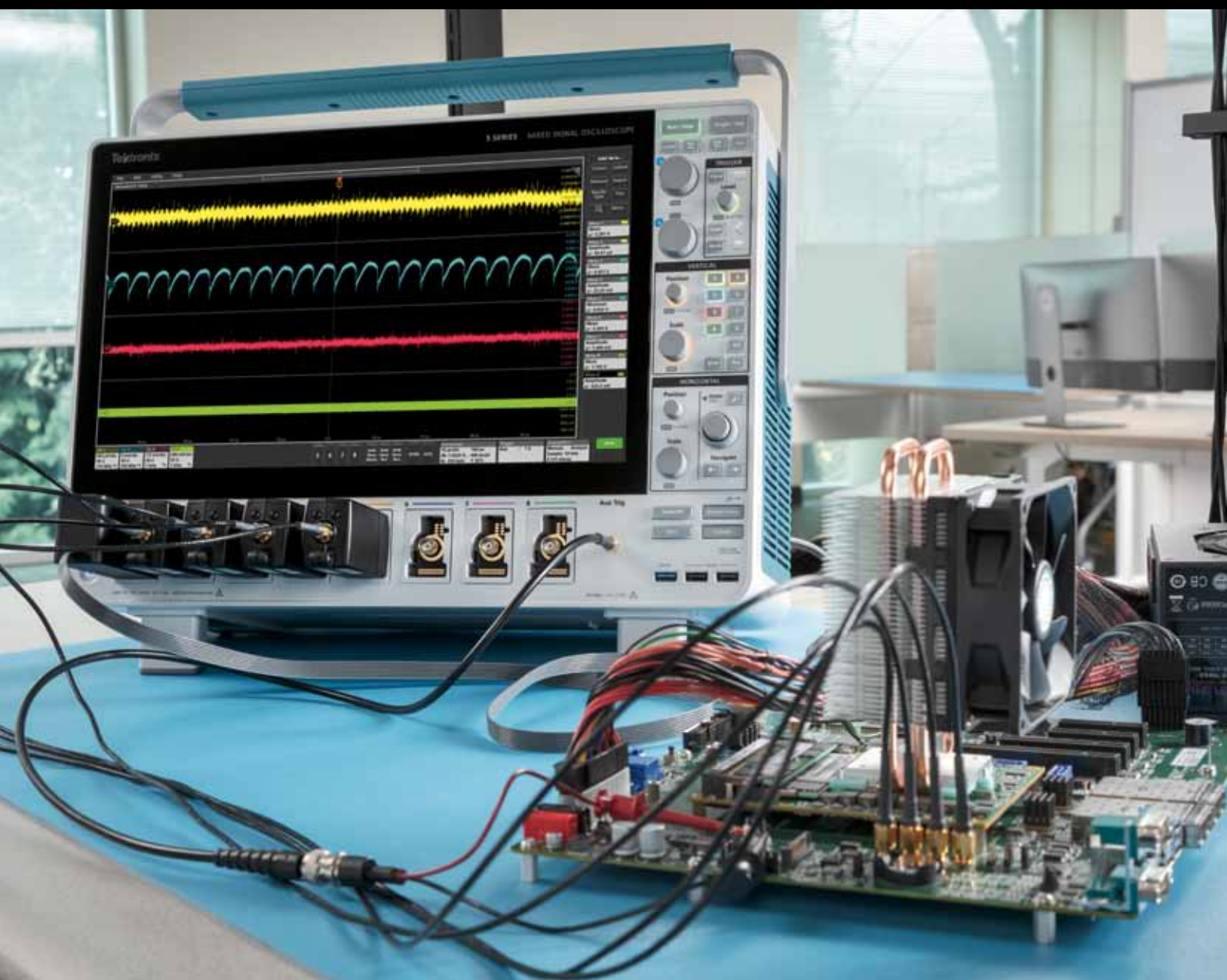




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Built on the performance and integrity that engineers rely on, the new 5 Series B MSO includes customer-centric updates led by an auxiliary trigger input that lets users synchronise the oscilloscope to an external signal, without consuming any of the full-capability input channels.

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The B version updates the original 5 Series MSO, which excited engineers with its big display and state-of-the-art intuitive touchscreen user interface. It offers advanced measurements that teams can use almost anywhere with TekDrive and TekScope.

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CONSIDERATIONS WHEN SPECIFYING ENCLOSURES FOR INDUSTRY 4.0 APPLICATIONS

Pat Cookson

Industry 4.0 — the deployment of distributed automation and data exchange in manufacturing technologies — is based around the Internet of Things (IoT) and cloud computing to create the ‘smart factory’, where physical machines are monitored and controlled in pseudo real time and autonomous decentralised decision-making manages the process.

The move to complex distributed computing brings with it some high-level technical issues: IT security, greatly aggravated by the inherent need to open up previously closed production systems; the need for high levels of IT system reliability; the repeatable low system latency requirements and stability needed for critical machine-to-machine communication; and the need to maintain the integrity of production processes. The distributed mini-systems will often have embedded IP capability, Wi-Fi and Bluetooth connectivity, processing and communicating information from their attached sensors and controls throughout the IoT rather than raw signals going back to a central control room.

In addition to these macro level concerns, at the micro level the widespread distribution of electronic modules and subsystems in the factory environment requires considerable thought to be given to the selection of the housing for the electronics. Given



that the selected enclosure must provide a secure and physically robust environment for the electronics, there are several criteria to consider when choosing the optimum product design.

A standard or application-specific design?

Selecting a standard enclosure from one of the many suppliers has some obvious benefits: there are no upfront non-recurrent design, engineering and tooling charges;

products are on the shelf ready for immediate delivery, so time to market is low; the unit costs are attractive; and the design will have been field proven in many different applications. Compared with an application-specific custom enclosure, designed specifically for the project, standard products are immediately available and, certainly in volumes up to the low thousands, are extremely cost-effective.

However, any standard enclosure will need modifying to meet the requirements of



a specific application, requiring machining with suitable apertures to accept switches, displays, I/O connectors and other components. They will also need to be printed with legends and logos. The best option is for the original manufacturer to provide a modified enclosure configured to the specific requirements of the equipment. It is certainly of great benefit to involve the standard enclosure manufacturer as early as possible in the development cycle. There is no need to over-order to allow for set-

up and wastage quantities if the standard enclosure is purchased and the modifications outsourced to one or more suppliers.

Physical protection

Small enclosures are usually made from die-cast or extruded aluminium or are moulded from flame-retardant or standard ABS or polycarbonate. As all materials have specific properties in terms of impact resistance, resistance to chemicals, resistance to abrasion and so on, the choice of material

will to a certain extent be controlled by the location and expected environment.

Environmental protection

By definition, Industry 4.0 requires electronic modules and systems to be installed on the factory floor, close to the equipment that is being monitored and controlled. The question of the level of protection against the ingress of dust and water therefore becomes significant in the specification criteria, defined in EN 60529 as IPxx, where the first digit

ENCLOSURES

defines the protection against solid objects and the second the protection against water ingress. An enclosure for general-purpose use would typically be rated IP54, whereas one for use in hostile environments would need to perform to a minimum level of IP65, but nowadays IP67 is becoming the de facto minimum requirement.

In general, enclosure manufacturers use two main techniques to achieve the designed protection level. Satisfactory IP54 sealing is readily achieved by using a tongue and groove construction to the joint between the body of the enclosure and a removable panel or lid. No gaskets are used; the seal is achieved through the combination of a recess in the base section that mates to the corresponding mirror profile in the lid when the lid is screwed down. To achieve higher levels of sealing in metal, plastic and extruded small enclosures will require a gasket between the two mating halves. Normally a separate, preformed moulded gasket is sandwiched between the two mating surfaces. A metal enclosure can be painted if required without having to mask the gasket area; the gasket can be easily replaced if it is damaged.



EMC performance

In many applications EMC capability is of no interest, but in the potentially electrically noisy factory floor environment, it can be a consideration. Moulded enclosures have one specific weakness: by virtue of the intrinsic properties of the material itself, plastic, unlike metal, offers no inherent attenuation to the passage of electric or magnetic fields. If EM radiation emitted by the housed electronics or their susceptibility

to external fields is a potential problem, the lack of screening could be an issue.

Internal coatings in a variety of materials can be applied to the inner surfaces of a plastic enclosure to give different degrees of attenuation dependent on the project requirements. By offering different materials in a range of thicknesses, the most cost-effective and technically competent solution can be provided. Metal enclosures, providing they are manufactured in such a way that electrical continuity is present between the top, base and removable panels and that any painted or anodised finish is purely for external decorative purposes, will provide a level of EMC likely to be more than sufficient for the majority of applications.



Heat dissipation

With small low-power systems, heat dissipation is not usually an issue, but if systems are generating sufficient waste heat it can become a problem. As with EMC, metal and plastic enclosures have significantly different properties. Metal enclosures have greater ability to provide conduction and convection cooling because of their greater conductivity; indeed, some extruded enclosures are designed with increased surface area to improve cooling performance. All types of enclosure can be modified with arrays of holes to improve convection cooling if required.

Modifications

In order to make a standard enclosure suitable for a specific use, it will need to be modified. The purchaser has three main options.

1. Purchase standard products, either directly from the manufacturer or through distribution, and then modify them as required



in-house. However, many electronic OEMs may not have the plant, equipment, expertise or interest in undertaking machining and painting procedures in their own premises. If there is in-house capability, to modify the housing as a part of the overall assembly process could be the best way to proceed. However, more standard units than are actually required will have to be purchased to allow for set-up procedures and wastage.

2. Buy standard products and outsource the modification processes to external contractors. This will incur additional costs, time penalties and logistics complications associated with managing the process of subcontracting, often to multiple suppliers, potentially further increasing the costs as each process will require extra units to allow for first-offs and set-up wastage.

3. By far the best option is for the original manufacturer to provide a modified enclosure configured to the specific requirements of the project. With this option, there is no need to over-order to allow for set-up and wastage quantities. Hammond Electronics has a long-established network of international and national broadband catalogue and specialist distributors throughout Europe. The close working relationship between Hammond and the distribution partners means that factory modified enclosures can be sourced from the distributor or from Hammond direct.

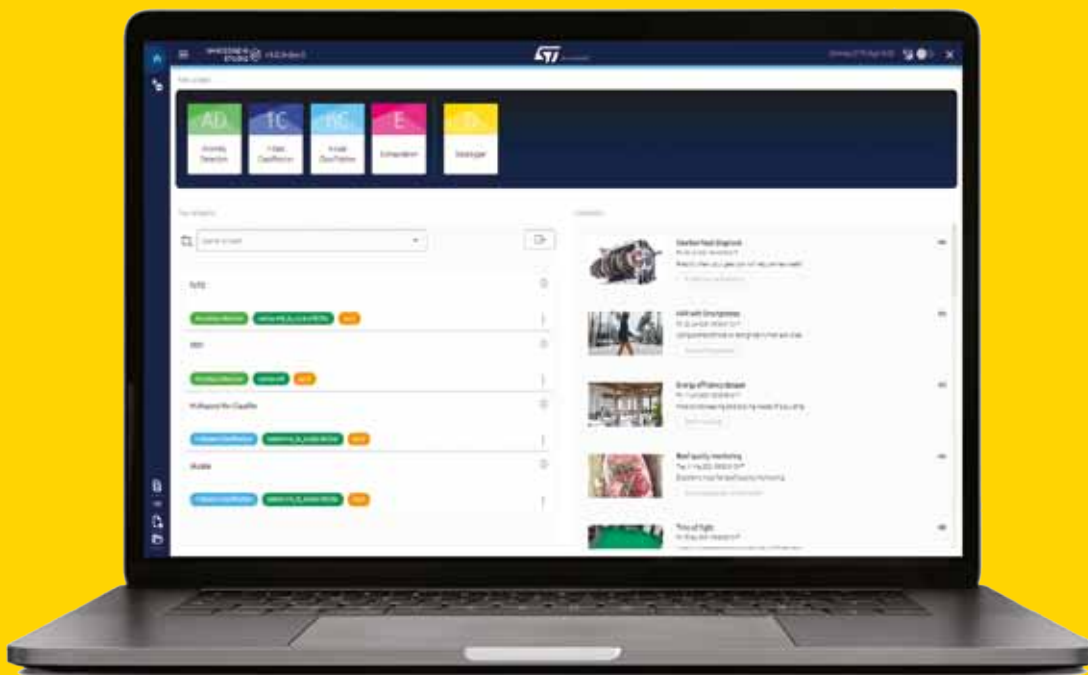
Enclosure manufacturers will typically be able to provide milling, drilling, punching, engraving, screen printing, painting and EMC coatings for their range of standard products. Manufacturers of moulded enclosures can normally also offer enclosures moulded in custom colours to meet any applicable identifying requirements or corporate branding needs.

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IMPROVING ENERGY STORAGE WITH BETTER SUPERCAPACITORS

Researchers from the University of Surrey's Advanced Technology Institute (ATI) and the University of São Paulo have developed a new analysis technique that should help scientists improve renewable energy storage by making better supercapacitors. Published in the journal *Electrochimica Acta*, the new approach enables researchers to investigate the complex interconnected behaviour of supercapacitor electrodes made from layers of different materials.

Improvements in energy storage are vital if countries are to deliver carbon reduction targets. The inherent unpredictability of energy from solar and wind means effective storage is required to ensure consistency in supply, and supercapacitors are seen as an important part of the solution. However, more supercapacitor development is needed to enable them to effectively store enough electricity.

In light of this, the research team used a cheap polymer material called polyaniline (PANI), which stores energy through a mechanism known as pseudocapacitance. PANI is conductive and can be used as the electrode in a supercapacitor device, storing charge by trapping ions.

To maximise energy storage, the researchers developed a novel method of depositing a thin layer of PANI onto a forest of conductive carbon nanotubes. This composite material makes an excellent supercapacitive electrode, but the fact that it is made up of different materials makes it difficult to separate and fully understand the complex processes which occur during charging and discharging.

To tackle this problem, the researchers adopted a technique known as the distribution of relaxation times. This analysis method allows scientists to examine complex electrode processes to separate and identify them, making it possible to optimise fabrication methods to maximise useful reactions and reduce reactions that damage the electrode. The technique can also be applied to researchers using different materials in supercapacitor and pseudocapacitor development.

"The future of global energy use will depend on consumers and industry generating, storing and using energy more efficiently, and supercapacitors will be one of the leading technologies for intermittent storage, energy harvesting and high-power delivery," said Ash Stott, lead scientist on the project from the University of Surrey. "Our work will help make that happen more effectively."

"Our work shows researchers how to accelerate the development of high-performance materials for use as energy storage elements, a key component of solar or wind energy systems," added ATI Director Professor Ravi Silva, principal author on the study.

USING NUCLEAR RADIATION TO TRANSMIT DIGITAL DATA WIRELESSLY

Radio waves and mobile phone signals typically rely on electromagnetic radiation for communication. Now engineers from Lancaster University in the UK, working with the Jožef Stefan Institute in Slovenia, have transferred digitally encoded information using nuclear radiation instead.

The researchers measured the spontaneous emission of fast neutrons from californium-252, a radioactive isotope produced in nuclear reactors. Modulated emissions were measured using a detector and recorded on a laptop.

Several examples of information, ie, a word, the alphabet and a random number selected blindly, were encoded serially into the modulation of the neutron field and the output decoded on a laptop, which recovered the encoded information on-screen. A double-blind test was performed in which a number derived from a random number generator was encoded without prior knowledge of those uploading it, and then transmitted and decoded. All transmission tests attempted proved to be 100% successful.



"We demonstrate the potential of fast neutron radiation as a medium for wireless communications for applications where conventional electromagnetic transmission is either not feasible or is inherently limited," said Professor Malcolm Joyce of Lancaster University. He explained that fast neutrons have an advantage over conventional electromagnetic waves, which are significantly weakened by transmission through materials including metals.

"In some safety-critical scenarios, such as concerning the integrity of reactor containments, and metal vaults and bulkheads in maritime structures, it can be important to minimise the number of penetrations made through such metal structures for communications cabling," Prof Joyce said.

"The use of neutrons for information transmission through such structures could negate the need for such penetrations and is perhaps also relevant to scenarios where limited transmissions are desirable in difficult circumstances, such as for emergency rescue operations."

Fast neutrons could also be incorporated into a mixed-signal, electronic system to achieve signal-mixing between electrons and neutrons. This could contribute to the requirement to ensure the integrity of information transfer.

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SIMULTANEOUS COATING AND DRYING IN ELECTRODE PRODUCTION

Researchers at Germany's Karlsruhe Institute of Technology (KIT) have developed an innovative concept for simultaneous coating and drying of two-layered electrodes. Drying times can be reduced to less than 20 seconds, which corresponds to half down to one-third of the usual production time, without capacity losses. Lithium-ion batteries can thus be produced more rapidly and at lower cost.

In lithium-ion batteries, electrode layers are of decisive importance, as these active materials store the energy. However, coating and subsequent drying of electrodes cause most of the battery production costs. A big cost reduction potential lies in process engineering. Researchers from KIT's Thin Film Technology (TFT) group, headed by Professor Wilhelm Schabel and Dr Philip Scharfer, have already succeeded in considerably increasing coating speed and developed an innovative drying process.

"Our work shows that in principle, we manage all process steps needed to produce batteries more rapidly and, hence, at lower cost in future without affecting quality," Prof Schabel said.

At usual electrode drying times of up to one minute and production speeds of 100 m/min and more, long drying lines are needed. In case of electrodes with a high coating weight, this is hardly feasible and very expensive. The new concept is based on the idea of using different active materials for the layers and applying them simultaneously. One layer is responsible for adhesion and another for specific capacity. This layer structure enables manufacture at a very high drying rate, so drying times are shortened to one-third.

In spite of the reduced drying time, no capacity losses occur and the range of the battery remains the same. The scientists also applied different active materials over the thickness of the anode, as a result of which different properties were distributed specifically in the electrode layers. In this way, electrodes can be customised and have better mechanical and electrochemical properties.

"Our research demonstrates that it may be possible in principle to increase battery production speed by 200–300%," Prof Schabel said.

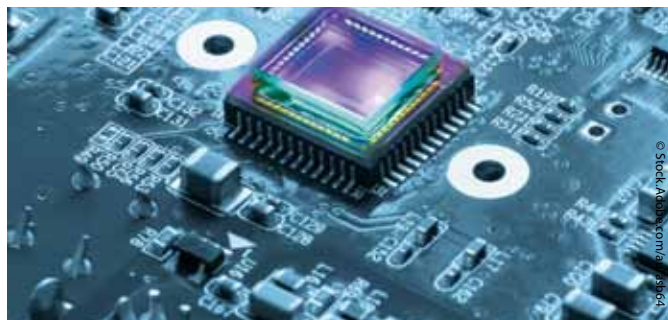
At the moment, the group is working on ways to transfer the simultaneous concept to the industrial scale. For this purpose, it tests purely convective drying with high-performance nozzles and laser drying modules. The results are also being transferred to other materials and used to optimise electrodes of sodium-ion batteries within Germany's Post Lithium Storage Cluster of Excellence (POLiS).

LIGHT SENSORS OPTIMISED FOR THE IoT ERA

Scientists from Incheon National University have developed a compact and robust optical sensor that can convert light to digital signals, making it ideal for deployment in the so-called 'trillion-sensor era' of the Internet of Things (IoT). Their research has been published in the journal *Small*.

An important part of the IoT economy is the presence of light/photo sensors, which are tiny semiconductor-based electronic components that detect light and convert it to electrical signals. Light sensors can be found everywhere around us, from household electronic gadgets and healthcare equipment to optical communication systems and automobiles.

Most light sensors used in cost-effective consumer products are energy efficient but are susceptible to noise (unwanted light information) in the external environment, which adversely affects their performance. To tackle this issue, products have been designed using light-to-frequency conversion circuits (LFCs), which show better signal-to-noise ratio. However, most LFCs are made of silicon-based photodetectors that can limit the range of light detection. Also, use of LFCs leads to chip area wastage, which becomes a problem when designing multifunctional electronic circuits for compact devices.



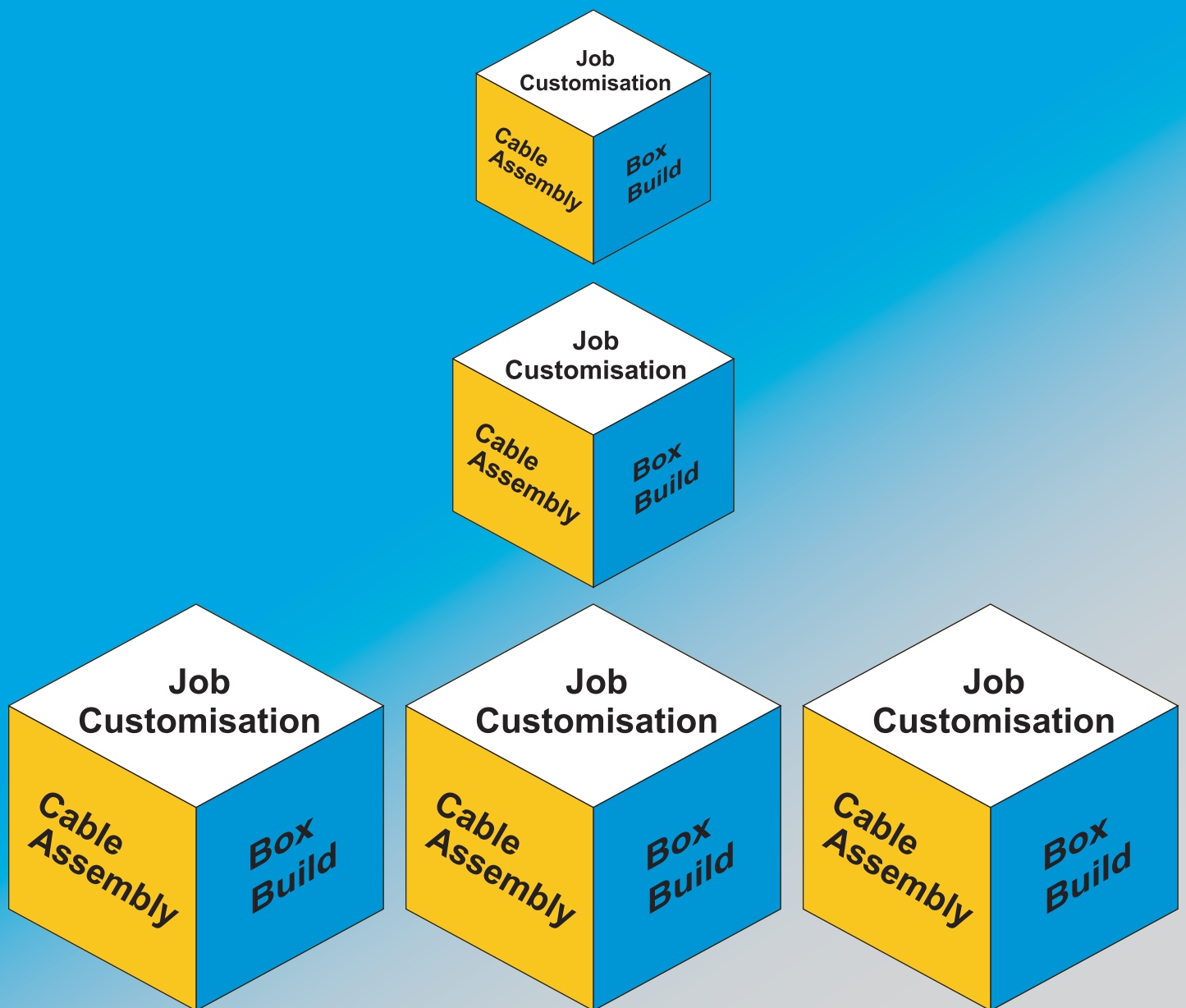
Led by Professor Sung Hun Jin, Incheon researchers demonstrated a highly efficient system of photodetectors that can overcome the limitations of conventional LFCs. They developed complementary photosensitive inverters with p-type single-walled carbon nanotubes (SWNT) and n-type amorphous indium-gallium-zinc-oxide (a-IGZO/SWNT) thin film transistors.

"Our photodetector applies a different approach with regard to the light-to-frequency conversion," Prof Jin said. "We have used components that are light dependent and not voltage dependent, unlike conventional LFCs."

The new design architecture allowed the team to design an LFC with high chip area efficiency and a compact form factor, making it suitable for use in flexible electronic devices. Experiments conducted using the photosensor system indicated excellent optical properties, including high tunability and responsiveness over a broad range of light. The LFC also showed possibility of large-area scalability and easy integration into state-of-the-art silicon wafer-based chips.

The LFC system could be used to build optical sensor systems that have high-level signal integrity, as well as excellent signal processing and transmitting abilities. These promising properties make it a strong contender for application in future IoT sensor scenarios, such as medical SpO₂ detection, auto-lighting in agriculture, or advanced displays for virtual and augmented reality.

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SIMULTANEOUS QUBIT OPERATION ON A QUANTUM CHIP

By simultaneously operating multiple spin qubits on the same quantum chip, researchers from the University of Copenhagen (UCPH) have overcome a key obstacle on the road to the supercomputer of the future. Their result, published in the journal *Physical Review X Quantum*, bodes well for the use of semiconductor materials as a platform for solid-state quantum computers.

One of the engineering headaches in the global marathon towards a large functional quantum computer is the control of many basic memory devices — qubits — simultaneously. This is because the control of one qubit is typically negatively affected by simultaneous control pulses applied to another qubit. UCPH quantum physicists Federico Fedele and Assistant Professor Anasua Chatterjee, collaborating with researchers from Purdue University, have now managed to overcome this obstacle with the use of semiconductor qubits, known as spin qubits.

“Broadly speaking, they consist of electron spins trapped in semiconducting nanostructures called quantum dots, such that individual spin states can be controlled and entangled with each other,” explained Fedele, formerly a PhD student and now a postdoc at UCPH.

The brain of the quantum computer that scientists are attempting to build will consist of many arrays of qubits, similar to the bits on smartphone microchips, that will make up the machine’s memory. While an ordinary bit can either store data in the state of a 1 or 0, a qubit can reside in both states simultaneously — known as quantum superposition — which makes quantum computing exponentially more powerful.

Spin qubits have the advantage of maintaining their quantum states for a long time. This potentially allows them to perform faster and more flawless computations than other platform types. They are also so minuscule that far more of them can be squeezed onto a chip than with other qubit approaches; the more qubits, the greater a computer’s processing power.

The UCPH team fabricated and operated four qubits in a 2x2 array on a single chip. The next step was getting them to communicate with each other, said Asst Prof Chatterjee.

“Now that we have some pretty good qubits, the name of the game is connecting them in circuits which can operate numerous qubits, while also being complex enough to be able to correct quantum calculation errors,” she said. “Thus far, research in spin

qubits has gotten to the point where circuits contain arrays of 2x2 or 3x3 qubits. The problem is that their qubits are only dealt with one at a time.”

It is here that the physicists’ quantum circuit, measuring no larger than the size of a bacterium, makes all the difference. The four spin qubits in the chip are made of the semiconducting material gallium arsenide. Situated between the four qubits is a larger quantum dot that connects the four qubits to each other, which the researchers can use to tune all of the qubits simultaneously.

“The new and truly significant thing about our chip is that we can simultaneously operate and measure all qubits,” said Asst Prof Chatterjee. “This has never been demonstrated before with spin qubits, nor with many other types of qubits.”

Being able to operate and measure simultaneously is essential for performing quantum calculations. Indeed, if you have to measure qubits at the end of a calculation — that is, stop the system to get a result — the fragile quantum states collapse. Thus, it is crucial that measurement is synchronous, so that the quantum states of all qubits are shut down simultaneously. If qubits are measured one by one, the slightest ambient noise can alter the quantum information in a system.

“To get more powerful quantum processors, we have to not only increase the number of qubits, but also the number of simultaneous operations, which is exactly what we did,” said Associate Professor Ferdinand Kuemmeth, who directed the research. The realisation of the new circuit thus marks a milestone on the long road to a semiconducting quantum computer.

At the moment, one of the main challenges is that the chip’s 48 control electrodes need to be tuned manually, and kept tuned continuously despite environmental drift, which is a tedious task for a human. That’s why the research team is now looking into how optimisation algorithms and machine learning could be used to automate tuning. The researchers have also begun working with industrial partners to fabricate the next generation of quantum chips, to allow fabrication of even larger qubit arrays.



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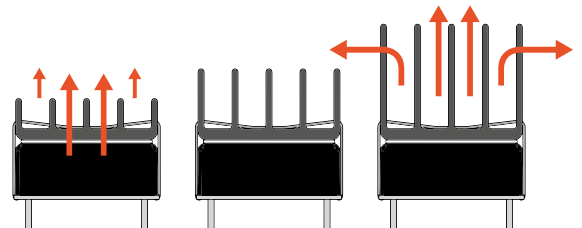


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ISO 26262 FUNCTIONAL SAFETY PACKAGES

Safety is a primary concern in automotive applications for ongoing operation and end users' wellbeing. Microchip Technology's certified functional safety packages enable engineers to develop their products as per the ISO 26262 functional safety standard. The release of ISO 26262 functional safety packages for the dsPIC33C digital signal controllers (DSCs) and PIC18 and AVR microcontrollers (MCUs) should accelerate the development of safety-critical designs targeting ASIL B and ASIL C safety level and certification efforts.

The complete functional safety ecosystem for dsPIC33C DSCs includes: AEC Q100 Grade 0-qualified functional safety ready dsPIC33C DSCs with dedicated hardware safety features; SGS TÜV Saar-certified ASIL B Ready Failure Modes, Effects and Diagnostic Analysis (FMEDA) report and Functional Safety Manual (FSM); TÜV Rheinland-certified functional safety diagnostic libraries for designs targeting up to ASIL C; a functional safety reference application, showing the steps required to develop compliant designs and the collateral that must be generated for (ASIL B or ASIL C) compliance; and various functional safety analysis reports and certification reports that help to ease compliance and certification.

The complete functional safety ecosystem for PIC18 and AVR MCUs includes: AEC Q100 Grade 1-qualified functional safety ready PIC18-Q84 MCUs with CAN FD and AVR DA MCUs with LIN interfaces, both with hardware support for capacitive touch sensors; SGS TÜV Saar-certified ASIL B Ready FMEDA report and FSM; functional safety diagnostic libraries; and ASIL B Ready certificates and certification reports to help ease compliance and certification.

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CABINET COOLERS

When hot weather causes the electronics inside a control cabinet to fail, the operator might choose to simply open the panel door and aim a fan at the circuit boards. The fan ends up blowing a lot of hot, humid, dirty air at the electronics

and the cooling effect is minimal. If the machinery starts functioning again, the likelihood of repeated failure is great since the environment is still hot and threatens permanent damage to the circuit boards. Worse yet, the open panel door is a safety violation that presents a shock hazard to personnel.

In order to stop electronic downtime, EXAIR has a complete line of cabinet coolers that are suitable for PLCs, line control cabinets, CCTV cameras, modular controls, etc. They are designed to mount in minutes through an ordinary electrical knockout and have no moving parts to wear out, eliminating maintenance concerns and making them virtually impervious to hostile environments. Wastewater treatment, chemical processing, food processing, paper manufacturing, steel mills and power generation are just a few of the facilities benefiting from this simple yet effective technology.

NEMA 12 (IP54) Cabinet Coolers are dust-tight and oil-tight. They are suited to general industrial environments where no liquids or corrosives are present.

NEMA 4 (IP66) Cabinet Coolers are dust-tight, oil-tight, splash-resistant and indoor/outdoor capable. They incorporate a low-pressure valve for the air exhaust, which closes and seals when not operating to maintain enclosure integrity.

NEMA 4X (IP66) Cabinet Coolers offer the same protection as NEMA 4 systems. They are available in 303SS and 316SS for food and chemical processing, pharmaceutical, foundries, heat treating and other corrosive environments.

High Temperature Cabinet Coolers for NEMA 12, 4 and 4X applications are suitable for ambient temperatures up to 93°C. They are suitable for mounting near ovens, furnaces and other hot locations.

Thermostat control to minimise compressed air use is available for all models. All EXAIR cabinet coolers are UL listed and CE compliant.

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MOSFETS

STMicroelectronics' super-junction MDmesh K6 series MOSFETs, part of the STPOWER family, are designed to enhance several key parameters to minimise system-power losses. They are especially suited to lighting applications based on flyback topology, such as LED drivers and HID lamps, as well as adapters and power supplies for flat-panel displays.

The 800 V series combines high performance with ease of use, allowing compact designs that feature high power density and efficiency. In addition, the K6 series has a reduced threshold voltage compared with the previous MDmesh K5 generation, enabling a lower driving voltage and thus reducing power losses and gaining efficiency mainly for zero-watt standby applications. The total gate charge (Qg) is also low, permitting high switching speeds and low losses.

An integrated ESD protection diode increases the overall ruggedness of the MOSFET up to Human Body Model (HBM) Class 2.

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Silicon Labs has released its EFR32FG23 Flex Gecko wireless system-on-chips (SoCs) — sub-GHz wireless solutions that combine long-range RF and energy efficiency with PSA



Certified Level 3 security to meet the demand for secure, high-performance, battery-powered IoT products. The SoCs are designed to expand range and power efficiency for multiprotocol sub-GHz connectivity for a wide range of Industrial Internet of Things (IIoT), smart city, and building and home automation applications.

Featuring an integrated power amplifier and good receive sensitivity, the SoCs deliver a range of >1.6 km and 10-plus-year battery performance with fast wake-up times. Together with optimised ultralow transmit and receive radio power (13.2 mA TX at 10 dBm 868 MHz, 3.7 mA RX at 868 MHz) and good RF (up to +20 dBm output power and -125.3 dBm RX at 868 MHz, 2.4 Kbps GFSK), the single-die, multi-core solution is suitable for battery-powered field area network nodes, wireless sensors and connected devices in remote locations.

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GRAPHICAL PANEL METER

Red Lion's PM-50 panel meter is available with a 3.5" or 4.3" graphical touchscreen display. Using simple 'swipe' technology, users can easily switch between relevant screens and

receive comprehensive operational data for monitoring equipment and production. Visual alerts notify the user that immediate action is necessary, either on the unit itself or via PM-50 app, available on Google Play or Apple Store.

The product offers built-in Wi-Fi connectivity for users to remotely access critical workflow and process data from the confines of the plant floor. Wired connectivity is also an option via Ethernet and Modbus.

Easy to install, program and expand, the product can replace a meter with a 1/8 or 1/16 DIN panel cut out. An on-device programming wizard, mobile app or web browser provides an easy and intuitive set-up. Additional capability is available with field-installable modules to provide outputs, communications and AC power functionality when needed.

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Optimized Linux® Graphics Development

A Free, Open-Source Linux GUI Toolkit Optimized for Microchip MPUs

Ensemble Graphics Toolkit (EGT) is a free, open-source C++ GUI development toolkit optimized to provide a high-performance user experience with Microchip microprocessors. EGT is a complete application-level graphics solution integrated with Microchip's extensive mainline Linux ecosystem to help designers of industrial, medical, consumer and automotive displays reduce development cost and time to market.

Designed and developed by Microchip, we are the source for expertise, service and support of the entire graphics stack and hardware. EGT offers modern graphical application development with a reduced BOM cost and power budget.

Highlights

- Zero-cost Linux graphical framework fully supported by Microchip
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- Import assets from industry-standard graphical design tools
- Enables multimedia playback on all Microchip MPUs
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- Optimized small memory footprint saves BOM cost and power
- Boot-time optimization under 3 seconds from a cold reset

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HIGH-PERFORMANCE BOX PC

IBASE's MAF800 is an industrial-grade embedded system that is suitable for use in machine vision and factory automation facilities to automate shop floor processes and defect inspection based on deep learning with automated optical inspection (AOI) or vision-guided robotics (VGR).

The base model has a compact and fanless design with a high-performance 8th Gen Intel Core i7-8700 processor and extensive connectivity with three GigE LAN ports and six USB 3.0 ports for easy integration in multi-camera machine vision applications. This includes locating and aligning parts for assembly with more speed and accuracy than manual positioning, the company says.

The product features a 9–36 V wide-range DC input and a second power input connector for the optional adaptor supporting a graphics card or a PoE card. It has an operating temperature range from -10 to +50°C, two SATA 3.0, a DVI-D and a VGA display interface, and 16 GB DDR4 system memory. It runs on both Windows 10 and Linux Ubuntu operating systems. Other configurations of the modular series include the MAF800-E, MAF800-2E and MAF800-L2E.

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



IC MODULES

Designers can now extend battery life and reduce size in space-constrained Internet of Things (IoT) devices with two IC modules with built-in inductors from Analog Devices. Both products are part of the company's Essential Analog family of efficient power ICs.

The MAXM38643 1.8 to 5.5 V input, 330 nA quiescent current (I_Q), 600 mA buck module and the MAXM17225 0.4 to 5.5 V input, 300 nA I_Q , 1A boost module with True Shutdown are claimed to feature the lowest I_Q compared to competitive solutions and to deliver more battery life. By integrating a preselected inductor, the micro system-level IC (uSLIC) modules are said to accelerate time to market and to be up to 37% smaller in size compared to a standalone IC plus external inductor. Applications include space-constrained consumer products, wearables, medical drug delivery, sensors and IoT devices, as well as wired, wireless and industrial products.

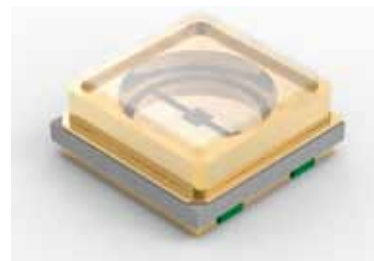


Battery-powered IoT devices require low I_Q in system standby mode to deliver long battery life. Further, ultralow shutdown current (0.5 nA on MAXM17225 and 1 nA on MAXM38643) allows systems to consume virtually no system power during shutdown mode. The MAXM38643 and MAXM17225 consume an order of magnitude less quiescent current (one-10th and one-20th, respectively) than competitive solutions with similar output currents. In addition, they have peak efficiencies of 96% and 95% respectively. As a

result, the modules consume less power to deliver longer life and reduced carbon footprint for both battery-operated and wired always-on devices.

The products utilise Analog Devices' uSLIC power module technology featuring stacked, integrated inductors that enable designers to reduce solution PCB surface area and eliminate the time spent on component selection and board placement. The modules can also increase functionality for many sensors, radio and digital circuits in consumer, medical and industrial applications which require low I_Q and high output current.

Analog Devices Pty Ltd
www.analog.com



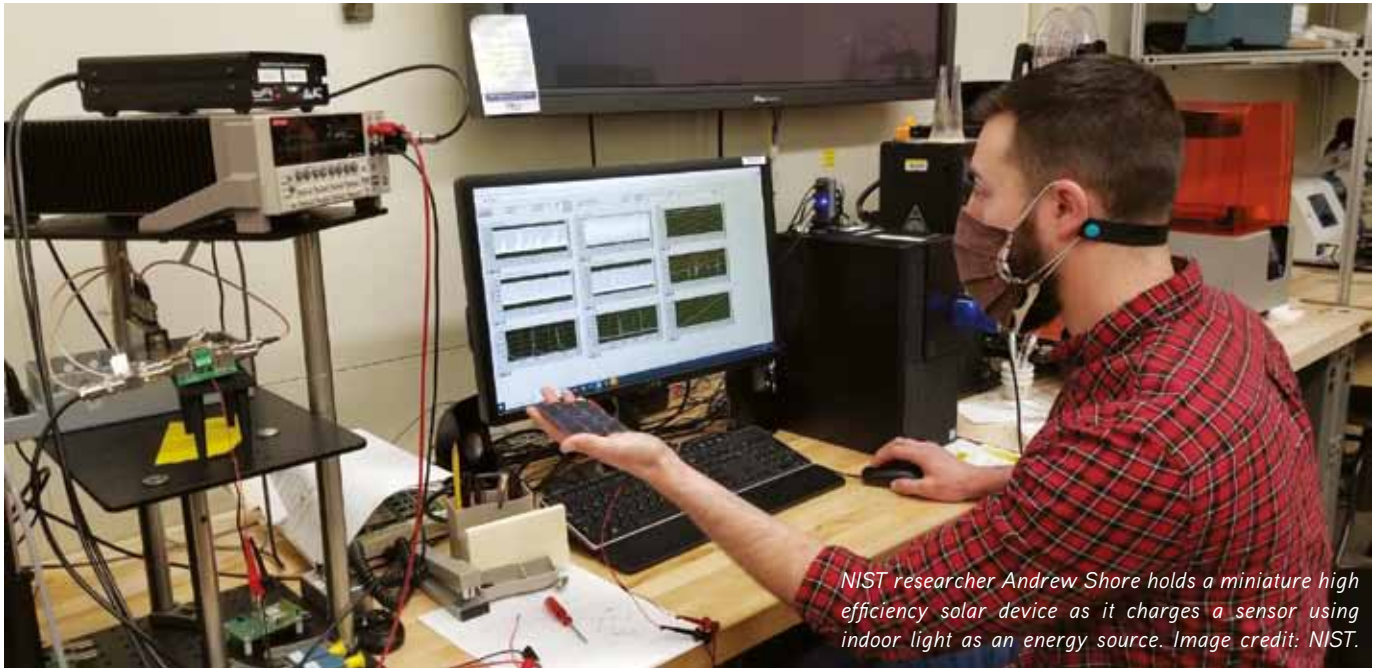
UV-C LEDs

Würth Elektronik offers UV LEDs with emission wavelength of 275 nm (UV-C), which kills germs by destroying the RNA structure of viruses and bacteria. The LEDs are thus suitable for disinfection in areas where chemical components are not suitable for use; this may include germicide cleaning of different surfaces, or air and water disinfection.

The LEDs feature compact size, low driving voltage, short switching time and robustness. They are built to maximise efficiency output with optimal light extraction, due to the use of highly transparent quartz glass. Low thermal resistance ceramic substrate is used to reduce heating effects in the chip and increase lifetime, while gold plating is used for optimal soldering and contact surfaces.

Application areas include medical hygiene, water and air purification, food and surface sterilisation, and more.

Würth Electronics Australia Pty
www.we-online.com



NIST researcher Andrew Shore holds a miniature high efficiency solar device as it charges a sensor using indoor light as an energy source. Image credit: NIST.

BRINGING PV MODULES INDOORS TO POWER IoT DEVICES

We usually think of photovoltaic (PV) cells fixed to roofs, converting sunlight into electricity — but bringing that technology indoors could further boost the energy efficiency of buildings and energise Internet of Things (IoT) devices such as smoke alarms, cameras and temperature sensors.

A new study from the US National Institute of Standards and Technology (NIST), published in the journal *Energy Science & Engineering*, now suggests that a straightforward approach for capturing light indoors may be within reach.

“People in the field have assumed it’s possible to power IoT devices with PV modules in the long term, but we haven’t really seen the data to support that before now,” said NIST mechanical engineer Andrew Shore, lead author of the new study.

Most buildings are lit by a mix of both the sun and artificial light sources during the day. At dusk, the latter could continue to supply energy to devices. However, light from common indoor sources, such as LEDs, spans a narrower spectrum of light than the wider bands emitted by the sun, and some solar cell materials are better at capturing these wavelengths than others.

To test the indoor charging ability of different materials, Shore and his colleagues used PV mini modules made of gallium indium phosphide (GaInP), gallium arsenide (GaAs) and silicon. GaInP and

GaAs are geared towards white LED light, while silicon is a less efficient but more affordable and commonplace material.

The researchers placed the centimetres-wide modules underneath a white LED, housed inside an opaque black box to block out external light sources. The LED produced light at a fixed intensity of 1000 lux — comparable to light levels in a well-lit room — for the duration of the experiments. For the silicon and GaAs PV modules, soaking in indoor light proved less efficient than sunshine, but the GaInP module performed far better under the LED than sunlight.

Both the GaInP and GaAs modules significantly outpaced silicon indoors, converting 23.1% and 14.1% of the LED light into electrical power, respectively, compared with silicon’s 9.3% power conversion efficiency. The rankings were the same for a charging test in which the researchers timed how long it took the modules to fill a half-charged 4.18 V battery, with silicon coming in last by a margin of more than a day and a half.



The NIST researchers tested miniature solar modules made of three different materials (left to right): silicon, gallium arsenide and gallium indium phosphide. Image credit: NIST.

The team was interested in learning if the silicon module, despite its poor performance relative to its competitors, could generate enough power to run a low-demand IoT device: a temperature sensor that they hooked up to the silicon PV module, placed once more under an LED. Upon turning the sensor on, the researchers found that it was able to feed temperature readings wirelessly to a computer nearby, powered by the silicon module alone. After two hours, they switched off the light in the black box and the sensor continued to run, its battery depleting at half the rate it took to charge.

"Even with a less efficient mini module, we found that we could still supply more power than the wireless sensor consumed," Shore said. This outcome indicates that the device could run continu-

ously while lights remain on, which would do away with the need for someone to manually exchange or recharge the battery.

The study findings thus suggest that an already ubiquitous material in outdoor PV modules could be repurposed for indoor devices with low-capacity batteries. The results are particularly applicable to commercial buildings where lights are on around the clock; the researchers are still yet to determine how well PV-powered devices would run in spaces that are only lit intermittently throughout the day, and how much of a factor ambient light from outside would be.

The team's next step is to set up light-measuring devices in NIST's Net-Zero Energy Residential Test Facility to gain an understanding of what light is available throughout the day in an average residence, Shore said. Then they'll replicate the lighting conditions of the net-zero house in the lab to find out how PV-powered IoT devices perform in a residential scenario. Feeding their data into computer models will also be important for predicting how much power PV modules would produce indoors given a certain level of light — a key capability for cost-effective implementation of the technology.

"We're turning on our lights all the time and as we move more toward computerised commercial buildings and homes, PV could be a way to harvest some of the wasted light energy and improve our energy efficiency," Shore said.

INVISIBLE PULSED LASER DIODE

ROHM's RLD90Q-ZW3 invisible pulsed laser diode is designed to realise a long detection distance and good sensing accuracy as a result of its narrow emission width.

The structure makes it possible to achieve high energy conversion efficiency and reduce wavelength fluctuations, contributing to low power consumption and long life.

The diode is suitable for laser range finders, automatic guided vehicles (AGVs) and security applications.

Fairmont Marketing
www.fairmontmarketing.com.au



ETHERCAT JUNCTION SLAVE MODULE

ICP DAS's ECAT-2515 EtherCAT junction slave modules are designed for realising flexible wiring by daisy chain and branch. The device can translate daisy-chain to branch topology, which should make the cabling easier than daisy-chain topology. It can also improve debugging efficiency.

If a slave device is not working or the cable is disconnected, the following slave devices on the same network all do not communicate with the master controller. With EtherCAT junction slaves, all slave devices can be wired as separated sections. If one slave device fails, only the slave devices in the same section will be influenced. The EtherCAT junction slave keeps the slave devices on another section to communicate with the master controller. Debugging can be made separately, thus improving the debugging efficiency.

The 1- to 5-port device comes in a compact size of 33 x 127 x 90 mm, has a plastic casing and supports DIN-rail mounting. The module is equipped to withstand harsh conditions as it has an operating temperature of -25 to +75°C with relative humidity of 10 to 90% RH, non-condensing. The device cannot be used as a standard Ethernet switch.

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



MULTI-CELL BATTERY FRONT END ICs

Renesas Electronics has introduced a family of multi-cell battery front end (BFE) ICs for battery management systems (BMS), built for the large, high-voltage battery packs that power e-scooters, energy storage, high-voltage power tools and other high-voltage equipment.

The ICs provide fast, flexible cell balancing up to 200 mA and over — a critical function to enable fast recharging and high utilisation in large battery packs with hot plug tolerance up to 62 V. They have been built with the high performance, flexibility and integration to help users simplify the design process and create robust battery systems.

Designed for higher-voltage mobility applications where larger cell count and temperature variance across cells are more likely to lead to cell-to-cell imbalances, the RAA489206 provides full high-side battery protection and monitoring for 4 to 16S cell battery packs. The RAA489204 provides improved daisy-chain operation with accelerated device-to-device communication and enhanced diagnostics compared with previous-generation devices, as well as internal cell balancing options and support for the higher voltages and cell count required by UPS systems, grid backup and other energy storage systems.

The ICs' high integration should simplify the design cycle and reduce system BOM costs, accelerating design and BOM selection time from months to weeks. The ICs also feature extensive built-in self-diagnostics, improving their safety functionality, reducing firmware workload and easing the design burden for meeting safety standards. Pin-to-pin compatibility with Renesas's previous BFE devices simplifies the design cycle even further, offering users a quick and seamless migration path.

Renesas Electronics

www.renesas.com



Simply scan the QR code
for more information.



Let's connect.

Weidmüller 

AdvancedLine Managed Switch Series

Network switches built tough

The AdvancedLine managed switch series from Weidmüller provides a robust, secure, and cost-effective solution for industrial network management. The AdvancedLine switches can increase network availability by means of ring redundancy and security control mechanisms; and offer a range of diagnostic options for sophisticated automation networks. Integration into common fieldbus protocols such as Modbus TCP, Ethernet/IP and Profinet can be readily achieved, and they can be easily and intuitively setup via a web interface. With versions for Fast Ethernet, Gigabit and PoE as well as port sizes between 5 and 24 ports and a large variety of SFP options for fibre interfaces offers a solution fit for all requirements. Its high operating temperature range also means the switches can be used in challenging environments such as production applications or in the field.

www.weidmuller.com.au

NANOTECHNOLOGY IS INSPIRING NEXT-GEN BATTERIES

Liam Critchley*

Rechargeable batteries are an important part of many modern-day technologies.

Researchers, manufacturers and end-user companies are always looking to improve the efficiencies of batteries, making them safer, smaller and more lightweight to fit in the requirements of new technologies — that is, the consumer desire to have higher-powered, smaller and more lightweight electronic devices. Conventional fabrication methods, electrochemistries and materials will take batteries technologies only so far, so a lot of interest in recent years has been around using nanomaterials within the electrodes.

Nothing is wrong with current battery technologies — as showcased by the 2019 Nobel Prize in Chemistry, which honoured the scientists behind the Li-ion battery — but change is inevitable. Without an ever-changing electronics industry, technological advances made in the past few decades would not have been possible.

While lithium-ion (Li-ion) batteries are ubiquitous nowadays, their efficiencies aren't overly impressive. They are much safer than other batteries while still having a good energy density, so there is room for improvement. Other types of batteries are gaining traction at both fundamental and commercial levels, but a drive to improve the already-established Li-ion batteries

by incorporating nanomaterials into them has begun.

Why nanomaterials?

The switch to trialling nanomaterials over bulkier materials is for many of the same reasons that other industries have made the switch (or have looked to make the switch). A number of properties can be harvested for a small amount of nanomaterials being included in a device (or within another material).

Not all nanomaterials are suitable for batteries, as some nanomaterials are inherently insulating in nature. Rather, it is the conductive nanomaterials that are of use in battery systems, such as those of solid-state nature, or those which are incredibly thin (for example, some 2D materials). Luckily, the use of nanomaterials in electrodes is not a completely new invention. It is merely a natural progression to make systems more effective without altering the internal workings of the technology. While the inclusion of nanomaterials might slightly alter the specific mechanisms of how the ions move into the electrodes (because of different-sized/geometry atomic holes) via different architectures, the general operational mechanism of the batteries remains

the same. This means that any safety or efficiency issues that arise can be pinpointed much easier than trying to develop a new type of battery from scratch. Sometimes, improving the status quo is better than trying to develop something completely novel.

Many of the nanomaterials trialled have high electrical conductivity, and with this comes a high charge carrier mobility. These properties stem from nanomaterials having a very active surface — and a very high surface area — compared to bulkier materials. In some cases, the active surface is the whole nanomaterial (2D materials). Given that nanomaterials are inherently thin, they are a lot more flexible — even the inorganic materials — than bulk materials, meaning that they are more useful for the batteries used in flexible and wearable technologies (Figure 1).

Despite their small size, a lot of nanomaterials are very stable and are resistant to high temperatures, harsh chemicals and high physical stresses. While this can't be said for all nanomaterials, enough of them are stable and conductive enough for battery electrodes. One disadvantage of nanomaterials is their higher cost because of the more complex fabrication methods required to make them. However, because only a small

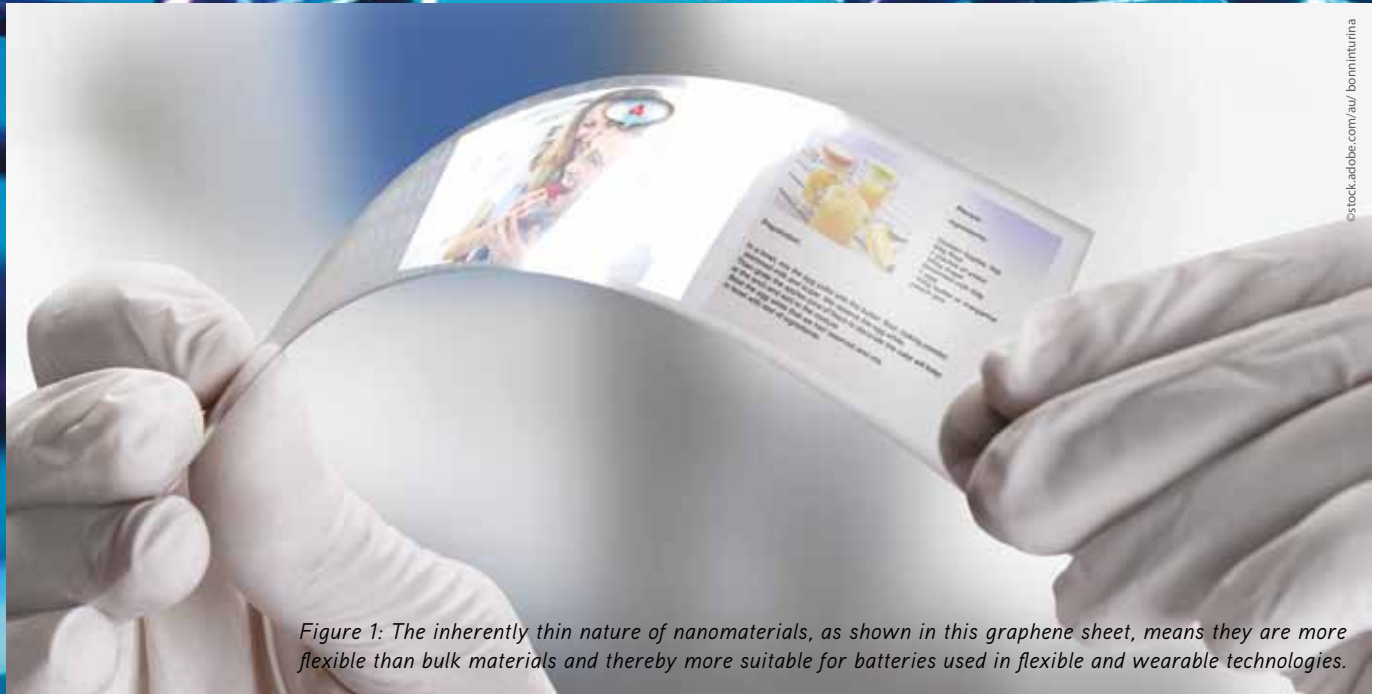


Figure 1: The inherently thin nature of nanomaterials, as shown in this graphene sheet, means they are more flexible than bulk materials and thereby more suitable for batteries used in flexible and wearable technologies.

amount is needed for the same (or better) properties than bulkier materials, the cost is a lot less than many people believe. The small addition of nanomaterials also means that less waste is often produced, and the batteries are more lightweight than when bulk materials are used.

Graphene is the frontrunner

Of all the nanomaterials being trialled, graphene is the frontrunner and is found in more prototypes than any other type of nanomaterial. A number of companies now commercially manufacture graphene batteries for different industrial sectors. Reportedly, some big mobile phone manufacturers might use graphene batteries in some next-generation phones in the near future (graphene is already used in the cooling systems of some phones).

Graphene exhibits some of the best-recorded values of almost all the properties that nanomaterials can exhibit, meaning that making compromises between the beneficial properties of different materials can often be negated by using graphene. Additionally, given that many batteries already use graphite — many graphene layers stacked on top of each other — it is a much more natural progression than other materials,

and systems have been developed that use graphite-graphene electrodes.

Graphene has one of the highest electrical conductivity and charge carrier mobilities known in the materials world. Moreover, it has an incredibly high tensile strength and flexibility (more than most nanomaterials and bulk materials), as well as being stable to high temperatures and harsh chemicals. The culmination of properties means that it can be used in a number of environments without its performance being affected, which is important when the batteries and the technologies they are in can get very hot internally, never mind the external heat they can be exposed to. Single-layer graphene is optically transparent, so it has the potential for being used to create transparent electrodes and transparent conductive films that could be used in batteries of the future that need to be invisible to the user.

Aside from the properties being more suited to batteries than most other nanomaterials, the industry is in a much better place to cope with huge demand should it arrive. Because the properties and potential for graphene are well understood, the industry has been preparing and growing in size around the world and graphene can now be produced at scale in a number of differ-

ent forms. The raw material side is more scalable than other nanomaterials, making it a much more viable commercial option.

Conclusion

There is a drive in modern-day society for more efficient and smaller batteries, regardless of whether the application is consumer phones or remote monitoring equipment. Companies are starting to trial nanomaterials in battery systems because they bring about performance benefits and can make the batteries smaller, while not significantly increasing cost because only a small amount is required. A number of companies manufacture graphene batteries, but while graphene batteries are available for the industrial markets, it might take some time for the high-tech consumer markets (phones, tablets, etc) to adopt graphene (or other nanomaterials) on a large scale because the status quo is well-tested and any changes in these markets can take a long time to come to fruition.

**Liam Critchley is a writer, journalist and communicator who specialises in chemistry and nanotechnology and how fundamental principles at the molecular level can be applied to many different application areas.*

Mouser Electronics
au.mouser.com

ARINC USB 3.0 INTERFACE

Alta Data Technologies has released an innovative USB ARINC-429 interface built directly in-line to a small, rugged cable assembly: the NLINE-UA429. It connects ARINC devices to notebooks, desktops and servers via USB 3.0 SuperSpeed. In addition to four or eight channels of ARINC RX/TX message controls, the product can generate or capture (o-scope) raw bus signals for protocol and electrical troubleshooting, and cybersecurity modelling.

The device is said to provide the latest interconnect technology for ARINC buses, along with a wide selection of ARINC interface boards, offering many choices for ARINC connections. All products are accompanied by the AltaAPI SDK and AltaView Windows analyser for quick integration for ARINC applications. For most existing applications, the NLINE-UA429 can be used with little or no code changes.

The product provides ARINC and 1553 users the convenience of USB without having to perform a slow 'Program then Run Sequence' typical of USB 2.0 products. It is suitable for both lab and deployed applications.

Metromatics Pty Ltd

www.metromatics.com.au



MANAGED SWITCH SERIES

The AdvancedLine managed switch series from Weidmüller provides a robust and secure solution for industrial network management.

The switches can increase network availability by means of ring redundancy and security control mechanisms, and offer a range of diagnostic options for sophisticated automation networks. Integration into common fieldbus protocols such as Modbus TCP, Ethernet/IP and Profinet can be readily achieved, and they can be easily and intuitively set up via a web interface.

With versions for Fast Ethernet, Gigabit and PoE, offering between five and 24 ports and with a large variety of SFP options for fibre interfaces, the switches can be tailored to fit all requirements. A high operating temperature range also means the switches can be used in challenging environments such as production applications or in the field.

Weidmuller Pty Ltd

www.weidmuller.com.au



TRANSISTOR OUTPUT AUTOMOTIVE PHOTOCOUPLER

Toshiba Electronic Devices & Storage has launched a high-voltage transistor output photocopler, the TLX9188, for isolated signal communication in automotive equipment, including electric mobility vehicles.

The high-voltage photo transistor delivers a collector-emitter voltage rating of 200 V, 2.5 times higher than the current TLX9185A. By specifying maximum values for switching characteristics (turn-on time, turn-off time), the photocopler can be used as a unidirectional switch. It can also be used in feedback circuits of analog signals in 100 to 200 V equipment, which should help to reduce the cost of application circuits.

Suitable automotive applications include battery management systems (voltage monitoring, mechanical relay sticking detection, ground fault detection, etc) as well as feedback of analog signals.

Toshiba (Australia) Pty Ltd

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SANDWICH-STYLE FABRICATION FOR ULTRALOW-ENERGY ELECTRONICS

A new 'sandwich-style' fabrication process, involving placing an atom-thick semiconductor between two mirrors, has allowed researchers from the ARC Centre of Excellence in Future Low-Energy Electronics Technologies (FLEET) to make a significant step towards ultralow-energy electronics based on the light-matter hybrid particles known as exciton-polaritons.

The breakthrough, led by the Australian National University (ANU), demonstrated robust, dissipationless propagation of an exciton mixed with light bouncing between the high-quality mirrors.

Conventional electronics relies on flowing electrons, or 'holes' (a hole is the absence of an electron, ie, a positively charged quasiparticle). However, a major field of future electronics focuses instead on use of excitons (an electron bound to a hole) because, in principle, they could flow in a semiconductor without losing energy by forming a collective superfluid state. Excitons in novel, actively studied atomically thin semiconductors are stable at room temperature.

Atomically thin semiconductors are thus a promising class of materials for low-energy applications such as novel transistors and sensors. However, precisely because they are so thin, their properties, including the flow of excitons, are strongly affected by disorder or imperfections, which can be introduced during fabrication.

The ANU-led FLEET team — with colleagues at Swinburne University and FLEET Partner institution the University of Wrocław — has coupled the excitons in an atomically thin material to light to demonstrate for the first time their long-range propagation

without any dissipation of energy, at room temperature. Their results have been published in the journal *Nature Communications*.

When an exciton (matter) binds with a photon (light), it forms a new hybrid particle — an exciton-polariton. Trapping light between two parallel high-quality mirrors in an optical microcavity allows this to happen.

In the new study, a sandwich-style fabrication process for the optical microcavity allowed the researchers to minimise damage to the atomically thin semiconductor and to maximise the interaction between the excitons and the photons. The exciton-polaritons formed in this structure were able to propagate without energy dissipation across tens of micrometres, the typical scale of an electronic microchip.

Microcavity construction is the key

A high-quality optical microcavity that ensures the longevity of light (photonic) component of exciton-polaritons is the key to these observations. The study found that exciton-polaritons can be made remarkably stable if the microcavity is constructed in a particular way, avoiding damage of the fragile semiconductor sandwiched between the mirrors during fabrication.



FLEET PhD student Matthias Wurdack. Image credit: Phil Dooley, ANU.

"The choice of the atomically thin material in which the excitons travel is far less important," said lead and corresponding author Matthias Wurdack.

"We found that construction of that microcavity was the key. And while we used tungsten sulfide (WS_2) in this particular experiment, we believe any other atomically thin TMDC [transition metal dichalcogenide] material would also work," he said. This is because TMDCs are excellent hosts for excitons, hosting excitons that are stable at room temperature and interact strongly with light.

The team built the microcavity by stacking all its components one by one. First a bottom mirror of the microcavity is fabricated, then a semiconductor layer is placed onto it, and then the microcavity is completed by placing another mirror on top. Critically, the team did not deposit the upper mirror structure directly onto the notoriously fragile atomically thin semiconductor, which is easily damaged during any material deposition process.

"Instead, we fabricate the entire top structure separately, and then place it on top of the semiconductor mechanically, like making a sandwich," Wurdack said. "Thus we avoid any damage to the atomically thin semiconductor, and preserve the properties of its excitons."

Importantly, the researchers optimised this sandwiching method to make the cavity very short, which maximised the exciton-photon interaction. Wurdack noted, "We also benefited from a bit of serendipity — an accident of fabrication that ended up being key to our success."

The serendipitous 'accident' came in the form of an air gap between the two mirrors, making them not strictly parallel. This wedge in the microcavity creates a voltage/potential 'slope' for the exciton-polaritons, with the particles moving either up or down the incline.

The researchers discovered that a proportion of exciton-polaritons travel with conservation of total (potential and kinetic) energy, both up and down the incline. Travelling down the slope, they convert their potential energy into an equal amount of kinetic energy, and vice versa.

That perfect conservation of total energy means no energy is being lost in heat (due to 'friction'), which signals 'ballistic' or

dissipationless transport for polaritons. Even though the polaritons in this study do not form a superfluid, the absence of dissipation is achieved because all scattering processes that lead to energy loss are suppressed.

"This demonstration, for the first time, of ballistic transport of room-temperature polaritons in atomically thin TMDCs is a significant step towards future, ultralow-energy, exciton-based electronics," said group leader Professor Elena Ostrovskaya, from ANU.

Apart from creating the potential 'slope', that same fabrication accident created a potential well for exciton-polaritons. This enabled the researchers to catch and accumulate the travelling exciton-polaritons in the well — an essential first step for trapping and guiding them on a microchip."

Long-range, room-temperature flow of exciton-polaritons

Furthermore, the researchers confirmed that exciton-polaritons can propagate in the atomically thin semiconductor for tens of micrometres (easily far enough for functional electronics), without scattering on material defects. This is in contrast to excitons in these materials, the travel length of which is dramatically reduced by these defects. Moreover, the exciton-polaritons were able to preserve their intrinsic coherence (correlation between signal at different points in space and time), which bodes well for their potential as information carriers.

"This long-range, coherent transport was achieved at room temperature, which is important for development of practical applications of atomically thin semiconductors," Wurdack said.

If future excitonic devices are to be a viable, low-energy alternative to conventional electronic devices, they must be able to operate at room temperature, without the need for energy-intensive cooling. "In fact," Wurdack said, "counterintuitively, our calculations show that the propagation length is getting longer at higher temperatures, which is important for technological applications."



VISUAL TRACE DIAGNOSTICS SOFTWARE

Percepio has announced version 4.6 of its visual trace diagnostics software, Tracealyzer, with improved support for Microsoft Azure and Azure RTOS ThreadX — two enhancements that should ease the development and debugging of Azure IoT systems.

As part of the improvements, Percepio has integrated its trace recorder in ThreadX, adding support for streaming recording where trace data is sent continuously to the host system and stored there. For ThreadX users, this means they can now capture longer software traces, spanning hours or even days, eg, for burn-in testing or profiling, or when looking for rare errors. Streaming support also enables live visualisation, ie, displaying the trace in real time while it is recorded.

Furthermore, the software has been enhanced to work with DevAlert, Percepio's cloud service for monitoring deployed IoT devices, running on Azure. DevAlert users deploying on Azure can now see their device issues — including early warnings and full insight into the software behaviour of deployed devices — and download and analyse the attached software traces, directly in Tracealyzer.

Macro Dynamics

www.macrodynamics.com.au

MACHINE LEARNING SOFTWARE

STMicroelectronics has announced Version 3 of NanoEdge AI Studio, the software tool for machine learning applications including connected devices, household appliances and industrial automation.

The software is designed to simplify the creation of machine learning, anomaly learning, detection and classification on any STM32 microcontroller. The latest release also includes prediction capabilities such as regression and outliers libraries. The tool makes it easy for users to integrate such cutting-edge

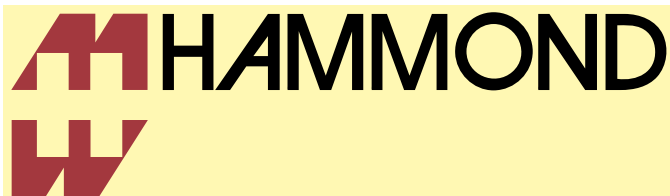


machine learning capabilities into their equipment quickly and easily; no data science expertise is needed.

Adding native support for all STM32 development boards, ST has also eliminated the need to write code for its industrial-grade sensors with high-speed data acquisition and management capabilities. The software enhances security by using local data storage and processing, instead of transferring to, and processing data in, the cloud.

STMicroelectronics Pty Ltd

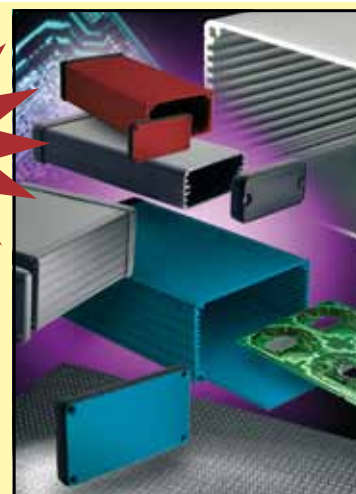
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CELLULAR ANTENNA

Antenova's Affini is a flexible printed circuit (FPC) antenna for the LTE, 4G and 5G NR networks in global markets. The antenna covers all main 4G bands plus 617–698 MHz, which offers 5G coverage and Band 71.

The cellular antenna measures 78 x 17 x 0.15 mm and has delivered high efficiency in tests. It has an I-PEX MHF1 connector, so it is easily designed in and it suits small devices that need to operate across wide areas. It provides good coverage indoors on the lower frequencies because at around 600 MHz RF signals can travel greater distances with penetration of walls and buildings.

The antenna is a useful choice for designers because it is physically small, plugs directly into a design and doesn't need a ground plane, matching network or transmission line. It has high efficiency, which will help manufacturers to gain certifications and PTCRB approval for their designs, and the design can be upgraded to use 5G modules. Applications include small devices operating on the 4G and 5G cellular networks, such as in telematics, OBD, cellular Wi-Fi hotspots, IoT, M2M, CCTV over 4G/5G, drones, Pico base stations and POS terminals.

Antenova Limited

www.antenova.com



SPECTRUM ANALYSERS

Rohde & Schwarz has extended its R&S FPL1000 family of spectrum analysers with the introduction of two base models offering measurement frequencies up to 26.5 GHz. The latest models provide capabilities from 5 kHz to 14 GHz and 5 kHz to 26.5 GHz.

The R&S FPL1000 is a single measuring instrument for general-purpose applications and various types of measurements. It can analyse signals with a bandwidth of 40 MHz and has battery operation that features an internal generator up to 7.5 GHz. The portable instrument is suitable for spectral measurements, power measurements with power sensors, and analysing analog and digitally modulated signals.

The device is quick and intuitive for measurements including spectrum analysis with measurement functions such as channel power, ACLR, signal-to-noise ratio, spurious, harmonic distortions, third-order intercept point and AM modulation depth. Capabilities extend further to include statistical ADP and CCDF analysis and versatile marker functions. Measurement applications are also available for analysing analog and digitally modulated signals.

The R&S FPL1-K7 option turns the device into an analog modulation analyser for amplitude, frequency and phase-modulated signals. The base unit's I/Q analyser supports the magnitude and phase presentation of I and Q within the analysis bandwidth. The I/Q data can be



exported for further analysis with third-party software products. The R&S FPL1-K54 provides EMI measurements for diagnostics of RF interference. The R&S FPL1-K70 vector signal analysis option also characterises digitally modulated single-carrier signals. There are additional options for multi-modulation analysis and measurement of BER on PRBS data.

The series delivers solid RF performance: typical phase noise is -108 dBc at 10 kHz offset (1 GHz carrier), together with displayed average noise level (DANL) of -163 dBm using the optional pre-amplifier. The instrument is suitable for use in the lab, monitoring satellite ground stations, communication links, education, test houses, in production and in service facilities.

Rohde & Schwarz (Australia) Pty Ltd

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GNSS RECEIVER

u-blox's NEO-M9V global navigation satellite system (GNSS) receiver offers both untethered dead reckoning (UDR) and automotive dead reckoning (ADR). The positioning receiver is suitable for fleet management and micromobility applications that require metre-level positioning accuracy even in challenging GNSS signal environments such as urban canyons.

Using inertial sensor measurements, UDR offers a smooth navigation experience in dense urban environments by bridging gaps in GNSS signal coverage and mitigating the impact of multipath effects caused by GNSS signals that bounce off buildings. ADR further increases positioning accuracy in demanding environments by including the vehicle speed in the sensor fusion algorithm. Offering both UDR and ADR on the same module delivers both good positioning performance and design flexibility, allowing users to provide optimal solutions for their customers on a case-by-case basis.

The product also features dynamic models optimised for both cars and e-scooters. By adapting the algorithms of the dead reckoning solution to the behaviour of these use cases, these dynamic models further increase the quality of the position reading.

The device is based on u-blox's M9 GNSS technology platform. Its ability to track up to four GNSS constellations maximises the number of GNSS satellites within its line of sight at any given moment. Integrated SAW and LNA filters offer good interference mitigation for a robust solution, accelerating product design and shortening time to market. Compatibility with the NEO form factor reduces migration efforts for those upgrading existing designs.

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

LOW-NOISE AMPLIFIER

Qorvo's CMD328K3 is a broadband MMIC low-noise amplifier that operates between 6 and 18 GHz with a noise figure of just 1.4 dB. The amplifier delivers greater than 27 dB of gain with a corresponding output 1 dB compression point of +12 dBm. The broadband device is a 50Ω matched design, which eliminates the need for external DC blocks and RF port matching.

Housed in a leadless 3 x 3 mm plastic surface-mount air cavity package, the product can be used as an alternative to hybrid amplifiers. It is suitable for electronic defence and communications systems where small size and low power consumption are needed, with applications including X-band and Ku-band radar, satellite communications and electronic defence receivers.

Mouser Electronics
au.mouser.com



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THERMAL FUSE WITH LOW TRIPPING TEMPERATURE

SCHURTER's RTS thermal fuse is getting a variant with a tripping temperature of $>175^{\circ}\text{C}$. The RTS is a compact overtemperature protection device for power semiconductors in SMD technology for high demands.

The RTS (reflowable thermal switch) was developed to protect highly integrated power semiconductors from overheating. Prior to mechanical activation, the thermal fuse can be soldered on conventional reflow soldering machines with profiles of up to 260°C .

Thermal runaway refers to the overheating of a power semiconductor due to a self-reinforcing and heat-producing process, especially when the trend now is towards increasing power density and miniaturisation of electronic circuits. The updated fuse protects these power semiconductors against thermal runaway, acting as a fail-safe device, and interrupts the circuit from as low as 175°C , thus addressing the operating temperatures of common power semiconductors even better.

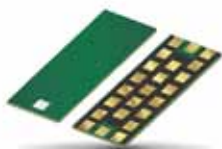
The overtemperature protection device comes in the same minimal dimensions and maximum breaking capacity despite its additional shunt functionality. With its small $6.6 \times 8.8 \text{ mm}$

footprint, it can handle operating currents of up to 130 A and rated voltages of up to 60 VDC.

The shunt version has an integrated resistance with low temperature dependence. This resistance is said to enable precise current measurement and additional non-thermal circuit protection, eg, via a controller.

SCHURTER (S) PTE LTD

www.schurter.com



MULTILAYER ORGANIC FILTERS

KYOCERA AVX's Multilayer Organic (MLO) filters utilise high dielectric constant and low-loss materials to realise high-Q passive printed elements, such as inductors and capacitors, in a multilayer stack. The filters can support a variety of frequency bands and multiple wireless standards and are less than 1 mm in thickness. All filters are expansion-matched to most organic PCB materials.

Additional features and benefits include: wide frequency range; good isolation; low loss; 50Ω impedance; no performance variance with temperature changes; surface mountability; and high part-to-part and lot-to-lot repeatability. The family includes high-pass, low-pass and band-pass filters.

Typical applications include mobile communication, GPS, vehicle location systems, wireless LANs, satellite receivers and instrumentation.

Richardson RFPD

www.richardsonrfpd.com



TFT LED DISPLAY MODULES

Displaytech, a division of SEACOMP, has made available a range of TFT (thin-film transistor) graphic modules.

The TFT LED RGB displays are available in sizes ranging from 1.8 to 7" and are suitable for various applications, including home automation, industrial controls, consumer products and medical devices. They are said to feature precise colour rendering that makes them desirable for use by small to large companies, including Tier 1 multinational corporations.

The control system (driver) is attached directly to the glass. The connection with the PCB is via an FCP (flexible printed circuit) connector on which the other control elements are located. This results in high quality, compact size and easy application.

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SLOT PC

Avalue Technology has launched the SLP-WHG: a high-performance slot PC with EtherCAT. Intelligent factory solutions like the slot PC can connect and extract data even from legacy systems or non-digitised environments, refining the data for intelligent management and data-driven digital transformation. The PC is designed to meet high-performance industrial automation applications with short cycle time, synchronised read speeds and data security.

The device features an Intel 8th Generation Core processor in a fanless chassis. Capacious DDR4 memory capacities up to 32 GB total provide fast memory caching opportunities or plenty of overhead for even large runtime applications. M.2 expansion opportunities are available for Wi-Fi, SSD storage and GNSS, plus PCI-Express 4x and 1x slots for add-in cards such as motion controller, digital or analog I/O and video capture. Rich I/O includes three Gigabit Ethernet, four COM ports, four USB 3 ports (3x Type-A, 1x Type-C), three HDMI display output and one 2.5" SATA drive bay.

The product is designed to withstand harsh environments and supports wide DC voltage input between 12 and 24 V, and wide operating temperatures from -20 to 50°C. The company provides VESA mounting options in the chassis so the PC can be fixed to a wall, device or unit. Furthermore, the device is CE/FCC Class A certified.

Avalue EtherCAT enhances throughput by up to 30% compared to equivalent devices without EtherCAT, the company claims. It offers time-deterministic synchronous control for a wide variety of automation usage. It supports third-party EtherCAT assistive-module support, giving operators the freedom to choose different motors and I/O based on cost/performance needs, thereby building an efficient operating environment. Deployment of each new system is fast and efficient due to Avalue's easy-to-use utilities.

Avalue

www.avalue.com.tw



METAL LINE SLIM SWITCH

SCHURTER introduces the MSS metal line slim switch — a flush mount push-button with a shallow mounting depth and stylish design. Sporting a multicolour side-ring illumination, the switch provides the user with visual feedback from the side in addition to the front. The additional coverage allows for lateral status indication, which may be especially desired from a distance. Non-illuminated versions are also designed to provide visual indication with a coloured bezel.

The switching technology is said to be precise and designed for applications where some degree of pressure is required to trigger the switching function. The capacitive technology triggers switching with only a touch, whereas mechanical technology has moving parts that can wear over time. Moving parts can also be subject to ingress. The switch requires a light pressure of 1–3 N on the surface, to provide the right amount of touch to prevent unintentional switching.

It has an IP rating of IP67 and a lifetime rating of >20 million actuations. Whether used in a home doorbell or medical product, a laboratory device or industrial equipment, the compact switch offers eight different bezel housing colours and a spectrum of RGB illumination colours for

a host of customised options. Size offerings are 19, 22 and 30 mm in diameter. In addition, with a slim mounting depth of 8 mm, the switch is versatile enough for a variety of applications — including those where depth is limited, such as door jams and densely packed enclosures.

The switching voltage and current are max 60 VDC and 100 mA. The operating temperature range is -40 to +85°C. The switching function is momentary (MO/NO) or latching (LA). Robust enough for demanding applications, the switch actuator is stainless steel with an impact resistance rating of IK06.

SCHURTER (S) PTE LTD

www.schurter.com

Outdoor wayfinders deployed at Sydney Olympic Park

Zytronic's all-weather projected capacitive (PCT and MPCT) touch sensors are helping visitors to Sydney Olympic Park navigate their way around.

The site of the 2000 Sydney Olympics still hosts some of Australia's most significant events, with its 660 ha comprising sporting venues, recreational facilities, parklands, cafes and restaurants. Sydney Olympic Park Authority's (SOPA) Master Plan 2030 is to deliver outstanding social, economic and environmental benefits for the people of Sydney and NSW; Design to Production (D2P), a digital communications and merchandising solutions provider, collaborated with media partner oOh!media to bring SOPA's plan to life with outdoor interactive directories, or wayfinders.

Specialising in delivering enhanced engagement through quality design and customer experience, D2P takes a holistic approach to help venue operators, such as SOPA, engage with their community and visitors. The Sydney-based company developed its double-sided outdoor interactive wayfinders supported by Zytronic distributor JEA Technologies, which is based in Melbourne. Collectively, they produced a 75" outdoor display fitted with an all-weather, vandal-resistant Zytronic 49" ZyBrid touch sensor on the front, enabling users to interact with D2P's precise wayfinding software.

D2P selected Zytronic's large-scale touch sensors for their robust nature, especially in outdoor applications. As these areas are mainly unsupervised, the sensor is made from 5 mm-thick, thermally toughened glass, which delivers vandal resistance. The custom-designed touch sensor incorporates infrared and UV filters to help protect

the underlying high-brightness display from solar damage. It also has an antiglare etched finish, allowing the totems to operate comfortably in Sydney's sweltering summers, with some days hitting temperatures of over 45°C.

"At almost 3 m tall with its 'Olympic Blue' livery, the SOPA wayfinders are unmissable," said D2P Director and co-founder David Astone. "Our intuitive wayfinding software integrates with SOPA's web content management system to ensure there is only one, easy-to-maintain, source of truth."

The elegant design of the SOPA wayfinder belies its rugged construction, with the sensitive

ZyBrid technology creating a user-friendly experience. Much like a smartphone's touch screen, the interactive display on the SOPA wayfinder is designed to provide a millisecond-fast, precise touch response. It also supports simple gesture controls, such as swipes and pinches, but it still works when the user is wearing gloves if the weather becomes inclement.

"Our 75" double-sided outdoor touch screen systems do not miss a beat; a true testament to our entire team with assisting in developing our SOPA wayfinders," Astone concluded.

JEA Technologies
www.jeatech.com.au





MODBUS/TCP TO RTU/ASCII GATEWAY

ICP DAS has released the GW-2200 series Modbus/TCP to RTU/ASCII gateway with a 2-port Ethernet switch and isolated RS-232/422/485 ports.

The gateway enables a Modbus/TCP host to communicate with serial Modbus RTU/ASCII devices through an Ethernet network and eliminates the cable length limitation of legacy serial communication devices. The module can be used to create a pair-connection application (as well as serial-bridge or serial tunnel application), and can then route data over TCP/IP between two serial Modbus RTU/ASCII devices, which is useful when connecting mainframe computers, servers or other serial devices that use Modbus RTU/ASCII protocols and do not themselves have Ethernet capability.

The module features a powerful 32-bit MCU to enable efficient handling of network traffic and also has a built-in web server that provides an intuitive web management interface that allows users to modify the configuration of the module, including the DHCP/Static IP, the gateway/mask settings and the serial port settings.

ICP Electronics Australia Pty Ltd

www.icp-australia.com.au

THUNDERBOLT INTERFACE APPLIANCE

Alta Data Technologies has released its MIL-STD-1553 Thunderbolt interface appliance: the NLINE-T1553. The product embeds the MIL-STD-1553 protocol engine, AltaCore, directly into the Thunderbolt cable assembly.



The device has full-featured controls for 1–2 channels of 1553 BC, RT and BM functions via a Thunderbolt USB-C connection. Combined with the standard AltaAPI software development kit (SDK) and signal capture o-scope capabilities, it offers 1553 functionality and ease of deployment for aerospace platforms.

For deployed systems, or lab usage, the product opens

many 1553 integration options. For example, the user can take an application developed for desktops or servers and use this exact same application on a notebook with an NLINE-T1553. There is also signal capture, which is an o-scope capability built-in to help troubleshoot cabling and cybersecurity issues.

The product provides 1–2 channels of full 1553 network controls via a rugged in-line cable, and packaging techniques to embedded 1553 design directly into MIL-810G/461F qualified cable assemblies. The Thunderbolt interface provides full PCI Express (PCIe) functions of a 1553 interface board, even hardware interrupts. In most cases, the exact same application code as used with a PCIe card can be used with the device. The user can now decide to burn a PCIe card slot or use an external device via an in-line USB-C cable.

Metromatics Pty Ltd

www.metromatics.com.au



PRIVATE LoRaWAN-IN-A-BOX SOLUTIONS

Digi-Key Electronics has partnered with Seeed Studio and Machinechat to launch its private LoRaWAN-in-a-Box solutions for the Internet of Things (IoT).

The ready-to-use solutions combine Seeed Studio's industrial-grade LoRaWAN (Long Range Wide Area Network) IoT sensors and gateways with Machinechat JEDI Pro Seeed Studio Edition IoT data monitoring and visualisation software, allowing for rapid IoT deployments and enhanced security features that give users complete control over device data, which should save time and reduce technical complexity. The first LoRaWAN-in-a-Box solution is focused on rapid deployment of smart agriculture and precision farming projects.

Designed for commercial IoT applications, including smart agriculture, precision farming and smart city use cases, Seeed Studio's SenseCAP industrial-grade LoRaWAN sensors, data logger and gateway solutions are designed for rapid installation and deployment. Machinechat's JEDI Pro Seeed Studio Edition software is meanwhile designed specifically for commercial IoT deployments, and can ingest data from SenseCAP LoRa sensors using the integrated Seeed Studio data collector (Chirpstack installation required).

The combined private LoRaWAN-in-a-Box solutions enable systems integrators and enterprise IT teams to rapidly transform their ideas into transformational IoT digital projects. By bundling Seeed Studio's LoRaWAN hardware solutions with Machinechat's innovative and easy-to-use software, Digi-Key customers should be able to build and deploy robust, private LoRa IoT deployments in days versus weeks.

Digi-Key Electronics

www.digikey.com

IMPROVING TOUCH SENSITIVITY IN INDUSTRIAL ROBOTS

Eureka Robotics, a tech spin-off from Nanyang Technological University, Singapore (NTU Singapore), has developed a technology that provides industrial robots with touch sensitivity close to that of human hands, meaning they are able to manipulate tiny glass lenses, electronics components and engine gears that are just millimetres in size without damaging them.

Current robots in the market have either high accuracy but low agility (where robots perform the same movements repeatedly such as in a car factory) or low accuracy but high agility (such as robots handling packages of different sizes in logistics). This is because the programming of the force controller is extremely complicated, requiring long hours to perfect the grip just for a specific task.

Seeking to master touch sensitivity and dexterity like in human hands, Eureka Robotics co-founders NTU Associate Professor Pham Quang Cuong and Dr Hung Pham developed

a complex artificial intelligence (AI) algorithm called Dynamis. The proprietary force feedback technology was previously demonstrated by a robot which assembled an IKEA chair in just 20 minutes, and has since been upgraded even further.

The new software powered by Dynamis, known as Force Sensor Robust Compliance Control, requires only a single parameter to be set — the stiffness of the contact (either soft, medium or hard). Despite its simple set-up, it has been shown to outperform conventional robotic controllers which required an enormous amount of expertise and time to fine-tune.

By deploying this technology, robotics engineers can now imbue robots with both high accuracy and high agility (HAHA) on a large scale, paving the way for industrial applications that were previously very difficult or impossible to implement, such as handling and assembly of delicate, fragile objects such as optical lenses, electronics components or engine gears.

"Today, Dynamis has made it easy for anyone to program touch-sensitive tasks that are usually done by humans, such as assembly, fine manipulation, polishing or sanding," said Assoc Prof Pham, who is also the Deputy Director of the Robotics Research



Eureka Robotics co-founders Dr Hung Pham and Associate Professor Pham Quang Cuong with a Denso Wave robot equipped with the Dynamis force feedback technology software. Image credit: Eureka Robotics.

Centre at NTU's School of Mechanical and Aerospace Engineering.

"These tasks all share a common characteristic: the ability to maintain consistent contact with a surface. If our human hands are deprived of our touch sensitivity, such as when wearing a thick glove, we would find it very hard to put tiny Lego blocks together, much less assemble the tiny components of a car engine or of a camera used in our mobile phones."

The technology has already been deployed in Eureka's custom-built robots, such as Archimedes, which can now handle fragile

optical lenses and mirrors with human-like dexterity. It will soon be made available for a large number of industrial robots worldwide by Denso Wave, part of the Toyota Group; customers will have the option to include the new technology as part of the force controller, which reads the force detected by a sensor on the robot's wrist and applies force accordingly. Apply too little force and the items may not be assembled correctly, while applying too much force could damage the items.

"The technology, which will be installed in Denso robots, is a technology for force feedback, which is becoming more and more important in the practical use of robotics," said Hiroyasu Baba, FA/Robotics Business Unit Product Planning Department, Manager of Denso Wave. "Thanks to the development capabilities of Eureka Robotics, the system is advanced yet easy to use and light enough to be integrated into our standard robot controllers."

To be equipped with the Force Sensor Robust Compliance Control capability, robots already running on Denso Wave's RC8 controllers will be required to perform a simple software update from December 2021 onwards, while newly shipped RC8 controllers will come packed with the software available for activation.

THIN AND FLEXIBLE PCBs BASED ON PARYLENE

Scientists at the Fraunhofer Institute for Electronic Nano Systems ENAS have successfully developed flexible printed circuit boards (PCBs), based on the polymer known as parylene, with an overall thickness of less than 20 μm and several metallisation layers.

For the realisation of advanced smart applications such as smart medical wearables, smart adhesive tapes or structural health monitoring of lightweight structures by integrated sensors, flexible electronics and in particular flexible PCBs are a key enabler. For the given applications, thin PCBs are preferred in comparison to thicker designs, since lower total thicknesses come along with better wearing comfort, eg, considering medical wearables for monitoring vital parameters or smart plasters. Similarly, thinner flexible sensors for structural monitoring can be better integrated in lightweight structures than thicker ones.

For existing technologies for flexible PCBs, the total thicknesses can easily cumulate up to several 100 μm , particularly if they include several metallisation layers. This limits their flexibility and integratability. Scientists at Fraunhofer ENAS have now succeeded in producing an ultrathin and flexible printed circuit board with several metallisation layers.

The key here was the use of parylene, which is deposited at room temperature without any intrinsic stresses. It provides good mechanical stability, even for low-layer thicknesses, while featuring a low Young's modulus and hence high bendability, even at low temperatures. At the same time, it provides comparably good thermal stability. Under these conditions, it was possible to extremely reduce the overall thickness of the parylene-based PCB while at the same time realising a high degree of flexibility.

In addition, the polymer offers other advantageous properties that are crucial for subse-

quent use in very different applications. These include ISO 10993 certified biocompatibility and biostability, chemical inertness and thus compatibility with common microtechnologies, optical transparency, electrical isolation and low permeability.

Using parylene to realise advanced flexible PCBs, the polymer acts as a flexible substrate, as a dielectric between the different metallic redistribution layers and as an encapsulation layer. The PCBs are fabricated using established microtechnologies, allowing a variety of metallisation technologies such as sputtering or additive manufacturing-based technologies and different metals to be used for the fabrication of the metallic interconnect layers. Doing so, dimensions as low as 10 μm can be realised. For the realisation of vertical interconnects between the metallic layers, the intermediate parylene dielectric with a thickness of only a few micrometres is patterned, whereas different methods can be applied to fill the resulting via again. Using these technologies, total thicknesses of less than 20 μm can be achieved for parylene-based flexible PCBs — even if they contain several metallisation layers.

This new generation of ultrathin and highly flexible PCB based on parylene can thus provide an advanced packaging platform for enabling new smart applications in the field of flexible electronics. Due to the biocompatibility of parylene, the fabrication of a fully biocompatible PCB is possible, when choosing biocompatible metals such as gold or titanium.

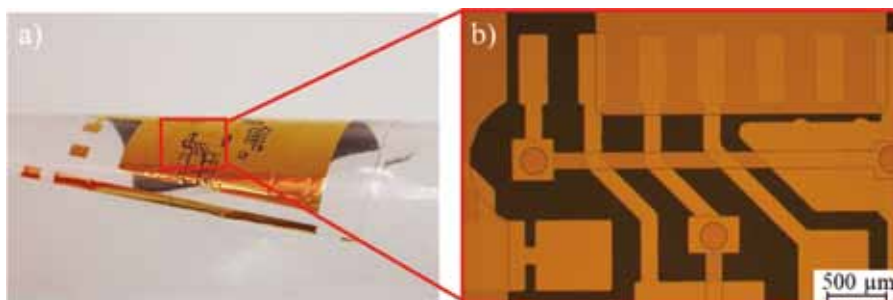


Photo (a) and microscopic image (b) of an ultrathin Parylene-based printed circuit board with two metallisation layers of gold. Image ©Fraunhofer ENAS.

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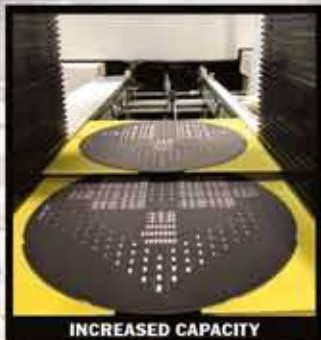


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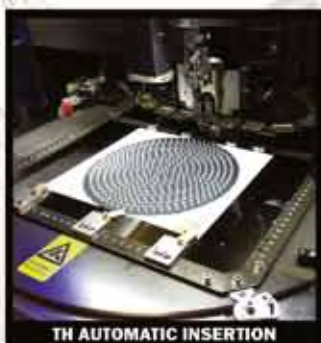
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