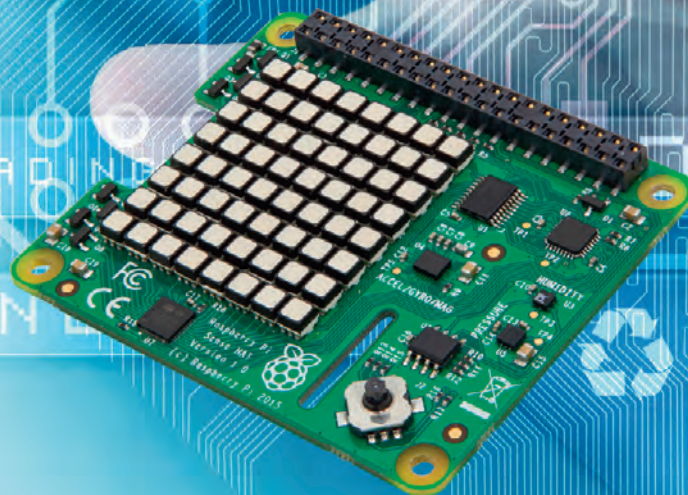
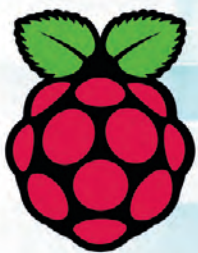
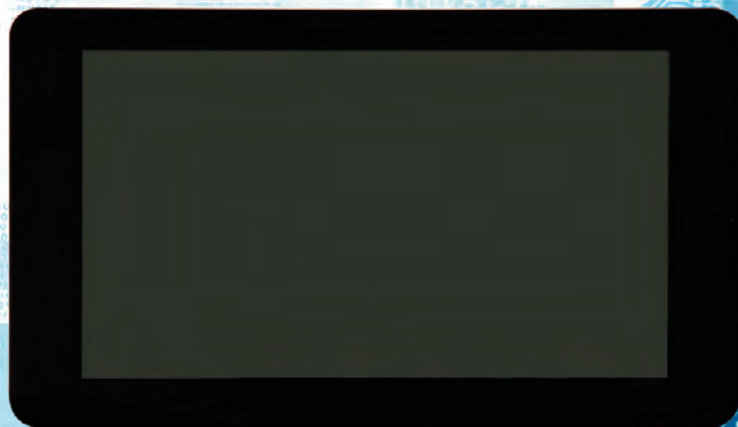


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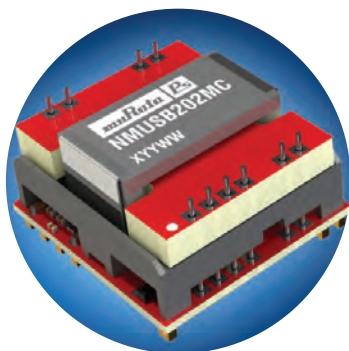
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COVER STORY



The Raspberry Pi Foundation's 7" touch-screen display connects to the Raspberry Pi's DSI display connector via an adapter board that handles power and signal conversion.

Touch-screen drivers with support for 10-finger touch and an on-screen keyboard will be integrated into the latest Raspbian OS for full functionality without the need for a physical keyboard or mouse. It is compatible with all Raspberry Pi models and a range of educational software and programs available on the Raspberry Pi will be touch-enabled, making learning and programming easier.


The Sense HAT, which is also compatible with all Raspberry Pi models, uses orientation, pressure, humidity and temperature sensors to measure whether the Raspberry Pi is accelerating, how hot the environment is, how humid it is and which direction the Raspberry Pi is facing. It connects via 40 GPIO pins and can be used for many different types of experiments, applications and games, including those due to be carried out on the International Space Station by UK ESA astronaut Tim Peake.

The LED Matrix displays the data from the various sensors. It can show which way is geomagnetic north by programming a compass using the magnetometer; or simply be used to play games like Tetris, Pong and Snake with the joystick. The joystick can also be used to enable interaction with the programs running on the Sense HAT.

Both products are available from au.element14.com, with local stock delivered the next working day. Visit us online to find out more about the newest Raspberry Pi additions.

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CONNECTORS IN MEDICAL ROBOTICS

Arthur Visser

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Traditionally employed in heavy industrial applications, robots are moving into other industries. In the medical field, they are used for surgery, therapy, diagnostics and much more.

Robots for specialised medical applications such as surgery bring together robotics and biology, and we're seeing an increase in the number of robots specifically designed and developed for this market sector. These robots are clearly different from the traditional industrial robot, and spin-offs from research done in this domain may lead to new consumer medical devices.

Additionally, cross-fertilisation with other high-tech markets such as space, military and aerospace markets is likely to push the technological boundaries. Hospitals have already employed robots to deliver medications, monitor patient conditions, interact with patients and much more.

According to the International Federation of Robotics (IFR), 21,000 professional service robots were sold in 2013, a modest growth in units of 4% versus 2012. The sales value decreased by 1.9% to \$3.57 billion. This means the average unit value for professional service robots was about \$170K.

The IFR stated that sales of medical robots decreased by 2% in 2013 to roughly 1300 units. This represents 6.2% of the total unit sales of professional service robots. The most important applications are robot-assisted surgery and therapy. In 2013, more than 1000 of these types of medical robot systems were sold, 2% less (in units) than in 2012. The sales volume of medical robots, however, increased in 2013 to \$1.45 billion. This represents 40.6% of the total sales value of all professional service robots and means an average unit cost of \$1.12 million.

Medical robots are clearly the most valuable professional service robots. In 2013, North America had the largest share of the global medical robotics market, followed by Europe, then Asia. Asia is expected to outgrow the other regions, however, as healthcare spending in the region increases, healthcare markets are reformed and patients become more aware of the possibilities. The ROW (rest of the world) region will also show steady growth over the coming years.

The IFR expects that in the period from 2014 to 2017, about 7130 medical robots will be sold. This would represent a total market value of almost \$8 billion if the

average unit cost remains the same. It also means a compound average growth rate (CAGR) of about 12.4% in units. The increasing demand in the medical sector can be explained by the emphasis in the healthcare market on minimally invasive surgeries through the use of robots. In addition, surgical robots often improve the accuracy of surgeries and thus reduce the complication rates. Apart from accuracy, robotic procedures also offer significant savings to hospitals and patients in terms of pre- and post-operative care costs and lengths of stay at hospitals. Other market drivers include the ageing population, rise in the incidences of neurological and orthopedic disorders, and growth in the demand for telemedicine. Technological advances also help to drive this market as new opportunities open up and new applications are made possible.

OEMs and equipment makers in the medical robot market include, among others: Accuray Inc. (US); Aeon Scientific (Switzerland); Hansen Medical Inc. (US); Health Robotics S.R.L. (Italy); Intuitive Surgical Inc. (US); Mazor Robotics Ltd. (Israel); Stryker Inc. (US) — acquired MAKO Surgical Corp. in 2013; Titan Medical Inc. (Canada).

With Google signing an agreement for strategic collaboration with Ethicon, a division of Johnson & Johnson, to develop surgical robots that use artificial intelligence, it is clear that other market players are jumping on the bandwagon.

Types of robots

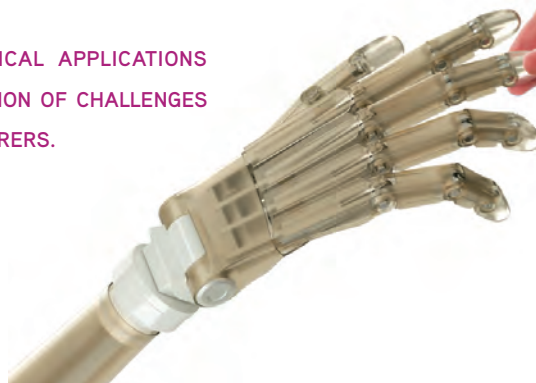
There are many types of medical robots, and the lack of clear (market) definitions makes it difficult to pinpoint exact volumes and market values. The following overview provides some guidelines to the various categories of medical robots we can distinguish:

Surgical robots

- Orthopedic surgical robots — such as the da Vinci surgical robot, the market leader with an installed base of more than 3300 units.
- Neurological surgical systems — includes the SYMBIS surgical system.



**CONNECTORS USED IN MEDICAL APPLICATIONS
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- Laparoscopic robotic systems — such as SPRINT (single-port laparoscopy bi-manual robot).
- Steerable robotic catheters — such as the Magellan Robotic System.

Furthermore, robotic systems in orthopedic surgery can be divided in the following three categories:

- Active systems, such as the ROBODOC (Curexo Technology Corp.) and CASPAR (computer-assisted surgical planning and robotics) technologies, can perform individual tasks autonomously, without control by the surgeon during the procedure.
- Semi-active systems are robot/computer-aided surgical actions, but final control is in the hands of the surgeon.
- Passive systems provide information during a surgical procedure; they do not perform an action and are controlled by a surgeon.

Rehabilitation robots

Rehabilitation robots aid in therapy for patients recovering from injuries and include:

- Assistive robots: These robots help patients, such as those that assist the elderly with basic household tasks.
- Prosthetics
- Orthotics
- Therapeutic robots: These robots help reduce stress and agitation, minimise feelings of isolation, and give people something to touch and be touched by.
- Exoskeleton robotic systems: These are robots that are worn on the body, much like in the movie *Iron Man*, to improve mobility and/or strength.

Non-invasive radio surgery robots

An example is the CyberKnife, which is dedicated to Linac (linear particle accelerator) radiosurgery, in which a compact Linac is mounted onto a robotic arm that moves around the patient and irradiates the tumour from a large set of fixed positions.

Hospital and pharmacy robots

- Telemedicine robots: These types of robots allow physicians to monitor patients remotely, such as after surgery.

- IV robots: This automated robotic system is designed for the preparation of injectable drugs.
- Pharmacy robots: These robot systems can be used for automatic suspension of medication or even a post-order-type service for medication.

Other robots

Examples of other robots not mentioned above include those used to assist with laboratory analysis, medication testing or cosmetic surgery.

Connector designs

Connectors used in medical applications create a unique combination of challenges for connector manufacturers. Medical equipment often must survive multiple sterilisations that employ heat, steam or radiation and be fabricated from corrosion-resistant materials. Safety for the patient and staff is a key consideration, making reliability and ergonomic finger-proof designs essential. Historically, connectors designed for use in medical equipment applications tended to be high-reliability/high-cost interfaces with relatively low volume.

The market for home-based medical monitoring and diagnostic devices is beginning to take off in Western economies and Asia/Japan. These devices are also a perfect fit for inclusion in the emerging Internet of Things (IoT). This market is in the early developmental stage and high-volume standard interfaces are yet to be defined, but once the market really takes off, the excellent growth potential for specific interconnects used in these applications will become clear. We also anticipate growing use of fibre-optic connectors in medical applications, not only for their signal integrity and lighter weights but also for their performance capabilities in video streaming (bandwidth requirements).

Wearable electronics and sensors are also trending in the medical world. Smartwatches and fitness bands are only the first wave of medical monitoring devices and will probably be followed by even more sophisticated devices.

For medical robots, connector designs must fulfil all these criteria, too. They need to be high-reliability interconnects that can withstand harsh conditions (cleaning, sterilising, radiation) and are properly sealed (often IP68). Other critical performance attributes may include: quick mate/un-mate features, often push-pull; corrosion-resistant materials; impact-resistant shells; hybrid variations of signal, power, coaxial and fibre-optic contacts; colour coding; mechanical keys to ensure proper mating; designs to ensure user safety (finger-proof); lightweight, ergonomic; use of 'soak cap' to protect the interface during cleaning; custom over-moulded assembly; fabricated from non-magnetic materials in MRI equipment; often shielded; can be handled by gloved hands.

Connector types frequently used in medical robot applications include: plastic circular pin-and-socket connectors; spring-loaded Pogo-type contacts; hybrid connectors that integrate power, signal, coax and fibre-optic contacts; micro and nano connectors.

To ensure the best connectors are used in the medical devices market, connector designs must comply with a range of standards and obtain the necessary approvals. Some of the applicable industry standards/approval agencies include: UL/CSA; CE; FDA; ISO 13485; ISO 80369-1; DIN 42802-1 and DIN 42802-2; IEC 60601-1; ANSI/AAMI EC53-1995.

With current market trends in technology and demand clearly in favour of the medical robotics market, we expect this market to outpace the general connector market in the coming years. The expectations of the IFR are in line with this expectation and various industry analysts expect even higher growth rates. This bodes well for the connector makers that are well established in this market.

Bishop & Associates
www.connectorindustry.com

For more information, contact Robin S Pearce, Bishop and Assoc – ANZ, apearce4@bigpond.net.au.

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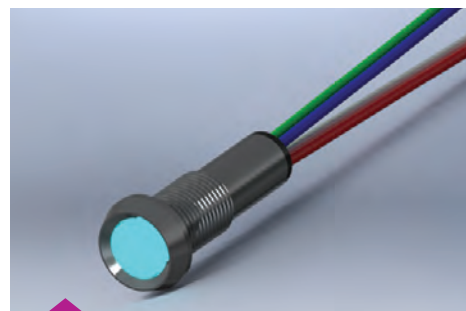
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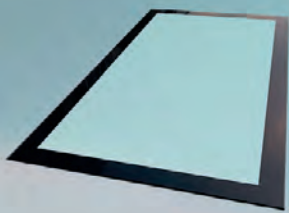
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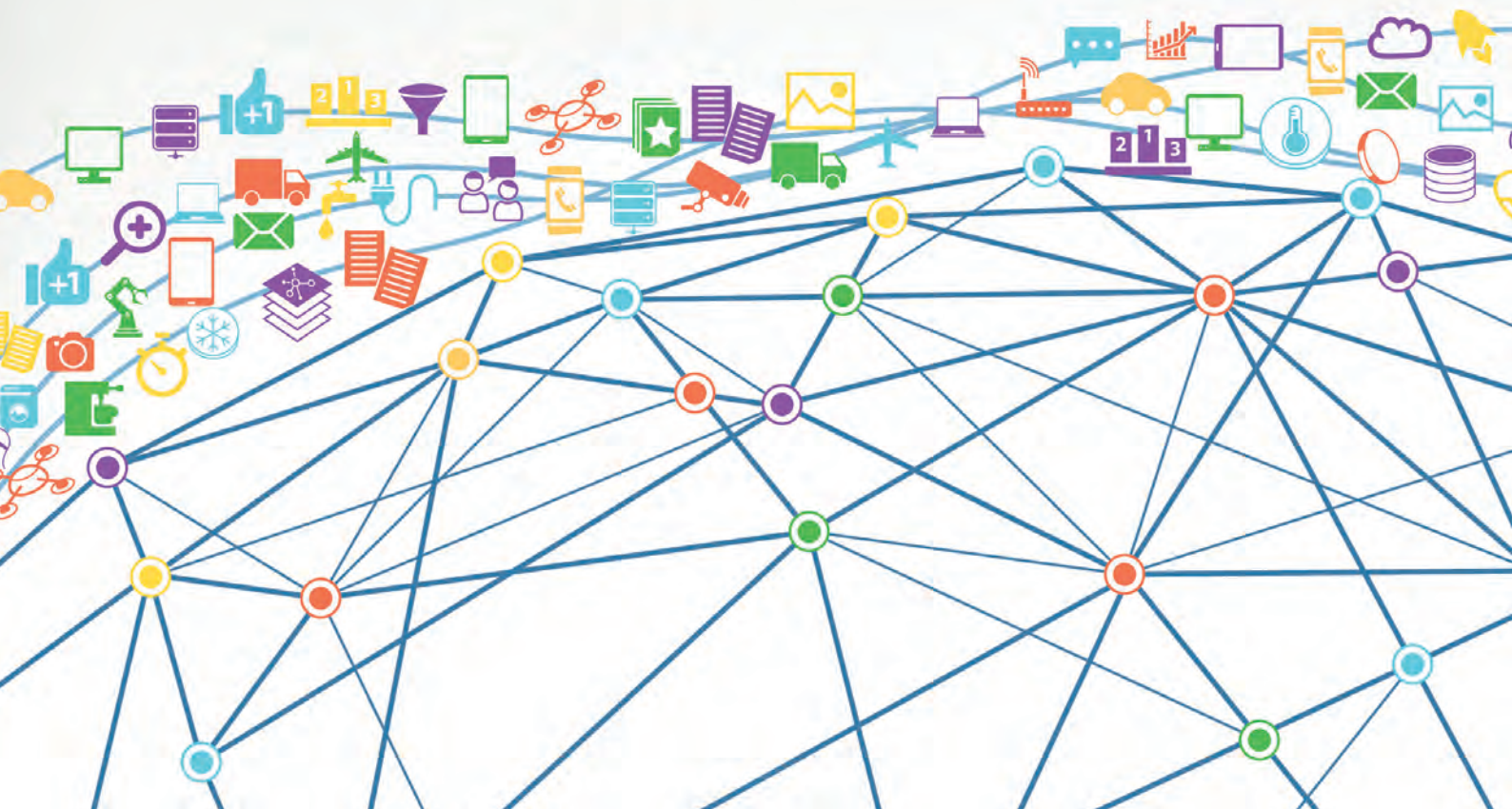
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TESTING THE IoT

By 2020, more than 50 billion devices will be digitally connected, representing \$19 trillion in business opportunity. As systems increase in size and complexity, engineers and scientists face new challenges when networking and synchronising devices to make intelligent decisions.



Although the Internet of Things may sound like marketing jargon to some test managers, smart sensing devices are poised to become the centre of a new technology revolution. Industry players such as Microsoft, Raytheon and Qualcomm have already achieved distributed sensing, intelligence and analytics through differentiated software and hardware platforms. For progressive test managers, IoT is the opportunity to achieve rapid improvement, higher throughput and lower test costs.

The Internet of Things (IoT) is reaching the test and measurement industry at an interesting time. Sceptical test managers may have heard about the next tech disruption, but some may have a hard time recognising how the technology could impact their systems. The same test managers have been at the helm of distributed sensing and analytics technology for decades — the same technology IoT proponents proclaim is driving progressive change.

The technology may seem familiar to automated test organisations and there is significant opportunity for forward-looking test managers to profit from this megatrend. The key is to understand how the IoT applies to test and measurement, and learn from established companies that are using a platform-based approach to benefit from this technology. By using a proven software and hardware platform, test managers can reap dividends of productivity today while preparing their organisations to thrive tomorrow.

So, what is the IoT? Usually it refers to systems that were formerly treated as isolated entities but are now sources of relevant data. Some examples in the consumer space include: smart appliances, thermostats and power meters.

The IoT is also changing industrial processes and business operations — this is the area where test managers can make a difference. The tools used in the Industrial IoT (IIoT) range from test and measurement instruments such as oscilloscopes, multi-meters and function generators to fully integrated smart testers. The secret ingredient that takes these tools from mere isolated things to IIoT-enabled devices is a combination of technologies: device-to-device communication, automated analytics and scalable systems. Fortunately for the test and measurement specialists, this is not uncharted territory. Industry leaders have implemented these technologies through software platforms for more than a decade.

A device-to-device communication network

At release in 2006, NI LabVIEW 8.20 software was notable for including a web server for building test and measurement systems. Why would someone automating data acquisition need a web server? For automated test developers at Microsoft working on testing Xbox 360 controllers, this technology presented an opportunity for unprecedented device-to-device communication. Combined with GPIB, serial and other network communication protocols such as TCP/



IP, a web server provided a way for test systems to communicate results to each other and back to a central archive.

When developing new functional tests for the Xbox 360 controllers, developers found that optimising as many parallel tests as possible in a limited production cycle time was a significant challenge. Microsoft realised that knowing the status of all of its testers and viewing a central repository of all test data presented an operational advantage to optimise these tests and produce less expensive, more reliable devices. Microsoft is not alone in this pursuit; test organisations around the world are building software infrastructure to remotely monitor, analyse and even control their production test systems.

Deriving value from test data

Similar to how infants babble to each other, for a long time test devices have muttered unintelligible command line statuses through serial ports. Device-to-device communication is truly valuable when meaningful insights can be derived from the data through automated analytics. This is an area where the test industry has long been ahead of other industries.

For aerospace giant Raytheon Missile Systems, wide varieties of analog data are logged to a central repository of binary files tagged with relevant metadata to allow the data to be analysed. Automated analysis of this data is conducted with tools such as

LabVIEW and NI DIAdem to gain a high-level view of the performance and immediately report results back to operators and managers. Without a software platform to manage this data and generate useful insights, test organisations will be overwhelmed by the substantial amounts of collected data and they'd be unable to derive value from it. In Raytheon's case, however, the insights gave the company the ability to reduce the time required for each test cycle by half.

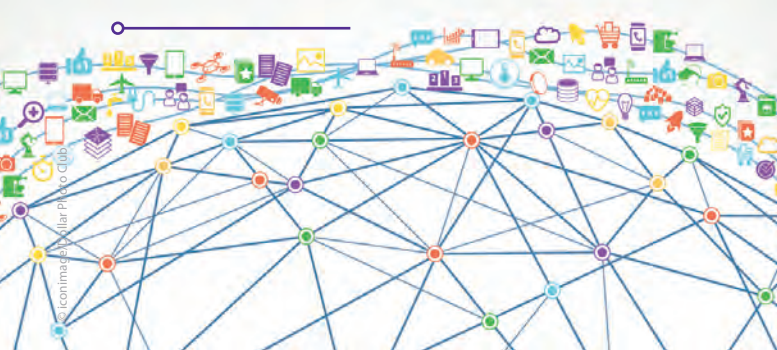
In addition to centralised analysis on the server, for distributed test systems, automated analysis on the node can provide significant operational advantages. Although raw analog data may overwhelm a network, an FPGA or CPU processing on the node can synthesise data into fragments such as average values that can be more succinctly communicated over the network to other stakeholders. Equipped with a high-level graphical programming approach called the LabVIEW reconfigurable I/O (RIO) architecture, test engineers can take advantage of user-programmable FPGAs and embedded controllers to perform distributed analytics or make instant decisions at the node without needing to send data back to a central server.

Planning for changing requirements

In addition to device-to-device communication and automated analysis implemented in software, another crucial aspect of IIoT systems already found in today's test and measurement applications is scalable hardware systems. For wireless telecom leader Qualcomm, disparate, lengthy measurements on traditional box instruments were driving up the cost of measurement in an extremely competitive and cost-sensitive industry. By upgrading from RF signal generators and analysers to NI's modular, PXI-based hardware platform, Qualcomm saved significant rack space and lowered the cost of test. More importantly, by taking advantage of the user-programmable FPGA hardware on NI's vector signal transceiver, Qualcomm decreased test time by a factor of 200.

Building on a flexible hardware platform that uses the latest commercial technology such as NI PXI turns future requirements from a threat of obsolescence to an opportunity to upgrade. Instead of replacing an entire box instrument for a new measurement specification, a new PXI module can be incorporated into the existing test system. Or if the processing power for a complex RF measurement is inadequate, the PXI controller can be replaced with the new NI PXIe-8880, which features an eight-core Intel Xeon processor. This flexibility opens up test systems to exciting new technology enablers, such as silicon advances, user-programmable FPGAs, and timing and synchronisation advances.

TEST & MEASUREMENT



IIoT systems are constantly evolving to include more and more nodes with varying I/O requirements. To meet these challenges, a software platform must support flexible, modular hardware solutions.

Business opportunity in the IIoT

Successful companies have used a proven software and hardware platform to implement elements of the IIoT. Microsoft built a networked software infrastructure to connect its testers and gained insights to double test throughput per station. Raytheon implemented automated analysis of data to reduce test cycle times by 95%. Qualcomm radically redefined its definition of test coverage through a modular, software-designed instrument approach.

Although the IIoT has already manifested itself in test and measurement over the last decade through software platforms such as LabVIEW, today's test managers are presented with significant new opportunities to make their test systems smarter. Web, cloud and mobile technology are redefining how humans interact with machines and machines with each other. For the first time, fully automated end-to-end testing, analysis and adaptation are real, tangible possibilities.

For some test managers and organisations, there may not be a choice. As test budgets are further squeezed, requirements continue to change rapidly and time-to-market pressures increase, piecemeal hardware systems with software built from scratch will become increasingly untenable.

LabVIEW and NI TestStand deliver the software platform needed for test engineers to use scalable test hardware such as NI's PXI hardware platform to achieve device-to-device communication and



AS TEST BUDGETS ARE FURTHER SQUEEZED, REQUIREMENTS CONTINUE TO CHANGE RAPIDLY AND TIME-TO-MARKET PRESSURES INCREASE, PIECEMEAL HARDWARE SYSTEMS WITH SOFTWARE BUILT FROM SCRATCH WILL BECOME INCREASINGLY UNTENABLE.

automated analysis. With a proven approach for defining acquisition, synchronisation, processing and analysis through high-level graphical programming, NI developed LabVIEW 2015 to help engineers write code faster. With NI's software portfolio, test engineers can spend more time focusing on the test challenges at hand without getting caught up in the low-level details.

This empowers developers to build a robust IIoT solution while avoiding the risk of building a software solution from the ground up. LabVIEW facilitates device-to-device communication through countless methods such as PXI chassis backplane communication buses, embedded network protocol support and HTTP web methods. LabVIEW and TestStand facilitate automated analysis wherever it needs to happen — on the instrument, on the tester or on the data server. Innovative technologies like NI Cloud Dashboard further extend test devices to be able to seamlessly upload streams of test data to the cloud where they can be accessible from any device with an internet connection.

This software platform puts control into the hands of test engineers, while empowering them to use hardware with industry-leading commercial technology like NI's new eight-core PXI controller or high-voltage system SMU.

Returning to the original question is the IIoT a disruptive new opportunity or just validation of proven technologies in the test and measurement industry? It is up to each test manager to decide. What is certain is that the IIoT will give rise to smarter test systems that will further redefine test and measurement in the decades ahead.

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The AirLink GX450 enables users to manage, monitor and administer their fleets remotely. The next-generation 4G mobile gateway delivers mission-critical communications for in-vehicle applications.

With LTE coverage supporting LTE frequencies 2100/1800/2600/900/800, the product extends broadband connectivity to a wide range of devices and applications. It extends the enterprise network and management to the fleet, ensuring secure broadband data access for mobile users in the field.



The compact device is rugged and secure with advanced GPS, making the cellular modem a powerful solution. Applications include transportation, industrial machine-to-machine (M2M) and enterprise applications. The product is also suitable for use in law enforcement, emergency services, utilities and field services for in-vehicle connectivity and access to critical information.

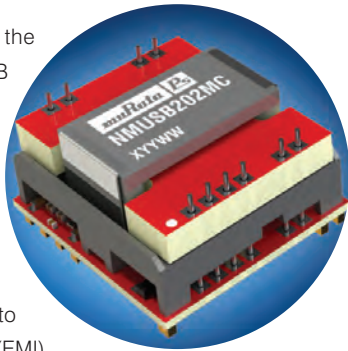
Used with the AirVantage Management Service (AVMS), the gateway supports over-the-air device registration, configuration and software updates. Dashboards display up-to-date views of the entire fleet and custom reports can be set up to monitor critical events and prevent downtime.

Designed for versatility with embedded intelligence, the product offers four configurations providing in-vehicle network connectivity via ethernet, serial, Wi-Fi and USB to suit a wide range of applications.

M2M Connectivity
www.m2mconnectivity.com.au

USB DATA ISOLATOR

Murata Power has released the NMUSB202MC Dual-Port USB Data Isolator. The surface-mount isolator provides an isolation barrier between a computer and two connected USB devices, helping to extend effective breaking of ground loops and immunity to electromagnetic interference (EMI) while allowing data transmission.



The product is a USB 2.0-compliant surface-mount module that supplies dual-port USB data isolation from a single upstream port with full 500 mA power available from each downstream port. The 5 V, 1.3 A USB data isolator features automatic switching between low speed at 1.5 Mbps and full speed at 12 Mbps.

Featuring verified integrity through 3 kVAC isolation, downstream short-circuit and overload protection and power surge notification, the device is suitable for harsh environments with risk of EMI or electrostatic discharge (ESD). Applications for the isolator include industrial and medical technologies, where non-isolated USB power can damage peripherals or users or EMI may cause inaccurate data readings.

Mouser Electronics
www.mouser.com

X-RAY INSPECTION SYSTEM

The TruView Prime X-Ray Inspection System is a fully motorised radiography system developed to meet the stringent requirements of semiconductor failure analysis, BGA and QFN inspection, electronics assembly and general quality inspection.

The product offers good image quality in a benchtop configuration. It can be configured as a generic X-ray inspection system, suitable for use in PCB inspection (BGA and QFN), or in an optional, high-magnification mode, suitable for semiconductor failure analysis. The system can be used for counterfeit part analysis, either in static mode or with the option of reel-to-reel hardware and control.



Systems are available starting at 80 kV 33 μ m and can be offered optionally as 90 kV 5 μ m close tube emitters. Both versions offer a full digital image flat panel detector sized at 102 x 76 mm. The product comes with base user software with many optional software application modules, depending on the inspection applications required.

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BIG DATA ANALYTICS

Paul Pilotte, Technical Marketing Manager

Up until recently, only data scientists were able to make sense of big data. Today, rather than hiring these specialists, companies expect their existing domain experts to be able to do the same work. Thankfully, analytics tools have evolved to address the challenges associated with big data, and you don't have to be an expert at Java programming to use them.

In the field of engineering in particular, the accessibility of such tools is significant. No longer limited by the storage capacity of their workstations, engineers are now able to process large data sets from diverse and disparate sources to inform better decision making. From medical devices to oil and gas, automobiles and aviation, we're seeing several industries take the next steps to accessing more of their data and building more sophisticated analytics.

Automotive companies are seeing their data analytics needs move beyond their design engineering departments to applications where they are integrating data analytics models into new systems and services. Some are taking fleet data from passenger and off-highway vehicles. They're also capturing field data from hybrid electric vehicles so that their engineers can build models to optimise fuel efficiency. For large off-highway vehicles (think loaders, trucks and dozers used in mining operations), they're capturing field data to ensure that they can meet service-level agreements and improve design reliability to maximise uptime.

Similarly, a medical device company wanted to bring in data from a vast pool of medical instruments and use these datasets to build neuroscience models. Once upon a time, these researchers would have had to be very familiar with Hadoop in order to achieve their goals; however, using big data tools from MathWorks, the company has been able to ingest, pre-process and apply machine-learning techniques to data without relying on the skills of mathematicians.

These sorts of applications are indicative of a trend where companies are accessing data from different sources and building complex models to better understand and predict how a design works in the real world.

For engineers, many of whom are trained using MATLAB, the tools' big data processing capacities means they don't need to

upskill too much to put them to use. Instead, via a familiar, intuitive and interactive user interface, they can plot data and visualise that data in either two or three dimensions — particularly important in the exploration and modelling stages. With this processing power at their fingertips, engineers are able to improve designs and optimise operational performance that directly impacts their organisation's bottom line.

When it comes to predicting which companies will benefit from data analytics moving forward, the financial services industry stands out. Organisations in this sector have long been employing tools for credit modelling, risk modelling and algorithmic trading, so the possibilities there will only continue to grow.

We're also seeing some exciting activity around the industrial internet or Industrial Internet of Things (IIoT). Unlike the consumer Internet of Things, IIoT includes devices designed for harsh environments which are built to last for decades. The IIoT is set to really benefit from data analytics, and this includes many design engineering fields such as automotive, aerospace, industrial automation and process control.

Data analytics opens up a whole new universe for users in this area. Within the software and internet industries, we will see a lot of other manufacturing and machine-based companies benefit from the ability to bring data in, explore it, build models and integrate those models using a common modelling workflow. Engineering companies are finding that if they can access data from lots of different sources while using more sophisticated predictive analytics tools, like machine learning, they can make more informed and accurate decisions and become big data experts in their own right.

MathWorks Australia
www.mathworks.com.au

CORE COMPONENTS FOR ELECTRONICS

IMP Electronics Solutions is a supplier of a range of core components used in the development and manufacturing of electronic products.

IMP globally sources PCBs, flexible circuits, rigid-flex circuits, membrane switches, decals, solder paste stencils, cable assemblies and LCD screens direct from the factories that manufacture the products. The company works closely with all its suppliers, each of which has passed a stringent audit to ensure that they can consistently meet customers' needs. The company says its teams in South Australia and China are committed to supplying high-quality electronics solutions, on-time delivery and good customer service.

IMP Printed Circuits

www.imppc.com.au

ELECTRONICS MANUFACTURING EQUIPMENT

Oritech has available a large range of soldering equipment from JBC, with many of the latest releases offering improved features and performance.

The company is also a distributor of Europlacer pick-and-place equipment — a range of intelligent machines suitable for the PCB loading industry. The company also offers turnkey PCB production lines, including Speedprint printers and HB Automation reflow ovens and wave solder machines.

Oritech Pty Ltd

www.oritech.com.au

SWITCHED JOYSTICK

Control Devices has developed the CDJ900 - a switched output joystick controller featuring single- and dual-axis outputs with IP67 fully sealed switched contacts with flying leads. The product's mounting design allows the switch assembly to be field replaceable. The assembly can have multiple switch contacts mounted in each axis.

Control Devices has a comprehensive range of handle types to provide a range of standard configurations, along with capability to support specific application and custom-design requirements. These may encompass both switched and proportional outputs. The company can incorporate push-buttons, toggles, thumb wheels, rocker switches and many other features to provide additional elements of operation and control.

Control Devices Australia

www.controldevices.net



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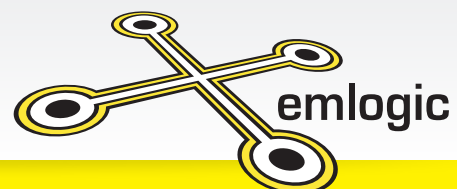
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DIE-CAST ALUMINIUM ENCLOSURES

Hammond Electronics' 1590 STOMP die-cast aluminium enclosures are designed to accept the most commonly used switches for stomp box applications. Stomp boxes are foot-operated equipment used by electric guitarists to produce preset effects such as distortion, wah-wah, delay, chorus and phaser. Many players will have a bank of up to 20 stomp boxes, each providing a different effect.

The products are available in rectangular, trapezoidal and octagonal designs. All are rugged, easy-to-machine enclosures which are able to cope with the on-stage environment. The latest addition to the family is a 119 x 94 x 42 mm rectangular unit, designed to accept deep break-before-make switches that stop conducted interference when operated. All types are finished in a smooth gloss polyester powder paint, which does not chip after machining and provides a good surface for labels and silk screening.

The units are available in seven vibrant colours: cobalt blue, green, light grey, orange, purple, red and yellow (the units can be supplied in other colours to order to match corporate styles). A lap joint seals the units to IP54, protecting against the ingress of dust and water, and the painted finish is only applied to the external surfaces, maintaining RFI integrity. The rectangular versions can have enhanced IP65 protection through the addition of an optional sealing gasket kit.

Hammond Electronics Pty Ltd
www.hammondmfg.com

TEST AND MEASUREMENT EQUIPMENT

With over 25 years of expertise, ADM Instrument Engineering is an Australian owned and operated retailer of power supplies, load cells, pressure sensors, panel meters, position transducers and other test and measurement equipment.

The company provides personal customer service and holds a wide product range for both common and rare industrial applications. Services include the supply of precision-engineered power and instrumentation products; expert consultancy across its entire product range; calibration services; repair and servicing down to the component level; and the rental or loan of selected handheld equipment.

ADM Instrument Engineering Group
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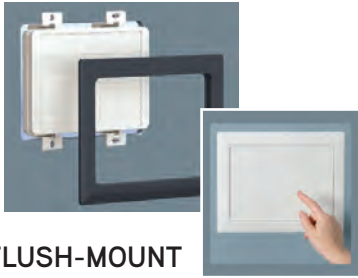
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For more details please visit: **www.imppc.com.au**



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FLUSH-MOUNT ENCLOSURES

OKW has extended its Interface-Terminal plastic enclosures series with a new range of accessory kits which allow the enclosures to be flush-fitted in walls or control panels.

The new wall/panel installation kits consist of four holding brackets that are fitted to the rear of the enclosure and are used to mount the assembly in the wall/panel aperture. A flush-fitting design frame then snaps onto the holding brackets to give an attractive and professional appearance which hides the aperture and assembly screws underneath.

These kits are suitable for applications where there are high architectural standards or in historically important buildings where concealing electronics equipment is important.

To assist with this, OKW offers the installation kits in three options: in off-white to match the standard enclosure colour; painted to match the building colour scheme; or with water transfer printing, eg. with wood finish to suit an historical building or traditional office decor.

These installation kits are designed for the basic Interface-Terminal enclosure configurations, consisting of a flat- or high-bottom part fitted with any of the front panel/cover options. The basic enclosures are available in three standard plan sizes of 135 x 190, 165 x 225 and 195 x 275 mm. Heights vary from 26.5 mm to 46.5 mm depending on the bottom/front section configuration selected.

In addition to the frame finishes, OKW can also supply the enclosures with additional holes for the push-buttons, connectors and displays, plus silk-screen printed legends and logos, and EMC shielding.

**ROLEC OKW Australia
New Zealand Pty Ltd**
www.rolec-okw.com.au

TOOLS, EQUIPMENT AND CONSUMABLES

Mektronics Australia is a distributor of tools, equipment and consumables. The company has grown in size over the last 30 years from servicing the electronics industry to now supplying a range of industries, including manufacturing, defence, aerospace, medical, rail, education and telecommunications.

The company supplies hand tools, tool cases, soldering equipment, fume extraction, static control, labelling systems, power tools, test equipment and other production and service aids from brands including Chemtronics, Electrolube, Multicore, MG Chemicals, Loctite, Techspray, Super Lube, Pace, Hakko, Metcal, Desco, Brady, Bofa, Suttons, CK Tools, Chicago Case, Wiha, Bernstein, Tronex, Idealtek, Bondhus, Bosch, Panasonic, Hitachi, Luke, Megger, Meanwell, Hammond and many more.

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PXI SIGNAL GENERATION AND ANALYSIS

Keysight Technologies has announced the release of four M9290A CXA-m PXIe signal analyser tracking generator options. The signal analyser, with a built-in tracking generator, has 3, 7.5, 13.6 and 26.5 GHz options, making it

a complete modular stimulus response measurement solution with wide-ranging tracking-generator frequency coverage. Vector signal analysis capabilities are also available on the device via the N9064A VXA X-Series measurement application or 89600 VSA software.

Adding the tracking generator to the instrument makes it suitable for characterising the behaviour of components or subsystems, including frequency response, conversion loss and insertion loss/gain, as well as analysing and identifying unknown signals. The modular stimulus response measurement solution allows system developers to fulfil the tasks for component characterisation while meeting the demands of shrinking the test footprint and budget.

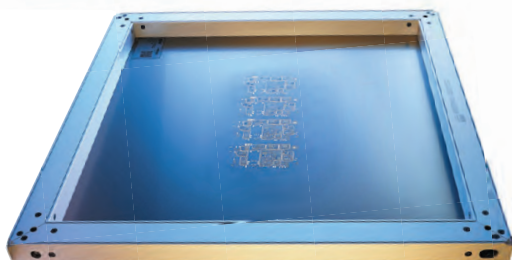
Keysight Technologies Aust Pty Ltd
www.keysight.com

ELECTRONICS CONTRACT MANUFACTURER

GPC Electronics is an electronics contract manufacturer whose business model centres on providing manufacturing solutions at low overall cost and risk. The company's focus is on making customers more competitive by managing complex business issues.

The company specialises in the introduction, manufacture and support of complex mid-to-high-volume and high-mix products. Its capabilities and expertise include supply chain management, product development, project management, SMT assembly, box-build, full turnkey assembly, customisation, test, materials procurement and logistics.

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DESIGNING PCBs

PART 2

There are many types of electronic design software packages available on the market and choosing the one that will meet all your requirements isn't easy.

When deciding which software to use, there are a number of factors to consider including: licence cost; design complexity; scalability requirement of the project; design and import/output restrictions; and PCB manufacturer's requirements.

PCB design software currently available in the market can be divided into two categories — free or open source software and commercial software. Below is a list of free/open source software:

Software	Website link
FreePCB	www.freepcb.com
ZenitPCB	www.zenitpcb.com
Fritzing	www.fritzing.org/home
ExpressPCB	www.expresspcb.com
Osmond PCB	www.osmondpcb.com
Kicad	www.kicad-pcb.org
Cometcad	www.cometcad.com
PCB Editor	www.pcb.geda-project.org
TinyCAD	www.tinycad.en.softonic.com
DesignSpark PCB	www.rs-online.com/designspark/electronics

*Free or Open source PCB design softwares**

Software	Website link
Altium	www.altium.com
Eagle	www.cadsoftusa.com (EAGLE light edition is free for all. However, if you earn (or save) money by using the Freeware version of EAGLE Light, you have to register it.)
Orcad	www.orcad.com
Easy-PC	www.numberone.com
Circuit maker	www.circuitmaker.com
PADS	www.pads.com
CR-8000/CR-5000/CADSTAR	www.zuken.com/en

*Commercial PCB design softwares**

Designers must check whether the software works on their operating system. Some software may only work on Linux or Macintosh. Some manufacturers do not allow users to export output in widely accepted file formats, restricting them from using other manufacturers.

Fabrication output formats

Each PCB fabricator will have different requirements for how you submit the design files. (For example, QualiEco only accepts design files from Altium. You just supply .PCB or .PCBDOC file and you are done.) The designer will be required to export fabrication output from the design files in a specific format. Therefore, it is extremely important to know various possible fabrication output formats before you choose PCB design software. If your software cannot export fabrication output in a commonly accepted format, you will be left with a restricted choice of manufacturers and you may end up paying a high cost for manufacturing.

Below are the two most-common file formats:

Gerber and NC drill files — All PCB manufacturers accept Gerber and NC drill files. There are two major generations of Gerber format: RS274-X (extended Gerber) and RS274-D (standard Gerber). Standard Gerber is now technologically obsolete. However, if your software can only generate standard format, you will need to supply a separate aperture list/report file to the manufacturer. The CAD engineer at the PCB manufacturing facility will use the aperture list to enter shape and size information manually in the CAM software. The NC drill file should be in ASCII format. Below is an example:

ODB++ (Open DataBase++) format — ODB++ format was designed to facilitate problem-free CAD-to-CAM data transfer. Unlike Gerbers and NC drill data files, ODB++ is a single file that contains all the information needed for PCB manufacturing. There are contradictory opinions about the accuracy and ease of Gerbers and ODB++ formats among PCB experts. However, we consider ODB++ outputs more reliable than any other format.

This is the second article in a three-part series on PCB design and manufacturing. The third article will provide insights on selecting the right PCB manufacturer; solving design and manufacturing hitches; and understanding special design requirements and challenges.

There are several free and commercial software solutions available in the market but we have only included the most popular ones.*

QualiEco Circuits Pty Ltd
www.qualiecocircuits.com.au

TRADE PROMOTION ORGANISATION

Founded in 1970 to help promote foreign trade, the Taiwan External Trade Development Council (TAITRA) is a non-profit trade promotion organisation.

Jointly sponsored by the government, industry associations and several commercial organisations, TAITRA assists Taiwanese businesses and manufacturers with reinforcing their international competitiveness and coping with the challenges they face in foreign markets. The company has a trade promotion and information network of over 600 trained specialists stationed throughout its Taipei headquarters, four local branch offices in Hsinchu, Taichung, Tainan and Kaohsiung, and over 52 overseas branch offices worldwide.

Taiwan Trade Centre Sydney enables businesses in Oceania to trade with Taiwan via the following services: arranging to exhibit at or visit Taipei trade fairs; providing suppliers' and industry information; arranging one-on-one trade meetings; arranging reverse procurement fairs for big buyers; arranging ePS-eProcurement sites for qualified companies; exposing companies worldwide; assisting with investment in Taiwan; business alliance services/assisting office set-up and providing general law regulation and tax incentive information; assisting business and healthcare tours to Taiwan; high-tech talent recruitment service; and providing free official trade show directories.

Taiwan Trade Centre

www.sydney.taiwantrade.com.tw



CONTRACT MANUFACTURING, PROJECT MANAGEMENT AND RF PRODUCT DESIGN

Microe is an Australian business providing high-technology design and manufacturing services for the aerospace/high-reliability electronics market.

Microe holds AS9100C accreditation for its quality management system and uses this system to deliver design and manufacturing services to high standards. The company has 1300 m² of cleanroom manufacturing space, along with a purpose-built open-plan production area for high-volume contract manufacturing programs.

The Microe team includes professional design engineers in various disciplines. A large manufacturing department is well equipped with both conventional and specialist RF/microwave electronics production equipment. The procurement team are specialists in expedited supply of components within the strict confines of AS9100C, in a marketplace where counterfeit avoidance mechanisms are crucial.

The company's services are suitable for specialist electronic design input, complex project management or high-volume build-to-print production. Microe also has customers in the defence industry.

Microe Limited

www.micreo.com



CONTROLLER

The NI PXIe-8880 is a high-performance Intel Xeon E5-2618L v3 processor-based embedded controller for use in PXI Express systems. It features a 2.3 GHz base frequency (3.4 GHz single-core, Turbo Boost mode) eight-core processor with up to 16 hyper-threaded virtual cores and the triple-channel 1866 MHz DDR4 memory.

The embedded PXI Express controller is suitable for high-performance, high-throughput and computationally intensive test and measurement applications such as 5G cellular research, semiconductor production test and RF record and playback, as well as any application for which test time and time to market are important. Because of the CPU's multicore nature, the embedded controller is particularly useful when paired with system design software that is optimised for parallel processing such as LabVIEW and TestStand.

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www.ni.com/oceania

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ELECTRONIC COMPONENTS

Ampec Technologies is a supplier of electronic components, cable assemblies and electronic product assemblies. Its services are suitable for the following applications: box assembly, including internal wiring and cable looms; cable assembly; PCBA for low-volume run or prototyping; metalwork; label printing; testing and packaging.

The company supplies a range of passive electronic components, including connectors, resistors, capacitors, potentiometers, inductors, joysticks, enclosures, power cords and self-clinching metal fasteners. It caters for companies with low- to mid-volume products, with quantity starting from one unit. The company provides sourcing services for component shortages and hard-to-find parts.

Ampec manufactures cable harnesses and looms per specific requirement from customers. It has ISO9001 accreditation and is UL listed for wiring harnesses. Most Ampec employees are trained to IPC/WHMA-A-620, which covers requirements and acceptance for cable and wire harness assemblies.

The company's experience in combining electromechanical assembly, cable assembly and metalwork disciplines enables a comprehensive product build, testing, packing and logistics service. It also offers service in fast-turn refurbishment and/or minor modifications to suit different requirements or industries.

Ampec Technologies Pty Ltd

www.ampec.com.au

ELECTRONIC DESIGN AND MANUFACTURING SERVICE

Hetech is a Queensland-based electronic design and manufacturing company that provides customer-specific solutions and concept-to-delivery products. The company partners with its customers, walking them through an all-encompassing range of product development services including concept generation, design, testing and volume manufacturing.

Hetech's design services are backed by a team of qualified and experienced electrical engineers based in Brisbane, as well as a number of contracting engineers Australia-wide. The company's 'design to manufacture' approach gives uses the certainty that their products will be designed to the agreed manufacture cost and time requirements.

Hetech

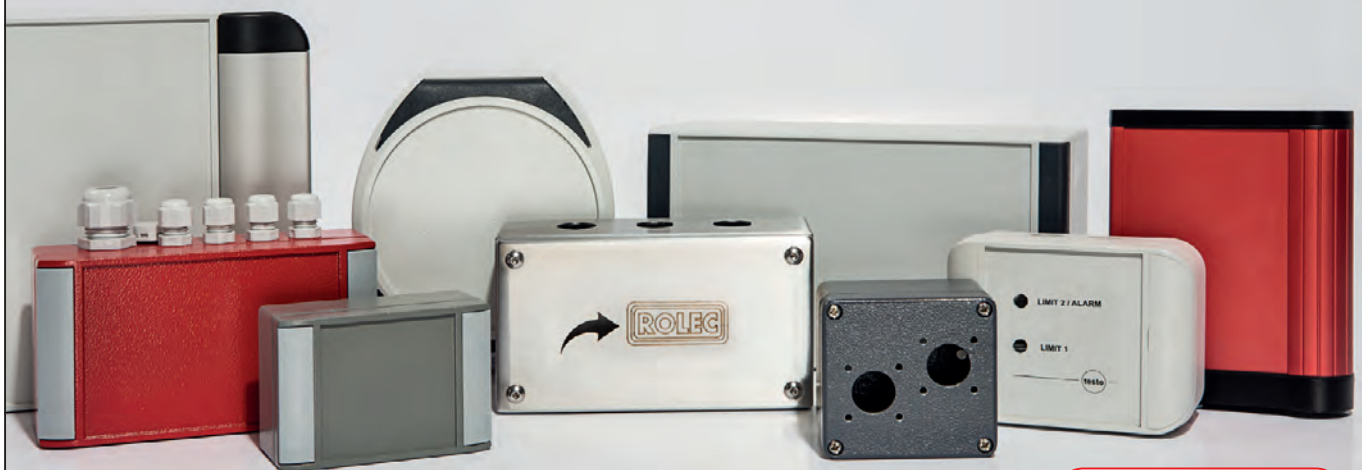
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ADHESIVE AND COATING MATERIALS AND EQUIPMENT

UV Pacific supplies materials and equipment relating to the adhesive and coating industry throughout Australia and New Zealand.

The company's UV/visible light curing materials for use on electronic assemblies, from Dymax Corporation, includes conformal coatings, potting, encapsulating, laminating and masking materials. Curing equipment from both Dymax and Honle can be supplied with either conventional lamps with wideband wavelengths or long-lasting LEDs over a selected range of wavelengths.

For automated dispensing, the range of Janome dispensing robots offers solutions for circuit board manufacturers. Sizes range from 200 mm² to 510 x 620 mm and can have up to four physical axes and two extra software axes. Options include camera functions, LAN port and fieldbus compatibility. Other models include screw insertion, board depaneling and soldering.

A range of dispensing equipment includes conventional pneumatic units as well as high-precision positive displacement systems. The ViscoTec ecoPENs give accurate and repeatable volumes and flow rates for robotic applications. Liquidyn jetting dispensers offer dispensing for difficult applications. For two-component potting applications, equipment ranges from the precise ecoDUO dispense units to the Meter Mix Systems piston or gear pump units, with the option of vacuum potting.

UV Pacific

www.uvpacific.com

ELECTRONIC CONTRACT MANUFACTURER

Entech Electronics is an electronic contract manufacturer with 25 years of ISO9001 certification.

The company's assembly facility services both low- and high-volume production and operates a dedicated prototyping cell. Entech provides turnkey box builds, multilayer PCBs up to 32 layers, membrane keypads, high-quality graphic overlays and decals.

For high-volume manufacturing, Entech offers its ISO certified, 100% Australian owned and operated facilities in China. The company's offshore manufacturing service features over 6000 m² of floor space, four SMT lines and over 180 staff.

Entech Group

www.entechgroup.net

EMS AND PCB ASSEMBLY MANUFACTURING SERVICE

Alfatron is a 100% Australian owned and operated company providing a manufacturing service for EMS and PCB assembly. The company specialises in small to medium projects, with the ability to review design for production, procure components, manufacture, test and assemble.

The company can review its customers' designs and provide recommendations to assist with an efficient design ready for the manufacturing process. Its automatic optical inspection (AOI) machines will inspect every solder joint and component identification on a PCB, while its in-circuit testing (ICT) service provides a comprehensive test bed for the final product.

Alfatron can assist with designing enclosures or utilise customers' existing tooling with its in-house ultrasonic welding and overmoulding services. Finally, once the PCB is manufactured the company can complete the project by assembling the final product, ready for its customers' clients.

Alfatron Pty Ltd

www.alfatron.com.au

5G CHANNEL SOUNDING REFERENCE SOLUTION

Keysight Technologies has introduced the 5G Channel Sounding Reference Solution. The reference solution is designed for accelerating research of millimetre-wave 5G channel models and includes ultrabroadband and MIMO — key requirements to measure the millimetre-wave channel and validate air interface standards.

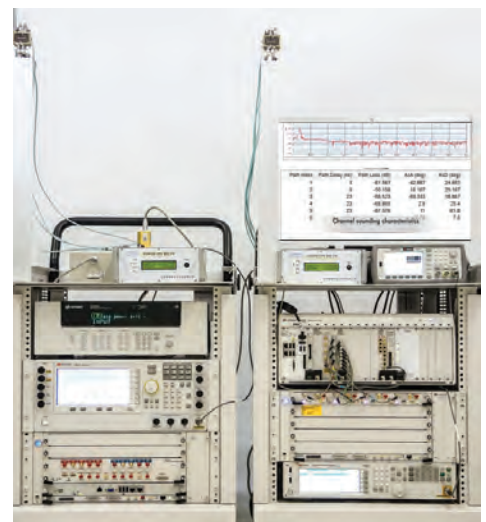
The reference solution combines metrology-grade hardware, software and expertise to allow users to quickly characterise the channel behaviour in frequency bands from 10–100 GHz and enable researchers to develop the necessary channel models for designing and validating air interface alternatives. Researchers can get absolute delay measurements with system-wide calibrations, precise timing and synchronisation.

Users will also save time and disk space by using the multichannel, real-time data processing and correlation of the channel impulse response data offered by the M9703A high-speed digitiser FPGAs. Engineers can use Keysight's SystemVue system-level design and simulation software platform to calculate channel parameter estimations and perform link-level simulations and validation of 5G designs with the imported channel models.

The reference solution also enables: Tx/Rx up to 44 GHz with 1 GHz bandwidth for four or eight MIMO channels; capture of multiple phase-coherent channels for real-time CIR data processing in FPGAs; flexibility and scalability to add more channels and tests as 5G standards evolve; and customisation of waveforms, models for channel parameter extractions and system integration.

Keysight Technologies Aust Pty Ltd

www.keysight.com





PCB TECHNICAL GUIDE

QualiEco Circuits has provided professional services for PCB manufacturing and assembly for over 12 years in Australasia. The company launched a free monthly technical guide at the 2015 Electronex exhibition in Melbourne.

The technical guide covers various aspects of PCB manufacturing in the form of a concise, educational bulletin for PCB designers, electronic engineers and purchasing officers. It will be published on QualiEco's website every month.

'PCB Wizards with QualiEco — Your Monthly Technical Guide' is an easy-to-read publication in which the QualiEco technical team can share its vast experience and practical ideas. The company says its helpful articles will save readers time and money by enriching their knowledge and simplifying the complexities of PCB manufacturing.

Readers will discover how to: review the ABCs of PCBs; understand manufacturers' capability statements; learn about PCB design software packages and common output formats; select the right PCB manufacturer first time; make the most of their money when ordering PCBs; solve PCB design and manufacturing hitches; understand special design requirements and their manufacturing challenges.

QualiEco Circuits Pty Ltd
www.qualiecocircuits.com.au

COMPONENTRY FOR OEMs

Altronic Distributors (Altronics) is a bulk wholesaler of componentry to OEMs as well as a local manufacturer of public address equipment. The company's focus is on providing good local service, coupled with indent sourcing for bulk users.

Altronics' latest ranges of components are said to be in high demand by Australian OEMs, including fans, industrial enclosures, cabling management products, weatherproof cable glands, switches, DC power connectors and much more. The company has also recently launched in-house customisation of products using a UV screen-printing process combined with automated CNC routing. These services provide manufacturers and installers with access to products tailored to their requirements.

Altronic Distributors Pty Ltd
www.altronics.com.au

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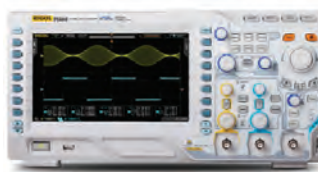
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EMONA

CHARGING LITHIUM-ION BATTERIES WITH SOLAR CELLS

© iStockphoto.com/Daniel Schonen

Most solar cells fail to meet the power requirements needed to directly charge lithium-ion batteries used in today's all-electric and plug-in hybrid electric vehicles.

Researchers at Case Western Reserve University, however, have wired four perovskite solar cells in series to enhance the voltage and directly photocharged lithium batteries with 7.8% efficiency.

The research, published in *Nature Communications*, holds promise for cleaner transportation, home power sources and more.

"We found the right match between the solar cell and battery," said Liming Dai, the Kent Hale Smith Professor of macromolecular science and engineering and leader of the research. "Others have used polymer solar cells to charge lithium batteries, but not with this efficiency."

In fact, the researchers say their overall photoelectric conversion and storage outperformed all other reported couplings of a photocharging component with lithium-ion batteries, flow batteries or supercapacitors.

Perovskite solar cells have active materials with a crystalline structure identical to the mineral perovskite and are considered a promising new design for capturing solar energy. Compared to silicon-based cells, they convert a broader spectrum of sunlight into electricity.

In short order, they have matched the energy conversion of silicon cells, and researchers around the world are pursuing further advances.

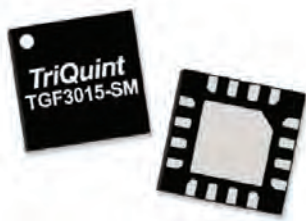
Dai's lab made multilayer solar cells, which increases their energy density, performance and stability. Testing showed that, as desired, the three layers convert into a single perovskite film.

By wiring four lab-sized cells, about 0.1 centimetre square each, in series, the researchers further increased the open circuit voltage. The solar-to-electric power conversion efficiency was 12.65%.

To charge button-sized lithium-ion batteries, they used a lithium-ion-phosphate cathode and a lithium-titanium-oxide anode. The photoelectric conversion and storage efficiency was 7.8%. Through 10 photocharge/galvanostatic (steady current) discharge cycles lasting nearly 18 hours, the technology maintained almost identical discharge/charge curves over all cycles, showing high cycling stability and compatibility of the components.

"We envision, in the not too distant future, this is a system that you could have at home to refuel your car and, eventually, because perovskite solar cells can be made as a flexible film, they would be on the car itself," said Jiantie Xu, who, with Yonghua Chen, is an equally contributing first author of the study. Both are macromolecular science and engineering research associates in the Case School of Engineering.

The researchers are developing small-scale prototypes and working to further improve the perovskite cell's stability and optimise the system.



INPUT-MATCHED TRANSISTOR

The 10 W (P3 dB), 50 Ω input-matched TGF3015-SM is a discrete GaN on SiC HEMT that operates from 0.03 to 3 GHz. The integrated input-matching network enables wideband gain and power performance, while the output

can be matched on board to optimise power and efficiency for any region within the band. The device is housed in a 3 x 3 mm package.

Key features include: output power (P3 dB) of 11 W at 2.4 GHz; linear gain of 17.1 dB at 2.4 GHz; typical PAE3 dB of 62.7% at 2.4 GHz; operating voltage of 32 V. With a low thermal resistance package and being CW and pulse capable, the product is suitable for military and civilian radar, land mobile and military radio communications, test instrumentation, wideband or narrowband amplifiers and jammer applications.

Wireless Components

www.wirelesscomponents.com.au



CELLULAR SYSTEM-ON-MODULE

MultiConnect Dragonfly cellular SoMs are complete, ready-to-integrate processing and communications devices that offer developers the functionality of an SoM with the convenience of an onboard cellular radio, all in one compact design. With the integrated Cortex M4 processor, developers can host their application and have access to a full suite of interfaces for connecting sensors or other remote assets.

The product comes with an ARM mbed compatible software library for fast development, as well as future support for MultiTech's hosted application store and device management systems. The supplied mbed libraries provide support for SMS, radio and connection management, IP protocol support and physical interfaces. The libraries can also be used as a reference for developing libraries in other languages.

The powerful suite of hardware and software products is said to reduce users' time to market and make their Internet of Things (IoT) devices a reality. Dragonfly is a certified as an end device for networks such as AT&T, Verizon and Sprint, providing a quick solution for users to deploy their applications to the market without further network care approval.

The lightweight SoM is suitable for most IoT applications. Features include LTE, HSPA+ and other variants; GPS/GLONASS support; and USB, UART, SPI, I²C, analog and digital I/O. The product can be designed in or retrofitted.

Elecom Electronics Supply
www.elecomes.com



REFLECTIVE SURFACE INSPECTOR

Designed for the inspection of reflective surfaces, the Micro-Epsilon reflectCONTROL Compact will automatically log and store results to enable objective comparisons. The device can be used in individual operations (eg, laboratories) as well as directly in production lines.

The fully integrated system is available in two versions, each of which provides different measuring fields. The 2D version recognises defects on reflecting surfaces, while the 3D version enables the measurement of reflecting surfaces at submicrometre accuracies. Pre-installed operating and evaluation software with the 2D version shows surface defects, while the 3D version provides a point cloud where data can be treated in the image processing programs.

All components are integrated in a compact device with height-adjustable legs. The housing includes a monitor for the striped pattern protection and up to two cameras. In order to avoid interference from ambient light, the measuring field can be darkened on all of the four sides.

The surface inspector can be integrated into a production line via an ethernet interface. A digital I/O interface enables triggering and an external operating monitor can be connected via VGA.

Bestech Australia Pty Ltd
www.bestech.com.au



BOX PC FOR WIRELESS COMMUNICATION

The robust box PC BL70W was developed for wireless applications in mobile markets. Its compliance with E-mark requirements makes it suitable for automotive applications in buses, construction vehicles or agriculture machines.

Despite its compact design, the product offers sufficient space for nine antenna slots as well as a multitude of application-specific I/O. It is equipped with four PCI Express Mini Card slots controlling up to eight SIM cards; a GPS/GLONASS interface; five slots for serial I/O or CAN bus; two USB 2.0 ports; and Gigabit Ethernet via robust M12 connectors.

The PC is designed for fanless operation in the operating temperature range of -40 to +85°C. Due to firmly soldered components and conformal coating, it resists the typical influences of automotive applications like shock, vibration and humidity.

The conduction-cooled box PC has been equipped with a powerful Intel Core i7-3517UE CPU running at 1.7 GHz. Due to the scalability within the Intel i7 family, users can size the computing power to their individual requirements. The device can easily be expanded with PCI Express Mini Cards or different I/O at any time.

The product can be used as a content or hotspot server, as a diagnosis interface or for fleet management control, as well as for passenger information systems and vehicle-to-land communication.

OEM Technology Solutions
www.oem.net.au

16 A PXI SWITCHING SOLUTIONS

Pickering Interfaces is expanding its range of 16 A PXI switching solutions.

The 16 A PXI power multiplexer (model 40-662) is available in seven configurations ranging from four-off 2:1 multiplexers to one-off 16:1 multiplexer. The 16 APXI power matrix (model 40-552) is available in four configurations with matrix sizes of 8x2 and 4x4 and the ability to expand the matrix size with the Y-axis loop-thru connections.

Both switching families feature the following: hot switching up to 16 A at 28 VDC; maximum DC hot switch rating of 300 VDC; hot switching AC signals up to 250 VAC at 16 A; ability to withstand 400 VDC for cold switching; high-quality, high-power electromechanical relays; 20-way GMCT connectors.

All PXI modules can carry the full 16 A current on each path simultaneously over the complete operating temperature range. Applications include electric vehicles, automotive ECU testing, AC mains switching, high-current power supplies, load switching and aerospace electric drive testing.

Pickering Interfaces provides a full range of supporting cable and connector solutions for the 16 A PXI switching family. The company can also manufacture cable assemblies to custom requirements.

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



ADAPTER FOR UNTHREADED CONNECTORS

The M12 PushPull adapter enables the use of unthreaded connectors in existing applications with a standard flange. This results in quick and secure mating and a compact design.

The product's unthreaded locking mechanism enables quick and secure mating, without the use of additional tools, and indicates correct assembly with a clearly audible click. The connection thereby retains its robustness and vibration resistance under demanding conditions.

The innovative locking system requires an M12-compatible flange on the device side, which has prevented the use of the PushPull system in existing applications until now. The adapter has a thread on one side which can be screwed into a standard M12 flange. The other side of the adapter features a flange suitable for the M12 PushPull locking mechanism.

The adapter enables PushPull functionality to be retrofitted to devices with a standard M12 flange. This means users will profit from the benefits of the innovative locking system in existing applications.

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POWER AMPLIFIER

The MACOM MAAP-011145 power amplifier is assembled in a 7 mm surface-mount, lead-free cavity package with a temperature-compensated integrated power detector operating from 17.65 to 19.75 GHz.

The circuit provides 25 dB small signal gain, 43 dBm OIP3, 2 W P1dB, 34.5 dBm saturated output power and bias of 1330 mA @ 6 V. It includes ESD protection and bypass capacitors to ease the implementation and volume assembly of the packaged part.

The power amplifier is specifically designed for use in point-to-point radios for cellular backhaul applications in the 18 GHz band.

Wireless Components

www.wirelesscomponents.com.au

CODING PLATFORM FOR WIRELESSLY CONNECTING DEVICES

The Digi XBee/Arduino-Compatible Coding Platform provides a comprehensive resource for developers to learn about the XBee API and other key features that enable wireless communications for many real-world applications, such as working control systems and sensing networks. XBee modules enable fast time to market, design flexibility, wide range and good data rates for those seeking to incorporate wireless capabilities into a whole range of products and solutions.

The coding platform offers experienced designers and engineers, as well as those just beginning to incorporate wireless communications into their designs, with specific information, hardware and documentation on wirelessly connecting devices using unlicensed 2.4 GHz XBee modules. It features an Arduino-compatible microprocessor, three XBee modules, LEDs, adapters, cables and other components in addition to software code examples. The platform also includes five interactive projects that use the Processing open-source programming language for quick and easy development.

XBee wireless networking technology helps deliver applications and devices fully integrated with Digi Device Cloud for secure, efficient management of multiple devices in true end-to-end wireless connectivity solutions. The XBee comes in two hardware footprints (through-hole and surface mount) and with a variety of antenna options that empower engineers with design flexibility.

Digi-Key Corporation

www.digikey.com



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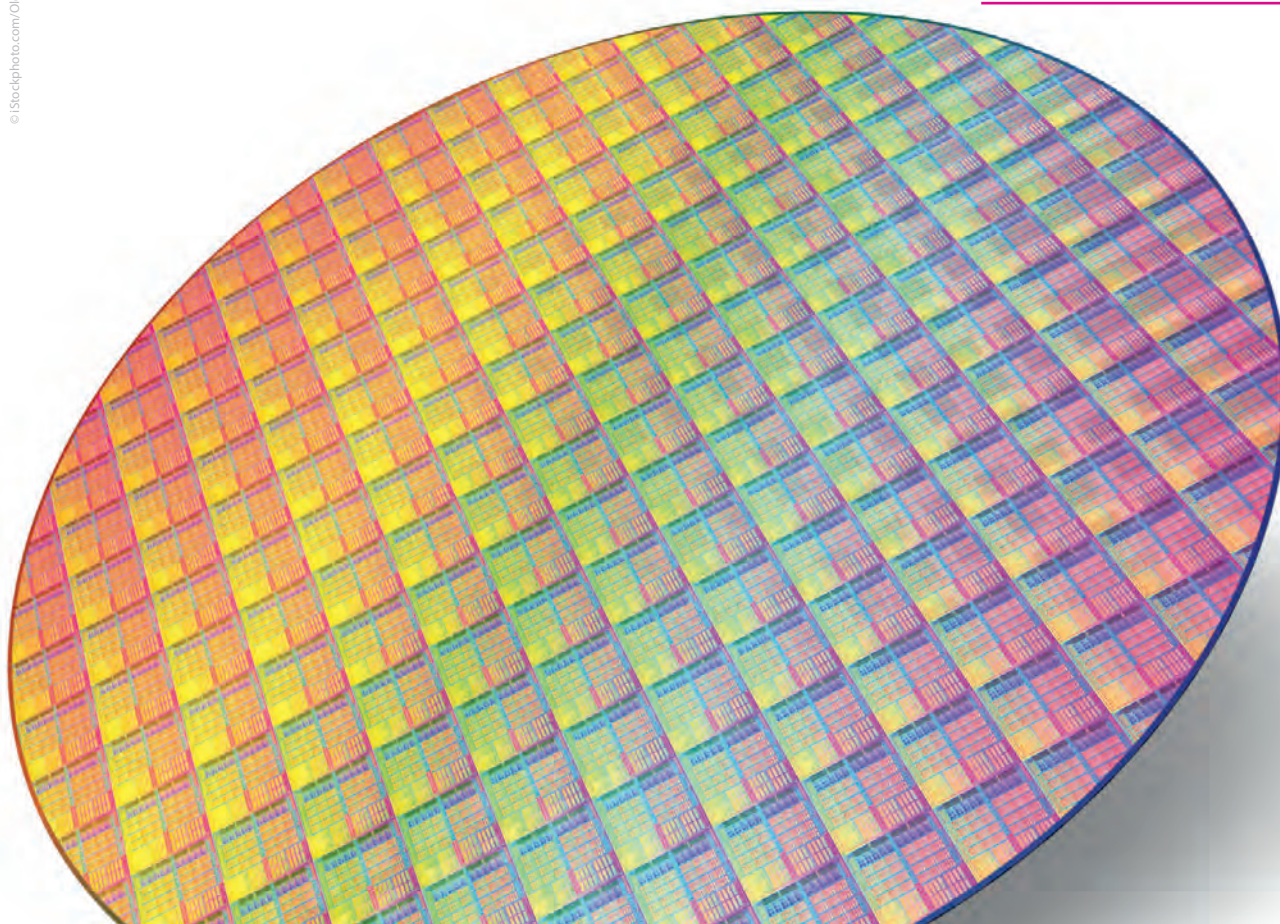
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BLACK PHOSPHORUS-BASED TRANSISTORS

Researchers have created a high-performance transistor using black phosphorus.

Transistors are made up of materials with semiconducting properties, which come in two varieties: n-type (excess electrons) and p-type (excess holes). With the black phosphorus (BP) crystal, researchers at the IBS Center for Integrated Nanostructure Physics at Sungkyunkwan University (SKKU) in South Korea, led in part by Director Young Hee Lee, have discovered that they can change its thickness and/or the contact metals and that will determine if it is high-performance n-type, p-type or ambipolar (functions as both n- or p-type) material.

What does this mean?

Silicon has to be extrinsically doped (inserting another element into its crystal structure) to make it n-type or p-type in order for it to work in a semiconductor chip. The BP crystals can operate as both n-type and p-type or something in between, but don't require extrinsic doping. This means that instead of having to fabricate a silicon-arsenic crystal sandwiched between silicon-boron crystals, a transistor can have a single, lightweight, pure black phosphorus logic chip — no doping required.

Additionally, changing the metals used to connect the chip to the circuit has an influence on whether BP will be n- or p-type. Instead of doping to make an n- and p-type material, both n- and p-type BP can be put all together on one chip just by changing its thickness and the contact metal used.

Why is this important?

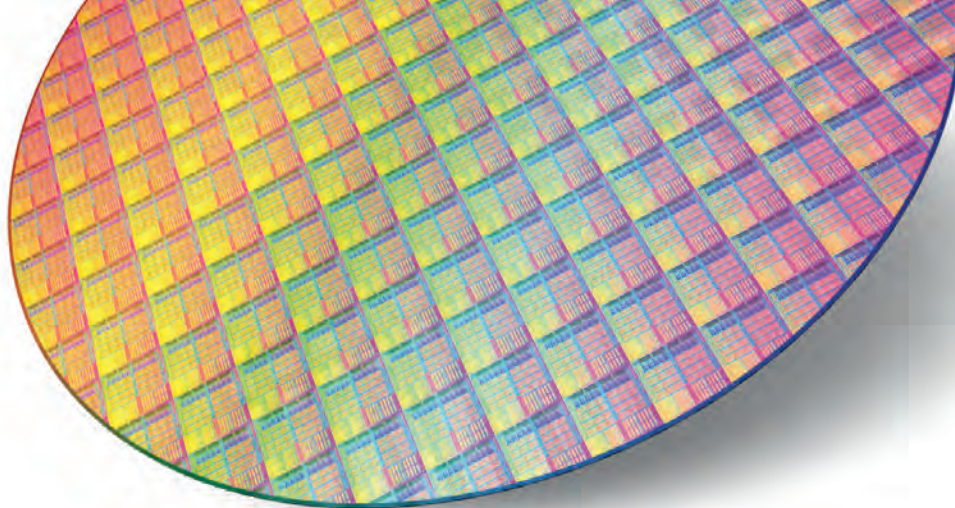
Technology manufacturers are in an arms race to make their devices lighter, smaller and more efficient. By using BP that is only several atomic layers thick, transistors can be made smaller and more energy efficient than what exists now.

Silicon chips exist in all of our electronic devices, and as manufacturers make devices smaller and more energy efficient, they begin to approach the threshold for just how small components can be. BP may provide a thinner, more efficient alternative to silicon chips in electrical devices.

Another example is tiny autonomous data recording and transmitting devices which will make up the Internet of Things (IoT). A major constraint from preventing IoT from taking off immediately is the inability to scale down the component size and the lack of a long-term power solution. Two dimensional layered materials (such as black phosphorus) are interesting in this aspect, since both the electrical and mechanical properties are often enhanced compared to their bulk (three dimensional) counterparts.

Is BP a good alternative to current semiconductor materials?

It is a great material for transistors since it has a high carrier mobility (how quickly an electron can move through it). This gives BP the ability to operate at lower voltages while also increasing performance, which translates to greatly reduced power consumption.



With aluminium as a contact, thicker BP flakes (13 nanometres) show ambipolar properties similar to graphene while thin 3 nm flakes are unipolar n-type with switching on/off ratios greater than 105. The thinner they can make the material, the better the switching performance.

Perello explained, "The driving force in back phosphorus is the carrier mobility. Everything centres around that. The fact that the band gap changes with thickness also gives us flexibility in circuit design. As a researcher it gives me a lot of things to play with."

Is it ready to compete with silicon?

Unlike other industry-standard semiconductor materials, there isn't a good method for making pure BP on a large scale. Currently, thin layers can be made only from scraping bulk crystalline BP samples, as no other manufacturing method exists yet. Tackling the scaling problem is already underway, with chemical vapour deposition (CVD) and other thin-film growth techniques being investigated in labs across the world. The lack of a monolayer fabrication technique isn't necessarily a problem though. "We can

probably operate with 3, 5 or 7 layers and that might actually be better in terms of performance," said SKKU research fellow David Perello.

When asked if BP was ready to compete with silicon today, Perello said, "I don't think it can compete with silicon at the moment, that's a dream everybody has. Silicon is cheap and plentiful and the best silicon transistors we can make have mobilities that are similar to what I was able to make in these BP devices."

This doesn't mean that BP isn't worth exploring further though. According to Perello, "The fact that it was so simple to make such an excellent transistor without having access to state-of-the-art commercial growth, fabrication and lithography facilities means that we could make it significantly better. We expect the upper bound for carrier mobility in black phosphorus to be much higher than silicon."

At present, BP isn't ready for commercial use and its potential has just started to be recognised. If it continues to perform in further tests, it should be a strong contender as a chip material for future technology.

new PRODUCTS

WIRE-TO-WIRE CONNECTORS

The Molex Ditto range of wire-to-wire interconnects and pre-assembled harnesses provide an alternative to plug-and-receptacle power connector systems. The devices are suitable for HVAC equipment; home security and appliances; and solid-state lighting applications including displays, signage and transportation lighting.

The genderless connector system provides a 2.50 mm pitch, single-housing-and-terminal interconnect solution which supports low-amperage, 20-26 AWG wire-size applications. The system is said to increase operational efficiency, with no changeover and less inventory required.

The product uses only one presser applicator machine, which is said to enable speedy tool set-up. The preassembled and ready-to-use Ditto pigtail harnesses allow for even faster application. The same-circuit-size configuration ensures compatibility and mateability.

The Molex Ditto polarised housing geometry prevents mis-mating, while the friction lock prevents accidental disengagement. The antitwist feature ensures proper seating of the terminal in the housing.

element14

au.element14.com



WIRELESS ROUTER

The Moxa WDR-3124A is a wireless router that combines both WLAN and WWAN connectivity to ensure that wireless devices remain connected. The product's auto-switch failover function enables automatic switchovers between 802.11n and HSPA standards, ensuring wireless availability for mission-critical systems.

Many industrial applications rely on moving equipment during operation, but long-distance transmission between remote stations is subject to Wi-Fi access failures and cellular communication can be expensive. The router combines both 802.11n and HSPA connectivity for seamless auto-switch failovers so operators can set Wi-Fi as the primary connection and automatically switch over to cellular if the Wi-Fi link goes down. This not only ensures seamless connections, but also reduces costs for cellular airtime since the cellular connection is only used when the Wi-Fi network is inaccessible.

To ensure wireless LAN and WAN connections, the device also supports Moxa's Turbo Roaming technology for seamless Wi-Fi roaming within milliseconds. Dual SIM card slots with GuaranLink technology ensure reliable cellular transmissions.

Madison Technologies

www.madisontech.com





INDUSTRIAL PANEL PC

IEI Integration's PPC-F12B-BT is an intelligent, metal bezel panel PC. Powered by the Intel Celeron J1900 quad-core SoC, the industrial panel PC can support up to 8 GB DDR3 SO-DIMM.

It features a 12" LCD screen and an ultralim aluminium front bezel, providing two types of touch options (resistive and projected capacitive). The full function LCD panel PC features multi I/O like 2x RJ45 LAN ports, 2x USB3.0, 2x USB2.0, 1x HDMI, 2x RS232, 1x RS422/485, 1x VGA and a microphone connector.

The device meets the IP65 rating providing resistance to dust and liquid ingress. It also supports IEI's Remote Intelligent Solution, the iRIS-2400, facilitating remote management and power control.

With a DC input range of 9-36 VDC, the multifunction panel PC can be used in applications including industrial, commercial, entertainment systems and hospitality.

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

POLYCARBONATE DECALS

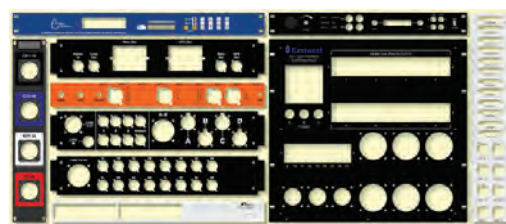
Utilising a polycarbonate decal is a stylish way to add a professional appearance to a product directly. Screen Process Circuits will screen print the user's desired logo, image or graphic on the subsurface of the polycarbonate, protecting the decal so that it is hardwearing and will last for years.

To meet users' requirements, the company can apply an adhesive entirely or partially, allowing for areas such as buttons, lights, cut-outs and windows. It will also offer advice to help select the most suitable material, texture and thickness, depending on the application. This ensures the decal will withstand any heat, cold, UV and abrasive conditions it may be subjected to.

Screen Process Circuits offers embossing, colour matching, die-cutting, routing and laser cutting. The company custom-makes users' decals to their exact specifications and has a fully equipped graphic/engineering design and artwork-creation facility. Artwork may be supplied by the user or created by the company.

With a wide range of uses, such as on instrument panels, instructions, machines, equipment and name plates, a polycarbonate decal is a tough, long-lasting choice. Screen Process Circuits has over 30 years' experience as a screen printer, providing quality products, quick turnaround and good service.

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HIGH-PERFORMANCE 2- AND 4-PORT VNAs

Anritsu expands its ShockLine family of vector network analysers with the introduction of the Performance ShockLine MS46500B series. Delivering a high level of value and performance, including high dynamic range and maximum output power, the series is said to lower the cost of test in applications up to 8.5 GHz.

The MS46500B series comprises the 2-port MS46522B and 4-port MS46524B models, and expands the ShockLine family to a broader spectrum of RF test applications. Each instrument features an independent source per VNA port, and all the sources can sweep at the same time for measurement of forward and



reverse s-parameters simultaneously. This Simultaneous Sweep feature allows 2-port measurements to be conducted twice as fast and 4-port measurements four times as fast. With shorter test times, the series improves throughput in manufacturing environments.

With its 140 dB dynamic range, low trace noise and fast sweep speed, the series addresses the S-parameter and time-domain measurement requirements of a complete range of passive device applications. Faster frequency and time domain measurements can be achieved with a time domain with time gating option. In this configuration, the 4-port MS46524B VNA can conduct single-ended, mixed-mode and time domain reflectometry (TDR) measurements on multiport and differential devices.

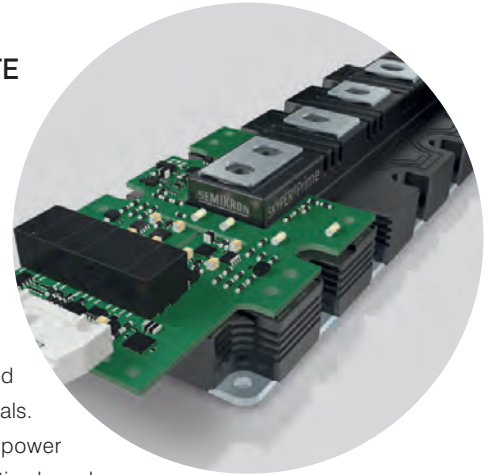
The series is housed in a 3U high chassis to fit into conventional rack systems, while for bench use the VNA's short depth allows more bench space for cabling and the DUT. The VNAs use industry-standard LAN communications for robust remote control in all test environments.

ShockLine software also provides a powerful graphical user interface (GUI) for manual test and engineering use. When attached to a user-supplied touchscreen monitor, the full-featured GUI provides comprehensive capabilities, including network extraction, embedding/de-embedding networks, and time domain with time gating. Developing and troubleshooting test programs are made easier due to advanced marker and limit lines features.

Anritsu Pty Ltd
www.anritsu.com

EFFICIENT IGBT GATE DRIVE WITHOUT EXTERNAL SENSORS

SKYPER Prime is an IGBT driver for Semitrans 10 and PrimePACK modules. Apart from control and protection functions, the IGBT driver offers galvanically isolated voltage and temperature signals. The absence of external power supplies, isolation or acquisition boards saves up to 10% of the system cost.



The sensor signals are available as PWM and allow direct connection to the controller. Extra A/D conversion, reducing the accuracy, is omitted. Due to the integrated overtemperature and overvoltage turn-off in connection with the no-tolerance fault management, the IGBT module can be safely operated at its performance limits.

SKYPER Prime drives Semitrans 10 package modules up to 1400 A and 1700 V. The operating area is tailored to the respective module and allows an increase in output power of up to 30% compared to existing solutions. This saves on safety measures and provides performance advantages. Accurate switching behaviour due to digital signal processing, fault management for parallel operation and symmetrical signal distribution provide for maximum output power.

The SEMIKRON ASIC chipsets integrated achieve an MTBF rate of >3 million hours at full load. Power supply, protection and driving functions are included in the ASIC chipset and external output stages ensure optimal thermal decoupling. The isolated information is transmitted via digital signals and is very robust, even at high dV/dt. The driver thus operates safely even up to 4 kV interference on the signal lines.

The SoftOff function and the VCE monitoring protect against overvoltage in case of a short circuit without the tolerance constraints of clamping circuits. Due to the short pulse suppression and an interface ground concept, high EMC stability is achieved. With the integrated sensor signal processing available to the user as digital signals and the ease of paralleling, the product offers an IGBT driver solution for high-power applications in the megawatt range.

Semikron Pty Ltd
www.semikron.com

DUAL MICROPHONE WITH SHARED REAR VOLUME

Sonion introduces a dual microphone with shared rear volume in one package: the M20.

The product offers 5 dB of directional improvement and stable directivity by design, with tight low-frequency phase matching, stable directivity over time, nanocoat resistance and low drift. It has ease of assembly, which is said to offer advantages over a traditional pair of single matched microphones.

Tenrod Australia Pty Ltd
www.tenrod.com.au



GIGABIT ETHERNET SWITCHES WITH PoE/PoE+

The EKI-9300 Series Gigabit Ethernet Switches are communication solutions for high-bandwidth ethernet-powered devices (PD) in industrial applications. They feature high power output (up to 30 W) designed for industrial-use, heavy-duty PoE devices; Gigabit Ethernet capabilities for large-bandwidth network transmissions; easy management tools (PoE Power Budget Control) for monitoring PDs; and industrial-grade reliability to withstand harsh environments.

The EKI-9316P and EKI-9312P are gigabit-managed PoE+ DIN-rail switches equipped with 12 (for EKI-9316P) and eight (for EKI-9312P) 10/100/1000 Base-T(X), 802.3af (PoE) and 802.3at (PoE+) compliant ethernet ports, and four Gigabit SFP Ethernet fibre ports for data uplinks. They feature 12/8 Gb PoE+ ports, allowing for large bandwidth transmissions and up to 30 W of power for heavy-duty PDs that require higher output. The series ensures a sufficient supply of power for mission-critical, power-sensitive applications.

The units are designed with a series of smart management tools that simplify the process of remotely monitoring and controlling the power devices. The tools include a power management function for system optimisation and a diagnostic function to detect PD conditions, failure detection and LED indicators. The switches are built to operate in industrial environments with sustained, precise performance for mission-critical automation applications.

Advantech Australia Pty Ltd

www.advantech.net.au

CONNECTORS AND ANTENNAS

Bulgin has announced that its 7000 Series, 6000 Series, 400 Series and Standard Power Buccaneer connectors, as well as its Buccaneer SMB Antenna, have been rigorously tested and certified to meet several ETSI and BS EN standards for random vibration, shock and bump. This latest certification complements existing IP ratings so that users can be confident that their chosen connector or antenna will meet the physical demands of applications subject to movement.

The environmentally sealed connectors are designed to offer rapid and secure mains power and data connectivity in harsh environments. They are suitable for challenging applications where exposure to shock, bump and vibration can be an issue, such as industrial machinery and onboard vehicle equipment for the automotive industry. The SMB antennas are suitable for RF equipment, enabling high performance and maximum system gain.

Walcom Pty Ltd

www.walcom.com.au

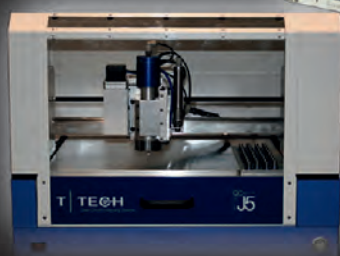
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SCHURTER
ELECTRONIC COMPONENTS

CSIRO AND NICTA JOIN FORCES TO CREATE NEW DIGITAL RESEARCH ENTITY

Researchers from CSIRO's Digital Productivity flagship and NICTA will come together to form a new CSIRO entity called Data61, led by Australian technology entrepreneur Adrian Turner.

"CSIRO and NICTA are two world-class research organisations with some of the world's leading scientists," said Minister for Industry and Science Ian Macfarlane.

"Both have an impressive track record in digital innovation and have demonstrated their ability to take home-grown technologies to market.

"Having a single national organisation will enable Data61 to produce focused research that will deliver strong economic returns and ensure that Australia remains at the forefront of digital innovation," said Minister for Communications Malcolm Turnbull.

"The new combined entity will continue to train Australia's future digital technology leaders through the enhanced PhD program, with more than 300 technology PhDs enrolled at partner universities."

Turner said he was joining CSIRO at an exciting time. His vision for Data61 is to harness the start-up culture of NICTA and multidisciplinary strength of CSIRO to deliver maximum benefit to Australia.

"So much of our understanding and interaction with the world is underpinned by digital technology and data.

"It is a fast moving and big growth area for Australia and Australian industry, and Data61 will be well positioned to play a leading role in defining the new economic structures and opportunities that are emerging globally."

For the past 18 years, Adrian Turner has been based in Silicon Valley, firstly working for global tech giant Phillips then building his own companies from the ground up.

Turner was formerly managing director and co-founder of the Borondi Group, a company that applies emerging technologies in traditionally conservative industries such as agriculture, mining and transportation.

Prior to that, he co-founded smartphone and Internet of Things security company Mocana Corporation, where he raised more than \$40 million from institutional and corporate investors.

POWER SOLUTIONS COMPANY WINS BUSINESS AWARD

Setec, a designer and manufacturer of power solution products, has been named the 2015 Telstra Victorian Medium Business of the Year.

The Knoxfield-headquartered company has designed and manufactured innovative power supplies, battery monitors and battery chargers for a range of industries including medical, gaming, recreational vehicles (RV) and RF communications.

Former CSIRO electronics engineer Peter Lloyd started the company, with his wife Jill, from a garage in Doncaster in 1968. Within 15 years of operation, Setec was shipping more than \$1m worth of power supplies within Australia and around the world. The company is still owned and operated by the Lloyd family.

"In order to be competitive, Setec must remain at the forefront of innovation in both product development and processes. We employ the latest manufacturing and engineering techniques to maintain the success that has been built over the years and continue into the next generation of family," said second-generation Setec CEO David Bayliss.

Bayliss saw an opportunity in 2014 for Setec to launch an innovative battery management range, specifically designed for the RV consumer market. The BM PRO range includes a device called the 'BatteryCheck', which connects to standard deep cycle batteries and uses advanced Bluetooth technology to communicate wirelessly with smartphones. This enables RV owners the ability to view comprehensive data about their batteries — all with the touch of a button.

Setec recently formed a development team in Penang, Malaysia. For time-critical projects, the company employs a lean development team utilising online product development freelancers — allowing them to bring products to the market in a more efficient way.

ELEMENT14 LAUNCHES RASPBERRY PI SPACE SENSOR MODULE

element14 has globally launched the latest addition to the expanding ecosystem of Raspberry Pi accessories, the Raspberry Pi Sense HAT, as featured in the 'Astro Pi' space mission. The Sense HAT will enable enthusiasts to control the same hardware used in space.

The Sense HAT attaches to the Raspberry Pi board and can be used for many different types of experiments, applications and games, including those due to be carried out on the International Space Station by UK ESA Astronaut Tim Peake. It is compatible with Raspberry Pi 2, and Raspberry Pi 1 models B+ and A+, and connects to the Raspberry Pi via the 40 GPIO pins.

It has the following technical specifications: gyroscope — angular rate sensor: $\pm 245/500/2000$ dps; accelerometer — linear acceleration sensor: $\pm 2/4/8/16$ g; magnetometer — magnetic sensor: $\pm 4/8/12/16$ gauss; barometer: 260–1260 hPa absolute range (accuracy depends on the temperature and pressure, ± 0.1 hPa under normal conditions); temperature sensor (temperature accurate to $\pm 2^\circ\text{C}$ in the 0–65°C range); relative humidity sensor (accurate to $\pm 4.5\%$ in the 20–80%RH range, accurate to $\pm 0.5^\circ\text{C}$ in the 15–40°C range); 8x8 LED matrix display; small 5-button joystick.





SIGNAL CONVERTER FOR DALI- CONTROLLED LED LIGHTING

Recom's signal converter RELI-DA01/R is an interface between dimmable LED drivers and DALI devices such

as switches, dimmers and sensors.

The product communicates with the DALI Bus and receives commands which convert into PWM or 1-10 V signals. This signal will interact with any existing dimmable LED driver, transforming the LED driver into a DALI-compatible LED driver with minimal changes to the system or recertifications.

The output can control up to six LED drivers, allowing the lighting in a whole room or office to be dimmed with just one DALI address. A built-in relay can be used to switch off the LED drivers under software control to give zero no-load consumption.

Due to a wide input voltage ranging from 90 to 264 VAC, the device can be used worldwide without further modifications. Measuring 150 x 40 x 30 mm, it is compact and weighs only 100 g. It is compliant with the DALI IEC62386 standard.

RECOM Asia Pte Ltd
www.recomasia.com

ESD PROTECTION DIODES

Vishay Intertechnology has released bidirectional symmetrical (BiSy) ESD protection diodes in the compact SOT-323 package.

Measuring 2.3 x 2.1 mm with a 0.95 mm profile, the

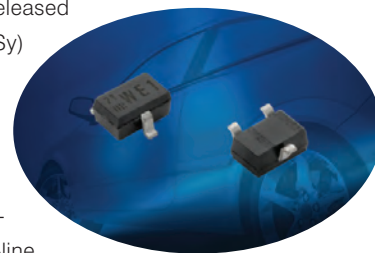
Vishay Semiconductors single-line VLIN26A1-03G and dual-line

VCAN26A2-03G offer low capacitance

and leakage current for the protection of automotive data lines against transient voltage signals.

For LIN bus applications, the VLIN26A1-03G provides transient protection for one data line as per IEC 61000 4 2 at ± 30 kV (air and contact discharge), while the VCAN26A2-03G protects two lines for CAN-Bus and FLEX-Bus applications. The AEC-Q101-qualified devices feature low load capacitance of 10 pF typical and 15 pF maximum; a low maximum leakage current of $< 0.05 \mu\text{A}$; and a working voltage of ± 26.5 V. The protection diodes are lead-free and RoHS compliant.

Fastron Technologies Pty Ltd
www.fastron.com.au



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DECADE RESISTANCE BOX

The Genrad 1433B decade resistance box is designed to check the accuracy of resistance measuring devices. Designed for precision measurement, it features high stability, low zero resistance and good frequency characteristics. It is available to rent from TechRentals.

As a handy point of reference, the product can be implemented as part of DC and audio frequency impedance bridges, calibration of platinum resistance thermometer (PRT) probe electronics, or other experimental arrangements often found in production test equipment and commercial instruments.

Other features include: NATA-certified calibration; accuracy of 0.01%; a low temperature coefficient; and six decades by 1 to 1.1 MΩ. The unit is both mechanically and electrically shielded.

TechRentals

www.techrentals.com.au

COMPLETE ETHERCAT SOLUTION

The ADLINK EtherCAT solution consists of the Talos-3012 automation controller and EPS Series I/O and motion control system. The solution provides time-deterministic control of automatic processes driven by integrated hardware and software elements, fast and easy API configuration and ADLINK's SoftMotion control kernel.



The Talos-3012 is an EtherCAT master controller with IEC-61131 compliant syntaxes. The controller allows emigration of legacy PLC programming to a PC-based environment and SoftMotion function blocks, with a single controller able to connect up to 64 axes and 10,000 I/O points of control through a daisy-chained slave system. Good computing power enables the controller to perform multitask processing for HMI, motion control, PLC and gateway operations in industrial automation applications.

The EPS Series slave system's modular design empowers flexible channel density in a 110 x 130 x 105 mm package. Incorporating the latest RISC processor and FPGA, the system provides a wide variety of I/O modules, including DI/O, AI/O, thermal measurement, motion control and EtherCAT communication modules, daisy-chained for system expansion with no compatibility issues. It also features a status monitoring function including overheating detection, low power detection, slave health reporting, error handling and usage cycle of relay switching, as well as motion control status.

ADLINK Technology Inc

www.adlinktech.com

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BETTER SOLID-STATE BATTERIES

David L. Chandler, MIT News Office

Researchers at MIT and Samsung have developed a new approach to one of the three basic components of batteries, the electrolyte.

The new findings are based on the idea that a solid electrolyte, rather than the liquid used in today's most common rechargeables, could greatly improve both device lifetime and safety — while providing a significant boost in the amount of power stored in a given space.

The new approach to the development of solid-state electrolytes could simultaneously address the greatest challenges associated with improving lithium-ion batteries, the technology now used in everything from cell phones to electric cars. The results are reported in the journal *Nature Materials* in a paper by MIT postdoc Yan Wang, visiting professor of materials science and engineering Gerbrand Ceder, and five others.

The electrolyte in lithium-ion batteries — typically a liquid organic solvent whose function is to transport charged particles from one of a battery's two electrodes to the other during charging and discharging — has been responsible for the overheating and fires that, for example, resulted in a temporary grounding of all of Boeing's 787 Dreamliner jets, Ceder explained.

Others have attempted to find a solid replacement for the liquid electrolyte, but this group is the first to show that this can be done in a formulation that fully meets the needs of battery applications.

Solid-state electrolytes could be "a real game changer", Ceder said, creating "almost a perfect battery, solving most of the remaining issues" in battery lifetime, safety and cost.

Costs have already been coming down steadily, he said. But as for safety, replacing the electrolyte would be the key, Ceder added: "All of the fires you've seen, with Boeing, Tesla and others, they are all electrolyte fires. The lithium itself is not flammable in the state it's in in these batteries. [With a solid electrolyte] there's no safety problem — you could throw it against the wall, drive a nail through it — there's nothing there to burn."

The proposed solid electrolyte also holds other advantages, he said: "With a solid-state electrolyte, there's virtually no degradation reactions left" — meaning such batteries could last through "hundreds of thousands of cycles".

The key to making this feasible, Ceder said, was finding solid materials that could conduct ions fast enough to be useful in a battery. "There was a view that solids cannot conduct fast enough," he said. "That paradigm has been overthrown."

The research team was able to analyze the factors that make for efficient ion conduction in solids and home in on compounds that showed the right characteristics. The initial findings focused on a class of materials known as superionic lithium-ion conductors, which are compounds of lithium, germanium, phosphorus and sulfur, but the principles derived from this research could lead to even more effective materials, the team said.

The research that led to a workable solid-state electrolyte was part of an ongoing partnership with the Korean electronics company

POWER



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Samsung, through the Samsung Advanced Institute of Technology in Cambridge, Massachusetts, Ceder said. That alliance also has led to important advances in the use of quantum-dot materials to create highly efficient solar cells and sodium batteries, he added.

This solid-state electrolyte has other, unexpected side benefits: while conventional lithium-ion batteries do not perform well in extreme cold, and need to be preheated at temperatures below roughly -6.67°C, the solid-electrolyte versions can still function at those frigid temperatures, Ceder said.

The solid-state electrolyte also allows for greater power density — the amount of power that can be stored in a given amount of space. Such batteries provide a 20 to 30% improvement in power



THE SOLID-STATE ELECTROLYTE ALSO ALLOWS FOR GREATER POWER DENSITY — THE AMOUNT OF POWER THAT CAN BE STORED IN A GIVEN AMOUNT OF SPACE.

density — with a corresponding increase in how long a battery of a given size could power a phone, a computer or a car.

“The quality of this work is top-tier,” said Ying Shirley Meng, an associate professor of nanoengineering at the University of California at San Diego, who was not involved in this work. “The team has a long, outstanding track record in computational materials science, and they succeeded again in providing the battery and materials communities new scientific insights to push the fields forward.”

Meng added that this study “provides some very significant design principles for designing and optimising new solid-state electrode (SSE) materials. Now the experimentalists can explore the new phase space with this guidance and speed up SSE discovery. It is very exciting.”

The team also included MIT graduate student William Richards and postdoc Jae Chul Kim; Shyue Ping Ong at the University of California at San Diego; Yifei Mo at the University of Maryland; and Lincoln Miara at Samsung. The work is part of an alliance between MIT and the Samsung Advanced Institute of Technology focusing on the development of materials for clean energy.

new PRODUCTS



SINGLE-BOARD COMPUTER

The iBase IB909 Series is a 3.5" SBC with onboard 5th Generation Intel Core i U-series processors. The series offers a selection of Intel processors manufactured on 14 nm process technology.

The product offers good computing performance, low power consumption and hyperthreading technology, with two logical threads per physical core improving the performance of multithreaded

applications. With integrated Intel HD graphics, it is designed to deliver enhanced video and good 3D graphics performance.

The industrial board supports two display interfaces: DVI-I and a 24-bit dual channel LVDS. The embedded board also supports Intel AMT 10.0 for remote control functionality.

The device measures 102 x 147 mm and supports up to 16 GB of memory in two DDR3L-1600 SO-DIMM sockets. It features two gigabit high-speed LAN ports, a watchdog timer, digital I/O, mSATA and iBase's iSMART green technology. Connectivity comes in two USB 3.0 ports, two USB 2.0 ports, two serial ports, two SATA III ports and two Mini PCI-E slots.

The single-board computer is suitable for applications in factory automation, medical, kiosk and networking markets.

Backplane Systems Technology Pty Ltd

www.backplane.com.au

CHIPSET FOR FAST-CHARGING SMARTPHONES

Dialog Semiconductor has released its iW630+iW1780+iW671 Rapid Charge adapter chipset. The chipset provides the high efficiency and power density needed for small-form-factor, fast-charging smartphones and mobile device power adapters.

The iW630 Rapid Charge interface IC works with Dialog's iW1780 PrimAccurate primary-side digital pulse width modulation (PWM) controller. The iW1780 uses a secondary-to-primary digital communication link signal to receive all rapid charge commands and then dynamically scales the output voltage regulation and output current limit of the power adapter to deliver more power through a standard USB cable.

Current sensing is performed by the iW1780 on the primary side, eliminating the need for a secondary-side current sense resistor for a high-efficiency solution. The iW671 synchronous rectifier further boosts efficiency by up to 88%.

Dialog Semiconductor

www.dialog-semiconductor.com/index



MEDICAL- GRADE PANEL PC

The MLC 4-21 medical panel PC, from ADLINK Technology, is completely fanless.

The fully sealed housing has only flat surfaces to ensure fast and effective cleaning. The PC is approved for IEC/EN60601-1 and IEC/EN60601-1-2 medical patient safety certifications.

The unit offers a 21.5" capacitive touch screen with Full HD resolution and an antiglare coating. Multitouch gesture control is supported, even when wearing protective gloves. The aluminium housing protects against dust and liquid intrusion; it also allows the use of disinfectants and cleaning agents. The housing and fanless design prevent the accumulation of microbes.

The device is equipped with the 4th generation Intel Core i7/i5 processor, delivering a balance of CPU/media performance and low power consumption along with enhanced security and I/O flexibility. Wireless connectivity is supported to provide flexible usage in a range of settings.

Designed to meet the needs of healthcare facilities, the product provides two HDMI ports and one VGA output to support a flexible arrangement of external monitors. Standard interfaces include two USB 2.0, two USB 3.0 and audio ports.

The PC is available with galvanic isolated COM ports and/or LAN ports to connect to medical devices. It is also designed with electromagnetic emission shielding, minimising interference with other equipment in accordance with IEC-60601-1-2.

ADLINK Technology Inc
www.adlinktech.com

SMALL-SIZED DRIVER IC FOR DC BRUSHED MOTOR

Toshiba has launched the TB9051FTG, a small-sized motor driver IC for DC brushed motors intended for automotive electronic throttle control.

The product offers efficient operation and a small P-QFN28 package (6 x 6 mm), realised by ultralow on-resistance as a result of applying DMOS transistors as driver circuits. Built-in detection circuits include overcurrent, overheat, low voltage and high voltage.

While primarily targeting vehicle engine applications, such as electronic throttle and valve control, the device can be also suitable for the control of onboard systems operating at up to 5 A, such as control of wing mirrors and trunk locks.

Toshiba (Australia) Pty Ltd
www.toshiba.com.au



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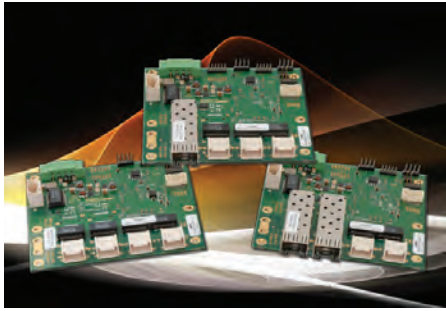


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RUGGED GIGABIT ETHERNET SWITCHES

The MAGBES-20 Series is the third generation of managed Gigabit Ethernet switches (MAGBES) by MPL.

The series consists of models with up to five ports that can be equipped with RJ45 connectors or lockable headers, of which two ports can be fibre using SFP modules. All ports have status LEDs, indicating the

activity and speed of each port.

The indication signals, reset and default settings can be accessed remotely. The compact switches can be used as an open frame solution or in MIL housing with connectors of the user's choice.

Supply power is 5-36 VDC and can be used under any condition less than 4 W. The product can be fanlessly operated at -20 to +60°C, with an optional extended temperature from -40 to +85°C. The range is designed to meet or exceed industrial, transport and military standards such as EN50155, MIL-STD-810-F/G and MIL-STD-461E.

The switches are configurable via web or command line interface. They can be used as stand-alone products or in a PC/104 or PC/104-Plus stack. They support all SFPs which are MSA compliant and ethernet compatible.

Other features include: digital diagnostic monitoring (DDM) according SFF-8472 (models with SFP slot); firmware updates via web interface; downloadable and uploadable configuration files in XML format.

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

PTC THERMISTORS

Vishay Intertechnology has introduced a series of mini radial-leaded positive temperature coefficient (PTC) sensing thermistors. Featuring <4 mm body diameters, a wide range of well-defined temperature levels from 80 to 150°C and standard $\pm 5^\circ\text{C}$ tolerances, devices in the Vishay BCcomponents PTCSL03 series are designed to provide compact remote overtemperature sensing in alternative energy, industrial and consumer applications.

The devices provide good long-term behaviour of $\Delta T \leq 1^\circ\text{C}$ after 1000 h for overtemperature protection and control in power supplies, power inverters, motor drives, lighting drivers, smart fuse boxes and pump motors. The sensors feature maximum R_{25} of 120 Ω , maximum voltage of 30 V, a dissipation factor of 5 mW/K and a fast thermal time constant of 6 s.

The devices consist of a medium-resistivity doped barium titanate ceramic chip with copper-clad steel wire leads. With rugged, durable construction, the sensors feature a high-temperature silicone coating and are also available as bare pellets on request. The RoHS-compliant devices are offered in tape-on-reel and bulk packaging.

element14
au.element14.com



LTCC BAND-PASS FILTER

Mini-Circuits' BFCN-4800+ LTCC band-pass filter has a passband from 4400 to 5200 MHz, supporting telemetry, satellite, mobile, military and commercial application bands.

The model provides 1 dB typical pass band insertion loss and 25 dB lower and upper stopband rejection (DC to 1800 MHz and 7500 to 12000 MHz, respectively). It also handles RF input power up to 1.5 W.

LTCC construction provides a tiny size (0.12 x 0.06 x 0.04"), thermal stability from -55 to +100°C and the ability to operate in tough conditions.

Clarke & Severn Electronics
www.clarke.com.au

RUGGED AND EXPANDABLE PANEL PCs

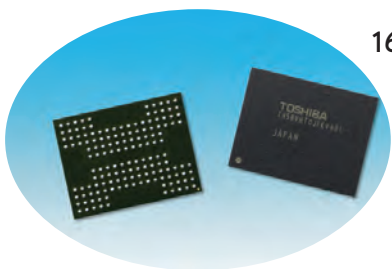
Avalue Technology is unveiling the ARC-1209 and ARC-1509 rugged and expandable panel PCs. The ARC series is suitable for industrial automation, home automation and human-machine interface applications.

The series is powered by an Intel Atom E3845 with integrated chipset and supports 204-pin DDR3L 1333 MHz SODIMM system memory with up to 8 GB capacity. I/O deployment includes one USB 3.0, three USB 2.0, two COM, one SATA II, Wi-Fi, one Mini PCIe supporting mSATA, three knockouts for antenna mounting and two LAN ports supporting Intel I210IT. The product supports optional dual display, three audio jacks, an extra Mini PCIe slot with a push-push SIM socket and future expansion for GPIO and CAN Bus.

The fanless, ruggedised panel PC can withstand industrial environments, with an operating temperature range of -30 to 60°C and wide voltage input between 12 and 26 V. The product also passes antivibration tests of up to 5 G_{rms} and antishock tests of up to 20 G_{rms} . The series features a front panel which meets IP65 compliance and has rear IP41 protection.

The series is equipped with a swappable 2.5" hard disk drive and service window. It is designed with nine extra expansion daughterboards to meet user demands.

Braetec Pty Ltd
www.braetec.com.au



16-DIE STACKED NAND FLASH MEMORY

Toshiba has announced the development of a 16-die (max) stacked NAND flash memory utilising Through Silicon Via (TSV) technology. Stacked NAND flash memories were previously connected together with wire bonding in a package. TSV technology instead utilises the vertical electrodes and vias to pass through the silicon dies for the connection. This enables high-speed data input and output and reduces power consumption.

The technology achieves an I/O data rate of over 1 Gbps, which is said to be higher than any other NAND flash memories with a low voltage supply: 1.8 V to the core circuits and 1.2 V to the I/O circuits, and approximately 50% power reduction of write operations, read operations and I/O data transfers.

The NAND flash memory provides a suitable solution for low latency, high bandwidth and high IOPS/watt in flash storage applications, including high-end enterprise SSD.

Toshiba (Australia) Pty Ltd
www.toshiba.com.au

ELECTROSTATIC METER

The Vermason 222ES is a handheld precision field meter that measures electrostatic voltage potential. The unit is suitable for conducting periodic facility audits in accordance with EN 61340-5, as well as monitoring packaging, materials, machines and other electrostatic generative equipment or processes. It is available to rent from TechRentals.

The product measures electrostatic voltage potentials over selected distances from 1 to 200 mm using the field-mill influence principle. Calculations are automatic and results are shown on the LCD display. Other features include a measurement range of 0 to 200 kV (default 20 kV at 20 mm); and 2-range, 3-digit display in V or kV.

TechRentals
www.techrentals.com.au



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PB
PREMIER BATTERIES

SMALL ELECTRONICS COMPANIES

OFFER SEMICONDUCTOR VENDORS FAST GROWTH

Semiconductor companies need to diversify their sales strategy to focus on the large number of smaller organisations that offer fast and stable growth, rather than relying on big deals from large customers that are in a constant state of flux, according to Gartner, Inc.

Start-ups and small electronics companies spent US\$78.3 billion on semiconductors in 2014, representing 23% of the total semiconductor market.

Gartner estimates there are more than 165,000 companies that buy semiconductor chips around the world: the top 10 spend nearly 40% of the total semiconductor revenue; the top 11 to 100 spend about 30%; and the remainder spend 30%.

Despite the top 10 accounting for such a large percentage of the market, some of the largest customers have decreased orders in the past five years, challenging the semiconductor vendors that mainly supplied to them.

While Samsung and Apple have significantly increased orders in the same period due to success in the smartphone market, semiconductor vendors are concerned about the risk of relying on large customers such as these.

"The industry has seen some fairly significant disruption in recent years, which has highlighted the risks associated with semiconductor vendors putting all of their focus on a limited number of large customers, when small companies offer highly profitable and stable growth," said Masatsune Yamaji, principal research analyst at Gartner.

"To overcome the risk, some semiconductor vendors have tried to increase their business with small customers, while others are also realising that they should adjust their strategies to do this."

China is the fastest growing among the major small-customer regions, with spending by these organisations on semiconductors growing from US\$7.5 billion in 2007 to US\$14.9 billion in 2014; growth in the smartphone and media tablet markets has been strong.

Gartner maintains that the number of customers will significantly increase after 2017, due to future growth of the electronics market and the increase in the number of Internet of Things solutions. It is anticipated that the maker movement, which creates and markets products that are recreated and assembled using unused, discarded

or broken products from computer-related devices, will drive the foundation of start-ups and growth of small customers.

Big deals are not confined to large organisations, with many successful vendors having success in the small-customer market by leveraging distributors, according to Gartner. Limited sales resources can be compensated for by aligning with good sales partners. Strong adherence to direct sales restricts the opportunities with small customers, especially among general-purpose semiconductor vendors. In fact, semiconductor distributors earn a large part of their revenue from general-purpose semiconductors.

"Semiconductor vendors should focus more on the high-tier customers and outsource sales activities with small customers to distributors," said Yamaji.

"Distributors can bring various products to market at the same time, so this outsourcing will reduce the load, not just for semiconductor vendors, but also for customers. Some distributors offer end-of-life product delivery services, so vendors should partner with these distributors to help small customers avoid having to order excessive loads."

To take advantage of the growing small-company market, Gartner recommends as a starting point that vendors need to evaluate how much revenue can be expected, compared with the large customers. The importance of the small customers for each vendor differs by its product type and its target sales region, so vendors need to have their own unique goals in the small-customer market.

"Before jumping in, semiconductor vendors also need to be aware of the risks associated with the small-company market, which is prone to shrinking when the macro economy weakens," said Yamaji.

"Revenue can also shrink even faster than large customers in many cases, so it is important to be aware of risk levels regarding any revenue decline. Vendors can reduce the risks by diversifying their customer base, which can spread the liability to allow for lost orders."

AC-DC FRONT-END MODULE

Vicor Corporation has introduced its high-density, low-profile, integrated VIA PFM AC-DC front-end power modules. The converter modules achieve a power density of 8 W/cm³ supplying an isolated, PFC-regulated 24 or 48 V SELV DC output at up to 400 W from the universal AC input range of 85 to 264 V with 93% peak efficiency.

The product is said to be 5x thinner than traditional 1U supplies, offering advantages to power system architects challenged by size constraints. With its 9 mm thin profile and 36 mm width, the device can be mounted on the sidewall of any typical 1U chassis.

The thermally adept units may be chassis mounted and conduction cooled to eliminate fans, thereby improving overall system reliability and minimising the power system footprint. High density, high efficiency and low thermal resistance make the modules suitable for a wide range of applications, including small-cell wireless base stations, size-constrained LED lighting applications and industrial and automation systems.

The power modules enable power system designers to create dense, efficient, flexible and scalable power systems. They integrate system functions including EMI filtering, transient protection and in-rush current limiting to reduce design time and design risk. Available in chassis-mount and PCB-mount configurations, the modules support a multiplicity of mechanical mounting and thermal management options.

Vicor Corporation
www.vicor-asia.com

MIXED-DENSITY CONNECTOR

Positronic has produced the WCBD Series, a waterproof version of the Combo-D mixed power/signal connector family.

The product provides the ability to mix power and signal in a single connector body capable of up to 40 A per size 8 contact. It features an IP67 rating suitable for non-sheltered/outdoor environments.

Mounting accessories and hardware prevent water and dust ingress into the enclosure. A composite mounting plate, optional stainless steel shell and heavy gold plating offer long-term corrosion resistance. The product has a flexible, thermal-resistant adhesive seal.

Other features include: vertical and right-angle solder PCB terminations in two tail diameters; an optional closed entry PosiBand female contact for ruggedised applications; and optional flying leads.

Positronic Asia Pte Ltd
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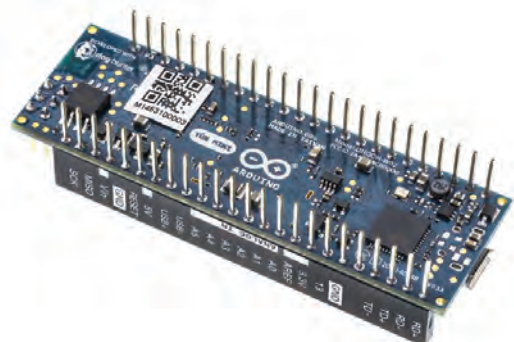
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WIRELESS DEVELOPMENT BOARD

Aimed at embedded engineers, hackers and students, the Arduino Yun Mini is a redesign of the Arduino Yun Wi-Fi microcontroller board and has been re-engineered to be used with a breadboard, making prototyping easier.

The product has PCB dimensions of 71.1 x 22.9 mm and a weight of 16 g. Its small size makes it suitable for use in small spaces and especially projects for home automation, where locating smaller devices in small boxes can improve siting flexibility.

The device offers a breadboard PCB with an ATmega32u4 microcontroller and the Qualcomm Atheros AR9331 system-on-chip IC with a MIPS 24K CPU, which operates at up to 400 MHz and supports a Linux distribution based on OpenWRT called Linino. A bridge library enables communication between the two processors, providing Arduino programs with the ability to run shell scripts, communicate with network interfaces and receive information from the AR9331 processor.

The board has built-in Wi-Fi and supports 20 digital input/output pins, seven of which can be used as PWM outputs and 12 as analog inputs. Other specifications include a 16 MHz crystal oscillator, a micro-USB connector, an ICSP header, two reset buttons and one user button.

RS Components Pty Ltd
www.rsaustralia.com

MARINE PANEL PCs

The APC-3220 Series marine panel PCs feature 12.1" bright (500 nits) displays that can be dimmed up to 100% in low-light environments. The series is certified to meet CE/FCC/IEC 60945 and IAC E10/DNV Standards.

Supplied with either the Intel Core i3-4010U 1.7 GHz processor or the Core i5-4310U 2 GHz processor, the PC provides an energy-efficient, multicore platform for industrial control or marine applications. The product is supplied with 4 GB of DDR3L memory and features an internal 2.5" SATA hard drive plus an onboard SD slot for operating system and data storage.

External rear-panel I/O includes two USB 3.0 ports, one RS232 port, one RS232/422/485 port, two Gb RJ45 LAN ports and an HDMI video port for communication with external systems and displays. A variable-brightness knob provides direct user control of the display. Optional front-panel controls and I/O include power button, LED power and hard drive activity indicators and a waterproof USB port.

The series operates from a 9 to 36 VDC power source and is supplied with a 240 VAC isolated power adapter. It is designed to be panel mounted in control room or marine bridge consoles.



Interworld Electronics and Computer Industries
www.ieci.com.au

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The Electronics Engineered Standards Program from STANLEY Engineered Fastening is said to reduce design times by 40% or more for micromechanical assembly components. Unlike spending critical engineering resources on trial-and-error fastening design, which prolongs time to market and increases costs, engineers achieve significant design cycle reductions by utilising the company's suite of online tools.

A library of over 280 engineered components is designed specifically for today's electronics device form factors. The components include cold-formed fasteners, rivets, inserts, press nuts and standoffs. The online catalogue also covers precision CNC, cosmetic finishes, performance coatings, micro-stampings, tools and automation systems.

Complementing this feature is the online 'Try it, Test it, Customize it' portal, which engages a global applications engineering team to customise designs, request samples and secure rapid prototypes and testing support. The catalogue provides 24 h real-time access to 3D models, 2D drawings, animations and design guide materials.

Selecting the right components and assembly solutions early in the development phase enables companies of all sizes to bring products to market fast by helping design engineers achieve a sound product that performs to testing requirements the first time out.

STANLEY Engineered Fastening
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LOW-POWER, LONG-RANGE RF MODULE

The MultiConnect mDot is a secure, programmable, long-range and low-power RF module that provides data connectivity to sensors, industrial equipment and remote appliances. By employing Semtech long-range spread spectrum technology, bidirectional data communication can be maintained over 16 km suburban (2-5 km dense urban), deep into buildings and within noisy environments using the unlicensed ISM bands in North America, Europe and worldwide.

The module includes an integrated ARM Cortex-M4 processor and mbed-compatible software library for developers to control, monitor and bring intelligence to their IoT applications. It features ultralow power of around 28 mA @ 13 dBm, Rx of 10 mA and sleep mode of 0.1 μ A. The product can run for years on batteries.

Interfaces include UART, SPI, I²C, 6 x DIO and 2 x analog, plus transparent interfaces for RS232 and RS485 cable replacement applications. Other features include 100 MHz clock speed; 512 KB Flash; 128 KB RAM; 860-1020 MHz frequency; adaptive data rates (300 bps to 300 Kbps); and AT-style control command.

Elecom Electronics Supply

www.elecomes.com



EIGHT-WAY SPLITTER/COMBINER

Mini-Circuits' ZN8PD-362HP+ eight-way 0° splitter/combiner provides power handling up to 100 W as a splitter, with 1 dB typical insertion loss (above 9 dB theoretical loss) for a wide range of applications from 600 to 3600 MHz. The combination of high power handling and low loss minimises power dissipation due to intrinsic losses, making it suitable for high-power signal distribution applications where low loss is a requirement.

The product provides 23 dB isolation, 0.35 dB amplitude unbalance and 4° phase unbalance. It also achieves good VSWR of 1.15:1 (ports 1-8) and is capable of passing up to 1.2 ADC current (150 mA each port) from input to output, supporting systems where DC power is needed at later stages in the chain.

The splitter/combiner comes housed in a rugged, aluminium alloy case (8.06 x 3.25 x 2.38") with SMA or N-Type connectors and an optional heatsink for efficient heat transfer to ambient.

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OPTICAL FIBRE LASER

FOR BIOMEDICAL APPLICATIONS

Francis Sedgemore*

A new optical fibre laser emits pulses with durations equivalent to just a few wavelengths of the light used.

The laser, developed by researchers at Graphene Flagship, is suitable for use in ultrafast spectroscopy and in surgical lasers that avoid heat damage to living tissue.

Advanced photonics applications such as high-speed spectroscopy require ultrashort pulses in order to capture transient physical phenomena in the materials studied. In practice, that means laser pulses in the femtosecond range. An example of such an application is pump-probe spectroscopy of photochemical relaxation processes.

"When engineering light to travel in ultrashort pulses, it is important to understand its wave nature," said Daniel Popa, head of the photonics group at the Cambridge Graphene Centre and leader of its graphene-based laser research project. "For light to propagate as does a mechanical wave on a stretched cord, the shortest possible pulse is defined by a single wave oscillation."

Time resolution is limited by the length of the laser pulse used. The shorter the pulse, the higher the spectroscopic resolution, with the highest possible resolution defined by the cycle length of the particular light frequency employed. In the visible and near-infrared regimes, in which most ultrafast lasers operate, the ultimate pulse duration lies between 2 and 5 femtoseconds. Shorter pulses require shorter wavelengths.

Theoretical limits aside, pulses as short as two cycles can be generated from laser cavities using a technique known as passive mode-locking. With titanium-sapphire lasers, common in photonics laboratories the world over, pulses of 5 femtosecond length can be produced at a wavelength of 800 nm, corresponding to less than two cycles. These pulses are not tuneable, however. Tuneable few-cycle pulses can be achieved by exploiting nonlinear effects in optical parametric amplifiers, but the practical arrangements tend to be complex and expensive.

Fibre lasers are attractive platforms for ultrashort pulse generation, owing to their simple, compact and cost-effective designs, their efficient heat dissipation and an alignment-free operation that does not require bulky optical set-ups. With fibre-based oscillators, ultrashort pulses can be generated by passive mode-locking, which requires a nonlinear component known as a saturable absorber. Graphene has the ideal physical properties to make such a saturable absorber.

Graphene-based mode-locked lasers have been demonstrated before, but it is the use of this novel two-dimensional material in a compact, all-fibre set-up that marks the work of Popa and his

colleagues. Their advance is outlined in a paper published recently in the journal *Applied Physics Letters*, the first author of which is doctoral student David Purdie.

With fibre lasers, femtosecond pulses are typically generated through soliton mode-locking. A soliton is a self-reinforcing solitary wave that maintains its shape without distortion as it travels at constant velocity along a waveguide such as an optical fibre. Solitons are the result of dispersive and nonlinear effects that cancel each other out in the waveguide medium, thereby allowing a stable pulse envelope to propagate.

All-fibre formats are preferable in terms of cost, compactness and robustness, and the strategy here is to use a cavity based on alternating segments of positive and negative dispersion fibres that lead to periodic broadening and compression of the pulses.

The key is to extract the pulse from such a cavity when its duration is at a minimum, and peak power thus at a maximum. Owing to the high peak power of the extracted pulse, new frequency components can be generated through nonlinear optical effects within an external length of fibre, and these are critical when it comes to further decreasing the pulse length. This is based on the mathematical relationship in waves between frequency and time domains known as a Fourier transform. To realise this transformation in physical form, the researchers engineered a dispersive delay line that folds the newly created frequency components into a single pulse.

The Graphene Flagship researchers' set-up was based only on standard telecommunications equipment, with a saturable absorber based on a composite of graphene and polyvinyl alcohol (PVA) fabricated by low-cost solution processing, with the graphene flakes exfoliated from bulk graphite by ultrasonic agitation of the solution. Evaporation leaves behind a 50 micron-thick graphene-PVA composite, which is then sandwiched between fibre connectors.

With this set-up, Purdie and his colleagues were able to generate 29 femtosecond pulses, which corresponds to fewer than six cycles at a wavelength of 1.5 microns.

Compensating for higher-order nonlinear and dispersive effects should lead to a shorter pulse length, and the use of a higher power diode, or a double-pumped configuration, could result in higher bandwidth pulses as well as increased output power. Finally, the addition of photonic crystal fibres could in principle allow for the generation of similarly short laser pulses at other wavelengths.

*Francis Sedgemore is the science writer for the Graphene Flagship.



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the GRUMPY page

Mike Smyth, specialist technical writer

Is built-in obsolescence a fact or an urban myth? Does household equipment really have a finite life determined by the manufacturer or is it something we consumers have conned ourselves into believing every time there is a gadget breakdown?

To a case in point. It had stood under the kitchen bench for close on eight years, a monument to legendary German technology and engineering that was supposed to last if not for 1000 years, at least for my lifetime. During those years the machine had produced shiny platters, gleaming cutlery and saucepans that looked like new.

And then it started. A little more noise than usual or was it imagination? But when the whine began there was no mistaking the fact that this dishwasher was in pain and so too would be my wallet because specialised machinery is never cheap to repair. So with everything shut down, the machine was emptied and its contents laboriously washed by hand in an exercise that was supposed to have disappeared with side-button boots and the hansom cab.

After a phone call, a mechanic turned up the next day bringing with him his mystery bag of two computers and a special cable, one end of which was magically fastened to the front of the dishwasher and the other end to one of the computers. He switched the machine on and immediately pronounced it as "not right". With the cable, computer and dishwasher connected, LEDs flashed and flickered holding the mechanic spellbound.

Eventually he pronounced the bad news in a suitable funereal voice that the main pump and an attachment thereto were on their last legs and could fail at any time but in the meantime we could keep using the machine. If it stops, you empty it and wash by hand, he said confidently. He added, almost as an afterthought, that these components are the most expensive in the machine.

Now eight years does not seem an awfully long time for a domestic machine to last and hence came up the question of built-in obsolescence. Even if the urban myth is true, there is still a major dilemma to be faced. Do you spend the money on a repair knowing that the rest of the machine is the same age and could fail soon too or do you cut your losses, put it out for a kerbside pickup and buy a new machine? The chances are that the price has probably come down since buying the original and the technology might have improved. Although the price of a new machine has probably fallen, since buying the original, it is more likely that additional technology and even more circuit boards, relays, micro-switches and other electronic wizardry have been added.

Does buying a more expensive model of anything give you a guarantee of longer life? Surely with today's manufacturing precision and with metallurgy now a fine art, we should expect machinery to last more than eight years.

And it's not just dishwashers. From garden equipment to motor cars that are loaded down with electronics and clever diagnostic systems, longevity is not something to assume where some of the replacement PCBs cost nearly as much as the original piece of equipment. Here the old dilemma raises its ugly head again — replace or renovate.

A PVR of my acquaintance was less than 18 months old when it refused to start recording at the beginning of a program. While this was almost certainly an electronic glitch to do with timers, clocks and sensors, its cause was no comfort to me and my foreshortened recording.

It seems that paying top price is no guarantee of reliable longevity. You may get a better guarantee, but then you should for paying top dollar. Let the buyer beware today seems as hollow as some of the wilder claims by equipment makers.

Of course part of the answer is more simplicity. Machines with 15,000 variables and combinations are there to sell for their apparent versatility, which is largely wasted on the average buyer, who chooses a setting and there it stays for the next millennium. All that other technology just takes up cabinet space and is wasted, just adding to the initial cost and subsequent servicing.



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