer you set a transition, the more likely you are to receive errors like switch or sensor bounce. This shows up as multiple openings and closures

of the sensor. Smart systems provide solutions for this by ignoring transitions that happen too close to the first transition or using other measures to move the transition point into an area that is more stable.

An often-overlooked solution in the IoT world is to look at the actuator for the sensor. In many cases, the switch arm or flag for the proximity switch may not be optimally set up. Perhaps using a different switch arm with a different range of motion, or one that uses a larger actuating point, gives a better performance.

Smart sensors use field processing that allows for sensors to be processed at the field level and only transmit the 'clean' information. This means that it is processed and attenuated to the proper levels and has some level of security and field wiring protection.[2] Many now come in a single package that provides a gateway/communication, voltage and failure monitoring, and back-up.

With more and more demand to have these sensors wireless and mountable in other locations, more demand for performance is desired. Failure is not an option and a plan must be part of your IoT solution for all foreseeable problems; this includes signal outage and power outage. You need to have a plan for addressing this sensor data when a failure occurs.

If you think about autonomous vehicles and their sensors, the more we rely on the sensors and the IoT, the better the reliability must be when lives are at stake. We have seen some of these failures end in accidents, so we must be diligent in optimising the performance of our sensors.

All parts of the IoT are on the rise and all must be improved to keep up with the demand: sensor performance, failure rate, gateway, communication and cloud infrastructure, and upgrading all of our software and program speed and processing.

Everything in our future *Jetsons* world must be dynamic and flexible to rise to the challenge of technology. In manufacturing optimisation, we talk about the fact that a chain is only as strong as its weakest link. The IoT is working on all phases to not be that weakest link. Sensors are improving to use less energy so they can run off backup for a longer time. Redundant systems are backing up the data. Gateways are becoming more secure and faster while using better communication protocols. The speed of 5G is right around the corner and our programs are being redesigned to process faster.

The future of IoT is bright indeed. Wear shades as needed!

Joseph Zulick is a writer and manager at MRO Electric and Supply.

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MRO Electric and Supply
https://www.mroelectric.com/

DC/DC CONVERTERS

Helios has announced the QAE100U series DC/DC converters from P-DUKE, which expand the existing series QAE40U and QAE60U to 100 W of output power. The letter 'U' in the series name refers to its ultrawide input range, including 8:1 of 9–75 VDC and 12:1 of 14–160 VDC. One single 12:1 ultrawide input range module can cover each kind of power system of rolling stock.

QAE100U is designed for rolling stock applications. Its 12:1 input range of 14–160 VDC can be suitable for 24, 36, 48, 72, 96 and 110 VDC power systems described in EN50155 and complies with the safety standards of EN50155, EN45545-2, IEC60950-1, IEC62368-1 and EN61373.

The product provides a single output with 5, 12, 15, 24, 28, 48 and 53 VDC output voltage. It can be installed on a PCB or chassis securely via screws. Heatsink options are also available for thermal demands.

Helios Power Solutions
www.heliosps.com.au

INDUSTRIAL DATA ACQUISITION SYSTEM

The Dewesoft IOLITEd is an industrial data acquisition system that brings easy-to-use data acquisition to industrial and monitoring applications. All signal amplifiers are designed to offer high-end signal conditioning with 24-bit resolution and a high sampling rate of up to 50 kHz/channel.

The product achieves high-end signal conditioning with a range of input and output slots, allowing the measurement of voltage, current, strain, stress, vibration, sound, temperature, digital, counters and more. Dewesoft X data acquisition software, featuring a series of supported industry-standard interfaces, works with the hardware to perform data collection without losing even a single sample. It also provides data visualisation and processing capabilities. Data can be stored in a time-series database and served to SCADA systems using standard interfaces such as OPC UA or XCP to support Industry 4.0 applications.

The device comes in single- and multi-channel versions. Multiple modules can be daisy-chained together with a single Ethernet/EtherCAT cable with RJ45 connectors. Devices can span up to 100 m apart and a single EtherCAT cable is enough for power, data and synchronisation between devices.

Metromatics Pty Ltd
www.metromatics.com.au

SAFETY-CERTIFIED CAPACITIVE TOUCHSCREEN CONTROLLER FAMILY

To reduce the risk of fires in the kitchen and flooding in the laundry, European IEC 60730 and US UL 60730 Class B specifications require safety mechanisms in home appliances such as ovens, cooktops, washing machines and clothes dryers. Helping designers meet these functional safety requirements in touchscreen-enabled appliances, Microchip Technology announced its maXTouch MXT336UD-MAUHA1 capacitive touchscreen controller family — said to be the market's only touchscreen controllers to offer pre-certified, Class B firmware. The family includes three controllers — the MXT112UD-MAUHA1, the MXT228UD-MAUHA1 and the MXT336UD-MAUHA1 — each fulfilling different screen size needs, ranging from 2 to 8″.

The Class B-certified touch controllers offer safety-related features that enable system shut-off through an intuitive soft button on a touchscreen, removing the requirement for an external safety certified stop or cancel button and associated microcontroller (MCU). They also allow an appliance to detect a touchscreen or appliance failure and shut down automatically through a variety of self-testing capabilities.

For example, if the glass breaks on a cooktop, the touchscreen will turn dark and shut off the machine, eliminating accidental damage in the home. As the number of touch-enabled home appliances continues to increase, the family shifts the required safety functionality to a simplified single touchscreen interface, helping OEMs reduce costs and improve time to market.

In addition, the family leverages a high signal-to-noise ratio (SNR) design and proprietary differential mutual acquisition scheme. This allows the machine to detect and track multiple fingers on surfaces exposed to moisture, water, grease and more — even if the user is wearing gloves.

Microchip Technology Australia
www.microchip.com

3D POWER PACKAGING® FOR LOW-POWER DC/DC CONVERTERS

A long-term goal for RECOM has been to develop DC/DC converters which can be handled, placed and soldered like any other modern SMT component, but also with a low profile to match today's slimline products.

What are the challenges with current packaging design for DC/DC converters?

Power density is one of the most important properties of a modern DC/DC converter design. Shrinking the design requires placing power components closer together. By doing so, you're placing multiple heat sources near one another, so one of the main challenges current packaging designs face is getting the heat out efficiently. Thermal design considerations in very high density designs become crucial.

Another major challenge with any DC/DC converter design is EMC. One way to increase the power density is to shrink the size of the passives by increasing the operating frequency of the converter (faster switching requires smaller component values). But if you do this, the layout of the board often determines if the converter will pass or fail an EMI test. A good way to keep the parasitic elements in a circuit low is to limit the length of connectors on your PCB, but traditional packaging designs have limits to how short these traces can be.

What are the benefits of advanced packaging techniques?

One of the advanced assembly techniques which really helps to overcome the challenges of current packaging designs is FCOL (flip-chip-on-leadframe) power components. This technique not only significantly reduces the connection parasitics, but by flipping the IC and placing it directly on a leadframe, the FCOL design also has a dramatically reduced thermal resistance. The assembly technique allows higher switching frequencies to be reached while still meeting strict EMC requirements.

In RECOM's 3D Power Packaging® technology, we additionally put active and passive components directly inside the PCB. This achieves similar results to the flip-chip-on-leadframe approach by shortening power paths and reducing the thermal resistance of the design, thereby allowing us to reduce the solution size and increase the performance of the module.

We're also using different techniques to solve different problems. There is no point making the converter smaller if you can't manage the heat and the electromagnetic disturbances it then creates. Customers often demand a holistic solution which addresses all thermal, EMC and power performance requirements in a single unit — in other words, they want a plug-and-play solution. For such customers, the RPM series is the way to go. It is a compact module that requires the minimum of external components (for example, two resistors to set the output voltage) to create a complete DC/DC power supply.

How is RECOM Advanced Packaging technology used for low-power DC/DC converters?

Advanced packaging technologies such as 3D Power Packaging are used in over-moulded flip-chip-on-leadframe designs, embedded active and passive components in the PCB, and multi-level designs. This helps RECOM to increase power density and raise switching speeds without harming the thermal performance.

Tell us about your products leveraging advanced packaging technologies.

The RPM, RPMB, RPMH and RBB series all use thermally optimized, multilayer PCB technologies with BGA chips and the RPX series incorporates FCOL technologies. And finally, the new RxxCTxxS uses a multi-level design and air-core transformer to reach very high isolation levels in a very low profile, IC-type over-moulded package.

The application of product is closely related to the development of industries. Can you share some applications that RECOM Advanced Packaging technology mainly focuses on?

We are very fortunate that our large product portfolio addresses various customer segments across the industry. The 3D Power Packaging products suit almost all kinds of applications and fulfil the market requirement of minimized PCB footprint, high power density, fully automated production process and time to market, as well as ease of use.

One example is drone applications (see image); the power module shown in the drone is up to 6 A for high power, which is good for the battery in drone applications. Other uses include telecom applications, ie, set-top boxes and gateways, for smart metering like 5G, industrial, robots, medical, mobility, energy, automotive, etc.

RECOM Power GmbH
www.recom-power.com

MIND THE GAP
THE SECOND LIFE OF EV BATTERIES

Alex Johns, Business Development Manager

Where do Tesla second-life batteries go, after they are retired from EVs and before they are ready for recycling?

For a country like Australia, which has pioneered large-scale battery energy storage systems (BESS) with the Hornsdale Power Reserve, it's a really important question. Tesla batteries are superb quality. When I oversaw the trial of five Tesla electric taxis stationed at Gatwick Airport in 2019, the fleet completed 1.5 million miles in three years and had 300,000 miles each on the clock, but the batteries were still at 82% state of health (SoH).

Tesla's warranty covers batteries down to 70% battery SoH and it has announced that it is establishing recycling which usually applies to batteries below 50% SoH.

So what is happening to the batteries that are between 70% and 50% SoH? These are still good for probably five years more life as part of a BESS.

There is increasing demand for second-life electric batteries, as the massive increase in battery storage capacity illustrates.

When the South Australian Hornsdale Power Reserve went live in 2017, it was the largest in the world at 150 MW/194 MWh. But just three years later the Californian Gateway Energy Storage at 230 MW/h overtook it, and the plant planned by Tesla at Moss Landing in California will be a huge 1500 MW/6000 MWh.

All these new giant BESSs are built with new battery packs. But the economies of the car market and BESS market work best with second-life batteries.

Market analysis has demonstrated that in most cases BESSs will be more profitable if constructed with second-life battery cells and the economies of the car market will make it essential to resell the battery.

Being able to demonstrate that your vehicle battery will go on to a long and meaningful second life is also hugely important emotionally and rationally to consumers. It will also be hardwired into the metrics of the vehicles to support environmental credentials, with the data from BESS deals delivering the proof.

Although EVs make up only 0.6% of new car sales in Australia, the fledgling market is dominated by Tesla and the second-life uses of electric batteries will be as important here as everywhere else in the world.

To ensure a second life of an electric battery, you need to know about it. It's like knowing the service history of a car. The more information you know about the battery, the higher its value.

If you know what the battery has done all its life — its voltage parameters, temperature parameters and C rates — then you are dealing with a known quantity. With this information it is possible to buy the battery with confidence, 'warts and all', or to use more modern parlance, in the full knowledge that some fuel cells have failed or will fail, and when.

Altelium is already providing the information to enable vehicle manufacturers to pivot their batteries from EV to BESS applications. Unequal access to knowledge has traditionally skewed markets or held back growth and in this respect the Altelium data is a tech breakthrough, giving equal access to information between buyers and sellers, and with it the ability to access the value in second-hand electric vehicle batteries.

THE MORE INFORMATION YOU KNOW ABOUT THE BATTERY, THE HIGHER ITS VALUE.

The know-how to drive the circular economy in electric batteries is therefore available, but this comes back to the original question. Where are the batteries?

To be clear, there are few if any Teslas currently going around with batteries at less than 70% SoH but one day there will be many of them. Will Tesla be tracking and contacting the owners of every vehicle over its lifetime? What will receivers' yards do when they take their first electric vehicle write-offs?

We need to ensure the systems are in place to make the most of these valuable resources which could be especially important to Australia, one of the first countries in the world to harness renewable energy on a giant BESS scale.
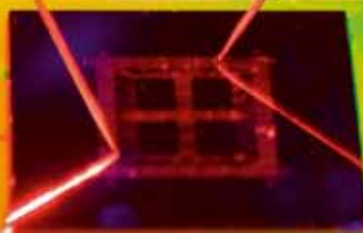
Altelium
https://altelium.com/

ARTIFICIAL INTELLIGENCE
IN A CHIP POWERED BY LIGHT

A team of Australian, American and Chinese researchers, led by RMIT University, has developed artificial intelligence technology that brings together imaging, processing, machine learning and memory in one electronic chip, powered by light.

The prototype shrinks artificial intelligence technology by imitating the way that the human brain processes visual information, combining the core software needed to drive artificial intelligence with image-capturing hardware in a single electronic device. It has been described in the journal *Advanced Materials*.

"Our new technology radically boosts efficiency and accuracy by bringing multiple components and functionalities into a single platform," said lead researcher Associate Professor Sumeet Walia, from RMIT.

"It's getting us closer to an all-in-one AI device inspired by nature's greatest computing innovation — the human brain. Our aim is to replicate a core feature of how the brain learns, through imprinting vision as memory.

"The prototype we've developed is a major leap forward towards neurorobotics, better technologies for human-machine interaction and scalable bionic systems."

Advancing AI
Typically artificial intelligence relies heavily on software and off-site data processing. The new prototype aims to integrate electronic hardware and intelligence together, for fast onsite decisions.

"Imagine a dash cam in a car that's integrated with our neuro-inspired hardware — this means it can recognise lights, signs, objects and make instant decisions, without having to connect to the internet," said Assoc Prof Walia, who co-leads the Functional Materials and Microsystems Research Group at RMIT.

"By bringing it all together into one chip, we can deliver unprecedented levels of efficiency and speed in autonomous and AI-driven decision-making."

The technology builds on an earlier prototype chip from the RMIT team, which used light to create and modify memories.

Associate Professor Sumeet Walia and Dr Taimur Ahmed.

New built-in features mean the chip can now capture and automatically enhance images, classify numbers and be trained to recognise patterns and images with an accuracy rate of over 90%. The device is also readily compatible with existing electronics and silicon technologies for effortless future integration.

See the light
The prototype is inspired by optogenetics, an emerging tool in biotechnology that allows scientists to delve into the body's electrical system with great precision and use light to manipulate neurons.

The AI chip is based on an ultrathin material — black phosphorous — that changes electrical resistance in response to different wavelengths of light. The different functionalities such as imaging or memory storage are achieved by shining different colours of light on the chip.

Lead author Dr Taimur Ahmed, from RMIT, said light-based computing is faster and more accurate, and requires far less energy than existing technologies. He explained, "By packing so much core functionality into one compact nanoscale device, we can broaden the horizons for machine learning and AI to be integrated into smaller applications.

"Using our chip with artificial retinas, for example, would enable scientists to miniaturise that emerging technology and improve accuracy of the bionic eye.

"Our prototype is a significant advance towards the ultimate in electronics: a brain-on-a-chip that can learn from its environment just like we do."

With further development, the light-driven prototype could enable smarter and smaller autonomous technologies like drones and robotics, plus smart wearables and bionic implants like artificial retinas.

STEPPER MOTORS

The FAULHABER DM66200H series stepper drives feature an aperture larger than most conventional motor solutions (up to 40 mm). Since the DM66200H is a direct drive it achieves high performance in terms of both speed and torque while also operating backlash-free.

Mechanically the drive can be integrated with limited effort, since it has a relatively low weight and an ultraslim design compared to most hybrid steppers with reluctance technology. Due to minimal wear (bearing only), it is also suitable for maintenance-free continuous operation.

The DM66200H rotor runs around the opening and drives the surrounding mechanics directly without the need for a transmission. Using tried-and-tested stepper technology, the drive is energy efficient and requires neither a brake nor an encoder. With a high resolution of 1.8° in full-step mode, it can execute positioning tasks precisely in open loop operation. Because the moving mass of the rotor is small, speeds of up to 2000 rpm are possible. A dynamic torque of up to 180 mNm can be achieved for moving large loads.

The product is suitable for applications where cables need to be guided through the aperture or where gases, fluids or light signals need to pass through the opening — including optics (eg, for microscope stages, apertures, zoom lenses, laser beam controls, etc), impellers, prostheses and robotics — as well as many different control and positioning tasks.

Other advantages include: ease of integration compared to torque motors, which are heavy and cannot achieve high speeds; and simple design compared to motor and bearing systems, which often require complex transmission and exhibit backlash. The DM66200H drive is designed to offer optimum speed-torque balance with minimal weight and volume.

ERNTEC Pty Ltd
www.erntec.net

WIRELESS IoT GATEWAY

The Sentrius IG60-BL654-LTE wireless IoT gateway, from Laird Connectivity, features extensive connectivity capabilities. The gateway allows users to capture data from Bluetooth 5-enabled sensors, augment the data with cloud-managed edge intelligence and transmit it to the cloud via Wi-Fi 802.11ac Wave 2 with 2x2 MIMO or LTE wireless connectivity.

The gateway delivers efficient multi-band Cat 1 LTE connectivity with 3G/2G fallback, with required SIM and LTE data allowance activated. It is available in two variants: one with integrated Amazon Web Services (AWS) IoT Greengrass and the other with a Linux build.

The AWS IoT Greengrass version includes managed IoT security services (such as a preconfigured AWS IoT Greengrass sandbox) and deployment tools. This variant allows users to deploy applications instantly over the air, and AWS IoT core enables data to flow directly to the cloud.

The Linux Build version is a long-term supported, open platform with Laird Connectivity's Linux Buildroot platform and hardware root of trust. This version is suitable for engineering organisations with embedded Linux experience that require multi-wireless connectivity.

The gateway includes regulatory approvals for FCC, IC, CE, MIC and UL. LTE variants to date carry PTCRB, GCF and AT&T certifications. The gateway is suitable for applications such as IIoT, medical IoT, Bluetooth 5 sensor connectivity and smart buildings.

Mouser Electronics
au.mouser.com

INTELLIGENT IIoT EDGE CONTROLLER

ICP DAS's WISE-5231M intelligent IIoT edge controller functions as a control unit for use in remote logic control and monitoring in various industrial applications. It offers a user-friendly and intuitive website interface that allows users to implement IF-THEN-ELSE control logic on controllers just a few clicks away; no programming is required. With the built-in IF-THEN-ELSE logic engine, the edge controller can execute the automation logic stably and efficiently, and it also provides mathematic operation, schedule and email alarm message sending functions.

The product provides support for I/O module connection, I/O data logging and IoT platform integration. It allows connection to XV-board, DCON I/O and Modbus TCP/RTU Slave modules all together. The wide range of selection options enables flexibility in I/O module integration to meet the requirements of various applications. It provides the MQTT client and can directly connect to major public IoT cloud platforms (such as Microsoft Azure or IBM Bluemix) and MQTT Broker. It also provides CGI command functions to integrate with IP cameras for access control applications.

Based on its I/O module connection ability, intelligent logic control, data logging and support for various communication protocols (SNMP, MQTT and Modbus TCP/RTU), the controller can help an IT/MIS/MES/SCADA system to manage field side I/O modules and sensors efficiently in applications such as unmanned facility room monitoring, intelligent factories and environment monitoring. The product is not just a concentrator of I/O modules and sensors; it is also a gateway to transfer the sensor data to IoT cloud platforms.

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

EXPLOSION-PROOF PIEZOELECTRIC SWITCHES

The piezoelectric switches in the SCHURTER PSE EX family feature aluminium or stainless steel housings, offering a long service life. Due to their hermetically sealed housing (IP69K) with no mechanical switching contacts, they are designed for use in potentially explosive installations above ground, as well as in areas with flammable air-gas mixtures, vapours and dust.

In addition to European ATEX certification for operation in potentially explosive atmospheres, all SCHURTER PSE EX products are also validated by the internationally recognised IECEx certification. For a manufacturer to offer ATEX/IECEx certified products, both product and production site certifications are required.

Explosion-protected components are recommended for use wherever explosive atmospheres can arise or prevail. Such atmospheres can occur in refineries (petrochemical industry), mills (food processing), gas works, the chemical industry and others. The switches are certified for above-ground applications, not for underground constructions.

SCHURTER (S) PTE LTD
www.schurter.com

DATA BUFFER

HMS Networks has launched Ewon DataMailbox — an online data buffer that enables easy retrieval of data from machines anywhere in the world. It is a freemium service within the Ewon Talk2M cloud, meaning that users can utilise it for free for an unlimited time.

The Ewon routers Cosy and Flexy connect to a remote machine and send data via Ethernet or cellular connection to the Talk2M cloud. As a part of Talk2M, the product allows application developers to retrieve historical data from multiple Ewon gateways using a simple API call.

Users can collect data from multiple machines anywhere in the world in a secure process in order to analyse this data at their convenience. This allows for big data analytics and dashboards for predictive maintenance and operational intelligence. It is possible to set up a data connection in a couple of hours, no matter how complex the IT environment is, and to scale up when necessary. Users can add machines to the process in a couple of clicks.

The product is an easy and scalable integrated solution to collect and process data from an unlimited number of sites, allowing users to increase their efficiency. Data is automatically stored and forwarded if the internet connection is down, so it will not be lost, and users always have access to a clean historical dataset for analytics applications.

Global M2M
www.globalm2m.com.au

TIME-OF-FLIGHT SENSOR

STMicroelectronics (ST) has extended its portfolio of FlightSense time-of-flight (ToF) sensors with the L53L5 — a 64-zone device that breaks a scene into separate areas to help an imaging system build a detailed spatial understanding of a scene.

The product comprises a 940 nm vertical-cavity surface-emitting laser (VCSEL) light source, a system-on-chip sensor integrating a VCSEL driver, the receiving array of single-photon avalanche diodes (SPADs) and a low-power 32-bit MCU core and accelerator running sophisticated firmware. It retains the Class 1 certification of all FlightSense sensors and is fully eye-safe for consumer products.

Housed in a miniature module, the ToF sensor contains optical elements in the receive aperture that creates 64 ranging zones. It is said to offer performance improvements in laser autofocus, touch-to-focus, presence detection and gesture interfaces, while helping developers create innovative imaging applications.

With a vertically integrated manufacturing model for its FlightSense sensors, ST builds its SPAD wafers on a 40 nm silicon process to offer 4 m ranging performance and up to 64 ranging zones, unlocking a host of features and use cases.

STMicroelectronics Pty Ltd
www.st.com
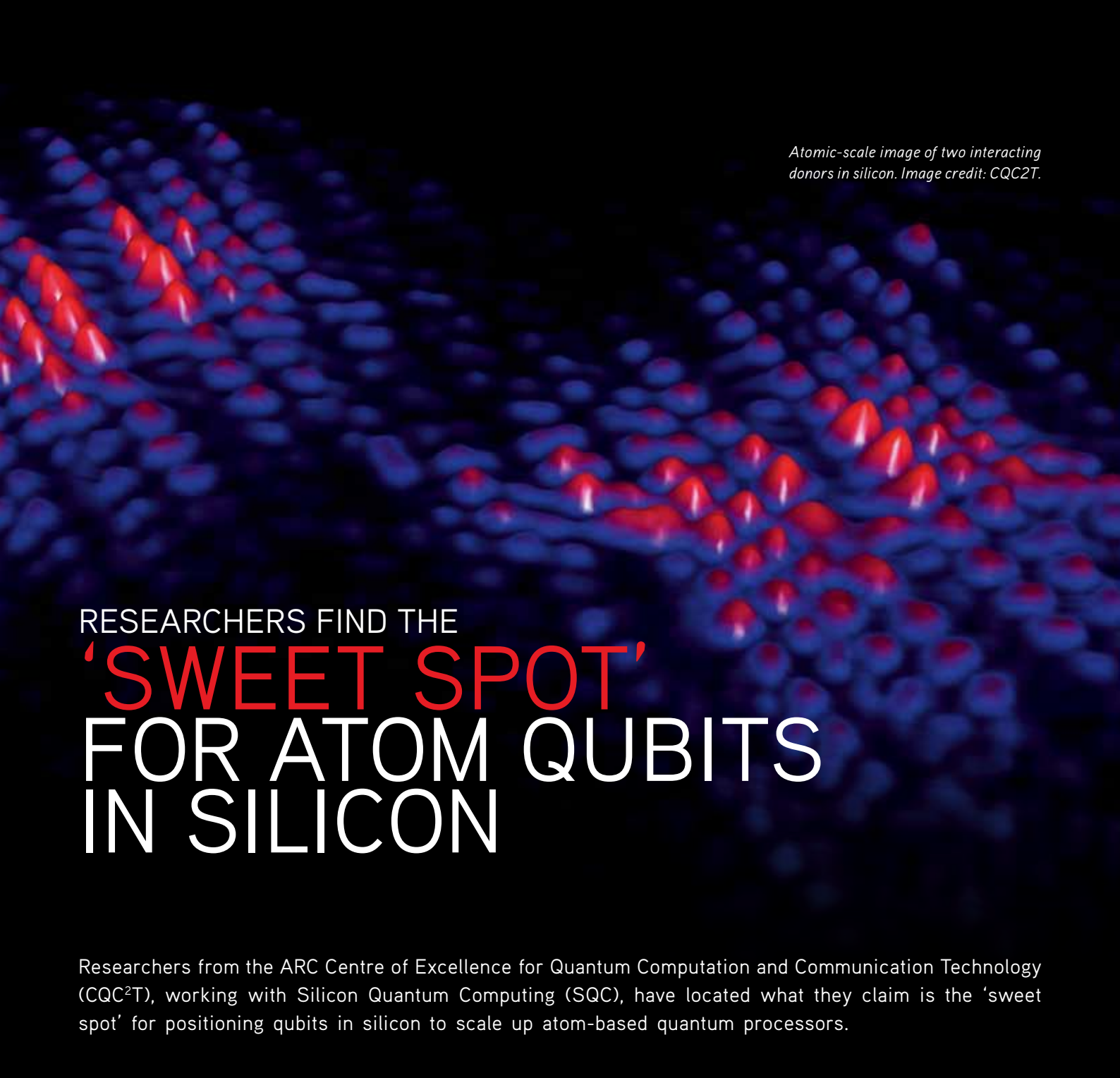
RESEARCHERS FIND THE
'SWEET SPOT'
FOR ATOM QUBITS
IN SILICON

Researchers from the ARC Centre of Excellence for Quantum Computation and Communication Technology (CQC²T), working with Silicon Quantum Computing (SQC), have located what they claim is the 'sweet spot' for positioning qubits in silicon to scale up atom-based quantum processors.

Creating quantum bits, or qubits, by precisely placing phosphorus atoms in silicon — the method pioneered by CQC²T Director Professor Michelle Simmons — is a world-leading approach in the development of a silicon quantum computer. In the new research, published in the journal *Nature Communications*, precision placement has proven to be essential for developing robust interactions — or coupling — between qubits.

"We've located the optimal position to create reproducible, strong and fast interactions between the qubits," said UNSW's Professor Sven Rogge, who led the research.

"We need these robust interactions to engineer a multi-qubit processor and, ultimately, a useful quantum computer."

Two-qubit gates — the central building block of a quantum computer — use interactions between pairs of qubits to perform quantum operations. For atom qubits in silicon, previous research has suggested that for certain positions in the silicon crystal, interactions between the qubits contain an oscillatory component that could slow down the gate operations and make them difficult to control.

"For almost two decades, the potential oscillatory nature of the interactions has been predicted to be a challenge for scale-up," Prof Rogge said.

"Now, through novel measurements of the qubit interactions, we have developed a deep understanding of the nature of these oscillations and propose a strategy of precision placement to make the interaction between the qubits robust. This is a result that many believed was not possible."

Finding the sweet spot in crystal symmetries

The researchers say they've now uncovered that exactly where you place the qubits is essential to creating strong and consistent interactions. This crucial insight has significant implications for the design of large-scale processors.

"Silicon is an anisotropic crystal, which means that the direction the atoms are placed in can significantly influence the interactions between them," said UNSW's Dr Benoit Voisin, lead author of the research.

"While we already knew about this anisotropy, no-one had explored in detail how it could actually be used to mitigate the oscillating interaction strength.

"We found that there is a special angle, or sweet spot, within a particular plane of the silicon crystal where the interaction between the qubits is most resilient. Importantly, this sweet spot is achievable using existing scanning tunnelling microscope (STM) lithography techniques developed at UNSW.

"In the end, both the problem and its solution directly originate from crystal symmetries, so this is a nice twist."

Using an STM, the team are able to map out the atoms' wave function in 2D images and identify their exact spatial location in the silicon crystal — first demonstrated in 2014 and later advanced in 2016. The latest research saw the UNSW team collaborate with The University of Melbourne, using the same STM technique to observe atomic-scale details of the interactions between the coupled atom qubits.

"Researchers from UNSW Sydney were able to obtain atomic-resolution images of coupled electron wave functions, while we conducted advanced theoretical simulations to analyse these images, which was crucial to map two-qubit interactions for the future of quantum computers," said The University of Melbourne's Professor Lloyd Hollenberg, CQC^{2}T Deputy Director and research co-author.

Dr Voisin added, "Using our quantum state imaging technique, we could observe for the first time both the anisotropy in the wave function and the interference effect directly in the plane — this was the starting point to understand how this problem plays out.

"We understood that we had to first work out the impact of each of these two ingredients separately, before looking at the full picture to solve the problem — this is how we could find this sweet spot, which is readily compatible with the atomic placement precision offered by our STM lithography technique."

Building a silicon quantum computer atom by atom

Scientists at CQC^{2}T are leading the world in the race to build atom-based quantum computers in silicon. The researchers at CQC^{2}T and its commercialisation company, SQC, are the only team in the world that have the ability to see the exact position of their qubits in the solid state.

In 2019 the Simmons group built the fastest two-qubit gate in silicon by placing two atom qubits close together, and then controllably observed and measured their spin states in real time. Now, with the Rogge team's latest advances, the researchers from CQC^{2}T and SQC are positioned to use these interactions in larger scale systems for scalable processors.

"Being able to observe and precisely place atoms in our silicon chips continues to provide a competitive advantage for fabricating quantum computers in silicon," said Prof Simmons said.

MOULDED POWER INDUCTORS

Mag Layers USA's MMD series moulded power inductors have a magnetic metal powder core and internal wire coil in a shielded construction for today's DC/DC applications and power supplies. Typical applications for the series include laptop, desktop and server power, as well as high-current power supplies, battery-powered devices and PMIC applications.

The shielded power inductors are produced on state-of-the-art manufacturing lines utilising second-generation, automotive-grade robotics. They feature soft saturating core materials in consumer, industrial and automotive grades.

The inductors are RoHS/Reach compliant, halogen-free and low resistance. They offer high current ratings in sizes from 4 x 4 to 17 x 17 mm.

Digi-Key Electronics
www.digikey.com

LoRA-COMPATIBLE, WIRELESS SYSTEM-ON-CHIP FAMILY

STMicroelectronics has expanded availability of its STM32WL long-range sub-GHz wireless system-on-chip (SoC) family, adding flexible configurations and package options for diverse mass-market applications.

With the ability to connect devices to LoRa-based low-power wide-area networks (LPWANs), the STM32WL series lets users create IoT devices that are compact and energy efficient. LPWANs provide connectivity over large geographical areas and in remote locations, extending the IoT's reach and enabling smart technologies to add greater value in industries including utilities, agriculture, shipping, transportation and more.

The series combines ST's STM32 ultralow-power microcontroller (MCU) architecture with a sub-GHz radio subsystem that supports multiple modulation schemes. These include both LoRa, which allows high receiving sensitivity at low RF signal power, and (G)FSK, (G)MSK and BPSK modulation used by Sigfox and wireless Meter-Bus (wM-Bus) protocols for instance as well as other proprietary protocols or sub-GHz standards. The radio has a selectable dual-power output that helps users comply with RF-power restrictions for unlicensed frequency bands in all territories worldwide.

The latest STM32WL models include the dual-core STM32WL55, based on an Arm Cortex-M4 core and a Cortex-M0+ MCU core which can both be used in a fully open and flexible way. The dual-core architecture ensures hardware isolation that enhances cybersecurity, allows application updates without the need to recertify the device as a new radio product and enhances real-time performance of both the radio and application.

The extended line-up also adds two non-LoRa variants, the single-core STM32WLE4 and dual-core STM32WL54, allowing developers flexibility to leverage the SoC in new wireless IoT projects.

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

POWER SUPPLY

SCHURTER's Power Supply IP42 is suitable for LED-related fixtures or appliances, such as LED decoration or advertisement devices, with protection class II according to IEC 61140.

The product comes in a fully isolated plastic case, with protections including short circuit, overload and overvoltage. It offers universal AC input (full range), no load power consumption <0.5 W and a 100% full load burn-in test.

The small and compact device also features constant voltage design and cooling by free air convection.

SCHURTER (S) PTE LTD
www.schurter.com
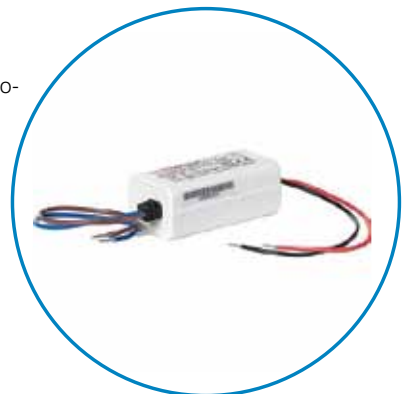
GIGABIT MANAGED INDUSTRIAL ETHERNET SWITCHES

Red Lion introduces the NT4008 series of 8-port Gigabit managed Industrial Ethernet switches. The switches are certified to meet PROFINET PNIO v2.34 Conformance Class-B standards to ensure seamless integration into PROFINET networks using standard PLC configuration and management tools.

The switches are UL Class 1, Division 2 and ATEX listed for use in hazardous and ordinary locations, ABS certified for shipboard applications and EN50155 certified for rail applications, ensuring operation in nearly any environment. Featuring IP30 metal DIN-rail enclosures, redundant 12–58 VDC power inputs, a wide operating temperature range of -40 to +75°C and up to 50G shock resistance, the switches are designed to handle extreme industrial conditions.

With copper and fibre options in both Fast Ethernet and Gigabit configurations, as well as security and traffic control, the switches combine the power of PROFINET real-time data exchange with high performance.

Control Logic Pty Ltd
www.controllogic.com.au

X-RAY SYSTEMS

PDR X-ray Solutions' GenX-90P and GenX-130P products are available in compact or large cabinet models. Both can accommodate PCB sizes up to 533 x 445 mm with an oblique angle viewing up to 70°.

The cabinets accommodate either 90 or 130 kV X-ray sources and are upgradable in the field from 90 to 130 kV if the user's imaging needs change in the future. The detector also is field upgradable.

The large cabinet models can be configured with many sizes of flat panel detectors or a versatile image intensifier for applications with a wide range of part sizes and imaging requirements. Custom algorithms can also be tailored to specific inspection needs.

The X-ray systems offer good image clarity with the company's proprietary HD camera and software. Additionally, the high-performance systems offer programmable 4-axis (X, Y, Z 1/Z2) fully motorised motion control.

Mektronics Co Pty Ltd
www.mektronics.com.au
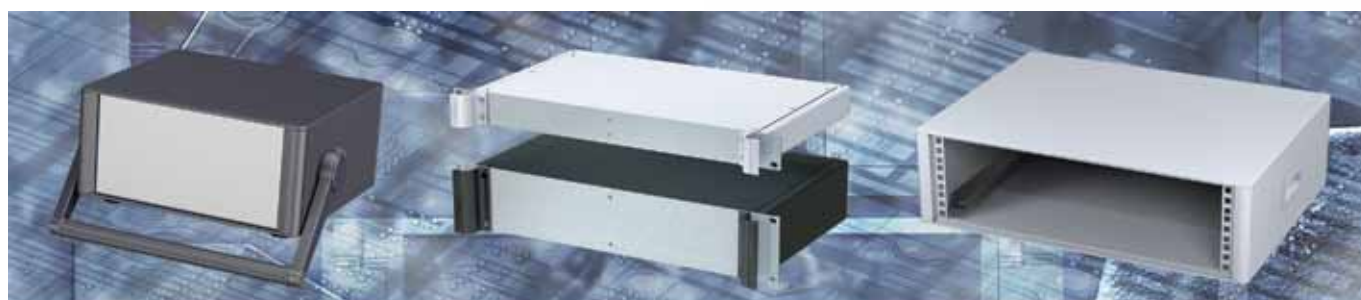
UV-C LEDs

UV-C light can eliminate 99.9% of viruses and bacteria on surfaces, in the air and in drinking water. Osram Opto Semiconductors now enables particularly small and robust disinfection applications with the launch of the Oslon UV 3636 — the beginning of a comprehensive portfolio in the UV-C LED sector.

UV-C light has been used for many years to disinfect air or water, but often with very large lamps based on conventional light technologies. A major advantage of modern, LED-based UV-C solutions is the compact size of the light sources. Due to their space-saving dimensions, the LEDs can be installed easily on the final application for direct interaction with the substance being sanitised, such as reducing germs in faucets and disinfecting the air in air-conditioning systems before it is blown into car interiors. The direct integration of the light sources also has the advantage of ensuring that the high-energy, short-wave UV-C light does not reach the surrounding area and therefore does not pose a risk to people. In addition, unlike conventional lighting technologies, LEDs are robust and insensitive to external shocks.

The Oslon UV 3636 is available in a low- and a mid-power version and features compact dimensions of 3.6 x 3.6 mm. With a wavelength of 275 nm, both versions are suitable for disinfection applications. The low-power version achieves 4.5 mW at 30 mA and the mid-power version reaches 42 mW at 350 mA. A high-power UV-C LED will be launched in early 2021.

Osram Australia Pty Ltd
www.osram.com.au
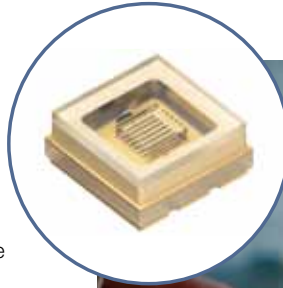
PROTOCOL EXERCISER FOR PCIe 5.0 TRAFFIC VALIDATION

VIAVI Solutions has introduced the Xgig Protocol Exerciser for the 5P16 platform for protocol traffic validation and performance evaluation. Together with the recently introduced Xgig 5P16 Analyzer — a 16-lane protocol analysis system for PCIe 5.0 — the product enables powerful real-time emulation, manipulation and analysis of PCIe 5.0 data traffic at all layers of the stack.

Component and equipment manufacturers are in a race to develop robust technologies that can handle emerging compute-intensive applications, from 400 Gigabit Ethernet and hyperscale networks to artificial intelligence. The protocol exerciser's flexibility and performance help manufacturers by enabling validation of complex test cases that were not previously possible, the company says.

The product enables in-depth protocol evaluation and debugging at 32 Gbps per lane, as well as testing for PCIe compliance, allowing development of network technologies to meet the demands of tomorrow's high-speed, high-performance computing applications. The Xgig Exerciser Solution includes a system chassis, test stand interposer for device under test (DUT) connectivity and the exerciser licence key. With a modular architecture and an implementation tightly coupled to a full-featured analysis system, the protocol exerciser reduces the need for extra hardware, while a familiar Xgig management interface helps limit training needs.

VIAVI Solutions Inc
www.viavisolutions.com.au

POWER SUPPLIES

Weidmuller's PROtop series of power supplies are designed to meet and exceed requirements in the most challenging of industrial environments.

With its integrated ORing MOSFET, the product can achieve direct redundant parallel connection without external diode modules, saving valuable space in the cabinet. Its powerful DCL boost technology means difficult loads are operated smoothly while downstream circuit breakers are tripped appropriately.

A communication capability allows a plug-on module for integration into control systems and a high-performance 'EX' option adds the features of IECEx approvals, with conformal coating to G3 ISA 71.04 standard.
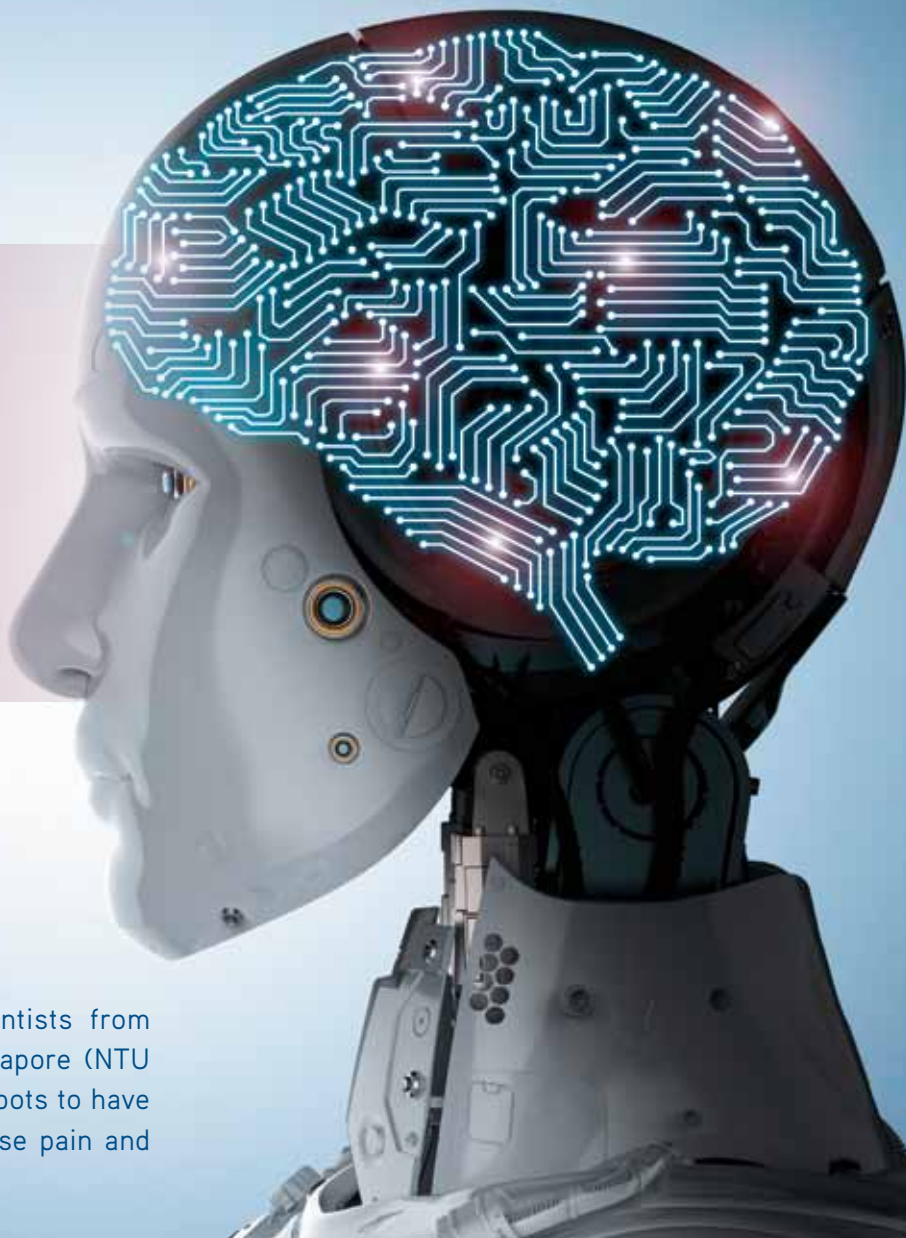
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'MINI BRAINS'
HELP ROBOTS RECOGNISE PAIN

Using a brain-inspired approach, scientists from Nanyang Technological University, Singapore (NTU Singapore) have developed a way for robots to have the artificial intelligence (AI) to recognise pain and to self-repair when damaged.

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Described in the journal *Nature Communications*, the NTU system has AI-enabled sensor nodes to process and respond to 'pain' arising from pressure exerted by a physical force. It also allows a robot to detect and repair its own damage when 'injured', without the need for human intervention.

Currently, robots use a network of sensors to generate information about their immediate environment. For example, a disaster rescue robot uses camera and microphone sensors to locate a survivor under debris and then pulls the person out with guidance from touch sensors on their arms. A factory robot working on an assembly line uses vision to guide its arm to the right location and touch sensors to determine if the object is slipping when picked up.

Today's sensors typically do not process information but send it to a single large, powerful, central processing unit where learning occurs. As a result, existing robots are usually heavily wired, which can result in delayed response times. They are also susceptible to damage that will require maintenance and repair, which can be long and costly.

The NTU approach embeds AI into the network of sensor nodes, connected to multiple small, less powerful, processing units that act like 'mini brains' distributed on the robotic skin. This means learning happens locally and the wiring requirements and response

time for the robot are reduced 5–10 times compared to conventional robots, the scientists say. In addition, combining the system with a type of self-healing ion gel material means that the robots, when damaged, can recover their mechanical functions without human intervention.

"For robots to work together with humans one day, one concern is how to ensure they will interact safely with us," said Associate Professor Arindam Basu, co-lead author of the study. "For that reason, scientists around the world have been finding ways to bring a sense of awareness to robots, such as being able to 'feel' pain, to react to it and to withstand harsh operating conditions. However, the complexity of putting together the multitude of sensors required and the resultant fragility of such a system is a major barrier for widespread adoption.

"Our work has demonstrated the feasibility of a robotic system that is capable of processing information efficiently with minimal wiring and circuits. By reducing the number of electronic components required, our system should become affordable and scalable. This will help accelerate the adoption of a new generation of robots in the marketplace."

To teach the robot how to recognise pain and learn damaging stimuli, the research team fashioned memtransistors, which are

> **THROUGH LAB EXPERIMENTS, THE TEAM DEMONSTRATED HOW THE ROBOT WAS ABLE TO LEARN TO RESPOND TO INJURY IN REAL TIME.**

'brain-like' electronic devices capable of memory and information processing, as artificial pain receptors and synapses. Through lab experiments, the team demonstrated how the robot was able to learn to respond to injury in real time. They also showed that the robot continued to respond to pressure even after damage, proving the robustness of the system.

When 'injured' with a cut from a sharp object, the robot quickly loses mechanical function. But the molecules in the self-healing ion gel begin to interact, causing the robot to 'stitch' its 'wound' together and to restore its function while maintaining high responsiveness.

"The self-healing properties of these novel devices help the robotic system to repeatedly stitch itself together when injured with a cut or scratch, even at room temperature," said Rohit Abraham John, first author of the study. "This mimics how our biological system works, much like the way human skin heals on its own after a cut.

"In our tests, our robot can 'survive' and respond to unintentional mechanical damage arising from minor injuries such as scratches and bumps, while continuing to work effectively. If such a system were used with robots in real-world settings, it could contribute to savings in maintenance."

Associate Professor Nripan Mathews, co-lead author of the study, concluded, "Conventional robots carry out tasks in a structured programmable manner, but ours can perceive their environment, learning and adapting behaviour accordingly. Most researchers focus on making more and more sensitive sensors, but do not focus on the challenges of how they can make decisions effectively. Such research is necessary for the next generation of robots to interact effectively with humans.

"In this work, our team has taken an approach that is off the beaten path, by applying new learning materials, devices and fabrication methods for robots to mimic the human neurobiological functions. While still at a prototype stage, our findings have laid down important frameworks for the field, pointing the way forward for researchers to tackle these challenges."

The research team is now looking to collaborate with industry partners and government research labs to enhance their system for larger scale applications.

new PRODUCTS

MICROPOWER MANAGEMENT UNITS

Analog Devices ADP1032 Micropower Management Units (PMUs) are high-performance, isolated devices that combine an isolated flyback and a DC-to-DC regulator providing two isolated power rails. Additionally, they contain four high-speed serial peripheral interface (SPI) isolation channels and three general-purpose isolators for channel-to-channel applications where low power dissipation and small solution size are required.

Operating over an input voltage range of 4.5 to 60 V, the units generate isolated output voltages of 6 to 28 V (adjustable version) or 24 V (fixed version) for V_{OUT1}. They also have factory-programmable voltages of 5.15, 5 or 3.3 V for V_{OUT2}.

By default, the ADP1032 flyback regulator operates at a 250 kHz switching frequency and the buck regulator operates at 125 kHz. The two regulators are phase-shifted relative to each other to reduce electromagnetic interference (EMI) and can be driven by an external oscillator in the range of 350 to 750 kHz to ease noise filtering in sensitive applications. The digital isolators integrated into the ADP1032 use Analog Devices' iCoupler chip-scale transformer technology, optimised for low-power and low-radiated emissions.
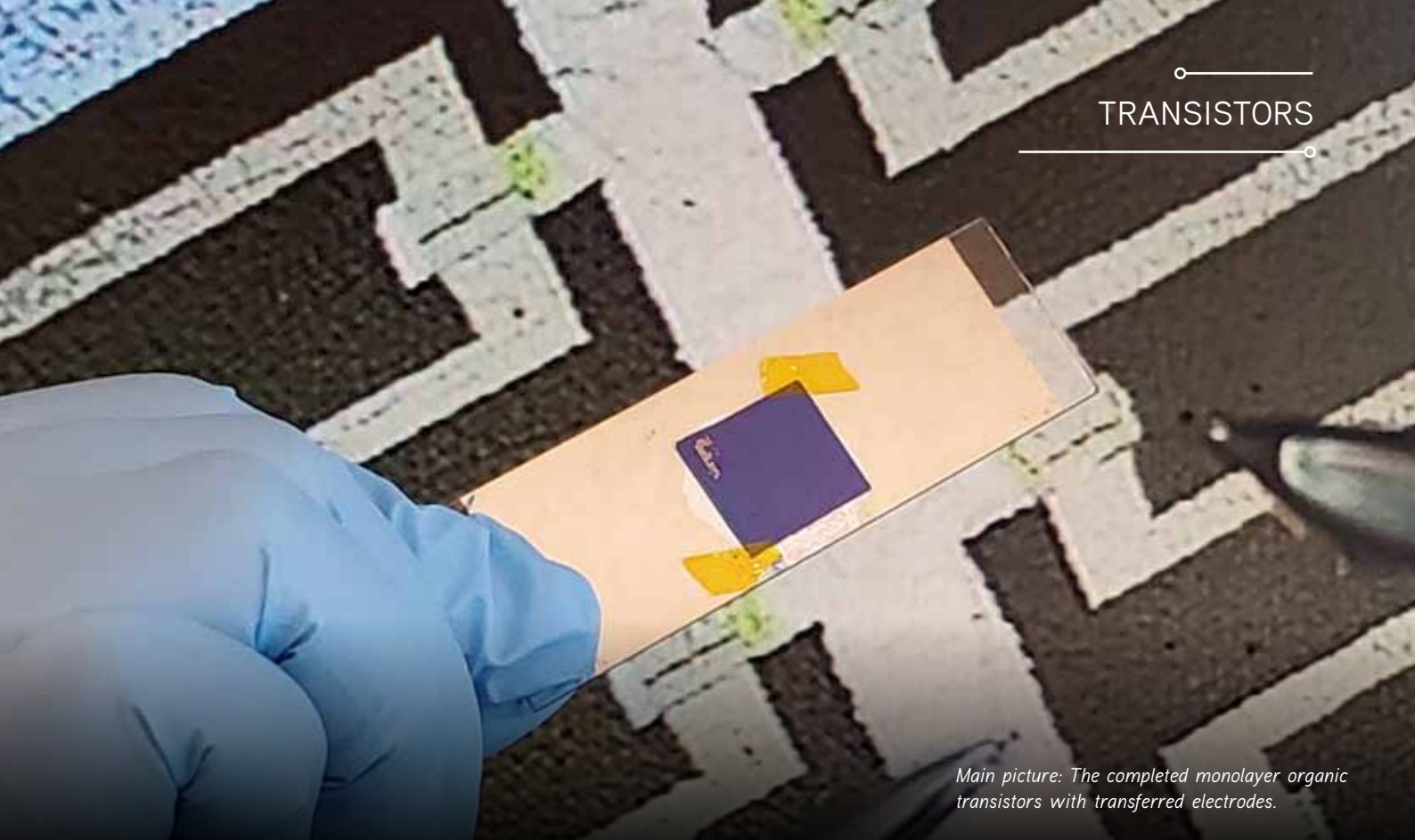
The PMU is available in a 9 x 7 mm, 41-lead LFCSP and is rated for a -40 to +125℃ operating junction temperature range.

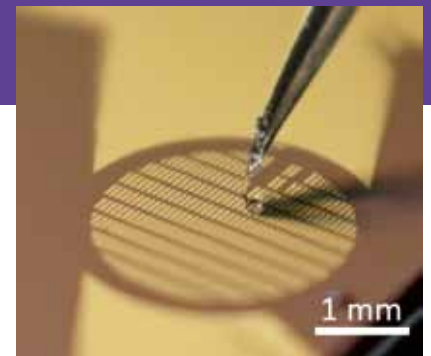**Mouser Electronics**
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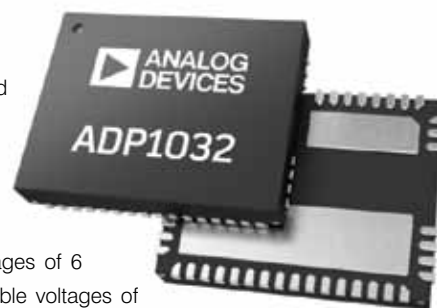
Main picture: The completed monolayer organic transistors with transferred electrodes.

ORGANIC FIELD-EFFECT TRANSISTORS
SUCCESSFULLY MINIATURISED

Below: The team used the high surface energy of the ultraflat monolayer surface to 'adhere' the metal electrode without using any interfacial layer, like a sticker.

Engineers from The University of Hong Kong (HKU) have developed a monolayer organic semiconductor layer for organic field-effect transistors (OFETs), enabling the transistors to be reduced in size without downgrading their performance. Their work has been described in the journal *Advanced Materials*.

1 mm

Field-effect transistors (FET) are the core building blocks of modern electronics such as integrated circuits, computer CPUs and display backplanes. Organic field-effect transistors, which use an organic semiconductor as a channel for current flows, have the advantage of being flexible when compared with their inorganic counterparts like silicon. Other benefits include high sensitivity, biocompatibility, property tunability and low-cost fabrication, giving OFETs great potential in areas such as wearable electronics, conformal health monitoring sensors, bendable displays etc. Potential applications include TV screens that can be rolled up; smart wearable electronic devices and clothing worn close to the body to collect vital body signals for instant biofeedback; and mini-robots made of harmless organic materials working inside the body for diseases diagnosis, mini-surgeries and other treatments.

Until now, the main limitation on enhanced performance and mass production of OFETs has been the difficulty in miniaturising them, as the performance of the transistor will drop significantly with a reduction in size. If the contact resistance of an OFET is large, the transistor channel is patterned to be shorter, and most of the applied voltage will be dissipated in the contact rather than the channel. The OFET properties will then be dominated by two contacts and behave like two back-to-back connected diodes rather than a proper functioning transistor.

Now HKU engineers led by Dr Paddy Chan have developed staggered structure monolayer OFETs, which have apparently demonstrated a record-low normalised contact resistance of 40 Ω·cm. Compared with conventional devices with a contact resistance of 1000 Ω·cm, the device can save 96% of power dissipation at contact when running the device at the same current level. Apart from energy saving, the excessive heat generated in the system — a common problem which causes semiconductors to fail — can be greatly reduced.
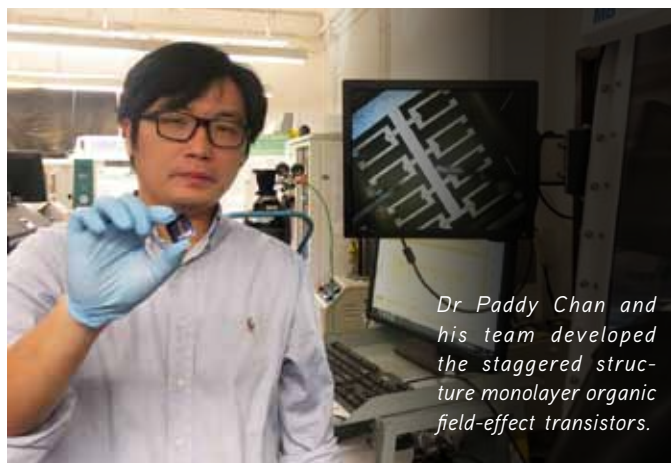
Dr Paddy Chan and his team developed the staggered structure monolayer organic field-effect transistors.

"We can further reduce the dimensions of OFETs and push them to a sub-micrometre scale, a level compatible with their inorganic counterparts, while [they] can still function effectively to exhibit their unique organic properties," Dr Chan said. "This is critical for meeting the requirement for commercialisation of related research.

"If flexible OFETs work, many traditional rigid-based electronics such as display panels, computers and cell phones would transform to become flexible and foldable. These future devices would be much lighter in weight, and with low production cost.

"Moreover, given their organic nature, they are more likely to be biocompatible for advanced medical applications such as sensors in tracking brain activities or neural spike sensing, and in precision diagnosis of brain-related illness such as epilepsy."

With a US patent having been filed for the innovation, Dr Chan's team is now working with researchers at HKU and the City University of Hong Kong (CityU) to integrate the miniaturised OFETs into a flexible circuit onto a polymer microprobe for neural spike detection in a mouse brain under different external stimulations. They also plan to integrate the OFETs onto surgical tools such as catheter tubes, and then use it to locate abnormal activity in animal brains.

"Our OFETs provide a much better signal-to-noise ratio," Dr Chan said. "Therefore, we expect we can pick up some weak signals which cannot be detected before using the conventional bare electrode for sensing.

"We believe that the ... OFETs are now ready for applications in large-area display backplanes and surgical tools."

MULTIFUNCTION PRINTERS

Epson has launched two SureColor T-Series wireless multifunction printers with integrated scanners — the 24″ SureColor T3160M and the 36″ SureColor T5160M. Both printers include an integrated scanner for scanning blueprints and drawings, making large copies and sharing high-quality technical documents.

Featuring a sleek design and compact footprint, the printers conveniently fit into modern work-from-home and small office environments, allowing for seamless team collaboration across CAD, architecture, engineering and corporate graphics workflows. They also support copy enlargements and reductions, as well as enhanced tracing and offer highlight detection for scanning annotated blueprints.

With integrated wireless and Wi-Fi Direct connectivity, professionals can easily print from virtually anywhere in the home or office with a smart device or from a USB thumb drive; with their enterprise security features and protocol support, users can also print and scan directly to email, network folder or USB drive. This makes for easy document sharing with team members, including remote and onsite departments, vendors and clients. Featuring an industrial-grade Epson PrecisionCore MicroTFP printhead for ultrafast print speeds, the T3160M and T5160M produce A1 prints in as fast as 34 and 31 s, respectively.

The multifunction printers leverage UltraChrome XD2 pigment ink technology for striking colour, crisp lines and smudge- and water-resistant prints. Supporting a variety of media — including rolls and sheets — the printers deliver detailed output on a wide range of media types. They are designed to help industry professionals create stunning CAD, GIS, architectural or engineering technical drawings.

Epson Australia Pty Ltd
www.epson.com.au

what's next

Record broken for world's largest swarm of drones

A 10-minute drone show held in Saint Petersburg, Russia, in September has broken the world record for the world's largest flying swarm of drones, with 2198 miniature unmanned aerial vehicles (UAVs) simultaneously launched into the night sky and at one point forming a flying dove with a wingspan of 600 m, which was visible from 3 km away.

Geoscan, which built and programmed the drones, has been producing drone displays for the past two years, starting with just 40 drones flying at once. The company's Salute drones, which are just 10 cm across, were designed exclusively for use in group flights and drone shows. Geoscan implemented u-blox positioning technology in the drones due to a combination of accuracy, reliability, performance and ability to access positional data from both the GLONASS and GPS satellite navigation constellations.

u-blox's NEO-M8P high-precision GNSS modules provide the drones with the positioning data necessary to ensure that they can be placed in the sky with a high degree of accuracy. This makes them less likely to collide with each other and enables them to be moved more quickly and efficiently. The end result is a more fluid drone show, in which the improved positional accuracy of each drone contributes to a better overall display and contiguous figure forms. The drones can also return to their base stations automatically at the end of a show.

The GNSS module used in the Salute drones implements a real-time kinematic (RTK) approach that improves positional accuracy by comparing the phase of a signal being broadcast from a positioning satellite with that of the same signal that has been received and rebroadcast from a fixed base station. The accuracy gained in this way enables drones to calculate their relative positions to within millimetres, and their absolute positions to within 1 cm of the intended position.

"The u-blox modules in our Geoscan Salute drones have improved our drones' positioning accuracies to about 1 cm, and have helped reduce pre-launch preparation time," said Semen Lapko, Head of Drone Show Project, Geoscan. "Drones now move more quickly and accurately, while also operating more efficiently."

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

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IT'S A HOLE IN ONE!

LARGE APERTURE BACKLASH FREE STEPPER DRIVES

Faulhaber has found the optimum speed-torque balance for a flat and low weight DM66200H Hollow shaft Stepper Motor.

This new drive solution is suitable for applications that require large aperture direct drive and low maintenance continuous operation.

Examples include:

- Precision optics
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- Impellers
- Prosthetics
- Robotics and many more

The tried-and-tested stepper motor technology is energy efficient and requires neither a brake nor an encoder for open loop control.

Key Features:

- 2 Phase permanent magnet stepper
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- Simple integration with variants for mounting flanges and/or cables
- Other customisations available

If you have a motor application that might suit this drive, please contact our knowledgeable staff to discuss.

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