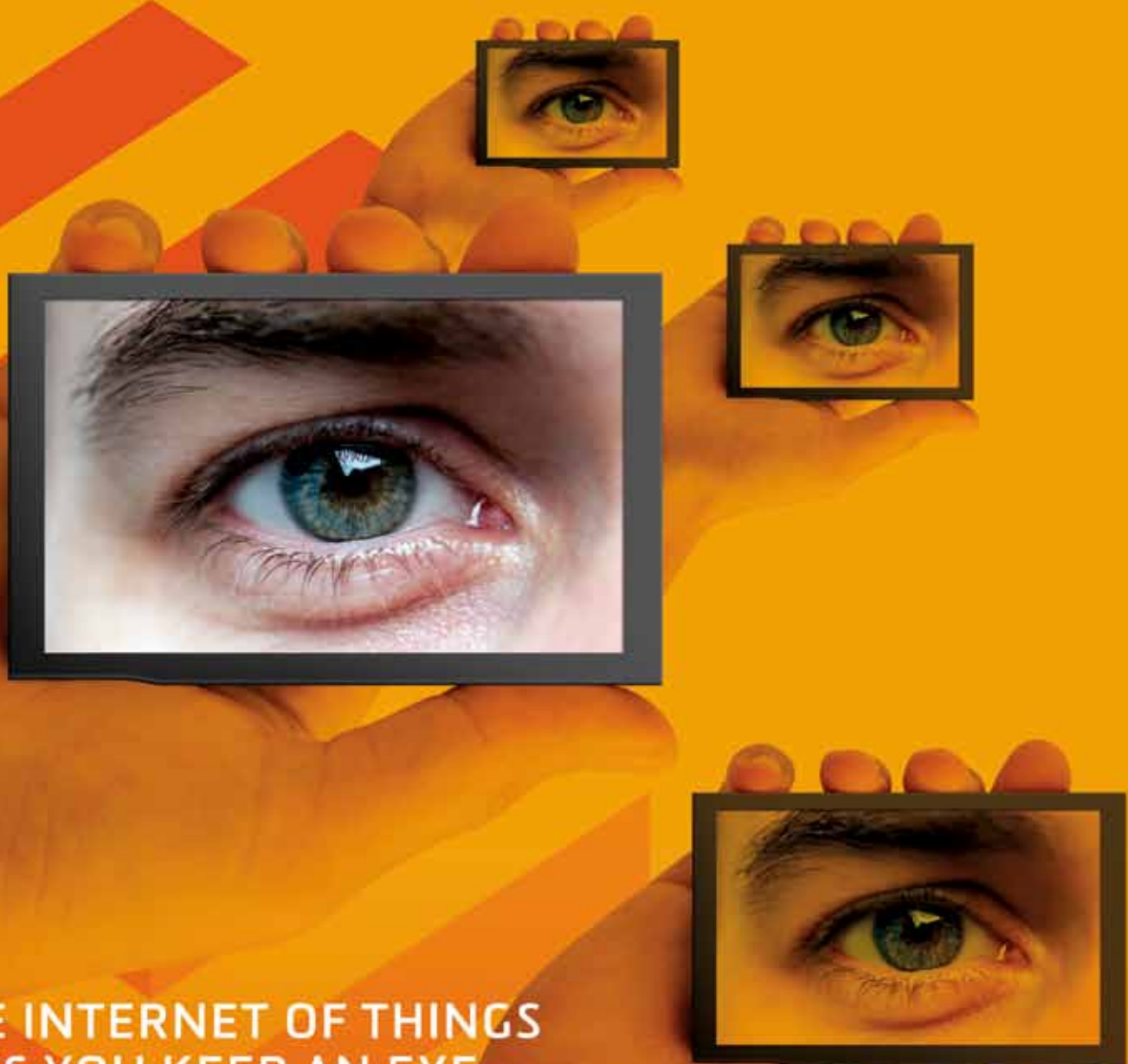


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The much-hyped arrival of the Internet of Things (IoT) has brought many breakthroughs in remote sensing and data acquisition. But it also brings the practical problems of building enclosures that will protect system electronics in often harsh environments for long periods of time without the need for constant maintenance.

To create a reliable, high-performance enclosure, Erntec's engineers must think outside the box to address issues such as ingress protection (IP); shock and vibration; UV and solar stability; physical security; thermal management; I/O or sensor connectivity; and RF transmission/reception.

In a recent vehicle-tracking application, for example, we were confident we could modify one of our standard enclosures. Aside from simple cut-outs for glands and labelling, we had to ensure this control box could be mounted effectively in a hostile environment and connect with magnetic sensors to receive critical data.

Using 3D modelling and regular meetings with our client, the design evolved. We built prototypes, which were tested with minor changes before the first production run.

Finally, by building additional sheet-metal brackets and machining the enclosure to facilitate the magnetic sensor, the application worked perfectly, allowing for IP69K ingress with high shock and vibration protection. So now their sensors make perfect sense.

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DIGITAL TWINNING

A LOOK AT THE TECHNOLOGY LANDSCAPE

Michael Parks, PE, for Mouser Electronics



Digital twins are changing how systems are designed and operated. Understanding the concepts and the enabling technologies is crucial to successfully incorporating digital twins into product development.

The digital twin (DT) represents a manufacturing paradigm shift that is long in the making. The fundamental premise is that for every physical product, there is a virtual counterpart that can perfectly mimic the physical attributes and dynamic performance of its physical twin. The DT exists in a simulated environment, controllable in very exact ways that are not easily duplicable in the real world — eg, speeding up time so that years of use can be simulated in a fraction of a second.

Thanks to the expansion of companion technologies such as artificial intelligence (AI), ubiquitous wireless internet access and inexpensive sensor platforms, DTs are quickly becoming a feasible reality for many companies looking to make better products and more informed business decisions.

Despite all the hype surrounding DTs, the actual concept is rather straightforward. With roots in modelling and simulation, advances in companion technologies, digital thread (to tie it all together) and machine learning (to make sense of it all), digital twinning is on the verge of shifting the landscape of engineering design.

Roots in modelling and simulation

DTs can trace their roots back through the history of modelling and simulation:

- A model, not totally unlike a DT, is a physical or mathematical representation of the characteristics and behaviours of an object, system or process. It dictates how the modelled entity reacts to and impacts its environment and other entities.
- A simulation takes a model or set of models and mimics their operations over time by interjecting artificial inputs (or accepting inputs from a human or an instrumented test object) and monitoring the outputs: this a concept known as 'live, virtual and constructive (LVC)' simulation.

Even before computers made it possible to represent tangible objects virtually in software, physical mock-ups representing

production systems were sometimes used to understand complex systems better: a great example of this is the full-scale simulators built by NASA to train astronauts to occupy various spacecraft. In recounting the events of Apollo 13's near disaster, the 1995 movie, named after the spacecraft, gives viewers an excellent basis for understanding the use cases for DTs. In the film, astronaut Ken Mattingly spends countless hours in a functional, exact replica of the ill-fated spacecraft. His goal was to solve the various technical hurdles that were thwarting the safe return of his fellow astronauts. The cost and effort of building exact duplications of the Apollo spacecraft was justified by the enormity of the undertaking and by the amount of planning and practice each mission required.

But what if the cost and effort to create a functional facsimile of a complex system could be made trivial compared to their total lifecycle costs and/or savings? What if, unlike a traditional model, it is possible to use a virtual representation for more than just system design — for instance, using virtual representation to help understand and control supply chain and other business functions associated with product manufacturing? And what if customers could get extremely intelligent predictive maintenance planning based on sharing operational and maintenance data across an entire fleet of systems? This is where the DT could help to change everything about design, construction, operations and maintenance of complex systems. In this context, the Internet of Things (IoT) would be the lifeblood, separating traditional models from next-generation DTs.

Advances in companion technologies

At the heart of digital twinning is a key concept: the virtual and the physical are inextricably linked. Thus, IoT and the more manufacturing focused Industrial Internet of Things (IIoT) have become key enablers that allow data to flow between the digital and physical twins. Embedded sensors on



a physical object can monitor all aspects of the object's operations as well as the operating environment. This valuable data will feed to the object's DT via IoT for operators and engineers to understand better how a system is operating in real-world conditions.

Reliably enabling a system's teleoperation requires near ubiquitous internet access. The forthcoming rollout of fifth-generation wireless networks (5G) will bring many advantages to the wireless market that will be necessary for further proliferation of IoT and IIoT. The advantages include increased reliability, more concurrent users and greater built-in support for device-to-device communications. A parallel development, multi-access edge computing (MEC), will help ensure network throughput by offloading cloud processing and maintaining it closer to the sensor nodes, which are foundational to IoT. In short, the processing horsepower packed into today's inexpensive embed-

Digital twins vs simulations

A false assumption suggests that DTs are just another type of modelling and simulation. If this were the case, DTs wouldn't be useful for electronics engineers. Electronic design automation (EDA) software, which enables circuit capture and simulation, has been around for decades. However, 'twin' is the emphasis here. It implies the existence is a physical duplicate: of course, under the consideration that the product doesn't solely live as 1s and 0s in a computer. For product developers who choose to embrace DTs in their design process, this means physical prototypes become even more important. Simulations are only as good as the assumptions made by the person who is running the simulation. However, DTs rely on aggregated real-time feedback from all prototypes being used in various real-world settings. This differentiating philosophy has significant implications for hardware designers.



AT THE HEART OF DIGITAL TWINNING IS A KEY CONCEPT: THE VIRTUAL AND THE PHYSICAL ARE INEXTRICABLY LINKED.

ded systems eliminates the need for raw data transport across networks (and/or the internet) to activate processing by high-powered servers.

The digital thread

A fully effective DT needs a closed data loop, or digital thread, that flows from conceptual design all the way to real-world feedback from fielded systems. Embedded electronic products require multiple disciplines to come together to design and manufacture a finished product. Computer-aided design/engineering (CAD/CAE) software suites enable designers and engineers to build the enclosure and mechanical aspects of a product. Electronic design automation (EDA) applications enable schematic capture and circuit board layouts. Computer-aided manufacturing (CAM) software translates the designs into instructions that manufacturing machinery understands to turn the digital into the physical. Each step along the process adds more data to the DT.

The digital thread is the connective tissue that enables the otherwise disparate applications to communicate. Permitting disparate software applications to interoperate, an emerging class of software known as robotic process automation (RPA) enables easily built digital threads. Running at a human user interface (UI) level, RPAs empower disparate applications to interoperate, without expensive software rewrites for each individual application. This capability will prove to be very useful as the digital thread continues to collect data and provide information to the DT from various business systems, such as customer relationship management and supply chain applications. Even after a product has been sold and is in use, the digital thread continues to feed telemetry data to the manufacturer for model refine-

ments on the basis of how a product is actually performing in real-world conditions.

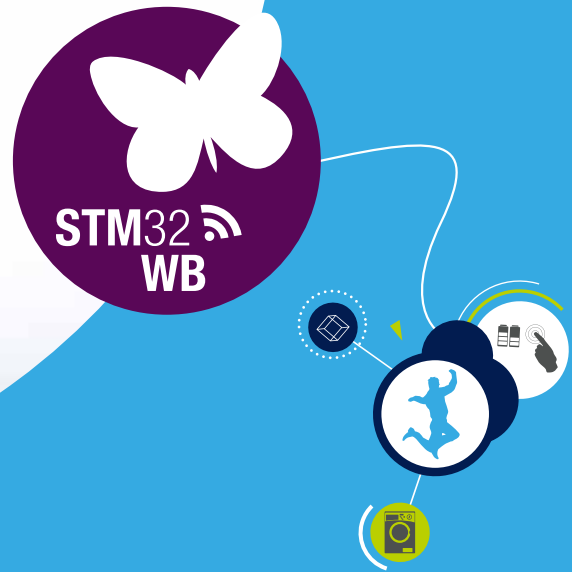
Machine learning turns data into information

All the data moving along the digital thread are impossible for humans to efficiently process on their own. Machine learning technology will be essential to sift through the mountains of data that feed back from fielded systems. Finding anomalies or trends will allow engineers and designers to refine future product iterations in a more predictive fashion than possible today. Cognitive digital twins, powered by AI technology, will allow products to improve over time without any human intervention. In short, instead of just performing mathematical analyses on raw data, a cognitive digital twin would be able to learn, reason, adapt its logic and make informed decisions on its own. The result: the ultimate in technology self-help! The implications of a more cost-effective, adaptable and intelligent product development lifecycle would seem to make any investment in this technology well worth it.

Conclusion

With DTs, every physical product can have a virtual counterpart that can perfectly mimic the physical attributes and dynamic performance of its physical twin. DTs are quickly becoming a feasible reality for many companies looking to make better products and more informed business decisions. Rooted in modelling and simulation, DT has gained traction due to advances in companion technologies, like wireless communications, sensors, AI, machine learning and more. Digital twinning may indeed shift the landscape of engineering design as we know it.

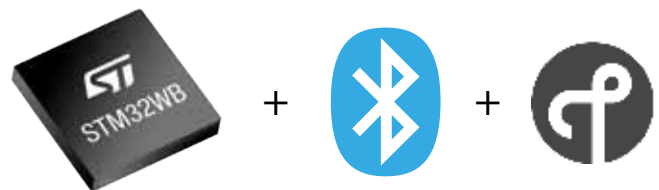
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The Coilcraft LPD8035V series offers high-isolation miniature coupled 1:1 inductors that provide 1500 Vrms 1-minute isolation between windings in a small package. They are said to offer significant size reductions over conventional bobbin-wound alternatives.

Features include: an ultrasmall package size of 8 x 6.4 x 3.5 mm; a tight coupling coefficient of >0.97; six inductance values from 4.7 to 150 uH; and peak current ratings up to 2.7 A. The product is AEC-Q200 Grade 3 (-40 to +85°C) qualified.

The series can be used as a flyback transformer, a coupled inductor in SEPIC applications and a common mode filter choke. It is also suitable for automotive and other high-temperature applications.

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DESKTOP PCB MILLING MACHINE

Milling directly from Gerber files, the Bantam Tools Desktop PCB Milling Machine effortlessly handles double-sided PCBs with 6 mm trace and space. It is said to enable the quick iteration of prototypes in-house and eliminate the wait for deliveries from PCB fab houses.

The machine enables users to prototype electronics on their desktop and have all the components they need at their doorstep. Bantam Tools' tight integration with design software allows users to quickly find and fix design errors and get projects done ahead of schedule, according to the company, empowering their need for fast time to market.

The product is suitable for applications such as rapid prototyping PCBs, proof-of-concept designs, quick iteration of electrical and mechanical components, and custom heatsink development.

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MONITORING RECEIVER

Narda Safety Test Solutions presents the SignalShark monitoring receiver. Powerful, portable, versatile and suitable for both mobile and fixed applications, the unit combines minimal noise with high intermodulation immunity. It has been designed specifically for rapid detection and analysis, classification and localisation of RF emissions between 8 kHz and 8 GHz.

One of the most common tasks in telecommunications measurements is an examination of signal levels versus frequency. Here, users benefit from the high dynamic range (HDR) of the SignalShark — that is, its ability to capture low-level signals in the presence of higher-level signals without problems. HDR necessitates a difficult balancing act between high sensitivity for low levels and maximum insensitivity to saturation due to high levels in the direct vicinity.

Measurement engineers are often faced with the tricky situation when they need to make high-sensitivity measurements at locations close to VHF antennas or base stations in order to trace unknown interference that is present at much lower levels. The SignalShark's preselector makes it possible for it to suppress frequency ranges that would interfere with the measurement.

The preamplifier and first mixer stage define the low intrinsic noise (displayed average noise level or DANL). The product's good dynamic range is the result of the combination of DANL with the 'insensitivity parameters' — that is, the second and third order intermodulation intercept points (IP2 and IP3).

Narda Safety Test Solutions GmbH
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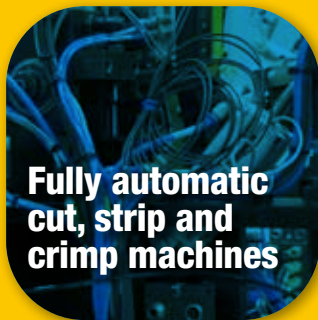
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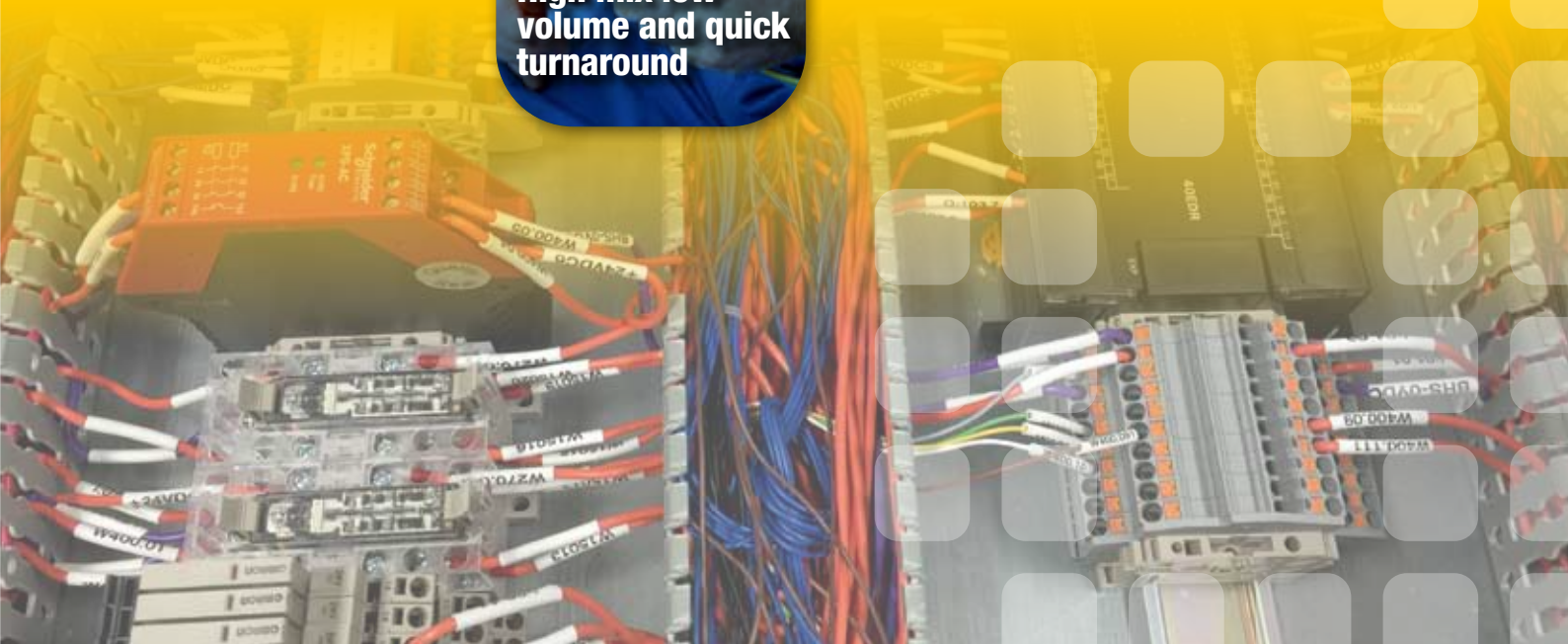


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SHORT CIRCUITS

HOLEY SILICON KEEPS ELECTRONIC DEVICES COOL

The ongoing downsizing of integrated circuits, as a result of electronics miniaturisation, is challenging engineers to come up with new ways to thwart component overheating. Now, US researchers have revealed that cooling can be better facilitated with the help of holey silicon — a computer chip wafer with tiny, vertically etched orifices that work to shuttle heat to desired locations.

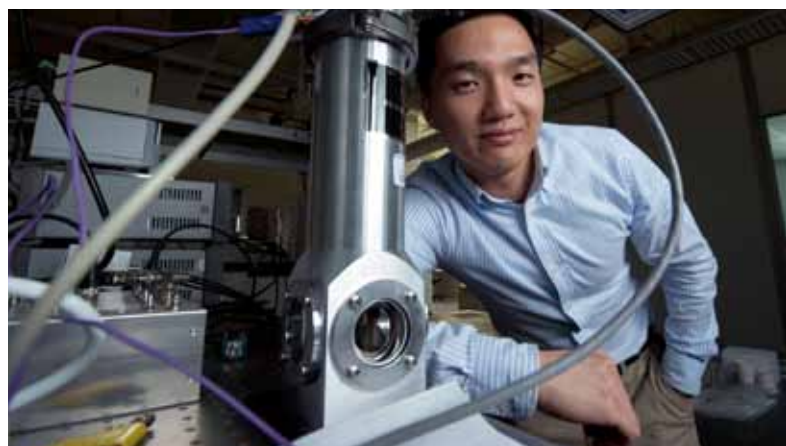
As explained by Jaeho Lee, from the University of California, Irvine's (UCI) Nano Thermal Energy Research Group, the temperature problem in electronics has grown in the past few years as microchip designers seem to have reached a size boundary. With larger components, manufacturers can use heat sinks, fins and even fans to funnel warmth away from critical hardware. On today's densely packed chips with billions of nanoscale transistors — often sandwiched in slim, pocketable consumer products — there's no room for such cooling technologies.

Other key issues are longevity and reliability. Semiconductor chips are being embedded in many new places, acting as sensors and actuators in cars and appliances and as nodes along the Internet of Things. These devices are expected to run continuously for years and even decades, but prolonged exposure to heat could cause the failure of such infrastructure.

"It's important that we continue to develop a better understanding of the fundamentals of thermal transport and find ways to control heat transfer at the nanoscale," said Lee.

In 2017, Lee and his collaborators at UC Berkeley employed nanometre-scale silicon mesh material to investigate properties of phonons — quasiparticles that give scientists insight into thermal transport mechanisms. The results were published in the journal *Nature Communications*.

"We know that phonons can show wave-like as well as particle-like behaviour during thermal transport," Lee said. "Using meshes with different hole sizes and spacing, we were able to clarify complex thermal transport mechanisms at the nanoscale."



Jaeho Lee, UCI assistant professor of mechanical & aerospace engineering, believes that holey silicon might be a breakthrough in the quest to keep modern electronics cool.

Knowledge gained from this study helped Lee understand how small, neck-shaped structures created by the etched holes in holey silicon cause phonon backscattering — a particle effect leading to low in-plane thermal conductivity. High cross-plane thermal conductivity was caused by long-wavelength phonons that help to move heat away.

Now, Lee is corresponding author on a new study published in the journal *Nanotechnology*. He revealed, "We found that heat prefers to travel vertically through but not laterally across holey silicon, which means the material can effectively move the heat from local hot spots to on-chip cooling systems in the vertical direction while sustaining the necessary temperature gradient for thermoelectric junctions in the lateral direction."

The lead author on the study, graduate student Zongqing Ren, said that lab simulations demonstrated that the cooling effectiveness of holey silicon is at least 400% better than chalcogenides — compounds commonly used in thermoelectric cooling devices. He thus concluded, "This innovation could potentially be ideal for keeping electronic devices such as smartphones cool during operation."

Image credit: Steve Zylius/UCI

CHARGE YOUR PHONE IN A CUP HOLDER

A cup holder that wirelessly charges electronic devices in a 3D space has been developed by the Electronics and Telecommunications Research Institute (ETRI) in South Korea.

Shaped just like a circular cup holder with a 10 cm diameter, the wireless 'E-Cup' generates and maintains a constant and uniform magnetic field. The electric current wirelessly flows to the batteries inside electronic devices based on the magnetic resonance. What's more, the technology can charge multiple devices at the same time, at the same rate as wired chargers, regardless of orientation or position.

But while the E-Cup matches the speed of wired chargers, it is less efficient; its power conversion reaches to about 60% when calculated in terms of DC-to-DC conversion. The ETRI team is working on raising that to 70% before the product can be commercialised.



"The newly developed technology has a wide range of potential applications, including phones, although it is still in infancy," said Dr Ho-Jin Lee from the Radio & Satellite Research Division of ETRI. "But at the same time it has a great potential to be improved."

ETRI has been working on wireless charging for several years, in 2015 beginning development of a 3D wireless charging technology based on magnetic resonance for electric bikes, drones and smart devices. They succeeded to overcome the limitations of its 2D design and expand to 3D design to accelerate the freedom of charge without a loss of efficiency.

The research team believes their smartphone charging technology can be applied to all areas of industry, with the market for wireless charging devices expected to grow to nearly US\$1 billion in 2022, according to MarketsandMarkets. They are also focused on developing highly efficient and safe wireless energy transfer technologies applicable to charge multiple devices in huge spaces, such as living rooms.



ONE STEP CLOSER TO TERAHERTZ COMPUTER CHIPS

Following three years of research, scientists from the Hebrew University of Jerusalem (HU) have created technology that will enable our computers, and all optic communication devices, to run 100 times faster through terahertz microchips. Their work has been published in the journal *Laser and Photonics Review*.

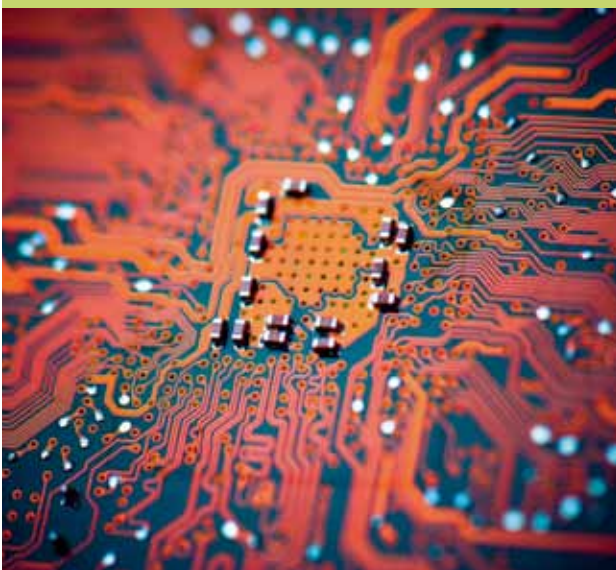
Until now, two major challenges stood in the way of creating the terahertz microchip: overheating and scalability. However, physicist Dr Uriel Levy and his team have now shown proof of concept for an optic technology that integrates the speed of optic (light) communications with the reliability — and manufacturing scalability — of electronics.

Optic communications encompass all technologies that use light and transmit through fibre-optic cables, such as the internet, email, text messages, phone calls, the cloud and data centres, among others. Optic communications are superfast, but in microchips they become unreliable and difficult to replicate in large quantities.

By using a metal-oxide-nitride-oxide-silicon (MONOS) structure, Dr Levy and his team have come up with a new integrated circuit that uses flash memory technology — the kind used in flash drives and discs-on-key — in microchips. If successful, this technology will enable standard 8–16 GHz computers to run 100 times faster and will bring all optic devices closer to the Holy Grail of communications: the terahertz chip.

“This discovery could help fill the ‘terahertz gap’ and create new and more powerful wireless devices that could transmit data at significantly higher speeds than currently possible,” Dr Levy said. “In the world of hi-tech advances, this is game-changing technology.”

Meir Grajower, the leading PhD student on the project, added, “It will now be possible to manufacture any optical device with the precision and cost-effectiveness of flash technology.”



ADVANCED MANUFACTURING HUB COMING TO ELECTRONEX

Electronex — The Electronics Design and Assembly Expo will this year feature a new co-located hub for advanced manufacturing technology, which will include technical displays and free seminars for visitors.

Electronex has been running for nine years now, enabling designers, managers, engineers, technicians, manufacturers and system integrators to discuss their specific requirements with industry experts and see, test and compare the latest products to help them in their business.

The event has recently experienced a resurgence in interest from high-tech manufacturing companies, regularly attracting senior engineers and technical experts from design, R&D, defence, government and more. In fact, a 2017 visitor survey revealed that more than 60% of the audience wanted to see advanced or smart manufacturing solutions at future events.

To satisfy this demand, event organiser Australasian Exhibitions & Events has created an Advanced Manufacturing Hub for the 2018 event, where exhibitors will be able to meet and discuss applications and solutions with key personnel in manufacturing and design. A series of free seminars will also be held, enabling exhibitors to

present insights into the latest technology and innovations for the future success of Australia’s manufacturers.

The Advanced Manufacturing Hub will enable senior engineers and managers to see and discuss the latest solutions and technology and hear from industry experts to futureproof their business in the global marketplace. The organisers are thus encouraging suppliers from the following sectors to consider attending:

- Industry 4.0
- Internet of Things
- Additive manufacturing
- Smart robotics
- Digitalisation
- Artificial intelligence
- Advanced materials
- Sensors/data analytics

The event will also be held in conjunction with the SMCBA Electronics Design and Manufacture Conference, which has been running since 1988 and is regularly staged concurrently with Electronex. The conference program is set to feature internationally acclaimed industry experts Susy Webb and Jasbir Bath, from the USA, among others.

Electronex 2018 will be held from 5–6 September at Rosehill Gardens Event Centre in Sydney.

For more information, visit <https://www.electronex.com.au/>.





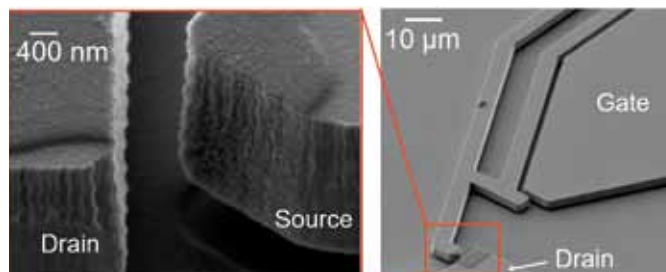
GRAPHITE-COATED RELAYS CAN WITHSTAND HARSH ENVIRONMENTS

UK researchers have created microelectromechanical relays suitable for harsh environments — by coating the contacts with nanocrystalline layers of graphite.

Micro- and nanoelectromechanical relays have effectively zero leakage current and can operate at much higher temperatures and levels of radiation than solid-state transistors. Such miniaturised relays have the potential to realise smart electronic components with integrated sensing, processing and actuation that are energy efficient.

Now, researchers at the Universities of Bristol and Southampton, in collaboration with semiconductor supplier Microsemi, have demonstrated how films of nanocrystalline graphite with a thickness of tens of nanometres can protect the relay tips against degradation over millions of switching cycles and provide a reliable electrical contact. Their work has been published in the journal *Carbon*.

“This is a breakthrough result that could pave the way for a new class of extremely energy-efficient electronic components for use in emerging paradigms such as autonomous sensor nodes in the Internet of Things,” said Dr Dinesh Pamunuwa, corresponding author on the paper from the University of Bristol.



A microelectromechanical relay with the contact electrode surfaces covered by a 100 nm thick layer of nanocrystalline graphite.

“The relays can withstand temperatures over 225°C and can easily absorb radiation doses that are two orders of magnitude higher than transistors are able to withstand. The challenge has been to make them reliable, and these thin films of nanocrystalline graphite effectively act as a conducting solid lubricant, protecting the relay electrodes as they physically make and break contact millions of times.”

SOLAR CELL MANUFACTURING MYTH BUSTED



European researchers have busted a 20-year-old myth surrounding solar cell production, finding that previous assumptions about the chemical processes involved are, in fact, inaccurate.

Photovoltaic solar panels absorb incoming sunlight, which excites electrons — sending them off in a predefined direction in order to generate an electric current that can drive motors or light a bulb. The cells are manufactured in a complex process where several chemical elements are deposited on a glass substrate, typically by evaporation. Thereby, a solar cell ‘grows’, layer by layer.

In the past, scientists discovered by accident that the efficiency of one type of solar cell technology improves vastly if they add sodium to the light-absorbing layer. At the same time, they observed that the sodium impacts the growth of this layer and the interaction of the other chemical elements; namely, that it inhibits the mixing of gallium and indium, which leads to less homogenous layers and thus impairs the results. Therefore, scientists and manufacturers have until now believed that the ideal way to produce a solar cell was to only add the sodium after the growth process was concluded.

By using a different approach, researchers from the University of Luxembourg, along with four international partners, have shown that the truth is more nuanced. While conventionally the light-absorbing layer is made up of thousands of individual grains, the research group chose a more demanding fabrication strategy and grew the layer as a single grain.

“Essentially, in this work we show that if the absorber is made of only one grain, adding a small amount of sodium helps to homogenise the distribution of the elements,” said principal investigator Diego Colombara. “This is very surprising, because more than 20 years of previous research have consistently shown the opposite effect on absorbers made of many grains.”

The researchers thus conclude that the sodium has a dual effect: it homogenises the elements inside each grain but it slows down homogenisation in the interplay between grains. The results of their study have been published in the journal *Nature Communications*.

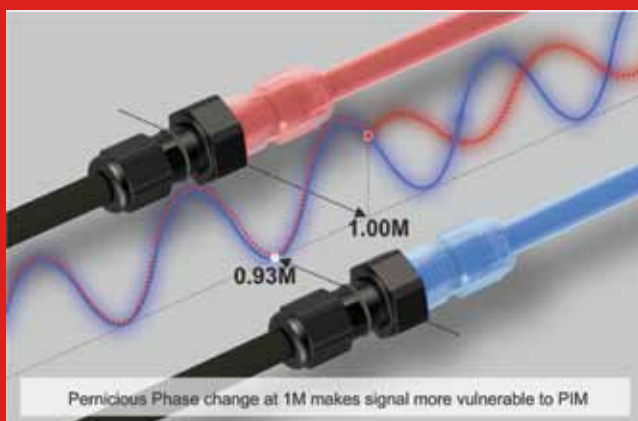
“This gives us the opportunity to rethink how we produce solar cells,” said study co-author Dr Phillip Dale.



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TAKE 1 CM OFF YOUR CABLE TO REDUCE PIM

A new study has discovered that cable lengths in mobile base station structures are much more important than previously thought, revealing that adjusting a jumper cable length by as little as 1 cm can significantly influence passive intermodulation (PIM).



PIM is a series of resulting signal harmonics and distortions that emerge between two or more interacting signals when transmitted through passive components such as cables and connectors, causing unwanted interference and degradation of wireless communications. 4G, 5G and future generation networks require stricter signal-to-noise ratios (SNRs) and the issue of PIM must be addressed if cellular capacity is to be maintained.

Now, a study by Hughes Electronics and the Biomedical and Communications (BiMEC) research group at London South Bank University suggests that standard metre-denominated lengths of cables are rarely phase congruent with commonly used (cellular telecom) frequencies and cause higher levels of PIM than are necessary.

"During our prior research into connector-related PIM we discovered that small adjustments to cable length made a significant difference to PIM results," explained Greg Rymar, head of research and product development at Hughes Electronics. "In particular, we found that industry-standard jumper and feeder cables denominated in multiples of 0.5 or 1 m lengths did not produce the most desirable results when it came to PIM.

"Our investigations showed the reason for the phenomenon was that these standard cable lengths are not in harmony with frequency wavelengths, ie, the cable length does not match the compound length of the carrier frequency sine wave, causing 'phase offsets' and triggering phase angle reflections, which can be seen as PIM.

"In addition, each reflection causes a loss of amplitude (VSWR) to the received signal and intermodulation (IM) becomes more acute as a result of the difference in power between transmitted and received signals. The more impoverished received signal strength is, the more vulnerable it is to PIM distortion levels."

Calculating overall phase displacement and adjusting cable length to harmonise phase in the operating frequency range is therefore a must for improving PIM performance, according to Hughes Electronics. In light of this, the company has added a length calculation service to its Network Approved rapid reaction non-standard jumper cable manufacturing service.

The addition of the service provides clients with the performance advantage of frequency- and phase-matched cables. The frequency-matched jumper cables are prepared in Hughes' central London workshop, using high-temperature inductive soldering, and incorporate an IP68 gastight moulded finish.

Hughes Electronics
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POWER ELECTRONIC STACKS

Power electronic stacks are assemblies that include power semiconductor modules, gate driver, snubber capacitors, protection, DC-link capacitors and cooling. Based on SEMIKRON's 40+ years of high-performance stack design, the company claims there are four essential ingredients needed for success.

In emerging markets, where product innovation is essential, companies need to be nimble and have a fast time to market. In global markets, multiple production locations play a vital role in ensuring rapid deployment to more than one country, while also meeting local demand and building customer relationships. Quality and cost control are crucial factors in the long-term success of any project. Finally, success in competitive markets is underpinned by good technical capability.

All four of these prerequisites are addressed by SEMIKRON's power electronic stacks. The company's product portfolio ranges from off-the-shelf platforms — with short lead times and delivered ready to install — to customised stacks with different levels of integration, from modules on heat sinks to fully integrated cabinets.

Semikron Pty Ltd
www.semikron.com.au



FANLESS EMBEDDED SYSTEM

iEi Integration's TANK-610-BW rugged fanless embedded PC is powered by Intel's Celeron N3160 processor and supports up to 8 GB of DDR3L RAM.

With a small form factor, the rugged, fanless embedded PC is designed to fit into space-limited areas. The dimensions of 18.4 x 20 x 5.8 cm make it compact in size, considering it is a fully featured industrial PC.

The product is also rich in I/O, supporting four USB 3.0 ports, two Gigabit Ethernet ports, six RS-232 COM ports and two RS-232/422/485 COM ports. For video-out the PC comes equipped with one VGA port supporting resolutions up to 2560 x 1600 and one HDMI port supporting resolutions all the way up to 3840 x 2160.

The device also has room for storage, featuring a 2.5" HDD or SSD bay and also one full-size mini PCIe slot that can accommodate a mSATA SSD. One half-size mini PCIe slot that can accommodate a Wi-Fi card for wireless network access is supported.

The product has a wide temperature range, withstanding temperatures of -40 to +60°C. This means it is able to withstand most environmental situations.

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



CORE ALIGNMENT FUSION SPLICER AND CLEAVER

The FiTEL S179 is a handheld, high-performance core alignment fusion splicer that delivers rapid splicing (6 s) and heating (9 s) with consistent results. It is available for rent at TechRentals.

The product has a wide, 4.3" LCD touch screen and a keypad for enhanced operator flexibility. It comes embedded with near field communication (NFC), which allows operators to lock and unlock the splicer via a smartphone.

The fusion splicer is highly effective for use in data centres, long-haul operations, Metro, LAN and FTTx fibre, including ultra bend-insensitive fibres as well as large area effective fibres. To support usability and visibility in low-light environments, the unit is equipped with 3+1 LED lights that illuminate the entire splicing chamber. The high-speed splicer includes a S326 cleaver and features state-of-the-art communication methods.

TechRentals
www.techrentals.com.au

FPGA PROCESSING MODULE

Extreme Engineering Solutions (X-ES) has introduced the XPedite2570, a rugged FPGA processing module with a high-speed optical front-end interface. Equipped with an integrated Xilinx Kintex UltraScale FPGA, the product optimises performance for high-bandwidth embedded computing applications.

The high-performance, conduction-cooled, 3U VPX FPGA processing module is based on the Xilinx Kintex UltraScale XCKU115 FPGA. The FPGA provides good performance/watt at 20 nm, as well as high signal processing bandwidth. The FPGA packs over 1.4 M system logic cells, 5520 DSP slices and 75.9 Mb of block RAM into the one package. It also provides a straightforward upgrade path for legacy systems, offering up to 40% power savings compared to the previous generation of FPGAs.

The device is a reconfigurable FPGA resource designed to meet the demands of high-bandwidth applications such as packet processing, signal processing and DSP-intensive applications. It features 12 rugged, protocol-independent fibre-optic transceivers operating at up to 10.31 Gbps, along with 8 GB of DDR4 ECC SDRAM in two independent channels capable of up to 38 GBps aggregate bandwidth. The product has several options for high-performance backplane I/O, including a x8 Gen3 PCI Express interface, dual GTH transceivers with a maximum data rate of 16.375 Gbps, and up to 44 LVDS transceivers for user I/O.

The company's board support package includes an FPGA Development Kit for Xilinx Vivado complete with a reference design, IP Integrator IP blocks, HDL, test benches and Linux drivers, so developers can jump right into application development without having to work through hardware integration issues.

Metromatics Pty Ltd

www.metromatics.com.au



Why TRI Components ?

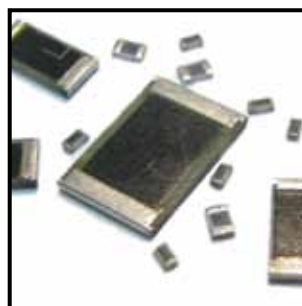
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RADAR SENSORS

Acconeer's A1 SRD radar sensors enable mm accuracy with low power consumption. The sensor is based on PCR (Pulsed Coherent Radar) technology, which has high-range resolution while only consuming microwatts of power, and offers several possibilities for integration into other battery-driven devices.

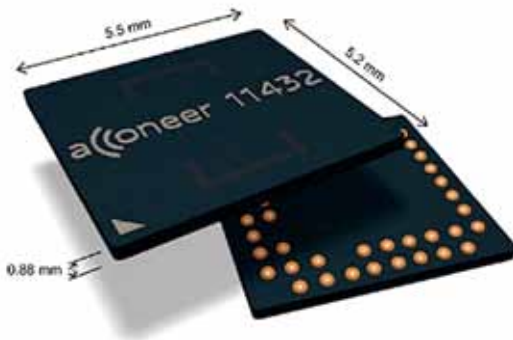
The small, one-chip sensor features optimised integration, with an embedded RF and antenna solution that requires no need for aperture. The robust unit is not compromised by any natural source of interference, such as noise, dust, colour and direct or indirect light.

Other characteristics include mm accuracy for one or more objects, continuous movement and speed measurement up to 1500 Hz, and the ability to distinguish between materials with different dielectric constants.

The company's 3D sensor technology is suitable for applications across multiple industries, including robots and drones, mobile and wearables, IoT, power tools and industrial, health care and fitness, and automotive.

Digi-Key Electronics

www.digikey.com



CAMERA WITH POLARISED IMAGE SENSOR

Teledyne DALSA has introduced its Genie Nano camera built around the Sony Pregius 5.1M polarised image sensor. It has a small footprint of 21.2 x 29 x 44 mm and lightweight frame of 47 g.

The Genie Nano-M2450-Polarized model features a monochrome quad polarisation filter, resolution of 2448 x 2048 pixels and image capture of 35 fps. With the company's TurboDrive technology, frame rates can increase by as much as 50%.

Polarisation enables detectability of stress, birefringence, through-reflection and glare from surfaces like glass, plastic and metal. Sony's image sensor, with its pixel-level polariser structure, enables the detection of both the amount and angle of polarised light across a scene. Four different angled polarisers (90°, 45°, 135° and 0°) are positioned on each pixel, and every block of four pixels comprises a calculation unit.

Adept Turnkey Solutions

www.adept.net.au

MOTION CONTROLLER FOR DC MOTORS

Available on request is the EPOS4 24/1.5 DC motor control module. Weighing just 17 g and measuring 39 x 54 mm, the position controller can also control both brushed DC motors and brushless DC motors (BLDC motors).

The product retains the full motion control capabilities of larger controllers, including RS232, USB, CanOpen and EtherCAT communications onboard or via adaptor modules. Feedback from the DC or BLDC motor is achieved using either hall sensors, incremental encoders or absolute encoders. It can be used with current/torque control, closed-loop speed control and position control.

Designed primarily for use on 12 or 24 V systems, the controller is based on a high PWM frequency of 100 kHz for adaption with highly dynamic ironless and coreless DC motors that have low inductance levels. Current limiting, overcurrent, overtemperature, undervoltage, overvoltage and short circuit protective functions are all included.

Free set-up software for auto configuration and tuning of motors is supplied, along with programming examples for PC, PLC, LabView and Linux environments. IEC61800-5-2 based Safe Torque Off (STO) makes the controller suitable for use in critical applications such as manufacturing processes and collaborative robotics.

maxon motor Australia Pty Ltd

www.maxonmotor.com.au



WEARABLE ENCLOSURE WITH STATION

The BODY-CASE wearable enclosure range by OKW Gehäusesysteme has been extended by a smaller size. In addition, a station is now also available for both enclosures. This means the enclosure can be kept safely when not in use, and an integrated charging option is also conceivable.

Possible applications include mobile data recording and data transmission; measuring and control engineering; digital communications technology; emergency call and notification systems; and bio-feedback sensors in the fields of health care, medical technology, leisure and sports, etc.

The enclosure range is suitable for portable technologies, so-called 'wearable technologies': it can be carried around the neck, arm or wrist, on articles of clothing or loose in a pocket. The wearable enclosure is particularly unobtrusive and does not restrict the wearer in any way, and is like an accessory.

The enclosure shells are highly polished and are made of high-quality ASA (UL 94 HB) in the colour traffic white (RAL 9016). The top parts are available with or without a recessed surface for decor foils or membrane keyboards. The matt TPV sealing ring is available in the colours vermilion (RAL 2002) as well as lava (similar to anthracite) and allows protection class IP65.

The range is available in two different sizes, with the version L featuring dimensions (L x W x H) 55 x 46 x 17 mm and the recently released version M featuring dimensions 50 x 41 x 16 mm. Depending on the operating elements and electronics required, the user can choose the most suitable size for their application. On the arm, the smaller version is a more suitable alternative for people with a slender wrist. There are also various matching accessories such as a wrist strap, a belt/pocket clip or a lanyard attachment.

The enclosures can be further modified by the OKW Service Centre. The options include, among others, mechanical machining for interfaces, a user-specific profile length, individual lettering and printing, or the manufacture and installation of digitally printed foils.

ROLEC OKW Australia New Zealand P/L

www.okw.com.au



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CERAMIC PRINTED CIRCUIT BOARDS

FOR AEROSPACE APPLICATIONS

Ceramic materials have been especially useful for highly reliable electronic applications. In the 19th century, ceramic material applications were the standards for isolators and light bulb sockets as well as the development of the use of high-technology application ceramics in radio tubes, early pacemakers and military electronics extensively used in the 1930s.

Since then, increased manufacturing technologies have enhanced the material class incredibly from plain materials through to new mixtures and nanotechnology, to the level of today's technical ceramics.

Properties and materials

Compared to the earlier standard ceramic materials, new technical ceramics have improved on their durability, inertness and chemical characteristics. Even the physical properties have undergone various changes. For example, they do not shatter as easily as they would have previously — a common issue with previous ceramic applications. In most application cases, specifically for applications in aerospace, there are a large variety of purposes for ceramics as the appropriate material system for printed circuit boards. However, it must be noted that ceramic materials are only a category of material and are not associated with the technology or a specific chemistry utilised in their application and function.

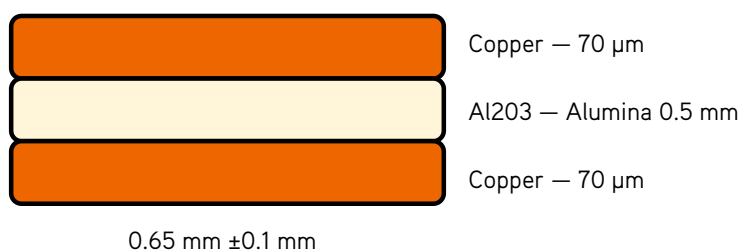
Ceramics are a large group of technical materials providing good opportunities for enabling advanced requirements. The greatest advantage of ceramic materials is their thermal mechanical behaviour. Among its thermal characteristics is the coefficient of expansion, thermal conductivity, thermal capacity, ageing under the influence of thermal cycling and the ability to withstand higher temperatures. The above characteristics are advantageous to electronic applications, especially for aerospace. For instance, unlike polymers and epoxies, ceramic materials do not show decomposition, and their chemical bonding does not break down from heat and UV radiation compared to other substances such as organics. Moreover, ceramics do not soak or absorb humidity in a significant scale and do not outgas in the extreme vacuum of deep space.

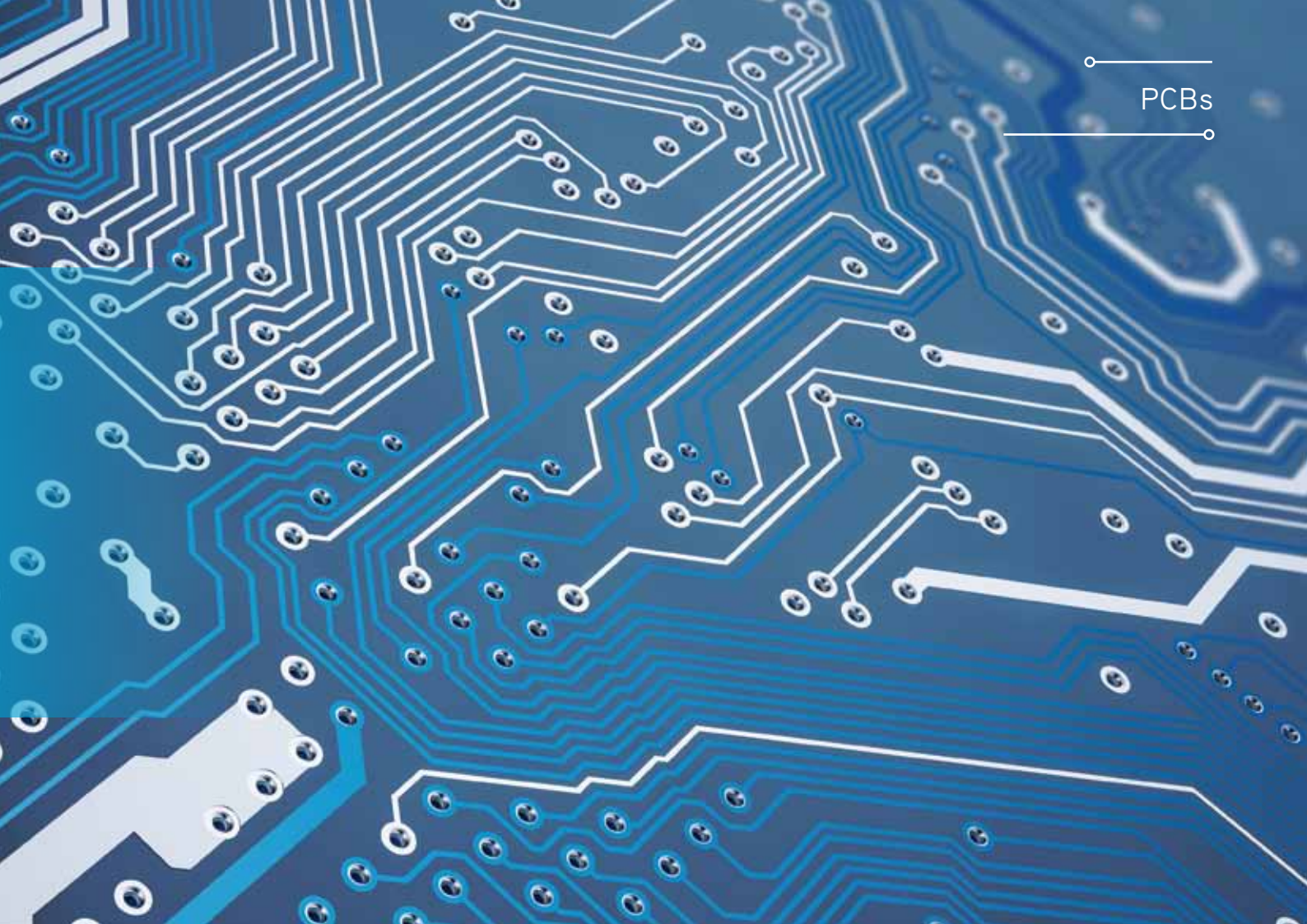
Function

In comparison with FR type PCBs, ceramic materials need structuring for electronic functionalities. This requires different technologies and the use of other materials. For instance, PCBs made of ceramic and copper may use alumina or aluminium nitride covered by copper foils using epoxy adhesives. While this is beneficial to most applications, this would not be beneficial in various thermal applications. This and other restrictions have led to product solutions such as direct bonded copper (DBC), including comparable covering techniques for aluminium nitrate, which is widely used for power chips such as an insulated-gate bipolar transmitter.

Materials and layer stack up

Alumina (Al₂O₃) is the most cost-effective ceramic material and also the most commonly used as it has great thermal conductivity at 24 to -28 W/mK, compared to metal core PCBs which have 1 to 4 W/mK.





Aluminium nitrate (AlN) provides superior thermal performance at 140 to 170 W/mK. It also a much higher raw material cost and is generally only designed in the highest of technology products.

Aerospace application

Aerospace applications usually do not have reduction, as their main target as the use of ceramic PCBs is mainly as a base for power dominated technology. To directly benefit from this group of materials, engineers and designers must have full knowledge and understanding of the limits and restrictions these materials possess and how they interact. The evaluation of necessary process conditions in combination with calculations and balancing of the advantages and disadvantages is required when deciding if the use of ceramics is beneficial to the required application.

Some advantageous characteristics of ceramic materials for electronics in aerospace include:

- Coefficient of thermal expansion — very close to silicon and far below that of most usual metals.
- Excellent electrical isolation — even in elevated temperatures and over lifetime.
- Good thermal conductivity as an isolator — useful for heat spreading and distribution.
- Stable dielectric properties and low losses at high frequencies.
- Chemical stability against many chemicals, moisture, solvents and consumables.
- Very slow ageing due to consistency of substance.
- Compatibility to noble metal paste sintering technology — resulting in highly reliable conductors.
- High processing temperatures — far removed from normal



Copper — 70 μ m

AlN — Aluminium nitrate 0.5 mm

Copper — 70 μ m

0.65 mm \pm 0.1 mm

operating range.

- Thermal resistance — showing no classic melting, decomposition or softening.
- Mechanical stiffness — allowing rigid carriers, hardness and wear resistance for sensors working in vacuum, fluids and in industrial pollution.
- Resistance to EUV, plasma and ion bombardment as well as practically no outgassing in high vacuum, ideal for sensors for EUV semiconductor equipment.

Conclusion

At PCB Global, we have the technology and the capabilities not only to fabricate ceramic PCBs, but to also assist you with any design specifications you may have regarding the application, use and outcome of the purpose of your ceramic PCB. For any enquiries or if you would like to arrange a quote for your ceramic PCB, please don't hesitate to contact us as sales@pcbglobal.com or through our online contact portal: www.pcbglobal.com/contact-us.html.

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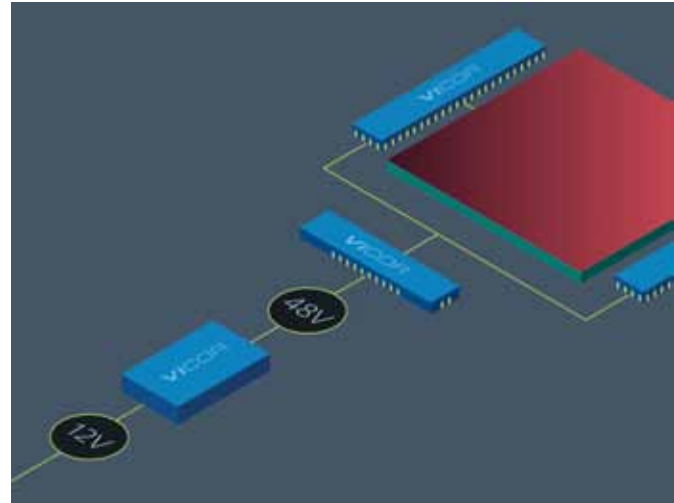
BOARD-TO-BOARD CONNECTORS

Würth Elektronik eiSos has expanded its portfolio of board-to-board connectors to include the WR-BTB series of plugs and receptacles. Examples of the SMT assembly connectors are plugs and receptacles with collars and chamfers in 1 mm and 0.8 mm pitch.

The robust plug connectors are designed for 30 mating cycles. The insulation material is of flammability class UL94 V-0 (certified UL approval E323964) and has an operating temperature of -55 to +85°C. The rated current of the partially gold-plated copper-alloy contacts is 0.5 A, with the voltage stability at 500 V. The contact resistance is 50 mΩ.

The plugs are available in 1 mm pitch with heights of 8.35 and 6.35 mm; the matching receptacles are available with 10.3, 7.3 and 5.3 mm heights. For the 0.8 mm pitch plugs, the heights are 7.6, 5.6 and 4.6 mm. The counterparts have heights of 11.75, 7.75 and 3.75 mm. All components also offer a variety of different numbers of poles.

Würth Elektronik EiSos
www.weonline.com



12 TO 48 V NBM MODULE

Vicor has announced a non-isolated upconverter to support 48 V high-performance GPUs in data centres that are still relying on legacy 12 V power distribution.

The 2317 NBM converts 12 to 48 V with over 98% peak efficiency, 750 W continuous and 1 kW peak power in a 23 x 17 x 7.4 mm surface-mount SM-ChiP package. The product provides a complete solution with no external input filter or bulk capacitors required.

By switching at 2 MHz with ZVS and ZCS, the NBM provides low output impedance and MHz fast transient response to dynamic loads. It incorporates hot-swap and inrush current limiting.

The NBM supports 48 V input GPUs using Power-on-Package (PoP) modular current multipliers (MCMs) driven from a 48 V node sourcing a small fraction (1/48) of the GPU current. Current multiplication overcomes the power delivery boundaries imposed by traditional 12 V systems standing in the way of higher bandwidth and connectivity.

Vicor Power-on-Package modules build on Factorized Power Architecture (FPA) systems deployed in high-performance computers and large-scale data centres. FPA provides efficient power distribution and direct conversion from 48 to 1 V for GPUs, CPUs and ASICs demanding up to 1000 A. By deploying current multiplication in close proximity to high current artificial intelligence (AI) processors, PoP MCMs enable high performance and system efficiency.

Vicor Corporation
www.vicorpower.com

INTELLIGENT MODEM AND SMS ALARM UNIT

ETM Pacific has released the ETM9140 3G/4G AUS Intelligent Modem and SMS Alarm. Combining a powerful microprocessor and built-in data logger with an industrial cellular wireless module, the product provides an alarm and monitoring or serial communications solution for demanding industrial applications.

The product provides 4G access, including 4GX compatibility with 700 MHz Band 28, but also has fallback to 3G. It has a phone book with five numbers and can send alarms via SMS or IP as well as receive commands and respond to status requests. It features customisable SMS commands and SMS alarm and control.

Logged data from the unit can include state, pulse counts and analog values. Data is sent in csv format to a nominated server and port by IP, from where it can be saved and or redirected by a server application. ETM Pacific can provide a complete logging solution with its ekoCALM service. Units for use on ekoCALM can be completely preconfigured by the company, so that all that is required on-site is to mount the unit, connect the antenna and plug in the power source.

With three inputs able to be pulse counters, five able to be analog inputs and all able to be digital inputs or outputs, plus low power consumption of less than 1 mW, the unit is suitable for remote applications where power is unavailable. It can be used with battery packs to provide up to two years' continuous monitoring of parameters including temperature, pulse counts and pressure for pharmaceutical, infrastructure and mining applications.

The modem can be combined with ETM's I/O board to allow for easy connection of 4–20 mA or 0–10 V sensors and/or output control via 0–30 V relays mounted on the I/O board.

ETM Pacific Pty Ltd
www.etmpacific.com



BRUSHLESS DC LINEAR ACTUATOR

The maxon motor BLDC combination linear actuator features a useful mixture of fast movements, high torque and holding ability. A precision ground metric thread and nut assembly can be customised to suit individual application mounting requirements.

The unit is available with an external thread for mounting the load and an internal thread for traversing the spindle with a stainless steel and brass combination suiting the application running characteristics. Ceramic and plastic materials are also available.

Featuring the EC-i 30 mm brushless DC motor, the linear actuator is held in an amalgamated bearing block with radial and axial bearings contained inside a planetary gear-head end flange. This is intended to reduce the size and eliminate many alignment issues associated with standalone ball screws and bearing blocks.

The series features speeds of up to 386 mm/s and linear forces up to 2700 N. The linear actuation length and system operating voltages are all changeable and high-resolution encoders enable positioning. The actuation system is suitable for use in general engineering machinery and manufacturing equipment.

maxon motor Australia Pty Ltd

www.maxonmotor.com.au



USB SOLID-STATE SP8T SWITCH

Mini-Circuits' USB-1SP8T-63H is an absorptive SP8T switch with USB control. The fast switching, solid-state switch operates from 10 to 6000 MHz with 250 ns typical switching speed.

High linearity (+50 dBm typ IP3) and high isolation (80 dB typical) allow the model to be used for a wide variety of RF applications — in particular, testing. Full software support is provided for USB control, including the company's user-friendly GUI application for Windows and a full API with programming instructions for Windows and Linux environments (both 32- and 64-bit systems).

The product is housed in a compact, low-profile, rugged metal case (6.5" x 2" x 0.475") with 9 SMA (F) connectors (COM, and J1 to J8) and a USB Mini-B port for power and control.

Clarke & Severn Electronics

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EMONA



CONNECTORS

Amphenol Industrial's Amphe-PD series connection system is designed to connect wire-to-wire, wire-to-board and busbar terminations. The series distributes higher currents with less heat than similar-sized connectors, according to the company.

The system features RADSOK technology for high amperage, low t-rise, low resistance and low mating forces. The RADSOK terminal features a stamped hyperbolic contact with multiple beams that provide optimal current-carrying performance and a long cycle life in a small footprint.

The connectors are available in a two-position, 3.6 mm RADSOK rated at 70 A or a two-position, 5.7 mm version capable of carrying 120 A continuously. The series produces good amperage without wasting valuable space, offering a compact solution for datacom applications which require small yet powerful connectors.

Mouser Electronics

www.mouser.com



PROGRAMMABLE AC/DC POWER SOURCES

The California Instruments Asterion line of AC power supplies by AMETEK Programmable Power combines intelligence and flexibility to create an advanced AC/DC platform. The easy-to-configure design features sophisticated technology for delivering high-performance, programmable AC and DC power.

The key to the product's high performance is AMETEK's iX2 current-doubling technology. With iX2, as the output voltage decreases from the maximum value to half the maximum value, the available output current increases up to two times the rated output current.

Other benefits include auto-parallel and clock/lock. With auto-parallel, users can combine up to six units to achieve 18,000 VA of output power. One unit becomes the master while the rest serve as auxiliary units.

The clock/lock feature allows users to easily configure multiphase systems, such as split-phase, three-phase or even higher phase count systems. This allows users to purchase only the power they need today and then easily add more power and/or phases later as required.

Test engineers will appreciate the Asterion AC source's ease of use, with AMETEK having developed a user interface specifically for this platform. The intuitive, touch-screen interface, not found on other AC sources, allows users to quickly and easily set up the source and run tests.

Fuseco Power Solutions Pty Ltd

www.fuseco.com.au

PICO-ITX BOARD

Advantech's 2.5" Pico-ITX SBC MIO-2360 is designed with the Intel Pentium N4200 and Intel Celeron N3350 processor. It provides high CPU and graphic performance as well as various expansion interfaces, including miniPCIe, mSATA and Advantech's MI/O extension.

The product presents a flexible and modularised-design solution through its plentiful connection choices. Its consistent rear I/O is fully compatible with the full range of 2.5" Pico-ITX product series. This offers users an easy way to upgrade their current platform design and product applications. When integrated with Advantech's innovative MI/O extension modules (MIOe-110/MIOe-120), additional I/O functions could be extended from the board level for more USB 2.0 and RS232/242/485 support.



The unit has a low TDP rating of 6 W that improves heat dissipation and enhances CPU performance. It supports multiple displays (24-bit LVDS+VGA/HDMI+MIOe) and 2K/4K resolution (4K UHD HEVC 10-bit) because of its Intel Celeron N4200, which is said to have 2.5x times better CPU performance and to offer over 2x better power saving compared with the Intel Celeron J1900 processor. The 9th Gen Intel Graphics Architecture (resolution: 1920 x 1200) offers full HD video playback, the latest media hardware acceleration and H.265 hardware video transcoding.

The device offers users various types of selected embedded OS including Windows Embedded and Linux (ie, Yocto development). Advantech's embedded SBC department has invested in developing its first Yocto project for MIO-2360, including a Yocto BSP, image and instructions based on Intel Pentium N4200 and Intel Celeron N3350 processors. The Yocto project is a suitable replacement for Window CE if product manufacturers would like to enhance their embedded development with extra functionality options and open source features for further use. The BSP also integrates with Advantech's WISE-PaaS/RMM remote management software, which provides real-time synchronised hardware and software monitoring and maintenance.

Advantech Australia Pty Ltd

www.advantech.net.au



LOW-DROPOUT VOLTAGE REGULATOR

STMicroelectronics' STLQ020 low-dropout (LDO) voltage regulator relieves the familiar trade-offs between quiescent current, output power, dynamic response and package size, to give designers extra freedom.

By combining small size with high performance and energy efficiency, the product is suitable for use in battery-powered consumer products like smartphones and tablets, smart watches, audio or media devices, and wearables. It helps extend battery life in IoT endpoints such as smart meters and wireless sensors, healthcare devices like wearable monitors, and industrial applications such as factory automation or sensor networking.

Drawing 300 nA quiescent current (I_q), and capable of supplying up to 200 mA to the load with good regulation, power-supply rejection (PSRR) and transient response, the regulator is available in a choice of compact packages reaching as small as a 0.8 x 0.8 mm flip-chip4.

The product features dedicated low-power design and adaptive bias circuitry, which ensures fast response and a stable output with high PSRR. In addition, dropout voltage as low as 160 mV (typical) at maximum load allows long equipment runtimes as the battery discharges. Also, with the advantage of its 5 nA logic-controlled shutdown mode, the device can extend the interval between coin-cell replacements in low-duty-cycle applications like remote sensors.

With an input voltage range of 2–5.5 V, the product can be powered directly from a suitable battery voltage (VBAT) or logic rail. The output voltage can be set between 0.8 and 4.5 V, with either fixed-output or adjustable-output versions available. The fixed output voltages are selectable in 50 mV increments.

STMicroelectronics Pty Ltd

www.st.com



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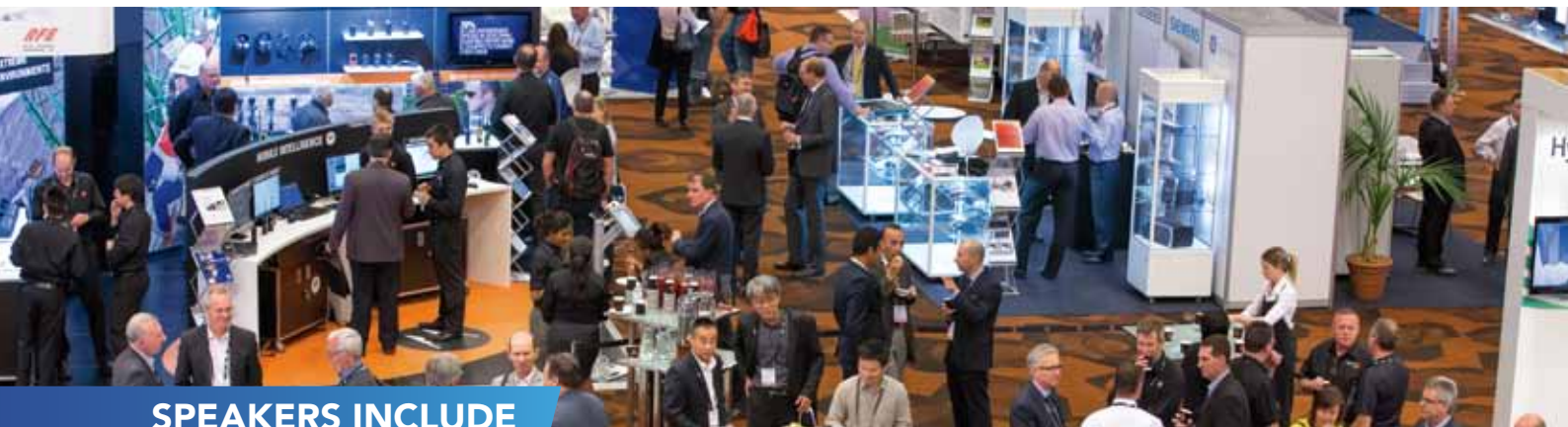
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GOOD AS GOLD

HIGH-CAPACITY DATA STORAGE TECHNOLOGY DEVELOPED

Australian and Chinese scientists have utilised the durability of gold in the creation of a high-capacity optical disk that can hold data securely for more than 600 years.

The rise of big data and cloud storage has necessitated an increase in power-hungry data centres. These centres not only use up colossal amounts of energy — consuming about 3% of the world's electricity supply — but largely rely on hard disk drives that have limited capacity (up to 2 TB per disk) and lifespans (up to two years).

Scientists from RMIT University in Melbourne and Wuhan Institute of Technology in China, led by RMIT Distinguished Professor Min Gu, have now used gold nanomaterials to demonstrate a next-generation optical disk with up to 10 TB capacity — a storage leap of 400% — and a six-century lifespan. Their work has been published in the journal *Nature Communications*.

Developed over five years, the technique behind the technology combines gold nanomaterials with a hybrid glass material that has impressive mechanical strength. The research progresses earlier work by Gu and his team that smashed through the optical limit of Blu-ray and enabled data to be stored across the full spectrum of visible light rays.

Glass is a highly durable material that can last up to 1000 years and can be used to hold data, but has limited storage capacity because of its inflexibility. The team decided to combine glass with an organic material, halving its lifespan but radically increasing capacity.

To create the nanoplasmonic hybrid glass matrix, gold nanorods were incorporated into a hybrid glass composite, known as organic modified ceramic. The researchers chose gold because, like glass, it is robust and highly durable. Gold nanoparticles allow information to be recorded in five dimensions — the three dimensions in space plus colour and polarisation.

The technology could radically improve the energy efficiency of data centres — using 1000 times less power than a hard disk centre — by requiring far less cooling and doing away with the

energy-intensive task of data migration every two years. Optical disks are also inherently far more secure than hard disks.

“All the data we're generating in the big data era — over 2.5 quintillion bytes a day — has to be stored somewhere, but our current storage technologies were developed in different times,” noted Gu.

“While optical technology can expand capacity, the most advanced optical disks developed so far have only 50-year lifespans.

“Our technique can create an optical disk with the largest capacity of any optical technology developed to date and our tests have shown it will last over half a millennium.”

RMIT's Dr Qiming Zhang, lead author on the study, added that the new technology could expand horizons for research by helping to enable the shift from big data towards 'long data' — the mining of massive datasets that capture changes in the real world over decades and centuries.

“Long data offers an unprecedented opportunity for new discoveries in almost every field — from astrophysics to biology, social science to business — but we can't unlock that potential without addressing the storage challenge,” said Zhang.

“For example, to study the mutation of just one human family tree, 8 TB of data is required to analyse the genomes across 10 generations. In astronomy, the Square Kilometre Array (SKA) radio telescope produces 576 PB of raw data per hour. Meanwhile, the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative to 'map' the human brain is handling data measured in yottabytes, or one trillion terabytes.

“These enormous amounts of data have to last over generations to be meaningful. Developing storage devices with both high capacity and long lifespan is essential, so we can realise the impact that research using long data can make in the world.”



ENTRY-LEVEL SPECTRUM ANALYSER

The R&S FPC1500 combines a spectrum analyser, a one-port vector network analyser with internal VSWR bridge, an independent CW signal generator and a tracking generator, all in one compact instrument. It provides solid RF performance and a comprehensive future-ready feature set, making it suitable for education, in service and repair shops and for professional hobbyists.

The base model of the analyser has a frequency range of 5 kHz to 1 GHz. Keycode options unlock higher frequency ranges up to 3 GHz or enable other measurement application features when required. Upgrades are activated immediately when the keycodes are entered and there is no need for upgrade calibration.

The product offers a low noise floor level of -150 dBm, which can be further extended to -165 dBm through an optional, keycode-activated preamplifier. Its high maximum input power allows users to measure RF signals up to +30 dBm (1 W). This combination of high sensitivity and high input power level gives the product a wide measurement dynamic range. The unit also offers good measurement and display resolution of 1 Hz RBW and 10.1" (1366 x 768 pixels), displaying signals in sharp detail.

The VSWR bridge enables the device to perform reflection measurements. This allows users to measure impedance on antennas or RF circuits with the Smith chart display or use distance-to-fault measurements to detect faulty locations on a long RF cable. There is no need to mount and dismount an external VSWR bridge when switching between the spectrum analyser and network analyser modes.

The integrated tracking generator enables scalar transmission measurements on passive and active RF components that do not produce their own RF signal. The product also has the ability to act as an independent continuous wave (CW) signal generator. Example applications include using the CW signal source as an LO signal for mixer measurements or as an input signal for amplifier gain measurements. Further, the device offers a coupled CW mode that couples the generated CW signal to the displayed centre frequency of the unit. Whenever a measurement requires a CW signal to follow the product's centre frequency, these operations can be set in a single step.

Rohde & Schwarz (Australia) Pty Ltd
www.rohde-schwarz.com.au



LDMOS TRANSISTOR

The AFT31150N is a 150 W peak power LDMOS transistor from NXP Semiconductors. It is designed for applications operating at frequencies between 2700 and 3100 MHz and is particularly suitable for use in pulse applications.

The transistor is characterised with series-equivalent large-signal impedance parameters and is internally matched for ease of use. It is qualified up to a maximum of 32 VDD operation, with integrated ESD protection and good negative gate source voltage range for improved Class C operation, according to the company.

The product is suitable for commercial S-band radar systems, maritime radar and weather radar applications. Additional features include: P1 dB of +51.8 dBm; power gain of 17 dB @ 3100 MHz; efficiency of 50%; and thermal resistance of 0.042°C/W.

Wireless Components

www.wirelesscomponents.com.au



SEALED LED PANEL INDICATOR

The Marl 665 series 8.5 mm mounting, professional LED panel indicator features a

hexagonal bezel and a self-lubricating PTFE 'top hat' style panel seal to aid with mounting. A range of high-intensity sunlight-readable LEDs is offered in red, yellow, green, blue or cool white.

Internal circuitry is designed for operation at 20 mA. Termination is achieved by 150 mm colour-coded flying leads, which are in accordance with Def Stan 61/12 part 18 chemical and flame retardant.

The device is fitted with a domed, shatterproof, polycarbonate, coloured diffused lens assembly to provide good wide-angle viewing. The precision-turned housing is manufactured from aluminium with a high-quality, hard anodised black finish which is in accordance with Def Stan 03-26 (50 µm).

The product works at pressures up to 10 psi (IP68) and is well protected against corrosive fluids such as sea water as well as against shock and vibration. Mean time between failures (MTBF) is over 100,000 h. The unit is supplied complete with full mounting hardware.

Aerospace & Defence Products

www.aerospacedefenceproducts.com.au



NODE AND LORA GATEWAY

Advantech in partnership with Semtech has expanded its line of wireless products with the launch of the Wizzard LRPv Node and SmartSwarm 243 LoRa Gateway.

LoRa is a proprietary chirp spread spectrum radio modulation technology for low-power WAN (LPWAN, also referred to as a low-power network) applications. An LPWAN is a type of wireless telecommunication WAN that is designed for long-range, low-bit-rate communication among 'things' (ie, connected objects such as battery-powered sensors). As the Advantech Wizzard LRPv Node and SmartSwarm 243 LoRa Gateway support long-range WAN communication, there is no need to pay additional telecommunication costs.

Advantech's Wizzard LRPv Node can connect up to four sensors simultaneously. It is suitable for production lines that have many sensors or for applications where there is limited space for additional devices. The software is specifically designed to be customisable so as to accommodate the most sophisticated of monitoring plans. The node offers high flexibility in both hardware and software aspects; therefore, it frees users from having to deploy an infrastructure-heavy wireless network, meaning that resources can be allocated to other more critical investments.

The node has two modes: sleep mode (for when the node is idle) and operation mode (for data transmission). It comes with an embedded alarm system to notify users when a threshold has been exceeded so that action can be taken. The smart design of the operation modes and alarm system helps control the budget by saving the power it consumed and notifying users if any emergent actions are required.

With an IP66 rating, both devices are protected against ingress from dust and powerful water jets. Furthermore, their dual-power design (BC/battery for the Wizzard LRPv Node and solar/battery for the SmartSwarm 243 Gateway) provides multiple deployment options.

Advantech Australia Pty Ltd
www.advantech.net.au

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COMPACT ELECTRONIC ACTUATOR

Southco has expanded its line of electronic access solutions with a compact electronic actuator that simplifies the upgrade from mechanical to electronic access. The AC-EM 05 Electronic Actuator offers an option for achieving electronic actuation of Southco's R4-05 Micro Rotary Latch series and other mechanical latches.

When connected to an electronic access control device, the product can be used to actuate a mechanical latch to remotely open or unlock a door or panel. With its small-profile design and efficient gear motor operation, the device is suitable for concealed applications where physical space constraints are a challenge.

The compact electronic actuator is widely used in automotive, enclosure and industrial machinery applications as well as self-service equipment to offer quick installation and lightweight solutions for implementing actuation. It can be easily paired with Southco's R4-05 Micro Rotary Latch series or any other comparable mechanism to provide electronic access control in limited-space applications.

McNaughtans

www.mcnaughtans.com.au



VACUUM INLET TRAPS

Mass-Vac manufactures a broad range of high-capacity vacuum inlet traps that protect vacuum pumps in manufacturing processes.

MV Multi-Trap Vacuum Inlet Traps are suitable for MOCVD, HVPE, GaN and AlGaIn processes that generate high volumes of particulates and condensable by-products in manufacturing HBLEDs and power semiconductors. Featuring a knock-down stage plus two stages of user-selectable filter elements, the traps are capable of up to 40,968 cm³ of solids accumulation with >99% efficiency for particulates and condensables.

Offered in 25.4, 30.48 and 40.64 mm diameter models, including a cooling option to facilitate removing condensables, the inlet traps can be designed to accommodate different production processes and pump capacities to 2000 CFM. They are available with activated alumina or charcoal filter elements for vapours, Sodasorb and other specialised elements for trapping other contaminants.

AVT Services Pty Limited

www.avt.net.au

SYSTEM-ON-MODULE

Artila Electronics' latest SODIMM module is based on the NXP i.MX6ULL ARM Cortex A7 CPU core, operating up to 800 MHz speed with Linux OS. The M-X6ULL is designed to meet the needs of many general embedded applications that require a power-efficient, high-performance solution, as well as embedded systems that require high-end multimedia applications in a small form factor.

The device is compact in size with the form factor of 68 x 43 mm. In addition, it has 200-pins connectors to allow the extension of more I/Os for peripheral signals like two 10/100 Mbps Ethernet, LCD, CAN, UART, USB, SD and I²C.

The product's 24-bit digital parallel display interface supports resolutions up to 1366 x 768 and the touch controller can support 4- and 5-wire resistive touch panel, which brings powerful touch-screen performance to the embedded users. Linux kernel 4.14 is pre-installed on the eMMC and the PREEMPT_RT patch is useful when real-time interactive interfaces and connectivity are crucial requirements.

The Artila team provides comprehensive software packages such as PHP, Python, Perl, Node.js and Node-RED, which are available for free, and users can find the updates from the Artila repository. Moreover, users can choose a light version of M-X6ULL with the removal of eMMC and a micro-SD socket replacement is available by request.

The system-on-module is integrated with 512 MB DDR3 SDRAM and 4 GB eMMC, which is suitable for power-optimised general embedded and industrial applications. The major target applications of the module are Industrial HMI and access control, IoT gateway, industrial control and automation, and test and measurement.

Micromax Pty Ltd

www.micromax.com.au



BREAKOUT BOARD

RECOM has released a breakout board to connect the SensorTile from STMicroelectronics to RECOM's R-78S evaluation board. The technology enables the SensorTile to draw a stable 3.3 V from a single AA battery down to voltages as low as 0.65 V. Engineers can therefore integrate a high-capacity single-cell AA battery into their designs and use test points to estimate the application's operation lifetime.

The R-78S3.3-0.1-EVM-1/STM-1 is a breakout board developed to be used with an STMicroelectronics STEVAL STLCS01V1 SensorTile module and the R-78S3.3-0.1-EVM-1 evaluation module to demonstrate IoT applications using the SensorTile module. When powered directly through a coin cell battery, the input voltage can soon drop after only a few hours of use. This causes the Bluetooth Low Energy transmission unit to stop operating properly and leaves the energy from the coin cell battery wasted. This can be averted by incorporating the functionality of

the R-78S, which boosts a single-cell AA battery voltage of 1.5 V up to a stable 3.3 V — demonstrated by the R-78S evaluation board.

Test points for measuring voltages and currents make it possible to effortlessly calculate the typical battery lifetime for the SensorTile in both active and standby modes. Combining a AA battery and the R-78S is said to ensure a long application lifetime and at the same time reduces maintenance costs, according to the company. There is also an option to use external input voltage from other low-voltage sources such as energy harvesting devices, which are typical in remote applications.

The R-78S evaluation board and the corresponding breakout board are available at authorised distributors.

RECOM Power GmbH

www.recom-power.com



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ATOM QUBITS 'TALK' TO EACH OTHER FOR THE FIRST TIME

Australian researchers are creating quantum bits from precisely positioned individual atoms in silicon — and have recently succeeded in making two of these atom qubits 'talk' to each other for the first time.

Led by UNSW Scientia Professor Michelle Simmons, director of the Centre of Excellence for Quantum Computation and Communication Technology (CQC²T), the team creates the atom qubits by precisely positioning and encapsulating individual phosphorus atoms within a silicon chip. Information is stored on the quantum spin of a single phosphorus electron.

"In placing our phosphorus atoms in the silicon to make a qubit, we have demonstrated that we can use a scanning probe to directly measure the atom's wave function, which tells us its exact physical location in the chip," Professor Simmons said. "We are the only group in the world who can actually see where our qubits are.

"Our competitive advantage is that we can put our high-quality qubit where we want it in the chip, see what we've made, and then measure how it behaves. We can add another qubit nearby and see how the two wave functions interact. And then we can start to generate replicas of the devices we have created."

For the new study, published in the journal *Nature Communications*, the team placed two qubits — one made of two phosphorus atoms and one made of a single phosphorus atom — 16 nm apart in a silicon chip. As explained by lead co-author Dr Matthew Broome, "Using electrodes that were patterned onto the chip with similar precision techniques, we were able to control the interactions between these two neighbouring qubits, so the quantum spins of their electrons became correlated.

"It was fascinating to watch," said Dr Broome, formerly of UNSW and now based at the University of Copenhagen. "When the spin of

one electron is pointing up, the other points down, and vice versa.

"This is a major milestone for the technology. These types of spin correlations are the precursor to the entangled states that are necessary for a quantum computer to function and carry out complex calculations."

Lead co-author Sam Gorman added: "Theory had predicted the two qubits would need to be placed 20 nm apart to see this correlation effect. But we found it occurs at only 16 nm apart.

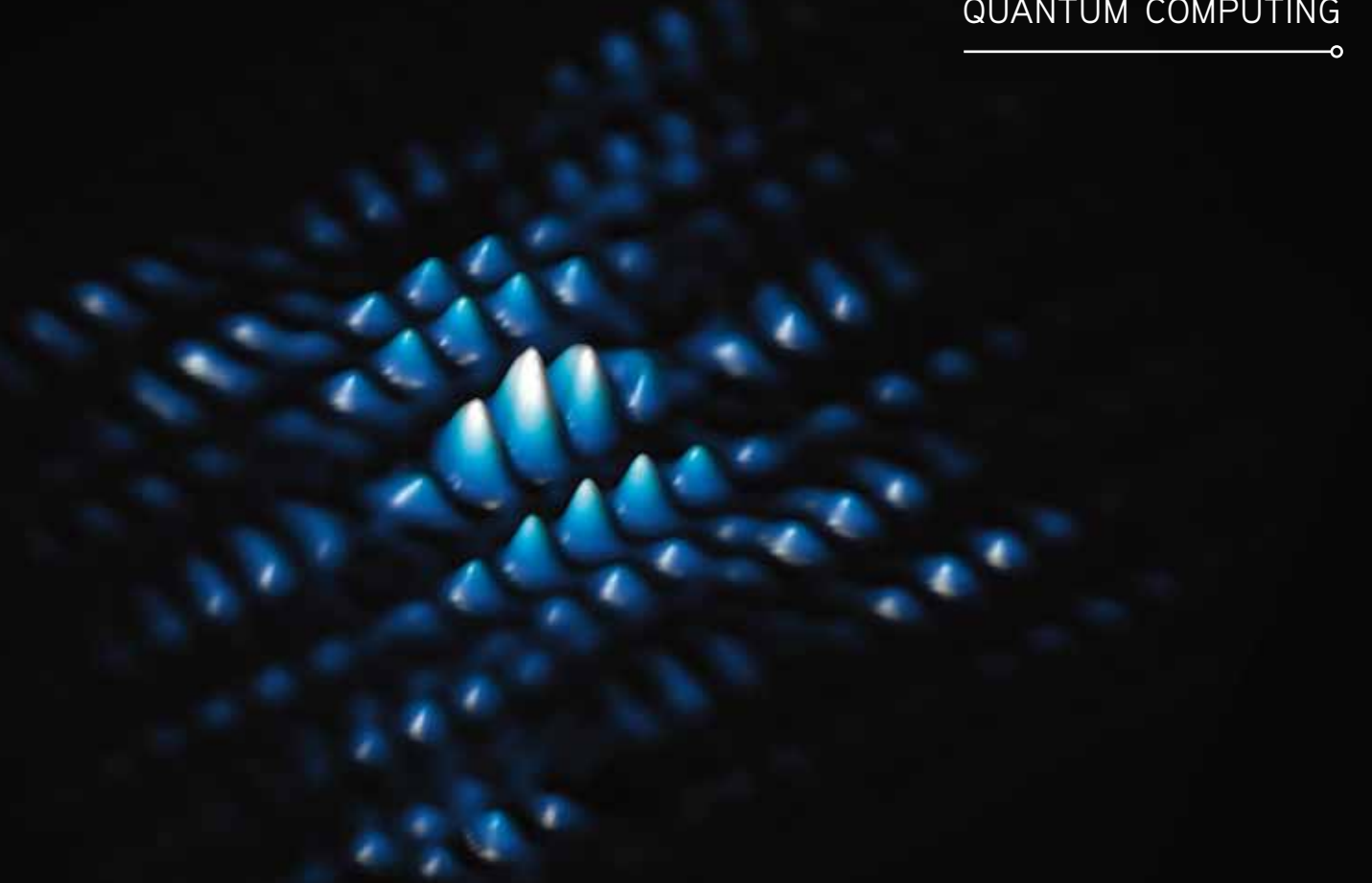
"In our quantum world, this is a very big difference," said Gorman, a PhD candidate at UNSW. "It is also brilliant, as an experimentalist, to be challenging the theory."

Scientists and engineers at CQC²T are at the forefront in the race to build a quantum computer in silicon, developing parallel approaches using single-atom and quantum-dot qubits. The team has chosen to work in silicon because it is among the most stable and easily manufactured environments in which to host qubits, and its long history of use in the conventional computer industry means there is a vast body of knowledge about this material.

In a recent paper published in the journal *Nano Letters*, the team used atomic-scale control techniques to produce quantum circuitry about 2–10 nm wide. Working in collaboration with Saquib Shamim and Arindam Ghosh of the Indian Institute of Science, the team managed to achieve the lowest recorded electrical noise of any semiconductor circuitry.

"Our results confirm that silicon is an optimal choice, because its use avoids the problem most other devices face of having a mix of different materials — including dielectrics and surface

Image credit: UNSW.



A scanning tunnelling microscope image showing the electron wave function of a qubit made from a phosphorus atom precisely positioned in silicon.

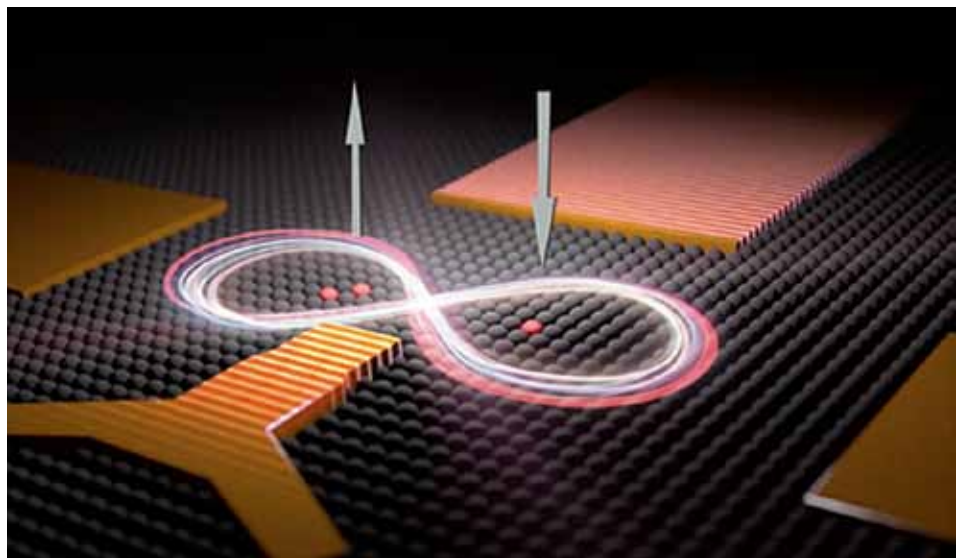
metals — that can be the source of, and amplify, electrical noise,” Professor Simmons said.

“With our precision approach we’ve achieved what we believe is the lowest electrical noise level possible for an electronic nano-device in silicon — three orders of magnitude lower than even using carbon nanotubes.”

In another recent paper in *Science Advances*, Professor Simmons’ team showed their precision qubits in silicon could be engineered so the electron spin had a record lifetime of 30 seconds — up to 16 times longer than previously reported. These long lifetimes allowed the researchers to read out the electron spins of two qubits in sequence with an accuracy of 99.8% for each, which is the level required for practical error correction in a quantum processor.

“The lifetime of the electron spin — before it starts to decay, for example, from spin up to spin down — is vital,” said Professor Simmons. “The longer the lifetime, the longer we can store information in its quantum state.”

“The combined results from these three research papers confirm the extremely promising prospects for building multi-qubit systems using our atom qubits.”



An artist's impression of two qubits — one made of two phosphorus atoms and one made of a single phosphorus atom — placed 16 nm apart in a silicon chip. UNSW scientists were able to control the interactions between the two qubits so the quantum spins of their electrons became correlated. When the spin of one electron is pointing up, the other points down.

PC CARD

HMS Industrial Networks has added the M.2 format to its IXXAT INpact PC card range, resulting in what is claimed to be the smallest PC interface for Industrial Ethernet and Profibus on the market. The interface means users can implement PROFINET, EtherNet/IP, EtherCAT, Modbus-TCP, Powerlink and PROFIBUS slave connectivity with a small footprint.

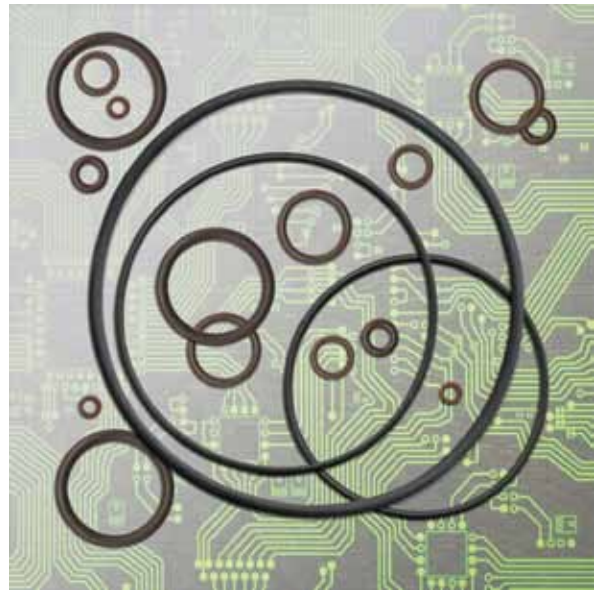
The compact form factor M.2 2260 (Key B-M) makes INpact M.2 suitable for small and mobile devices, typically used for service, configuration, data analysis or process data visualisation purposes. The product also fits well in modern embedded computer-based controllers, where it enables direct and easy connectivity to desired industrial networks.

The device comes with a comprehensive driver package for Windows, Linux, INtime and QNX, offering an easy and fast development process. A uniform programming interface allows users to switch seamlessly between different INpact cards and protocols without changing the software.

The multinetwork capability of the product is based on Anybus CompactCom technology, in which the FPGA-based Anybus NP40 network processor provides all functionality required to handle communication between the Industrial Ethernet or fieldbus network and the user application. The solution features real-time performance, making it suitable for demanding industrial applications.

The interface is available as finalised product with a pre-installed network protocol, but it also features a flexible, multiprotocol Common Ethernet version which enables users to save storage cost. Users can simply select and upload the desired Industrial Ethernet protocol to the INpact by themselves, depending on their networking needs.

Global M2M
www.globalm2m.com.au



SEAL MATERIAL

DowDuPont Transportation and Advanced Polymers has introduced the DuPont Kalrez 9600, an innovative perfluoroelastomer compound developed to meet the needs of the semiconductor fabricating industry.

A well-balanced, high-purity perfluoroelastomer product, the product provides long seal life by offering enhanced performance properties in an array of aggressive and emerging high-temperature plasma applications. It has good ozone, ammonia, fluorine and oxygen radical resistance as well as ultralow outgassing and high thermal stability.

The material is based on a cross-linking system and is identifiable by its olive-green colour. It is especially suitable for plasma deposition applications such as atomic layer deposition and chemical vapour deposition, as well as etch processes used to fabricate next-gen chips in the semiconductor industry.

The product is available in a broad range of standard O-ring sizes and custom parts, including bonded door seals for a variety of sealing applications.

DuPont (Aust) Limited
www.dupont.com.au





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SPLASHPROOF CABLE ASSEMBLIES

Dytran Instruments has released three cable assemblies featuring an IP65-rated connector that keeps the connection between cables and accelerometers dry during vehicle dynamics testing. Models 60033A, 60034A and 60035A are 4-pin, triaxial, four conductor shielded cables, offered in various terminations and lengths that have been designed to thrive in harsh environments.

The addition of an IP65-rated connector makes the cable assemblies suitable for use in outdoor or indoor applications where they may be exposed to dust and moisture. When properly mated with an industry standard pin-out, hermetically sealed, triaxial accelerometer, the ¼-28 4-pin connector makes the cable dust-tight and is protected against the ingress of water caused by splashing. The cables are splashproof and protected against dust ingress up to the black moulded triaxial splitter.

The triaxial cable assemblies are jacketed in Teflon and have an operating temperature of -55 to +135°C. Model 60033A terminates to three Santoprene BNC plugs, Model 60034A terminates to flying leads and Model 60035A terminates to three 10-32 plugs. The basic cable used for each models can withstand a voltage potential of up to 250 V between conductors.

The cable assemblies are suitable for field testing, outdoor and marine applications, undercarriage and suspension testing, NVH applications and more.

Metromatics Pty Ltd

www.metromatics.com.au

DESIGN SOFTWARE

MathWorks has announced Release 2018a (R2018a) of its MATLAB and Simulink product families, introducing a range of additional capabilities.

The release includes two previously unavailable products: Predictive Maintenance Toolbox, for designing and testing condition monitoring and predictive maintenance algorithms, and Vehicle Dynamics Blockset, for modelling and simulating vehicle dynamics in a virtual 3D environment.

Further to the additional features and the two products, the release also includes updates and bug fixes to 94 other products.

R2018a is available immediately worldwide.

MathWorks Australia

www.mathworks.com.au

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More information at www.anritsu.com
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DC/DC CONVERTER SERIES

Mornsun has extended its 24 V isolated, regulated DC/DC converters with a 100 W series. The URF24_QB-100WR3 series DC/DC converters meet EN62368 and EN50155 standards, with EMI meeting CISPR22/EN55022 Class B.

The ¼ brick package has international standard pin-outs and can be supplied without a base mount, making thermal heatsink connection possible through the base. The device also has a heatsink option.

In addition to being suitable for traditional industry applications, such as industrial, communications, power grid, rail transportation, etc, the converters are also applicable to emerging manufacturing industries, eg, intelligent manufacturing and intelligent robots, as well as energy industries including wind energy controllers, electric vehicles, etc.

The devices feature input voltage of 4:1 (9–36 VDC) and isolation voltage of 2250 VDC. They have an operating temperature range of -40 to 85°C, with up to 94% efficiency, as well as input undervoltage, output short circuit, overcurrent, overvoltage and overtemperature protections.

DLPC Pty Ltd

www.dlpc.com.au



TIME-OF-FLIGHT SENSOR

The VL53L1X time-of-flight sensor from STMicroelectronics extends the detection range of the company's FlightSense technology to four metres, bringing low-power distance measurement and proximity detection to a wide variety of applications. Unlike proximity sensors that use simple IR (infrared) technology, which only measure signal strength and can be affected by the object's reflectivity, FlightSense sensors directly measure distance to the object based on the time for emitted photons to be reflected, enabling good distance ranging regardless of the object's surface characteristics.

With low power consumption and fast ranging performance, the VL53L1X is suitable for mobile robotics for wall following, cliff detection, collision avoidance and hover/landing assistance for drones or unmanned aerial vehicles (UAVs). The power-saving presence-detection mode enables innovative auto-sleep/wake-on-approach use cases for PCs, notebooks and IoT devices, in addition to camera auto-focus assist and gesture recognition. Further applications include washroom automation in toilets, faucets or soap dispensers, and package counting to aid inventory management in vending machines or smart-shelf systems.

The fully integrated and miniaturised device measures 4.9 x 2.5 x 1.56 mm, allowing use even where space is limited. It is also pin-compatible with its predecessor, the VL53L0X, allowing easy upgrading of existing products. The compact package contains the laser driver and emitter as well as the Single-Photon Avalanche Diode (SPAD) light receiver that gives ST's FlightSense sensors their high ranging speed. Furthermore, the 940 nm emitter, operating in the non-visible spectrum, eliminates distracting light emission and can be hidden behind a protective window without impairing measurement performance.

STMicroelectronics Pty Ltd

www.st.com



1 W COMMODITY DC/DC CONVERTERS

RECOM now offers the RFB, RFM and RFMM commodity DC/DC converters.

The RFB, RFM and RFMM are SIP4 and SIP7 case DC/DC converters that are typically used in power isolation and voltage matching applications in board interfaces, which have become high-volume commodity applications. They are fully specified 5 to 5 VDC converters with 1 or 4 kVDC isolation, an industrial operating temperature range of -40 to +85°C (without derating) and UL/EN certifications.

The series has the same high-quality, international certifications and warranty as RECOM's standard products. Engineers may also want to reconsider using discrete designs, according to the company, as the converters offer modular advantages with no further concerns necessary.

Samples are available from all authorised distributors.

RECOM Power GmbH

www.recom-power.com



LOW-COST DEBUGGING AND PROGRAMMING IS NOW FASTER AND MORE FEATURE RICH WITH MPLAB PICKIT 4 DEVELOPMENT TOOL

The debugging process remains an important area where many embedded design engineers would like to see improvements, according to AspenCore's 2017 Embedded Market Study. To address these needs and enhance the development experience, Microchip Technology Inc. introduces the MPLAB® PICKit™ 4 In-Circuit Debugger.



The low-cost PICKit 4 in-circuit programming and debugging development tool is meant to replace the popular PICKit 3 programmer by offering five times faster programming, a wider voltage range (1.2–5 V), improved USB connectivity and more debugging interface options. In addition to supporting Microchip's PIC® microcontrollers (MCUs) and dsPIC® Digital Signal Controllers (DSCs), the tool also supports debugging and programming for the CEC1702 family of hardware cryptography-enabled devices.

This low-cost programming and debugging solution is ideal for those designing in the 8-bit space, but it is also perfectly suited for 16- and 32-bit development due, in part, to its 300 MHz, high-performance ATSAME70Q21B microcontroller on board. The benefits of faster programming time are less waiting and better productivity during development. This is especially important when designing with 32-bit microcontrollers with larger memory capacities.

The PICKit 4 development tool enables debugging and programming using the graphical user interface of MPLAB X Integrated Development Environment (IDE). The tool connects to the design engineer's computer using a hi-speed USB 2.0 interface and can be connected to the target via an 8-pin single inline header that supports advanced interfaces such as 4-wire JTAG and serial wire debug with streaming data gateway. It is also backward compatible for demo boards, headers and target systems using 2-wire JTAG and In-Circuit Serial Programming™ (ICSP) compatibility.

The new interfaces make this low-cost tool compatible with Microchip's CEC1702 hardware cryptography-enabled devices. This low-power, but powerful, 32-bit MCU offers easy-to-use encryption, authentication and private and public key capabilities. CEC1702

users can now benefit from using Microchip's development tools and support rather than being required to invest in third-party tools for programming and debugging.

"A better and faster development tool doesn't have to be expensive," said Rodger Richey, Microchip's director of Development Systems. "The MPLAB PICKit 4 programmer has all the features a design engineer needs for working with PIC, dsPIC and CEC1702 devices, as well as the capability to support future products for many years to come. Our mission is to provide the highest-performing and easiest-to-use development tools in the industry at an affordable price."

For more information about the MPLAB PICKit 4 development tool, visit: www.microchip.com/PICKit4.

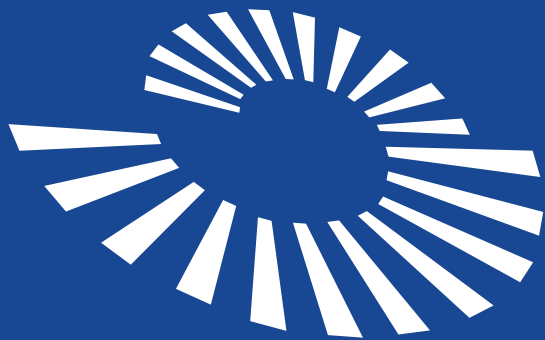
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EV test development time reduced by 90%

Automotive manufacturer Subaru is using hardware-in-the-loop (HIL) technology from NI to simulate actual road conditions for electric vehicle testing, eliminating environmental factors to reduce test time and costs.

Traditionally, engineers have conducted vehicle tests using finished cars on test courses or public roads to check the vehicle's performance and safety response. However, certain limitations, such as weather and fluctuating road surface conditions, can make it difficult to conduct reproducible tests on roads in a timely manner.



Moreover, electric vehicles are extremely complex due to their many subsystems, which are all interdependent on each other. This complexity makes the job challenging for automotive test engineers with short development cycles and pressure to limit costs.

To combat these issues, Subaru replaced the roads in the validation tests with an NI HIL simulation solution built on NI PXI products and LabVIEW software. With the HIL system, Subaru can eliminate environmental factors and thoroughly and efficiently test a vehicle's embedded controller in a virtual environment before running real-world diagnostics on the complete system.

"By using NI PXI products and LabVIEW, we were able to completely implement a customised HIL system in just one to two weeks and develop our software in-house," said Daisuke Umiguchi, Electrified Power Unit Research and Experiment Dept, Subaru Corporation. "This helped us keep product purchasing costs to around one-third of the cost of adopting solutions from other companies and, because of our familiarity with LabVIEW, keep our software development costs to around one-sixth of the cost of commissioning an outside developer."

Subaru further outfitted its vehicle test solution with a controller-driven dynamometer by HORIBA and CarSim vehicle dynamics simulation software deployed by Virtual Mechanics. Together, they produce load conditions equivalent to those generated on actual roads. This driving system transmits the calculated values to the NI HIL system in real time to create closed-loop control between the models on the HIL system and the driving system. As a result, the HIL interaction system can apply the appropriate load to the vehicle throughout the tests.

Subaru plans to use this test system at the final stages of development for electric vehicles as a final quality check, and eventually expand its use for all car types. By adopting this system, the company anticipates reducing labour hours by half compared to conventional methods.

National Instruments Aust Pty Ltd
www.ni.com



RUGGED COM EXPRESS MODULE

The CB71C from MEN Mikro Elektronik is an ultrarugged COM Express module for rail, public transportation and industry applications, eg, data acquisition, infotainment, transcoding and live 3D. It is 100% compatible with COM Express Type 6 Pin-Out and conforms to the VITA 59 standard, which specifies robust mechanics to ensure operation even under harsh environmental conditions.

The product is based on AMD's V1000 APU family. It is equipped with a Radeon Vega next-generation 3D graphics engine with up to 11 compute units, and supports up to four displays with a resolution of up to 4K without the need for additional graphics hardware. With up to four high-performance processor cores, the module is also suitable for virtualisation.

Based on the Rugged COM Express standard, the device is embedded in a closed aluminium frame, which ensures optimum EMC protection and efficient conduction cooling supporting a temperature range of -40 to +85°C. To withstand serious shock and vibration, only soldered components are used.

The unit can be equipped with a wide range of long-term available processors with scalable performance, all supporting ECC. Passive cooling is possible with low-power versions. It can be equipped with up to 32 GB of directly soldered DDR4 main memory and a 16 GB eMMC. Available high-speed interfaces include PCI Express 3.0 links, DDI (DP, eDP, HDMI), SATA 3.0, Gigabit Ethernet and USB 3.0.

The board features an advanced board management controller with monitoring functions for safety-relevant applications. In addition, the unit has a Trusted Platform Module and supports hardware memory encryption, providing protection against both physical and inter-VM storage attacks. This is important for security-critical applications such as payment and ticketing terminals, fleet management or monitoring.

OEM Technology Solutions

www.oem.net.au

SINGLE-PIN HIGH-VOLTAGE CONNECTORS

GES High Voltage has optimised its Series 100 single-pin high-voltage connectors, designed for operating voltages up to 100 kV DC.

The connectors now come in high-quality PTFE according to IEC 60664 and a CTI-value of 600. The rugged housing complies with IP62 (mated condition), providing protection and mechanical firmness in harsh environments. Several options for contact pins and cable attachment are provided.

The high-voltage connectors are particularly suitable as voltage outputs on diverse high-voltage devices and sources. The plugs and receptacles are fully compatible with the previous version.

VGL Allied Connectors

www.alliedconnectors.com



AUTOMOTIVE RADAR TEST SOLUTION

Automotive radar applications are an indispensable part of advanced driver assistance systems (ADAS) for both manned and autonomous vehicles, but growing demand — especially in higher frequencies, such as 79 GHz applications — has led to design challenges for engineers. The Keysight E8740A Automotive Radar Signal Analysis and Generation Solution enables radar-based, advanced driver assistance systems to proactively detect and mitigate risks of collisions.

The product uses mmWave technology providing signal analysis from 3 Hz to 110 GHz in a continuous sweep. It performs analysis and generation of automotive radar signals across full frequency ranges for 24, 77 and 79 GHz radar, and provides scalable analysis bandwidth from 2.5 to >5 GHz, depending on test requirements.

The system offers a scalable test platform that covers present and future frequencies and bandwidths with intuitive tools enabling engineers to identify, isolate and correct crucial design errors with confidence. Its measurements are said to offer greater sensitivity and dynamic range to ensure better SNR, with displayed average noise levels (DANL) of -150 dBm up to 110 GHz. It uses the SystemVue Automotive Radar Library (W1908) to generate frequency-modulated continuous waveforms (FMCW) and scenarios.

Keysight Technologies Australia Pty Ltd

www.keysight.com



COMPACT AC/DC CONVERTERS

MORN SUN's latest converter ranges are designed to offer technological and process improvements while also making advances in overall performance and size, along with compliance to IEC62368, UL62368 and EN62368 standards (pending).

The products offer wide operating temperature ranges of -40 to +70°C for the LDE series and -40 to +85°C for the LHE series. Their high isolation voltage of 4 kVAC delivers good system safety, while their EMC/EMI performance meets CISPR32/EN55032 Class B.

The LDE/LHE range features integrated internal components, allowing for a 20% size reduction compared to previous models. Further improvements enable greater consistency and performance.

Upgraded automation technologies give the ranges in excess of 300 kh MTBF and a complete suite of protections, including output short circuit (OSC), output overcurrent (OCP) and output overvoltage (OVP). This reduces the failure rate of the converter itself and enhances safety performance for back-end power modules and the load in adverse working conditions.

Other features include universal input (85–264 VAC/100–370 VDC) and low ripple and noise (50 mV TYP). The converters come in a plastic case that meets UL94V-0.

The LDExx-20Bxx range offers 3, 5, 6, 10, 15 and 20 W modules, while the LHExx-20Bxx range offers 5, 10, 15, 20 and 25 W devices. They can be widely used in any application requiring a power source, including LEDs, street lighting control, grid power, instrumentation, industrial control, communication and civil applications.

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FLEXIBLE LITHIUM-ION BATTERY

SHAPED LIKE THE HUMAN SPINE

Researchers from Columbia University have developed a lithium-ion battery with impressive flexibility, high energy density and stable voltage, no matter how it is flexed or twisted. The secret to the battery's success? It is shaped like the human spine.

With the rise of wearable electronics, demand has increased for high-performance flexible batteries. Up to now, however, researchers have had difficulty obtaining both good flexibility and high energy density concurrently in lithium-ion batteries. The prototype lithium-ion battery, developed by a team led by Assistant Professor Yuan Yang, seeks to address this challenge.

"We've developed a simple and scalable approach to fabricate a flexible spine-like lithium-ion battery that has excellent electrochemical and mechanical properties," said Yang. "Our design is a very promising candidate as the first-generation, flexible, commercial lithium-ion battery."

Yang was apparently inspired in his research by the suppleness of the spine while doing sit-ups in the gym. The human spine is highly flexible and distortable as well as mechanically robust, as it contains soft marrow components that interconnect hard vertebra parts.

Yang used the spine model to design a battery with a similar structure. His prototype has a thick, rigid segment that stores

energy by winding the electrodes ('vertebrae') around a thin, flexible part ('marrow') that connects the vertebra-like stacks of electrodes together. His design thus provides excellent flexibility for the whole battery.

"As the volume of the rigid electrode part is significantly larger than the flexible interconnection, the energy density of such a flexible battery can be greater than 85% of a battery in standard commercial packaging," Yang explained. "Because of the high proportion of the active materials in the whole structure, our spine-like battery shows very high energy density — higher than any other reports we are aware of. The battery also successfully survived a harsh dynamic mechanical load test because of our rational bio-inspired design."

Yang's team cut the conventional anode/separator/cathode/separator stacks into long strips with multiple 'branches' extending out 90 degrees from the 'backbone'. Then they wrapped each branch around the backbone to form thick stacks for storing energy, like vertebrae in a spine. With this integrated design, the battery's energy density is limited only by the longitudinal percentage of vertebra-like stacks compared to the whole length of the device, which can easily reach over 90%.

The battery shows stable capacity upon cycling, as well as a stable voltage profile no matter how it is flexed or twisted. After cycling, the team disassembled the battery to examine the morphology change of electrode materials. They found that the positive electrode was intact with no obvious cracking or

“ THE RESEARCHERS CONTINUOUSLY FLEXED OR TWISTED THE BATTERY DURING DISCHARGE, FINDING THAT NEITHER BENDING NOR TWISTING INTERRUPTED THE VOLTAGE CURVE.

peeling from the aluminium foil, confirming the mechanical stability of their design.

To further illustrate the flexibility of their design, the researchers continuously flexed or twisted the battery during discharge, finding that neither bending nor twisting interrupted the voltage curve. Even when the cell was continuously flexed and twisted during the whole discharge, the voltage profile remained. The battery in the flexed state was also cycled at higher current densities, and the capacity retention was quite high (84% at 3C, the charge in one-third of an hour). The battery also survived a continuous dynamic mechanical load test, rarely reported in earlier studies.

"Our spine-like design is much more mechanically robust than are conventional designs," Yang said. "We anticipate that our bio-inspired, scalable method to fabricate flexible Li-ion batteries could greatly advance the commercialisation of flexible devices."

The study has been published in the journal *Advanced Materials*. Yang and his team are currently optimising the battery's design and improving its performance.

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VISION AND SENSOR FUSION PROCESSOR

The S32V234 vision and sensor fusion processor is designed to support safe computation-intensive applications in vision and sensor fusion applications, including advanced driver assistance systems (ADAS), front camera systems, pedestrian and object recognition, surround view and machine learning.

The processor combines a robust, heterogeneous mix of CPU, GPU and image processors to deliver high-performance processing, vision acceleration and security features. The product integrates four Arm Cortex-A53 cores running at up to 1 GHz with a NEON coprocessor and an Arm Cortex-M4 CPU. The Cortex-M4 allows automotive operating systems to interface with external devices separate from the Cortex-A53 CPU.

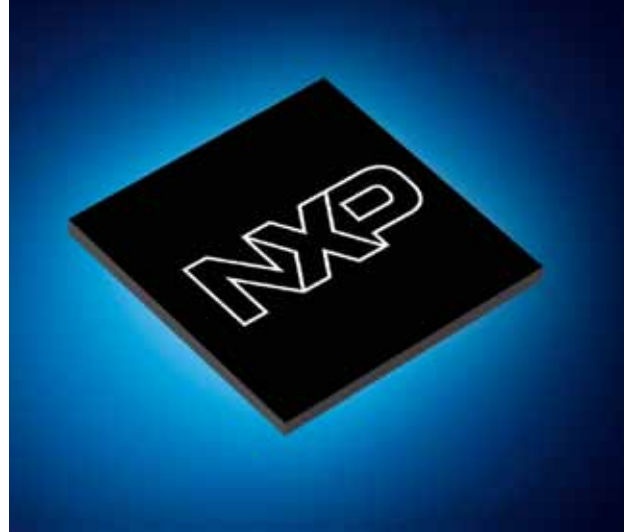
The processor offers 4 MB of on-chip system RAM and two 32-bit DRAM controllers with support for LPDDR2/DDR3/DDR3L, all with ECC memory. For image processing and vision capabilities, the device includes dual APEX-2 vision accelerators, a GC3000 3D GPU with surround-view support, MIPI CSI2 and parallel image sensor interfaces, and an embedded image signal processor. It also offers an array of connectivity features, including Gigabit Ethernet, Zipwire serial interface, dual CAN-FD interfaces, dual-channel FlexRay communication and a PCI Express (PCIe) lane.

Security capabilities include an on-the-fly AES decryption engine (OTFAD) and a Cryptographic Service Engine (CSE) that meets Secure Hardware Extension (SHE) protocol specifications. The device also features automotive safety compliance capabilities developed through NXP's SafeAssure program, which helps manufacturers achieve system compliance with ISO 26262 and IEC 61508 functional safety standards.

The processor is supported by the SBC-S32V234 Vision Prototype Kit, which offers options for Linux (Yocto) and AutoSAR operating systems. The kit is supported by a complete series of enablement tools and the S32 Design Studio integrated development environment (IDE).

NXP Semiconductors (Australia & New Zealand)

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TRANSFORMERS FOR PoE++

TDK has released a series of EPCOS transformers designed for an output of up to 60 W, which are therefore suitable for PoE++ according to IEEE 802.3bt. The B82806D0060A** series comprises four types with different turns ratios for output voltages of 3.3, 5, 12 and 24 V. The SMD components have dimensions of 30 x 22 x 11.4 mm and are designed for a wide range of operating temperatures from -40 to +125°C.

The electrical insulation of the RoHS compatible transformers complies with UL 1446 class 130 (B) and can withstand a high-voltage test between the primary and secondary sides at 1500 VAC, 50 Hz for 1 s. The low DC resistance values — depending on the type — can be as low as 3.5 mΩ. This results in high efficiency, making the transformers suitable for active clamp forward converter topologies. The typical switching frequency is 250 kHz.

An increasing number of devices offer LAN connectivity for communication purposes. The obvious solution therefore is to power them via the LAN cable as well (Power over Ethernet), so that no separate power supplies are necessary. The IEEE 802.3bt (PoE++) standard, which is designed for

four pairs of cables, has been developed in order to supply devices with a higher power demand. The EPCOS transformers are designed

specifically for this application segment. Typical applications are video and POS systems, but also lighting controller systems, fire alarm systems and access systems that are used in building management.

EPCOS
www.epcos.com



LTE IoT CATEGORY M1 MODULE

Telit's quad-band, dual-mode ME910C1-AU, based on the Qualcomm MDM9206 LTE IoT modem, has become the first module to receive LTE Category M1 (Cat M1) certification for operation on Telstra's mobile network. Certification means IoT integrators and providers looking to deploy in Australia can take advantage of the 3 million km² of Telstra's LTE Cat M1 coverage built specifically for the IoT.

The ME910C1-AU module is a member of Telit's xE910 family and can easily be applied as a pin-to-pin replacement for existing devices based on the family's modules for 2G, 3G and LTE Categories 1, 3 and 4. With the company's design-once-use-anywhere philosophy, developers can cut development time by simply designing for the xE910 LGA common form factor, giving them the freedom to deploy technologies best suited to the application's environment. The module also features optimised power consumption and optional quad-constellation GNSS support capabilities.

The longevity of the LTE Cat M1 standard and extensive feature set make it suitable for both new and existing applications in vertical segments like telematics, smart energy and metering, asset tracking, retail, point of sale, security and surveillance, industrial control and automation, smart home and smart buildings.

Telit Wireless Solutions (Australia) PTY LTD
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HOUSINGS FOR HEAVY-DUTY CONNECTORS

With its Heavycon D7 housings, Phoenix Contact enables signal and power transmission in a confined space with a compact design. The HPR housings in size D7 are made from corrosion-resistant die-cast zinc with a powder coating and have been optimised for railway applications.

Even in extreme applications, the housings are sealed up to IP68 degree of protection. The screw locking ensures vibration- and shock-proof use. The housing surfaces and NBR seals are electrically conductive. Combined with shielded cable glands, they offer EMC protection.

The housings are tested according to IEC 61373 and EN 50155. Robust, vibration-proof contact inserts with crimp connection in two- and three-position designs complete the range. The square inserts are suitable for applications up to 40 A and 400 V.

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ZERO-BACKLASH SERVO GEARMOTOR

maxon motor has released a servo motor and gearhead combination that can produce 364 Nm with a peak torque rating at the output of 686 Nm. Fitted with both an encoder and a holding brake inside the IP-rated motor's rear enclosure, the combination can move heavy loads into position and make sure they stay there.

The high acceleration of the brushless DC motor with high-grade neodymium magnets enables a zero to 2600 rpm speed change in under 4 ms. Being both brushless DC and slotless gives the motor zero cogging or position detent for smooth position transitions and low-speed performance.

The solid construction and sealed nature of the motor drive components makes it suitable for mining, food, process control and manufacturing environments. Customisation of the motor and gearhead features is possible and both 24 and 48 VDC supplies can be used. The unit is compatible with standard servoamplifiers and position controllers from maxon motor.

maxon motor Australia Pty Ltd
www.maxonmotor.com.au



DC-DC POWER MODULES

Maxim Integrated Products' family of micro system-level IC (uSLIC) modules are said to help reduce solution size and increase efficiency for designers working on space-constrained applications.



The MAXM17532 and MAXM15462 ultrasmall (2.6 x 3 x 1.5 mm) integrated DC-DC power modules are part of Maxim's extensive portfolio of Himalaya power solutions for industrial, healthcare, communications and consumer markets. The modules provide users with the benefits of high-quality switching regulators with the size and simplicity of a linear regulator (LDO).

The power modules shrink the solution size of the power supply by 2.25x with an ultrasmall package size. This is achieved by integrating a synchronous wide-input Himalaya buck regulator with built-in FETs, compensation and other functions with an integrated inductor. The combination of these components enables the designer to use the modules in small space-constrained systems while complying with mechanical and EMI standards.

In addition, engineers simplify designs as they no longer need to deal with conventional bulky, power-hungry regulators. Instead, they can integrate the ready-made power module into almost the same space of a tiny LDO. In such a small size, designers can achieve high efficiency and lower noise with increased stability.

The DC-DC buck regulator modules, which operate over a wide input range from 4 to 42 V, support multiple applications across nominal input voltages of 5, 12, 24 and 36 V with good headroom. They operate over a temperature range from -40 to 125°C.

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SMART CAMERA KIT

congatec has announced its MIPI-CSI 2 Smart Camera Kit — an application-ready kit for the evaluation and deployment of MIPI-CSI 2-based rugged smart camera analytics in harsh industrial, outdoor and in-vehicle environments. Developers benefit from an instantly deployable, industrial-grade smart MIPI-CSI platform. Built with commercial, off-the-shelf available components, the product is said to simplify development and accelerate the time to market of smart camera analytics solutions for the edge of the IIoT.

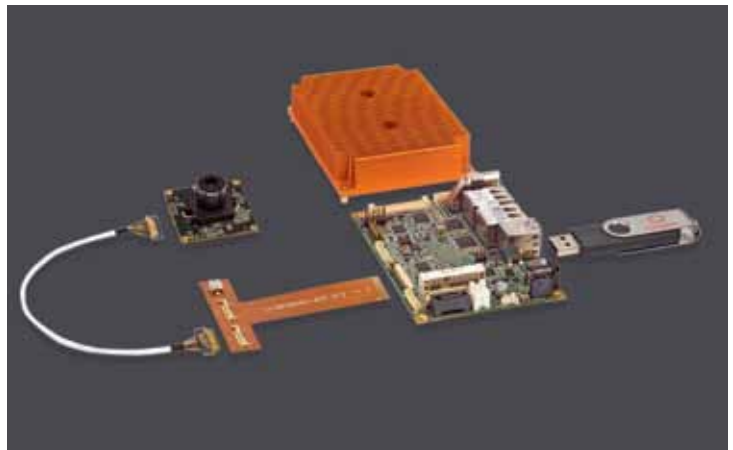
The kit includes all the building blocks of a smart camera solution and can be easily customised to support further applications and features. It is 100% compliant with the latest MIPI-CSI standard and optimised to run the MIPI-CSI 2 camera from Leopard Imaging, based on ON Semiconductor's AR0237 HD sensor, together

with the rugged conga-PA5 Pico-ITX single-board computer based on Intel Atom E3900 processors for the extended temperature ranges. It comes with all required configurations and patches, and is ready to run code on the basis of the Linux Yocto kernel.

MIPI-CSI is a widely used camera interface for consumer-grade mobile devices. Implementing this high-speed protocol on embedded boards such as the Pico-ITX motherboard simplifies the support of high-performance applications, including 1080p, 4k, 8k and beyond for rugged, industrial-grade 24/7 embedded systems. Typical smart camera applications at the IIoT edge include industrial and medical imaging and vision systems; situational awareness and video surveillance systems in smart cities; intelligent vehicle applications; augmented reality in maintenance; gesture-based controls; and biometrics recognition.

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HOW VOICE RECOGNITION WILL CHANGE INDUSTRY



Since its release, Amazon has sold over 20 million Echo devices with Alexa — the voice-activated assistant. It has changed the way we complete many daily tasks — from shopping to getting weather updates. Could it do the same for manufacturing? Jonathan Wilkins, marketing director at obsolete parts supplier EU Automation, explains how voice recognition technology can improve manufacturing processes.

Computers are being developed at a rapid pace — from bulky processors in the 1990s, to touchscreen mobile phones that can hold impressive amounts of data. Speech recognition is estimated as the next interface that we will use daily and developers have been refining the technology for over 50 years.

Audrey, first developed in 1952 at Bell Laboratories, was able to recognise digits from one single voice. Once refined, the tech was introduced to smartphones, but was quickly neglected because of inaccuracy. Now, voice recognition is a part of everyday life as Android estimates that, last year, 20% of queries were spoken — that's around 20 billion spoken queries a day.

As the technology becomes smarter, it will be able to go from answering daily queries to conversing with manufacturers about their processes. Machines in factories are already communicating with one another, sending real-time data about their condition. Speech recognition can streamline this process further, improving productivity and efficiency on the factory floor.

Productivity

The main benefit of using speech recognition technology in a factory is that employees will be able to use both of their hands.

Employees in the factory need to keep track of everything they do and look for instructions using computers or devices. With speech recognition, they can put the device down and concentrate on the task at hand.

Removing devices in some areas of the factory, such as the warehouse, can greatly improve productivity. In warehouses, pickers can use both hands to sort through products and ask for instructions using speech recognition.

For most applications, speech recognition still requires a device. Wearable devices, such as smart glasses, are becoming more popular in manufacturing and remove the need for handheld devices. Now, workers can see the information in front of them while they complete the task, increasing the chances of them completing it accurately first time around.

Remote

Manufacturers often run multiple plants that are miles apart, some of which are in remote locations. Employees in these remote facilities may work alone and be there just for machine maintenance.

Normally, in an emergency or a breakdown, this employee calls another facility for instructions, which can take too long and increase plant downtime or inactivity.



THE MAIN BENEFIT OF USING SPEECH RECOGNITION TECHNOLOGY IN A FACTORY IS THAT EMPLOYEES WILL BE ABLE TO USE BOTH OF THEIR HANDS.

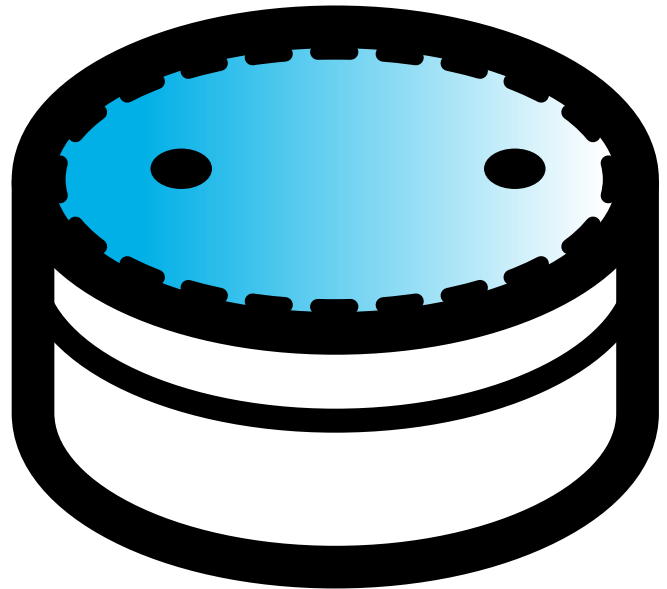
Voice search technology can help employees in this situation, as they will be able to solve issues more quickly and efficiently. The technology will search through all the possible outcomes and instruct the employee in how best to fix the system.

Advancements in machine learning mean that manufacturers and machines will be able to learn from each other. Voice recognition will develop this further, as devices will begin to understand their users and give the correct advice or information more often than not.

In the future, developers want to ensure voice recognition technology can answer more queries correctly. They may be able to answer questions in specific contexts, such as know if the person is correctly completing a task and even answer half-queries.

As more people introduce Alexa, Siri and others into their homes, speech recognition technology will develop to help with more tasks. Now that the technology is refined, industries such as manufacturing can embrace speech recognition to streamline its processes and better understand its machines.

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MAJOR CHANGES NECESSARY FOR THERMAL MANAGEMENT OF LEDs



Global electrochemicals manufacturer Electrolube has addressed growing concerns affecting LED manufacturers regarding the thermal management of LEDs. The changes that will impact on the LED market are being driven by two major factors surrounding the issue of silicone.

Firstly, silicone-based thermal management materials have been found to contribute to problems with long-term reliability and contamination. According to a report from The Lighting Industry Association, a European trade association dedicated to serving the UK lighting industry and its supply chain, some VOCs and chemicals may react with the silicone dome of LEDs to produce discolouration and surface damage, which may affect the total light output. However, some VOCs may not chemically react with the silicone material directly but may diffuse into the silicone and oxidise during the presence of heat or light. The long-term reliability issues of silicone-based products are now causing global LED manufacturers to shift their demand towards non-silicone products.

The second factor contributing to the increasing demand for non-silicone products is the global shortage of silicone, which is forcing suppliers to pass on price increases to customers. Some manufacturers of silicone-based thermal management products are warning of hefty price increases up to 25%. However, the ever escalating growth of the global LED market will further fuel the trend towards non-silicone solutions and is expected to last until 2022. Accommodating the forthcoming market changes, Electrolube's range of non-silicone thermal management solutions delivers a high-performance alternative to silicone materials and provides LED manufacturers with an immediate drop-in solution.

Thermal management substantially impacts on the lifetime, cost and performance of an LED luminaire. Without suitable thermal management, a luminaire will be thermally inefficient, have a reduced operating life and encompass high maintenance costs. Electrolube's expansive range of thermal management products includes encapsulation resins, thermal pastes, bonding products,

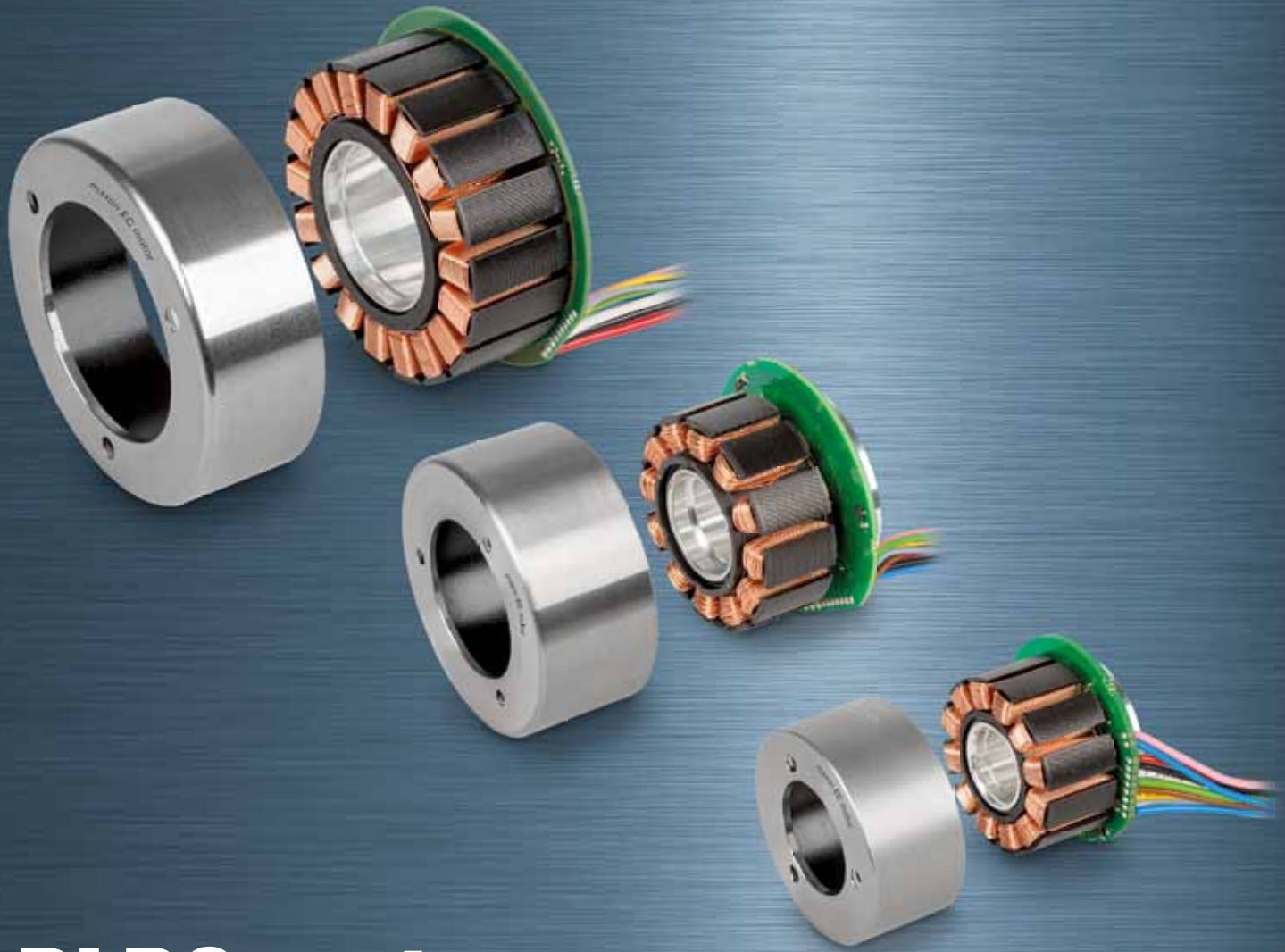
thermal gap pads and phase-change materials that incorporate a variety of different blend materials, such as epoxies, polyurethanes, silicone and non-silicone products.

Electrolube's non-silicone thermal pastes include HTC (Heat Transfer Compound) and HTCP (Heat Transfer Compound Plus), which avoid silicone migration onto electrical contacts. Potential issues with silicone migration include high contact resistance, arcing, soldering problems and mechanical wear. The company's 'X' range of non-silicone thermal products features the low-viscosity HTCX, for ease of use, and HTCPX, for gap filling applications. These 'Xtra' versions of HTC and HTCP provide increased thermal conductivity, lower oil-bleed and lower evaporation weight loss, making them comparable or better than some silicone-based materials. Both products provide a wide operating temperature range from -50 to +180°C and demonstrate good dielectric strength of 42 kV/mm.

With thermal conductivity of 1.35 W/mK, HTCX provides good stability, making it suitable for applications exposed to varying temperature and humidity conditions. The non-silicone HTCPX has high thermal conductivity of 3.4 W/mK, which assists rapid heat dissipation over uneven surfaces. Due to its high viscosity, the material offers stability under vibration, making it suitable for use as a gap-filling material.

Electrolube is represented in over 55 countries with an established network of subsidiaries and distributors. With three manufacturing base options, located in the UK, China and India, the company provides security of scale, delivering a tailored service with good technical support.

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A new laser technique that 'writes' graphene onto toasted bread, potatoes and other foods could lead to the development of edible electronics.

Jeff Fitter/Rice University

GRAPHENE ON TOAST

EDIBLE ELECTRONICS ARE NOT FAR AWAY

US scientists have developed a way to write graphene patterns onto virtually any surface — including food — paving the way for edible electronics capable of tracing the progression of foods from farm to table, as well as detecting harmful organisms.

Graphene is composed of a single layer of carbon atoms arranged in a honeycomb pattern. Stronger than steel, thinner than a human hair and more conductive than copper, it is an ideal building block for the next generation of compact, smart electronics.

Several years ago, James M Tour and his colleagues at Rice University heated the surface of an inexpensive plastic with a laser in air to create something called laser-induced graphene (LIG) — a foam made out of tiny cross-linked graphene flakes. The process can embed or burn patterns that could be used as supercapacitors, RFID antennas or biological sensors.

Based on these results, the researchers theorised that any substance with a reasonable amount of carbon can be turned into graphene. To test this theory, Tour's team sought to burn LIG into food, cardboard and several other everyday, carbon-based materials.

The researchers used a single laser pulse to convert the surface layer of the target substance into a disorganised jumble of atoms called amorphous carbon, more commonly known as black soot. Then, they conducted multiple laser passes with a defocused beam to convert the soot into graphene.

By defocusing the laser beam, the researchers could speed up the conversion process. And, unlike previous LIG processes, the graphene conversions conducted in these experiments were done at room temperature without the need for a controlled atmosphere box.

Overall, the process demonstrated that LIG can be burned into paper, cardboard, cloth, coal, potatoes, coconuts, toasted bread and other foods. The team's success was documented in the journal *ACS Nano*.

As for useful applications of this technology, the researchers suggest that food items could eventually be tagged with RFID antennas made from LIG that could help track where a food originated, how long it's been stored and how it got to the dining table. They additionally suggest that LIG sensors could be used to uncover *E. coli* and other harmful organisms lurking in salads, meats and other foods.



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Subscriptions: For unregistered readers price on application

Printed and bound by Dynamite Printing
Print Post Approved PP100007394
ISSN No. 0728-3873

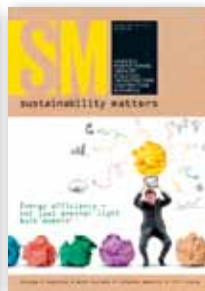
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