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Oscilloscope experiments in accelerator physics often require accurate measurements of pulse parameters or of the jitter between two signals. This data needs to be measured during start-up and characterisation of the experimental set-up as well as during operation for continuous monitoring. For monitoring, the data needs to be stored and downloaded at a high update rate in order to catch every pulse of a free electron laser.

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The RTO is suitable for precise measurements in many accelerator physics lab applications, such as in synchrotrons or free electron lasers. With its excellent signal fidelity, high acquisition rate and real-time digital trigger system, it is the instrument of choice for applications in the 600 MHz to 4 GHz class.

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MAKING TRANSISTOR CIRCUITS MORE ROBUST

IN POWER ELECTRONICS

Reinhard Zimmermann, Product Marketing

Fast IGBTs (insulated gate bipolar transistors) have so far been the last word in power electronics, providing the best of both worlds in FETs (field-effect transistors) on the input with bipolar transistors on the collector-emitter path.

SiC (silicon carbide) FETs have meanwhile been seeing increasing use in more demanding applications, as they allow higher switching frequencies while reducing switching losses. But both technologies have one thing in common: they need optimal control and connections to provide years of reliable service under possibly harsh conditions, so false triggering must be avoided at all costs.

IGBTs contain monocrystalline silicon and are generally considered to be a cost-effective standard solution, whereas SiC FETs use silicon carbide to allow higher junction temperatures and thinner insulation layers on the gate to improve thermal conductivity and power density. Switching losses in SiC FETs are at least four times lower than in IGBTs (Figure 1). In particular, SiC FETs eliminate the current tail typical of IGBTs on switching off — an advantage that especially pays off in the high-performance range and higher switching frequencies, allowing a noticeable increase in efficiency from using SiC FETs in bridge circuits, for example. Alternatively, increasing the switching frequency at constant efficiency can save cost and weight in passive components, especially in inductances. Being more expensive, SiC FETs are more commonly found in demanding tasks; IGBTs dominate the mass market.

Preventing false triggering

Assessing robustness in IGBT and SiC FET circuits quickly involves the risk of focusing too much on the transistor specifications while neglecting the driver module and circuit layout; as so often in analog engineering, the devil is in the detail — that is, parasitic components not shown in any circuit diagram. To illustrate the issues facing developers in real life, we have included parasitic capacitances and inductances that play a role in IGBTs and SiC FETs in a simple block diagram and marked them green (Figure 2).

The circuit must be dimensioned to avoid false triggering in extreme situations. Spontaneous short circuits in a component such as a bridge circuit would cause EMC problems and reduce the component's service life, or possibly even cause its complete destruction.

Preventing this involves dealing with the two major causes for false triggering:

1. Impact of parasitic capacitances such as C_{reverse} (Miller capacitance) and C_{input}
2. Impact of parasitic inductances such as L_{gate} and L_{emitter}

Cause 1

C_{reverse} needs to be charged if collector-emitter voltage increases during off operations in the IGBT. The charging current can be estimated to a degree using the following formula:

$$I_{\text{Creverse}} = C_{\text{Reverse}} \times dU_{\text{CE}}/dt$$

Note that C_{reverse} strongly depends on not only voltage, but also temperature and current. It makes sense to take measurements in real-life conditions as this value is insufficiently defined in most data sheets.

3. Charging C_{reverse} is not the actual problem, however — the actual problem arises when the charging current causes Miller capacitance, input capacitance C_{input} has been charged far enough to reach or exceed threshold voltage (Figure 3).

The C_{input} charging current can be defined as follows:

$$I_{\text{Cinput}} = I_{\text{Creverse}} - I_{\text{Driver}}$$

I_{driver} depends on gate resistances, and also L_{gate} in dynamic operation. The latter depends on circuit layout and the package used.

This yields a series of parameters that can be tweaked to keep Miller capacitance from causing false triggers:

- Limit dU_{CE}/dt to flatten the switching ramps and I_{Creverse} curve. However, this will unfortunately also increase switching losses as a side effect.

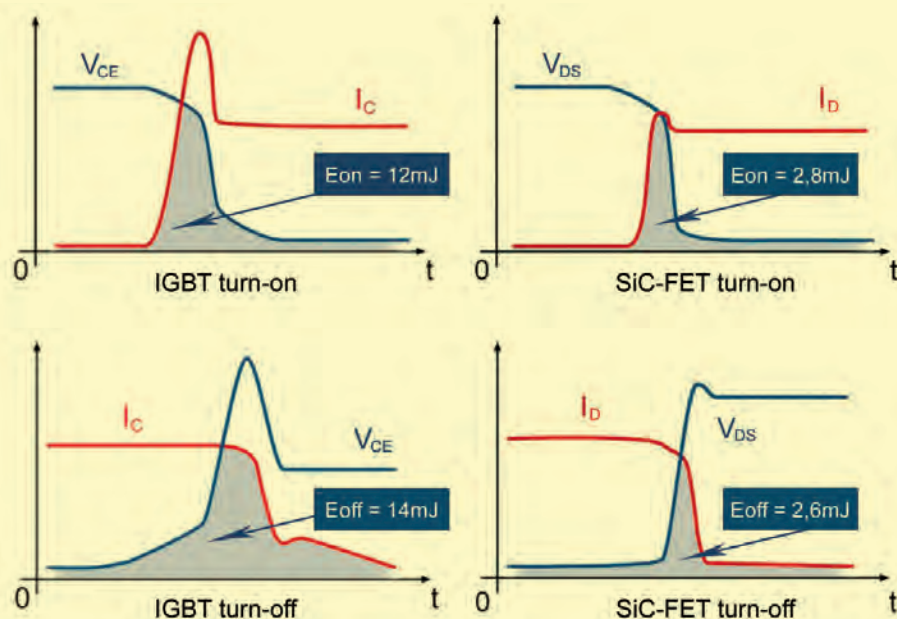


Figure 1: The greyed area under the current/voltage curves during on (upper diagrams) and off operations provide a measure of the switching losses. Steeper switching ramps give SiC FETs (right) around four times the efficiency of IGBTs at ambient temperatures of 25°C, taking losses from one body diode into account.

- Reduce parasitic inductance L_{gate} by optimising the circuitry, thus reducing the voltage rise at the gate.
- Use a negative n gate-emitter voltage to widen the safety margin up to the threshold voltage.

The last solution is the most elegant.

Cause 2

When switched on, the load current flows through the transistor, and therefore also through the emitter inductance. Breaking the current will cause negative voltage at $L_{emitter}$ according to the following formula:

$$-U = L_{emitter} \times \frac{di}{dt}$$

This will bring the emitter voltage to below GND. However, the driver takes the gate down to GND, resulting in a positive gate-emitter voltage. Exceeding the threshold voltage will cause a false trigger, switching the transistor on.

Parasitic inductances from other bridge branches and the circuit need to be included in designing bridge circuits. Not insulating the driver circuit will result in power GND and driver GND having a significant impact on parasitic inductances, and therefore also the risk of false triggering in a bridge. This article cannot cover every conceivable bridge design, so we recommend downloading the white paper 'Designing Robust Transistor Circuits with IGBTs and SiC MOSFETs'

from www.recom-power.com/papers for further details.

How to minimise the impact of parasitic inductances:

- Cut di/dt as slower drops in current will reduce the voltage induced between the gate and emitter. However, this will also increase switching losses.
- Reduce circuit inductances. The shorter the conductors, the lower the parasitic voltages.
- Use a negative gate-emitter voltage to widen the safety margin to the gate-emitter threshold voltage.
- Use galvanically isolated gate drivers and isolated DC/DC converters. Connecting the driver supply connected directly to the respective emitters will largely eliminate the impact of circuit inductance.
- Use drivers with separate connections for the control emitter (Kelvin contact). This may also cause parasitic inductance, but it will not flow through the load current and cause any significant issues.

Measuring circuit robustness

Reliably measuring IGBT and SiC FET parameters is anything but trivial. Parasitic inductances L_{gate} and $L_{emitter}$ prevent a direct path to the gate and emitter, rendering reliable measurement of the safety mar-

gin to the gate-emitter voltage threshold impossible during dynamic operation; this again confirms the old rule of garbage in, garbage out.

One solution would be to measure cross-current on the bridge, although care does need to be taken to avoid additional resistances or capacitances in the gate-emitter circuit that would alter switching behaviour in IGBTs or SiC FETs. One tried and true measurement method crosses a current shunt upstream from the high-side collector via voltage drop; this requires an oscilloscope with isolated inputs and a corresponding probe.

A reading free of suspicious current will not guarantee freedom from false triggering in the series, however. First, gate-emitter threshold voltages vary widely between individual transistors of the same type; and second, junction temperature plays a significant role (Figure 4). Bulletproof reliability would require transistors with minimum threshold voltage as seen on the diagram, which would need to be measured at the maximum permissible temperature and greatest possible di/dt and dv/dt .

Isolated DC/DC converters ensure optimised power supply

As mentioned at the outset, switching losses are mainly determined by control quality so gate drivers and their supply require special attention. The drivers are directly coupled to the high potential of the transistors, so both the input signal and the power supply to driver ICs need to be thoroughly insulated. Isolated DC/DC converters provide a very convenient solution.

The driver modules on the market are asymmetrically controlled with positive and negative voltages; IGBT and SiC FET drivers differ in the voltages required.

Data sheets specify voltages between 3 and 6 V for IGBTs; these can decrease to 1 to 2 V with increasing junction temperature. Values of 15 V have become established for fast triggering in real-life applications.

Preventing false triggering despite steep ramps during switching requires negative offset voltage on the gate, as described above. Values of -9 V have proven safe in practice. This is why dual isolated DC/DC converters with asymmetric voltages at 15 and -9 V have turned out to be especially suitable in supplying IGBT drivers.

Threshold voltages on SiC FETs are significantly lower than on IGBTs, and also decrease with increasing temperature.



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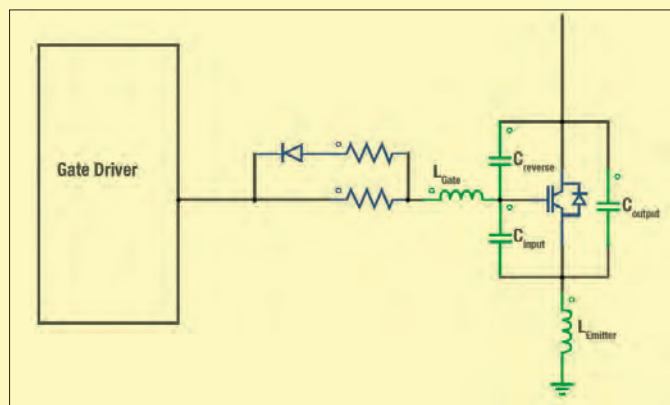


Figure 2: An IGBT and SiC FET circuit in principle with parasitic capacitances and inductances from the transistor marked green.

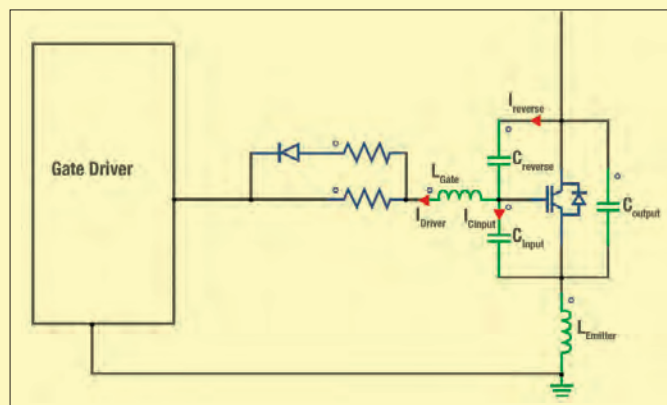


Figure 3: The charging current from $C_{reverse}$ may charge C_{input} so far as to exceed the threshold voltage and give a false on trigger.

This would lead to the logical conclusion that SiC FETs also require more negative offset voltage on the gate. In contrast, studies conducted at the University of Nottingham suggest that the gate oxide changes to a varying degree throughout the lifetime of the transistor.

Threshold voltage decreases by around 0.2 to 0.3 V over a lifetime of a thousand hours, and then remains stable at gate source voltage of -5 V. The change is around five times that at $U_{GS} = -10$ V, and the variation between transistors is so high that some SiC FETs were already 'normal on' at 0 V. This resulted in the recommendation not to use gate offset voltage values more negative than -5 V.

A positive voltage of +15 V would be theoretically possible as on an IGBT; the threshold voltage is substantially lower, ensuring reliable switching behaviour in

SiC FETs. However, the output characteristics at different gate source voltages have demonstrated that higher gate source voltages would achieve a substantially lower $r_{ds(on)}$ (Figure 5). A gate-source voltage of +20 V makes the most of a SiC FET's benefits, so an isolated DC/DC converter running at +20/-5 V is the best choice for supplying the driver.

Particular attention should be given to the insulation resistance of the DC/DC converter; high switching frequencies — usually 10 to 50 kHz in IGBTs, and more than 50 kHz in SiC FETs — and steep ramps subject the insulation barrier to constant stress. Spikes are often significantly higher than an oscilloscope can catch. Relying on measurement alone and using a converter on insulation that is too tightly dimensioned as it risks long-term reliability in the system, so developers tend to allow for

sufficient safety reserves and use converters with the best possible insulation when dimensioning fast power switches.

A complete line of isolated DC/DC converters for IGBT and SiC FET applications

Power module manufacturer RECOM has developed a complete family of DC/DC converters specifically designed for supplying IGBT and SiC FET drivers.

The converters have asymmetric outputs at either +15/-9 V for IGBTs or +20/-5 V for SiC FETs, and are available at input voltages of 5, 12, 15 and 24 V. The power required significantly depends on the switching frequency of the system; values of 1 W are mostly enough for frequencies up to 10 kHz, whereas frequencies of 50 kHz and more require up to 2 W. The products run in power-sharing mode, which means that the rated power can be distributed over the two outlets.

There are other differences in insulation; products in the RKZ family are available at insulation voltages of 3 and 4 kVDC, with RxxP2xx versions as high as 5.2 kVDC.

RECOM subjects all newly developed converters to intensive HALT (highly accelerated long time) tests in its in-house environmental laboratory to ensure long service lives even under extreme conditions. The guarantee lasts three years. All converters are manufactured according to the RoHS2 and Reach directive, are certified according to UL 60950-1 and can be sampled by all major distributors.

RECOM Power GmbH
www.recom-power.com

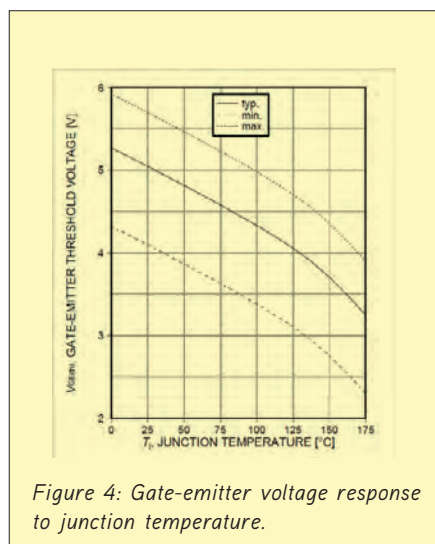


Figure 4: Gate-emitter voltage response to junction temperature.

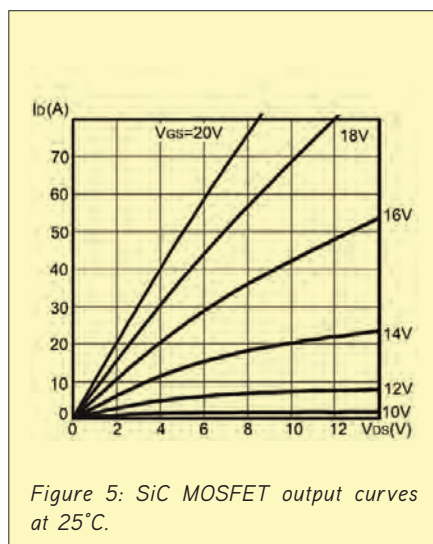


Figure 5: SiC MOSFET output curves at 25°C.

Cable Assembly & Box Build Assembly



Electrical box assembly



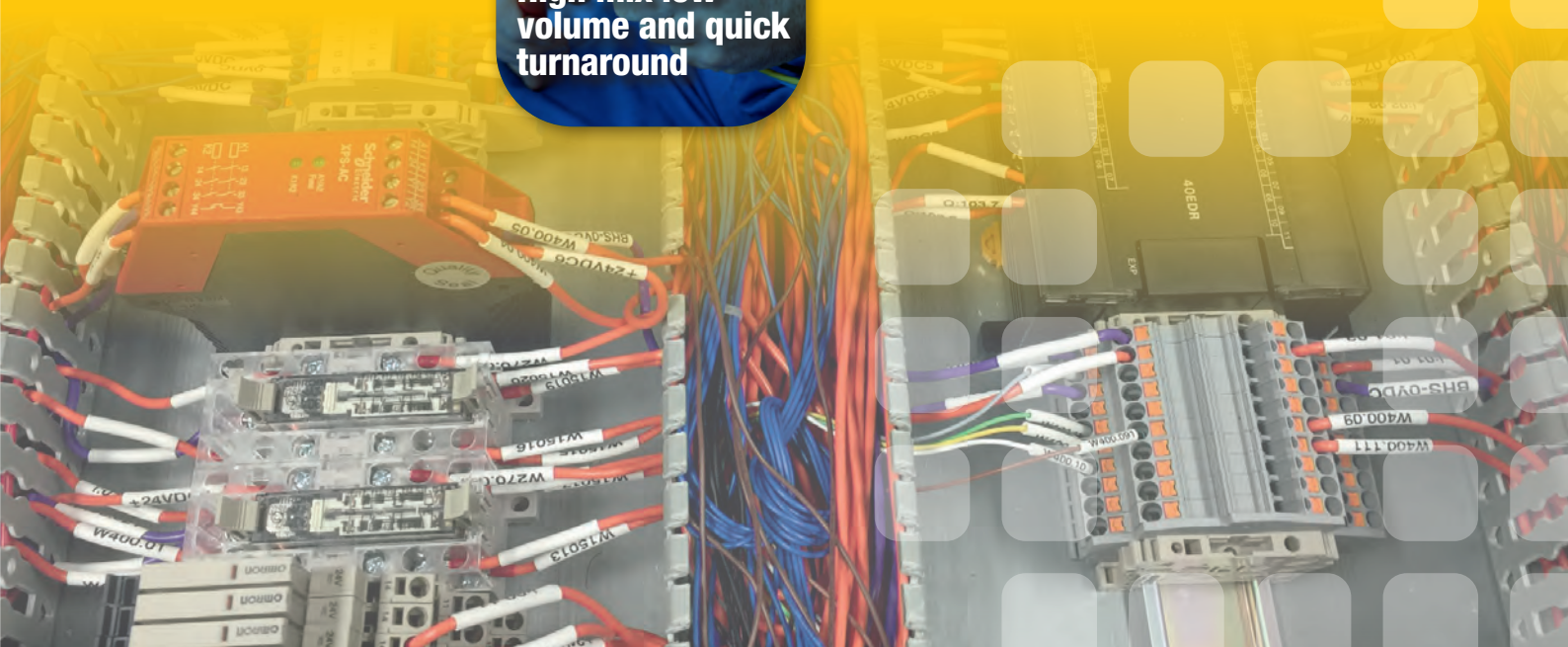
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PXIe ARBITRARY WAVEFORM GENERATORS

The Spectrum M4x series PXIe arbitrary waveform generators provide an automated testing application that requires fast and accurate electronic signal generation. Based on the modular instrumentation standard, the product includes five new modules that provide one, two or four channels.

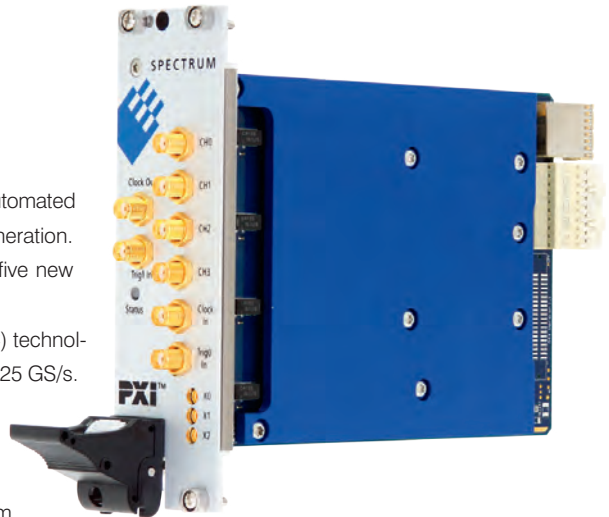
Each channel is equipped with 16-bit digital-to-analog converter (DAC) technology. The various models have maximum clocking rates of 625 MS/s or 1.25 GS/s. The combination of high resolution and fast clocking rates makes them suitable for generating precise and flexible wave shapes with frequency content from DC to 400 MHz.

The product features a Xle x4 Gen 2 interface that allows waveform data to be transferred to the 4 GB of onboard memory, at speeds up to 1.4 GBps. Fully PXIe compliant, the modules can be used in any PXIe or PXI hybrid chassis. Support is also provided for chassis distribution features such as the PXIe/PXI reference clock, star-trigger and trigger bus.

The product includes a number of operating modes such as single-shot, loop, FIFO, gating and sequence replay. In FIFO mode, the instruments can stream data continuously from PC memory over the PXIe interface. The product can also output signals while new waveform data is being sent to the onboard memory.

TRIO Test & Measurement Pty Ltd

www.triotest.com.au



COMPUTER-ON-MODULES

The congatec conga-SA5 computer-on-modules are credit card-sized modules for the SMARC 2.0 specification. They are based on the 14 nm Intel Atom, Celeron and Pentium processors.

The product has pre-integrated onboard wireless interfaces for IoT connectivity. Developers and OEMs

benefit from a module standard with more pre-integrated functionalities, making carrier board design considerably easier and more efficient.

The modules come with the Intel Atom processors x5-E3930, x5-E3940 and x7-E3950, for the extended temperature range -40°C to +85°C, or with the Intel Celeron N3350 or quad-core Intel Pentium N4200 processors. All variants integrate Intel Gen 9 graphics for up to three high-resolution 4K displays that can be connected via dual-channel LVDS, eDP, DP++ or MIPI DSI. The modules provide up to 8 GB high-bandwidth LPDDR4 RAM with up to 2400 MT/s.

Soldered down connectivity modules with 2.4 and 5 GHz dual-band WLAN 802.11 b/g/n/ac plus Bluetooth low energy (BLE), as well as additional NFC functionality, can be integrated. The product offers 2x Gigabit Ethernet with hardware-based real-time support via precision time protocol (PTP).

Up to 128 GB of non-volatile storage are available on the module with the eMMC 5.0 interface, doubling the bandwidth to 3.2 Gb (read) compared to eMMC 4.0 for shorter boot times and faster data load.

All modules support Windows 10, including the complete Windows 10 IoT range and Android for mobile applications.

Congatec Australia Pty Ltd

www.congatec.com

NODES

Opto 22 Node-Red nodes make it easier to prototype and develop applications for connecting physical assets to cloud applications.

The product enables nearly anyone to rapidly develop IIoT applications, opening a path to quickly connect legacy physical assets to the digital world. It is a visual wiring tool and is currently available for a variety of platforms including OS X, Microsoft Windows, Linux and Raspberry Pi, as well as cloud offerings such as IBM Bluemix and AT&T Flow.

The node benefits from a large library containing over 500 prebuilt and ready-to-deploy nodes, which allows IIoT application developers to leverage existing software code and deploy it directly into their applications. It allows developers to save useful functions, templates or node flows for re-use. These flows are stored using the JSON format, which can be easily imported and exported.

Through a visual browser-based drag-and-drop interface, the product allows developers to focus on identifying an opportunity and developing a response, rather than building the components of an application by scratch.

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The instrument features high-speed testing, including a 9 s Category 6 auto test and built-in alien crosstalk testing capability. PLA004 (Cat 6A/Class EA) and CHA004 (Cat 6A/Class EA) adapters are included.

Other features include: a ProjX management system for tracking complex jobs; a Taptive user interface with simplified testing protocols across multiple media types; LinkWare management software for test analysis and professional test reports; and dedicated diagnostics.

TechRentals

www.techrentals.com.au

LONG-RANGE RF MODULE

The MultiConnect xDot is a secure, CE/FCC/RCM certified, ARM mbed programmable, low-power RF module that provides long-range, low bit rate M2M data connectivity to sensors, industrial equipment and remote appliances.

The product is LoRaWAN 1.0x compliant, providing bidirectional data communication up to 15 km line of sight and 2 km into buildings, using sub-GHz ISM bands in Australia, North America and Europe. It is said to bring intelligence, reduced complexity and a lower overall bill of material cost to the edge of the network while supporting a variety of electronic interfaces to connect just about any 'thing' for years on battery power.

The module features a Cortex M3 STM32 MCU, 32 MHz clock speed, 256 KB Flash and 32 KB RAM. It has frequency of 860–1020 MHz (918–925 MHz in Australia) and data rates of 300 bps to 50 Kbps. It has ultralow power of 1.9 μ A in sleep mode.

Interfaces include up to 19 digital I/O, 11 analog inputs, two DAC outputs, I2C, SPI, wake pin, reset pin, full UART and MBED/simple UART (RX and TX only). AT-style control command is supported.

Elecom Electronics Supply

www.elecomes.com



USB 2.0 AND 3.0 CONNECTORS

The CUI USB 2.0 and 3.0 connectors are available in Type A, Type B, Micro AB, Micro B, Mini AB and Mini B USB versions.

Able to support data rates up to 5 Gbps in USB 3.0 models, the product is suitable for a variety of I/O applications in consumer and portable electronic devices, including mobile computing equipment, digital audio devices and high-volume storage products.

Offered in jack or plug connector types with horizontal or vertical orientations depending on the model, the product has a number of mounting styles including surface mount, cable mount, mid mount SMT and through hole, allowing them to plug into virtually any design.

All models feature a voltage rating of 30 VAC, current ratings of 1 or 1.8 A and reliability as high as 10,000 mating cycles for specific models. Colour insulator options of black, blue and white are also offered. The USB connectors also feature an operating temperature range of -25 to 85°C and RoHS compliance.

Mouser Electronics

www.mouser.com

GNSS RECEIVER

The u-blox SAM-M8Q GNSS receiver has an integrated antenna and is housed in a 15.5 x 15.5 x 6.3 mm package. The module can be easily embedded in small devices that require location information, such as asset tracking and telematics systems, and generic automotive after-market applications.

The combination of an integrated wide-band antenna along with the module's SAW filter and low-noise amplifier (LNA) architecture ensures that the receiver delivers robust performance in the presence of high frequency signals from other electronic equipment, such as cellular modems, which can cause interference.

The module is able to offer simultaneous reception of GPS, GLONASS and Galileo satellite signals.

u-blox Singapore Pte Ltd

www.u-blox.com

Waterproof Appliance coupler

Waterproof appliance coupler with protection degree IP67 and IP69K



SCHURTER presents the new waterproof IEC connector consisting of the appliance inlet type 4761 and the rewirable cord connector type 4762. With its high protection class IP67 or IP69K connected or unconnected with cover, this appliance coupler is perfect for supplying power to appliances used in harsh environments such as industrial, marine, laboratories or any type of outdoor appliances.

The Push/Pull locking system provides a strong reliable connection, yet at the same time ensures a break-away cable in the event of overdue stress. The blue shape and colour of the pull-out mechanism indicate the pull-out direction. A clear catch sound is heard upon the seated connection. The connector style is similar to the international standards of IEC and UL/CSA 60320, but is distinguished by a special arrangement of the contacts, so as not to interchange with conventional power cords. This ensures the maximum power applied, IP protection and the cord retention. The connector can be temporarily submerged in water and can be cleaned with high-pressure hot water cleaners. Both components are very easy to terminate. The inlet 4761 is available with solder or quick connect terminals. The easy wiring style connector requires no special tools for wire assembly.

The appliance couplers with gripped housing are available in black and white colours; the dual components, appliance inlet and cord connector can be ordered as complete sets or individual components. Accessory covers are available for both plug parts, providing a waterproof protection IP67 in plugged state and IP69K in an unplugged state. These protective covers also offer protection against pollutants, which can potentially contaminate the contacts.

The waterproof appliance coupler set is VDE and UL/CSA approved. It offers rated current from 10A to 15A at 250VAC according to IEC and UL/CSA standard. The maximum operating temperature is +120 °C. Quick connect terminal options for the inlets are 4.8 x 0.8 mm, 6.3 x 0.8 mm or solder. The cord connector can be assembled with cables from 6.0 - 10.0 mm, maximum wire size acc. to IEC 1.0 mm², according to UL/CSA 14AWG (2.08 mm²).

The approvals of these connectors according to IEC/UL 60320 simplify the process for the equipment manufacturer to obtain approval of their appliances, because many equipment standards with respect to the power supply refer to these component standards.

Accessories:

Protection cover for IP67 / IP69K for 4762 unplugged

Protection cover black: 0098.0106

Protection cover white: 0098.0108



About SCHURTER

SCHURTER is an internationally leading innovator and manufacturer of electric and electronic components. The company focuses on safe power supply and easy-to-use equipment. Its extensive product portfolio comprises standard solutions in the fields of circuit protection, plugs and connectors, EMV products, switches, input systems and electronic manufacturing services. SCHURTER's global network of representative offices ensures reliable delivery and professional customer service. Where standard products are unsuitable, the company develops client-specific solutions.

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STANDARDISING IoT CONNECTIVITY BY THE KILOMETRE

SIGFOX, LoRa OR LTE?

Barry Manz*

As everyone is probably tired of hearing, the Internet of Things is supposed to connect everyone with everything connectable, everywhere.

There are basically two ways to provide connectivity between IoT devices and their host systems at distances beyond those of ZigBee, Wi-Fi and Bluetooth: cellular networks and low-power wide area networks (LPWANs) developed by other companies. The goal of the LPWAN developers is to deploy networks in as many urban areas as possible before wireless carriers deploy theirs in the form of three solutions:

- EC-GSM (extended coverage), which allows existing GSM cellular networks to be used for IoT applications through the addition of software.
- Variants of LTE called, for the purposes of this article, LTE-M, as it is an umbrella term that covers a variety of LTE specifications destined for IoT connectivity use.
- The fifth generation of wireless, 5G, coming sometime after 2020.

So the race is on. The wireless carriers have an enormous advantage in that they already have coverage virtually everywhere,

but if the LPWAN providers rapidly get their solutions in place, it's reasonable to assume that the potentially enormous revenue to be gleaned from IoT connectivity will wind up being shared between the wireless carriers and LPWAN providers.

LPWAN variants

LPWANs can be differentiated by the modulation schemes they employ, which are ultra-narrowband, narrowband and wideband. Ultra-narrowband networks trade on the fact that as transmit bandwidth shrinks the noise floor rises, which positively impacts receiver sensitivity, range and the need for lower transmitted power. Ultra-narrowband systems can achieve only low data rates and small data packet sizes, along with unidirectional or bidirectional communications. Narrowband networks can provide a satisfactory compromise between their narrower and wider counterparts, providing considerable range and capacity. Finally, wideband networks,



with channels sizes of 500 kHz to greater than 1 MHz, have the highest data rates. The performance of ultra-narrowband, narrowband and wideband networks varies greatly with each vendor.

The contenders

In addition to IoT connectivity provided by wireless carriers (LTE/4G/5G), there are a variety of competitors, the largest six of which are covered below: LoRa, Symphony Link (and Ensemble), SIGFOX, Weightless, Nwave and Ingenu. All have developed solutions that make them different from each other in many ways based on the use of proprietary software, networking techniques and other factors.

LoRa

LoRa (an acronym of Long Range) is the physical layer of a set of open standards for bidirectional devices championed by the LoRa Alliance. Its network implementation is called LoRaWAN and

was developed by Semtech, along with IBM Research and Actility. LoRa uses chirp spread spectrum modulation and a base station can typically cover hundreds of square kilometres.

The technology allows communication to be conducted over multiple channels at varying data rates, depending on range and required message duration. Data rates range from 300 bps to 50 kbps, managed by the network server along with the RF output power of each user IoT device. The approach provides security at the network, application and device levels and can accommodate all classes of bidirectional IoT devices.

Symphony Link and Ensemble

This technology, developed by Link Labs, is a proprietary variant of LoRaWAN that uses its physical layer but a different MAC architecture to provide additional functionality. The company's premier product, called Symphony Link system, uses an eight-channel base station operating in the 433 MHz or 915 MHz ISM bands as well as the 868 MHz band used in Europe. It can transmit over a range of at least 16 km and backhauls data using either Wi-Fi, a cellular network or Ethernet using a cloud server to handle message routing, provisioning and network management.

SIGFOX

SIGFOX is the product of a company by the same name that has deployed networks in 19 countries, making it the current leader of the pack. SIGFOX operates at 868 or 915 MHz and transmits very small amounts of data very slowly (300 bps) using Binary Phase Shift Keying (BPSK). SIGFOX can achieve long-range coverage and has general characteristics that make it suited to any IoT application requiring only small amounts of data.

A SIGFOX network uses ultra-narrowband modulation that allows messages to travel up to 1000 km with a single base station, with capacity of up to 1 million IoT devices per base station. Data payload is 12 bytes per message and up to 140 messages per day per device, which is adequate for a substantial number of applications. Initial networks were unidirectional but bidirectional capability may soon be available.

Weightless

This open standard has three versions: Weightless-N, Weightless-P and Weightless-W. Weightless-N is unidirectional, provides range of more than 5 km and is the most basic variant. Weightless-N-enabled IoT devices can operate for 10 years before battery replacement. Weightless-P is a bidirectional version with a more complete feature set and a range of 2 km or more, whose enabled devices can last between three and eight years. Weightless-W is the most extensive bidirectional implementation and offers a range of more than 5 km, and enabled devices can operate between three and five years.

The Weightless network uses GMSK and offset-QPSK spread spectrum modulation schemes and 12.5 kHz-wide channels, and has a transmitted RF power of only 17 dBm. When enabled in an IoT device, quiescent current consumption is only 100 μ W, making it compatible with the many IoT sensors that get their power



from a lithium-ion watch battery. Weightless can be used in any licence-free band. 128/256 AES encryption and authentication are available for both the terminals in the network.

Nwave

Nwave uses ultra-narrowband technology and software-defined radio (SDR) techniques and can operate in any unlicensed frequency band. The base station can accommodate up to 1 million IoT devices over a range of 10 km with RF output power of 100 mW or less and a data rate of 100 bps. Battery-operated devices can operate for up to 10 years.

Ingenu (formerly On-Ramp Wireless)

Ingenu's Machine Network operates in the 2.4 GHz band and bases its capabilities on a modulation scheme called Random Phase Multiple Access (RPMA) that uses direct-sequence spread spectrum and tight control over transmit power along with high receiver sensitivity to provide a high link budget. RPMA 'self modulates' to find an interference-free transmission path between the network and device. The company claims it can cover over 480 km per base station under typical conditions.

Last but not least

The elephant in the room is LTE delivered by wireless carriers. As IoT has been in the works for years, the Third Generation Partnership Project (3GPP) has been working to accommodate it in the wireless standards development process. LTE-M was rolled out in 3GPP Release 12 and Release 13 adds many specifications focused exclusively on serving IoT. It includes narrow 200 kHz bandwidth capability and also 'wider' bandwidth capability of 1.4 MHz bandwidth, the latter still being much narrower than standard LTE. All duplex modes are designed to minimise latency, transmit power for enabled devices is a modest 20 dBm, and other provisions should allow them to operate for up to five years on two AA batteries. It also presumes that the cost of LTE modems will need to decline by up to 50%.

There is speculation about whether wireless carriers will ultimately reign over all of IoT connectivity. Those who believe that it will note that the physical infrastructure is already in place, so only relatively minor modifications will be required, and that the wireless industry has huge resources that it will surely devote to ensure it gains most of the market. As this story goes, it's possible that the wireless industry could wipe out all its competitors in one fell swoop. That said, while AT&T recently announced that it will use an 'all-LTE' approach to providing IoT connectivity, it will not rule out using one or more of the LPWANs if it makes sense in a specific situation.

At the other end of the spectrum are those who believe that wireless carriers will take advantage of the potentially higher performance they can provide to serve the most demanding, high data rate cloud-based applications that require connection of IoT devices over huge geographical areas, thus justifying higher service costs. A typical application might be a manufacturer of industrial machines enabled with IoT sensors that are installed throughout the world. The remainder of the market would be served by LPWAN providers. Regardless of how this marketplace eventually matures, there is now no doubt that IoT will be far more visible to greater numbers of people in the next few years.

Mouser Electronics
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**Barry Manz is President of Manz Communications, Inc. He has worked with over 100 companies in RF, microwave, defence, test and measurement, semiconductor, embedded systems, lightwave and other markets. He edits for the Journal of Electronic Defense and Military Microwave Digest, and was chief editor of Microwaves & RF magazine.*



MODULAR PXIe-BASED DIGITISERS

The Spectrum GmbH M4x.22xx series modular PXIe-based digitisers offer one, two or four fully synchronous channels.

Each channel is equipped with its own analog-to-digital converter (ADC), with real-time signal sampling at rates from 1.25 GS/s to 5 GS/s, and scope-like signal conditioning circuitry that allows programming of parameters such as input gain, signal offset and coupling.

The digitisers also offer bandwidth up to 1.5 GHz, making them suitable for automated testing applications where wideband electronic signals from DC to the GHz range need to be acquired and analysed.

Typical applications include semiconductor and component testing, radar, wireless and digital communications, laser and optical systems, automotive, power, physics, surveillance, medical science, aerospace and defence.

The flexible front-end circuitry of the product is complemented by a trigger system, an onboard acquisition memory of 4 GSamples and a host of data acquisition and readout modes. The combination makes it simple for the cards to capture even the most complex signals as well as work effortlessly with other modules in a test system.

Acquisition and readout modes include single-shot capture (for transient recording), FIFO (for streaming data directly over the bus), segmented memory (multiple recording), gated acquisition (gated sampling) or the combination of segmented acquisition of fast signals in parallel with slow continuous data recording (ABA mode). Trigger events can also be time stamped.

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SHORTCIRCUITS



A SUPERCOMPUTER WITH HIGH PERFORMANCE DENSITY

Japanese computing companies ExaScaler and PEZY Computing have announced the ZettaScaler-1.8, said to be the first supercomputer with a performance density of 1.5 petaFLOPS/m³ (Rpeak). The supercomputer was unveiled at SC16, the International Conference for High Performance Computing, Networking, Storage and Analysis.

The supercomputer is cooled by ExaScaler immersion liquid cooling technology and powered by Vicor 380 to 48 V and 48 to 1 V modules. Powered by 380 VDC, the product utilises Vicor converters to provide 48 V to high-density, high-efficiency direct-to-PoL current multipliers feeding PEZY Computing's low-voltage, high-current processors.

"ExaScaler and PEZY Computing have achieved substantial improvements in efficiency and density with 380 to 48 V converters and 48 V direct-to-PoL VTM current multipliers from Vicor," said Motoaki Saito, founder and CEO of ExaScaler and PEZY Computing.

The ZettaScaler-1.8 is a prototype of the ZettaScaler-2.0, due to be released in 2017 with a performance density three times higher than the ZettaScaler-1.8.

WEARABLE COPPER RIBBONS FOR HARVESTING AND STORING ENERGY

Scientists from the University of Wollongong (UOW) have developed a flexible copper strip that could be the answer to powering electronic devices via the clothes we wear.

Collaborating with the University of Central Florida's (UCF) NanoScience Technology Center, the researchers integrated a perovskite-based solar cell and a supercapacitor in a thin copper ribbon. This enabled the ribbon to simultaneously harvest and store energy — unlike other wearable power sources which typically require one device to harvest the energy and another to store it.

"Presently, most portable electronic and wearable devices carry rechargeable batteries, even when they are used in places where solar energy is plentiful," said UOW Senior Lecturer Dr Konstantin Konstantinov.

"We've reduced this need by integrating a solar cell and a supercapacitor in one device.

"The electrons generated by the solar cell are directly transferred and stored on the reverse side of its electrode, which in turn also functions as an electrode for the supercapacitor."

Writing in the journal *Nature Communications*, the researchers revealed, "When the flexible solar ribbon is illuminated with simulated solar light, the supercapacitor holds an energy density of 1.15 mWh cm⁻³ and a power density of 243 mW cm⁻³." Furthermore, they successfully used a tabletop loom to weave the ribbons into a square of yarn to demonstrate their potential in wearable electronics.

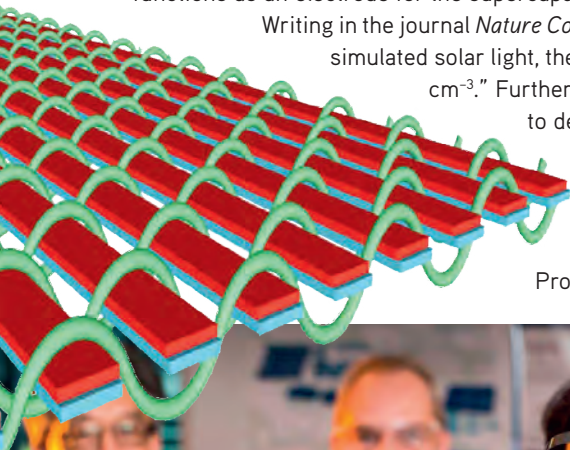
UCF nanotechnology researcher Associate Professor Jayan Thomas said one major application for the method could be in the military, with the ribbons incorporated into the jackets of soldiers who spend all day walking in the sun.

"Some of them are carrying more than 30 pounds of batteries on their bodies," said Professor Thomas. "It is hard for the military to deliver batteries to these soldiers in this hostile environment."

Dr Konstantinov added that the ribbon could also serve as a self-sufficient energy system for electric vehicles, noting, "Cars parked directly under the sun have an opportunity to utilise the abundant energy from sunlight. The flexible ribbon could be incorporated into the body of the car to make that possible."

According to UOW PhD student Md Monirul Islam, the next step is to use a lithium-ion battery instead of a supercapacitor to store the energy.

"Since the energy density of lithium-ion batteries is higher than that of supercapacitors, fabricating thin-film lithium-ion batteries instead of supercapacitors on the reverse side of the solar cell ribbon would considerably improve its energy density and possible applications," he said.





SOLAR CELLS MERGED WITH A LIQUID BATTERY

US researchers have been seeking a solution to a fundamental limitation of solar cells: the dark of the night.

While lithium-ion batteries are these days being used in everything from hybrid vehicles to laptop computers, they are too expensive a solution to use on something as massive as the electric grid. Professor Song Jin, from the University of Wisconsin-Madison, had a better idea: integrating the solar cell with a large-capacity battery.

Along with colleagues from UW-Madison and the King Abdullah University of Science and Technology in Saudi Arabia, Jin made a single device that eliminates the usual intermediate step of making electricity and instead transfers the solar energy directly to the battery's electrolyte. He chose a 'redox flow battery' (RFB), which stores chemical energy in a tank of liquid electrolyte.

"The RFB is relatively cheap and you can build a device with as much storage as you need, which is why it is the most promising approach for grid-level electricity storage," said Jin.

In the new device, standard silicon solar cells are mounted on the reaction chamber and energy converted by the cell immediately charges the water-based electrolyte, which is pumped out to a storage tank. According to Jin, discharging the battery to power the electric grid at night could hardly be simpler: "We just connect a load to a different set of electrodes, pass the charged electrolyte through the device and the electricity flows out."

Wenjie Li, a UW-Madison graduate student and first author on the study, explained that the team's device "harvests sunlight to liberate electrical charges and directly changes the oxidation-reduction state of the electrolyte on the surface of the cells".

"It's essentially a solar battery, and we can size the RFB storage tank to store all the energy generated by the solar cells," he said.

According to Jin, having the solar cells directly charge the electrolyte "makes for simplicity, cost reduction and potentially higher efficiency". Solar charging and electrical discharging can be repeated for many cycles, he said, with little efficiency loss.

With their concept now proven and published in the journal *Angewandte Chemie International Edition*, the researchers are now working on improvements. One improvement would be to match the solar cell's voltage to the chemistry of the electrolyte, minimising losses as energy is converted and stored. Another would be searching for electrolytes with larger voltage differential, which currently limits energy storage capacity.

"It's not just about the efficiency of converting sunlight into electricity, but also about how much energy you can efficiently store in the device," said Jin.

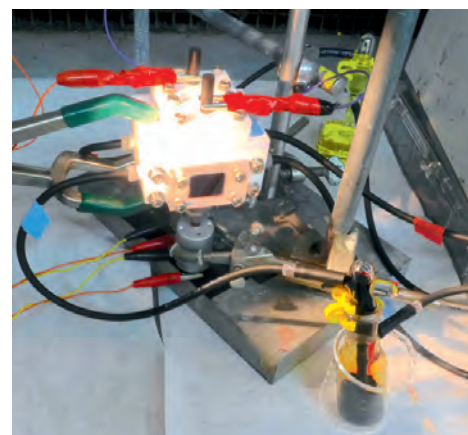


Image credit: David Tenenbaum, University Communications/UW-Madison.

This solar-charged device directly transfers energy from sunlight into a liquid battery and stores it in the container at lower right. During the discharge cycle, electricity leaves the device through electrodes at the top.

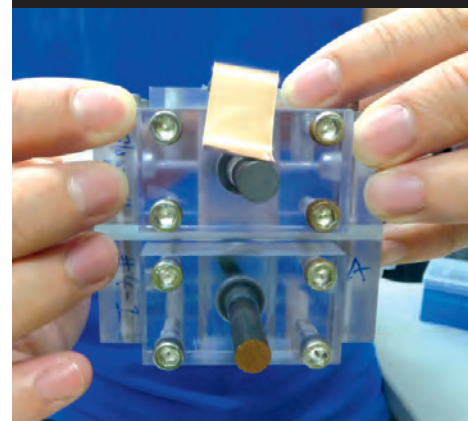


Image credit: David Tenenbaum, University Communications/UW-Madison.

This solar-charged battery directly stores energy from sunlight in a tank.

MADE IN JAPAN: THE RASPBERRY Pi 3 MODEL B

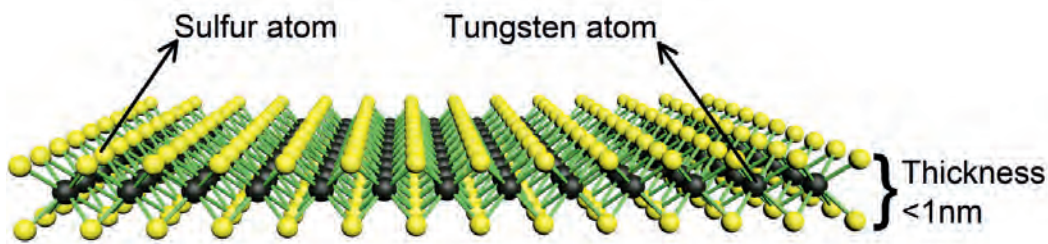


RS Components, in conjunction with the Raspberry Pi Foundation, has announced that its latest iteration of the Raspberry Pi 3 credit card-sized single-board computer will be manufactured in Japan under a local contract manufacturing arrangement.

Driven by the powerful onboard 64-bit ARM Cortex-A53 quad-core processor, the first 'Made in Japan' model will be the Raspberry Pi 3 Model B, which has significantly upgraded processing capabilities and delivers 10x faster performance than the original Raspberry Pi. This increase in global production is expected to serve the demand for the platform in the Asia-Pacific region.

"Existing models of the Raspberry Pi will continue to be manufactured in South Wales, UK, with the dual manufacturing locations in place to cater for future demand growth globally," said William Chong, head of product, supplier, inventory and pricing management, Asia-Pacific, RS Components. "Asia-Pacific is a significant growth market for Raspberry Pi, and this new 'Made in Japan' element means that we are now geared up for this growth."

All versions of the Raspberry Pi will be available to order from the RS Components website. A range of Raspberry Pi Starter Kits is also available, including the 'official' high-quality kit and the premium and value kits, meeting the needs of a range of customers and budgets. The starter kits allow users to begin their prototyping and development projects as soon as they have the board in their hands.



At just one atom thick, tungsten disulfide allows energy to switch off and on, but it also absorbs and emits light, which could find applications in optoelectronics, sensing and flexible electronics. The NYU logo shows the monolayer material emitting light.



GROWING ATOMIC-SCALE MATERIALS

Scientists from New York University (NYU) have developed a method for growing an atomic-scale electronic material at what is said to be the highest quality ever reported.

The promise of two-dimensional electronic materials has tantalised researchers since the discovery of graphene more than a decade ago. Also called 'monolayer' materials, graphene and similar 2D materials are one atom in thickness, several hundred thousand times thinner than a sheet of paper.

These materials boast major advantages over silicon — namely unmatched flexibility, strength and conductivity — but developing practical applications for their use has been challenging. For example, graphene (a single layer of carbon) has been explored for transistors, but its lack of an energy band gap poses difficulties for semiconductor applications.

"You can't turn off the graphene transistors," said Davood Shahrjerdi, an assistant professor at the NYU Tandon School of Engineering.

Shahrjerdi and doctoral student Abdullah Alharbi chose to work with tungsten disulfide — a synthetic material with a wide range of electronic and optoelectronic applications and a sizeable energy band gap. When the number of atomic layers increases, the band gap

becomes tuneable, and at monolayer thickness it can strongly absorb and emit light, making it suitable for applications in optoelectronics, sensing and flexible electronics.

Efforts to develop applications for monolayer materials are often plagued by imperfections in the material itself — impurities and structural disorders that can compromise the movement of charge carriers in the semiconductor (carrier mobility). Shahrjerdi and Alharbi managed to reduce these structural disorders in tungsten disulfide by omitting the growth promoters and using nitrogen as a carrier gas, rather than the more common choice of argon.

"We developed a custom reactor for growing this material using a routine technique called chemical vapour deposition," said Shahrjerdi. "We made some subtle and yet critical changes to improve the design of the reactor and the growth process itself, and we were thrilled to discover that we could produce the highest quality monolayer tungsten disulfide reported in the literature."

The researchers reported their results in the journal *Applied Physics Letters*. Shahrjerdi said of the technique, "It's a critical step toward enabling the kind of research necessary for developing next-generation transistors, wearable electronics and even flexible biomedical devices."

THE TOP 10 HOTSPOTS FOR WEARABLE ELECTRONICS INNOVATION

Analysts from Lux Research have ranked the global hotspots for wearable electronics innovation based on three broad criteria: research and development, funding and adoption. The results are as follows:

1. United States
2. Switzerland
3. United Kingdom
4. China
5. Canada
6. Australia
7. South Korea
8. Israel
9. Japan
10. Singapore

The US was found to be dominant in all aspects of wearables innovation, with its most significant strength being in government grants and accelerators. The country has five accelerators dedicated to development of wearables and a dozen government grants to support wearables for health, safety and communication.

Switzerland ranks second on the strength of its ability to leverage its historic strength in watchmaking to work on novel smart watches. The third-ranked UK, on the other hand, stands out for its diverse pool of institutions, companies and organisations developing wearable technologies in applications including disease management, military operations, employee wellness and fashion.

China, ranked fourth, lacks as many start-ups as the US, but its start-ups receive the most venture capital on average led by Codoon, ANTVR, Beijing Baofeng Mojing Technology and Huami, each of which has received over \$35 million.

Finally, report author Noa Ghersin noted that a number of countries have emerged with varying degrees of specialisations, looking to "become leaders in the development of specific wearable form factors or applications".

"Canada, for example, dominates smart textiles, and Australia focuses on sports," she said.



RUGGED SWITCHES

Crystal Group has announced the expansion of its rugged switch line with the introduction of the RCS7450 and RCS7750 rugged switches. Designed for deployment

in harsh environments, the rugged switch line provides robust networks with long-term field operation. IT teams will now be empowered to deploy simple to complex networks that are optimised to their specific requirements while in the field.

The rugged switches are designed with improved cooling, shock, vibration and humidity performance, extending performance within industrial and military environments. Built on the Brocade ICX 7450 and ICX 7750 network switches, they are enterprise-class, stackable LAN solutions for small and medium-size applications. While meeting relevant industry and military standards, the rugged switches offer high port density and flexibility even under extreme conditions.

The RCS7450 is available with 24 or 48 copper ports or with 48-port fibre SFP connectors. It can deliver 960 Gbps in stacking bandwidth, up to 336 Gbps in full duplex switching capacity and up to 250 Mpps forwarding capacity.

The RCS7750 offers 48 port SFP connectors, 5.67 Tbps in stacking bandwidth, up to 1.92 Tbps in full duplex switching capacity and 1.4 Bpps forwarding capacity.

Both units are available in a 1U form factor and weigh between 7.26 and 9.98 kg, depending on supply configuration. Mounting for the units complies with the EIA-310 19" rack standard using Delrin glides or a fixed mount.

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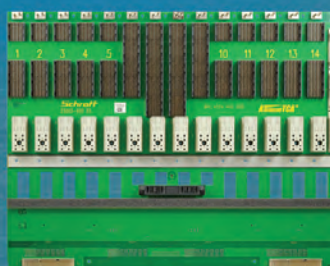
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THE TIME FOR 1500 V PV SYSTEMS HAS COME

With global non-renewable resources becoming increasingly scarce, renewable energy is being called upon in all major electricity markets.



The International Energy Agency (IEA) forecasts that the share of renewable energy in global power generation is expected to be over 30% before 2030, solar PV power generation accounting for 10% of it. By 2040 it will be over 50% (solar PV: 20%) and grow to over 80% (solar PV: 60%) at the end of this century. Meanwhile, global solar power capacity is growing sharply and could reach 540 gigawatts (GW) by 2020, according to a study by SolarPower Europe (SPE).

As a cost-competitive, reliable and sustainable electricity source, solar PV is currently blossoming. Europe is the biggest solar market at 157 GW, with the fastest growth in the UK. China is the fastest growing market globally, which is expected to add 86 GW until 2020. The Indian market is predicted to rank in third place with 54 GW, followed by Japan and the United States.

Up until now, the comparably high cost of power generation has been the main barrier to mass deployment of PV markets.

Therefore, more attention is paid to how to reduce the cost and how to improve the efficiency. Statistics show that the Chinese market price for PV modules has dropped from ¥36/W to the present ¥3.5–3.8; for grid-connected PV systems from ¥60/W to ¥7–8; and for inverters from ¥4/W to ¥0.3 from 2007 to 2015.

Beyond China, other markets' prices reduce too. The global average inverter prices will be reduced by 9% per year, dropping from US\$0.17/W in 2013 to US\$0.11 in the next five years. And the global price of crystalline silicon PV modules on average declines slightly by 5% in 2015, compared with 13% in 2013 and 11% in 2014. Such cost reduction trends are likely to continue, but price pressure is expected to be maintained, though the demand for PV in China, Japan and other emerging markets continues to grow and global inverters could reach around 70 GW (AC grid-connection) in 2018. Achieving PV grid parity is a matter of time. With the realisation of grid parity, it will greatly reduce the cost of power



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generation. On one hand, increase the generation capacity of the system; on the other hand, reduce the costs of initial investment and maintenance.

Advantages of 1500 V systems

What is a 1500 V system? It simply defines that the withstand voltage of cables, converters, inverters and other components used in PV systems increases from 1000 to 1500 V. An advantage of this is that it costs less but is more efficient than 1000 V systems.

Boosting voltage to reduce line losses is an effective measure for design cost reduction. Higher voltages of input reduce wire losses on the AC side and DC side, as well as winding losses in the low-voltage side of the transformer, and improve the power plant system's efficiency by 1.5–2%. Calculated by $P = UI$, given that the power is constant, the current will drop to 1/1.5 when the voltage increases 1.5 times. Similarly, assuming the length

and diameter of the cables are confirmed and the resistance R is constant, the cable loss will be 1/2.25 when the current lowers 1.5 times, as in Ohm's Law $P = I^2R$. To sum up, equipment loss will reduce and power generation increases when DC-side voltage rises from 1000 to 1500 V.

A complete PV power generation system design should have a PV array, a combiner, a DC cabinet, an inverter and a step-up transformer. Compared with traditional 1000 VDC voltage systems, 1500 V systems have fewer connections between the sting arrays and inverter. The PV arrays are constructed in the form of strings and then connect with the combiners in parallel, DC cabinet, inverter and power grid in sequence.

Another measure for design cost reduction comes from fewer components. 1500 V systems expand the number of single-string components from 22 to 32, reducing the quantities of strings, inverters, combiners and DC-side cables. A lower volume of equipment due to higher power density is also beneficial to reducing the costs of transportation and maintenance. For example, in a 10 MW PV power plant, a 1500 V system could reduce 568 strings and 38 PV combiners, with a cost reduction of US\$77,390. Due to less equipment, the costs of post-operation and maintenance will be reduced accordingly.

	1000 V system	1500 V system
Number of strings (blocks/strings)	22	32
Power per string (W/string)	5500	8000
Number of connected strings	1818	1250
Power per array (W/array)	110,000	160,000
Number of arrays	91	63

Design comparison between 1000 and 1500 V systems.

Challenges of 1500 V systems

Although changing voltage from 1000 to 1500 V benefits the system a lot, it is challenged by three aspects: PV module and related components technology, raw material and certification. Therefore, a benign collaboration across the industry and new standards meeting the requirements of 1500 V systems are needed.

PV module and related components technology

Seen from the PV module itself, the main challenges are electrical safety and potential performance degradation. Seen from the system design, it causes a stricter product selection, better-matched components and higher risk of potential induced degradation (PID).

Raw material

The insulation and the electric clearance count most when the voltage rises to 1500 V, for higher voltage may cause disruptive discharge. So, it will have higher requirements for the reliability of raw materials in terms of the layout of backboard, electrical connectors and electrical insulation. This technology requires the cooperation of other circuit breakers, fuses, lightning protection devices and switching power supplies, owing to higher requirements of withstand voltage and reliability than 1000 V systems.

Operating Voltage (V)	Pollution Degree						
	1	2			3		
		Material Group			Material Group		
		I	II	IIIa/IIIb	I	II	IIIa/IIIb
≤50	0.2	0.6	0.9	1.2	1.5	1.7	1.9a
>50 and ≤125	0.3	0.8	1.1	1.5	1.9	2.1	2.4
>125 and ≤250	0.6	1.3	1.8	2.5	3.2	3.6	4.0
>250 and ≤400	1.0	2.0	2.8	4.0	5.0	5.6	6.3
>400 and ≤500	1.3	2.5	3.6	5.0	6.3	7.1	8.0
>500 and ≤800	1.8	3.2	4.5	6.2	8.0	9.0	10.0
>800 and ≤1000	2.4	4.0	5.6	8.0	10.0	11.0	12.5
>1000 and ≤1250	3.2	5.0	7.1	10.0	12.5	14.0	16.0
>1250 and ≤1600	4.2	6.3	9.0	12.5	16.0	18.0	20.0
>1600 and ≤2000	5.6	8.0	11.0	16.0	20.0	22.0	25.0
>2000 and ≤2500	7.5	10.0	14.0	20.0	25.0	28.0	32.0
>2500 and ≤3200	10.0	12.5	18.0	25.0	32.0	36.0	40.0
>3200 and ≤4000	12.5	16.0	22.0	32.0	40.0	45.0	50.0
>4000 and ≤5000	16.0	20.0	28.0	40.0	50.0	56.0	63.0
>5000 and ≤6300	20.0	25.0	36.0	50.0	63.0	71.0	80.0
>6300 and ≤8000	25.0	32.0	45.0	63.0	80.0	90.0	100.0
>8000 and ≤10000	32.0	40.0	56.0	80.0	100.0	110.0	125.0
>10000 and ≤12500	40.0	50.0	71.0	100.0	125.0	140.0	160.0

a IIIb is allowable if operating voltage is less than 50V.

Certification

1500 V systems require a full range of certification standards for production components. Since 2013, multiple component groups have been certified with TUV for 1500 V, but very few for special devices, such as high-voltage power supply and others, meet the standard.

The 1500 V system solution

A PV power system usually takes power from either AC grid power or a high-voltage DC battery. The former needs a long wire to connect the AC power because it is usually installed in a sunny position in remote areas, which greatly increases the costs. Therefore, taking power from a high-voltage DC battery is more popular.

As a PV combiner and PV inverter are key components of PV systems, the power solution has been challenged with 1500 VDC voltage. Most manufacturers directly use power products on the market because there are lots of difficulties when converting 1000 VDC high-voltage into 24 V low-voltage, and some choose to self-design a power solution to save costs. It cannot be denied that there are certain advantages to self-design; however, solutions provided by professional power manufacturers are far superior in terms of reliability and performance (eg, high temperature, life, altitude, etc).

Besides, using a power module greatly simplifies the system design and avoids the risks of system failure caused by supply. Moreover, certification is the greatest challenge for power products. 1500 VDC high voltage should meet the relevant standards for higher safety distance and creepage distance, which self-designed solutions find difficult to meet. High altitude also exacerbates the technical difficulty for PV module design.

High-voltage PV modules from professional manufacturers could solve the abovementioned problems and provide a more reliable and longer life-cycle power solution, which usually has CE certification meeting different requirements for PV modules in different countries.

To address the need for 1500 V systems, MORN SUN has released 15/40 W 1500 VDC input PV15/PV40-29Bxx. Featuring 200–1500 VDC ultrawide input voltage, CE/CSA approval and built-in input undervoltage protection, the system is suitable for high-altitude applications (up to 5000 m).

Summary

The gradual large-scale popularity of PV energy is the rational development trend of global energy. MORN SUN actively participates in the development of green energy technology and developed the 1500 V high-voltage PV power module PVxx-29Bxx series to address the needs of control monitoring units in 1500 VDC PV power systems. PV power simplifies circuit solutions, reduces the cost of building and maintenance and comprehensively enhances the stability, security and reliability of the system.

Written by MORN SUN. MORN SUN products are distributed in ANZ by DLPC and in Victoria by Fairmont Marketing.

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DEVELOPMENT KIT

Digi International has announced the ConnectCore for i.MX6UL Development Kit — a complete, off-the-shelf single-board computer (SBC) designed specifically for rapid development, prototyping and production of a secure gateway platform for intelligent connected devices.

The product enables efficient, rapid delivery of connected products and applications requiring multiple access points, offering high levels of flexibility while facilitating the development of key areas for powering IoT and M2M solutions.

Delivering a complete software platform requiring little to no hardware development to create a wide range of connected devices, the kit leverages the NXP i.MX6UL system-on-module (SOM) to provide: a complete IoT design platform; an off-the-shelf SBC with all the features and capabilities to build industrial-strength wired and wireless connected devices; and an intelligent and secure communication engine.

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CALIBRATION SERVICES

Keysight Technologies One-Stop Calibration Services ensure ongoing accuracy and availability of test assets, as well as electrical, physical, dimensional and optical equipment from virtually any manufacturer. This helps engineers develop, deploy and maintain test systems at a lower cost.

The service offers multivendor system support and is now covering more than 100,000 products, including benchtop PXI and AXIe instruments.

Keysight Technologies

Australia Pty Ltd

www.keysight.com

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ERNTEC



RIBBON FUSION SPLICER, CLEAVER AND STRIPPER

The Fujikura FSM70R is a 12-core ribbon fibre fusion splicer. It is fitted with a fixed v-groove for splicing ribbon fibre up to 12 fibres. It has an automated wind protector that accelerates the splicing process by closing to initiate the splice process and opening once the process is complete. It is available to rent from TechRentals.

An auto-start tube heater provides heat to both sides of the splice protection sleeve, allowing for a 40 s shrink time for 12-fibre ribbon. The outcome is a total splice process time of approximately 55 s.

Other features include: a CT-30 cleaver and thermal jacket stripper; onboard training and support videos; a detachable work table and arc-free calibration system; and a 40 s automated tube heater.

TechRentals
www.techrentals.com.au



RESISTIVE TOUCH SERIES MONITORS

The Faytech resistive touch series monitors are available in sizes from 7" to 21.5" and are designed for demanding applications.

The product has lockable standard connectors, a cable-channelling back cover, an LED backlight, resistive touch screens, extra robust components, a wide-range power supply, multiple video inputs and an extended temperature range.

The sunlight-readable, 1000 nit rugged monitors are dust- and water-resistant to the IP65 protection rating and sealed in an aluminum enclosure. They feature an all-in-one cable system with HDMI or VGA picture connection, USB for touch and 8–36 VDC power connection. The operating temperature is -25°C to +75°C.

High-performance LCD panels with LED backlighting and long life, coupled with specialty films and enhanced polarisers, allow good pictures even under direct sunlight. Buttons are available on the front to change brightness levels. A resistive touch screen is fitted to the monitors. Mounting is VESA 75.

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

MODULAR DC-DC CONVERTER

The Vicor DCM in a VIA Package is a ruggedised, modular DC-DC converter, operating from an unregulated, wide-range input, to generate an isolated and regulated high-efficiency output with high power density.

The DCMs are said to offer power system engineers a better brick with their enhanced functional integration by incorporating EMI filtering, transient protection, inrush current limiting and a secondary-referenced control interface for trim, enable and remote sensing. Configurations are available for both onboard mounting and for chassis mounting.

Aimed at a variety of applications, including industrial and communications, Vicor has added three 48 V input nominal modules (36–75 V range) in a 3414 VIA package (3.38 x 1.40 x 0.37"). The converters have output voltages of 12, 24 and 48 V with power levels of 320 W, achieving a power density up to 183 W/in³.

Vicor Corporation
www.vicorpower.com



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WHAT'S IN STORE FOR THE SEMICONDUCTOR INDUSTRY IN 2017?

Marco Cassis*

The electronics market is forecast to continue its positive momentum from 2016 into 2017, and that is good news for the semiconductor market.



2017

The increasing pervasion of intelligence and connectivity across a broad range of applications and devices, along with the need for more efficient power and resource consumption, is at the heart of this trend.

In 2017, expect car digitalisation and electrification to accelerate. This is being driven by the strong demand among consumers, manufacturers and governments for three important advances. All want to make driving greener, with a strong focus on engine management, fuel efficiency and electrification. They want to make driving safer, relying on improvements in assisted driving and security. And they want cars to be more connected, with an emphasis on infotainment and telematics.

Catalysing these efforts are new-product innovations and introductions that meet important performance requirements in MCUs, sensors, power — including wide bandgap technologies like

silicon carbide — and connectivity that will dramatically improve advanced driver assistance systems (ADAS) and vehicle-to-vehicle and vehicle-to-infrastructure (V2X) communications. We will not see fleets of self-driving cars in 2017, but our inexorable progress to them is well underway.

The IoT is creating or transforming a broad range of markets that all rely on the same technology bricks: flexible processing options, connectivity, security, power management and analog functions. Add the right design tools and software ecosystems to designers' creativity to quickly and easily convert ideas into prototypes and you get the right recipe for a significant further expansion of IoT devices across all categories in 2017.

Expect further strides in use time, connectivity, security and wireless charging for most of the personal devices we are already familiar with, including smartphones and wearables. 2017 should

2017 PREDICTIONS



THE IoT IS CREATING OR TRANSFORMING A BROAD RANGE OF MARKETS THAT ALL RELY ON THE SAME TECHNOLOGY BRICKS

see also the first major wave of new devices and form factors for augmented reality (AR) and virtual reality (VR) for both consumer- and professional-grade applications.

Cities and homes will take another step in the adoption of electronics-based management systems. In the home, smart meters are being rolled out around the world to enable remote monitoring and tariff-based optimisation of energy use, while home owners will increasingly adopt a broad range of smart locks and connected security systems, as well as household robotics. Smart lighting will expand from the home to municipal-area systems, with new public lighting able to respond to changes in ambient conditions. At the city level, think about sensors that can reroute pick-up/delivery services and traffic patterns to changing congestion or can guide drivers to preregistered and reserved parking spaces — these are the opportunities in smart cities that will contribute to semiconductor growth in 2017 and beyond.

Factories, too, will be getting smarter. Global efforts, which fall under the umbrella of 'Smart Industry', are defining the next wave of factory automation, motion control and power management equipment. The factories of the future are rapidly becoming factories of the present because they are enabled by semiconductors. These 'intelligent' factories employ advanced microcontrollers, sensors and connectivity products to increase production and overall efficiency by reducing energy use and downtime with optimised maintenance



schedules while simultaneously improving process flow and data security. One example: electric motors, which consume about half of all electricity used worldwide, could be made even more efficient using a range of smart motor strategies that could reduce costs significantly.

What has started just a few years ago — the pervasiveness of IoT in multiple markets and the efforts to make driving smarter — is just the beginning. This is what is making 2017 another promising year for the semiconductor industry.

**Marco Cassis is an Executive Vice President of STMicroelectronics and President of the company's Asia Pacific Region.*

STMicroelectronics Pty Ltd
www.st.com



MINI CARD

The MEN Mikro Elektronik PCI Express Mini Card PX6 protects user systems from unauthorised access. An integrated smart card stores the access codes for data transfer into the cloud. The encryption is independent of the cloud provider.

To protect data transfer from undesirable access, an existing system can easily be secured by integrating the smart card reader. The module can be used with the same slot as an existing mobile interface card.

The secure communication is realised via VPN connection. Therefore, the smart card stores the security certificate as well as the private key used for authentication. In addition, the smart card itself is secured with a PIN before getting access to the private key.

This module is used in entertainment or storage systems in railways or stationary. The robust box PCs, as well as the modular CompactPCI systems, offer corresponding slots.

The PX6 is designed for an extended temperature range of -40 to +85°C and is certified to ISO7816 smart card specification.

OEM Technology Solutions

www.oem.net.au

PANEL INDICATOR LED

The Marl 612 Series Tri-colour panel indicator LED is a small panel mounting device. It features a black anodised aluminium housing, a standard industrial mounting size of Ø6.35 mm and is sealed to IP67.

The product has three colour-coded terminal wires for ease of identification. These are anode red and anode green, while common cathode amber can be generated by powering red and green simultaneously. This means a single indicator can be used for three different colours, providing an efficient, space-reducing indicator.

Other features include a smoked lens and wide viewing angle offering good on/off contrast ratio, good reliability and it is weatherproof. The product is suitable for portable equipment, high vibration applications and status panel indication.

Aerospace & Defence Products

www.aerospacedefenceproducts.com.au



MEMORY

The Fujitsu Semiconductor 4 Mb ReRAM MB85AS4MT memory operates with a wide range of power supply voltage, from 1.65 to 3.6 V. It features a small average current in read operations of 0.2 mA at a maximum operating frequency of 5 MHz.

It is suitable for battery-operated wearable devices and medical devices such as hearing aids, which require high-density, low power consumption electronic components.

The package is a 209 mm 8-pin small outline package (SOP), pin-compatible with other non-volatile memory products.

Other features include serial peripheral interface, 1.2 million write cycles, write operating current of 1.3 mA (during write cycle time), data retention of 10 years up to 85°C, unlimited read cycles, standby current of 10 mA, sleep current of 2 mA, and write cycle time (256 B page) of 16 ms (with 100% data inversion).

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DC FAN

The CUI CFM series DC fan has frame sizes of 40, 50, 60, 70, 80, 92 and 120 mm. It delivers airflow ranging from 10 CFM in the 40 mm series to over 200 CFM in the 120 mm series.

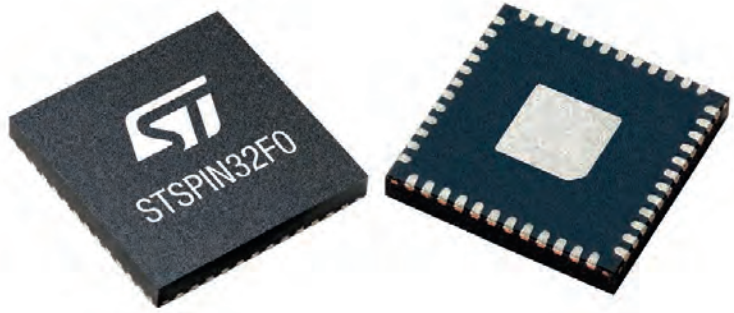
Available with rated voltages of 5, 12, 24 and 48 VDC, all DC fans feature dual ball bearing construction for maximum reliability and come as standard with auto restart protection. Static pressure values range from 2.79 up to 19.8 mm H₂O with low rated currents from 0.1 to 1.4 A. Options for tachometer signal, rotation detector and PWM control signal are also available depending on the model.

The product also carries UL/cUL 507 and TUV (EN 60950-1) safety approvals while complying with EN55022 Class B limits for conducted and radiated emissions. All models are RoHS compliant.

The DC fans are suitable for IT and telecommunications equipment, medical devices and industrial applications.

Digi-Key Corporation

www.digikey.com



SYSTEM IN PACKAGE FOR MOTOR CONTROL

STMicroelectronics is accelerating Industry 4.0 with a powerful single-package device for intelligent motor control.

The STSPIN32F0 system in package combines the power and flexibility of a microcontroller-based drive with ease of use and space efficiency. Target applications include smart manufacturing equipment, power tools and cooling fans, as well as emerging high-tech product categories such as drones, small robots and home appliances containing high-efficiency motors, such as high-performance portable vacuum cleaners or air purifiers.

The product combines a microcontroller and an analog IC in a tiny 7 x 7 mm QFN package, delivering the flexibility and power of a microcontroller-based motor drive with the convenience, simplicity and space efficiency of a single IC. It is equally suitable for developers with existing investment in motor control IP or those seeking an off-the-shelf motor control algorithm.

The system is said to simplify design challenges by leveraging the extensive STM32 development ecosystem, with software tools, firmware libraries and middleware available on top of motion-control algorithms such as field-oriented control (FOC) and six-step control to streamline firmware development.

STMicroelectronics Pty Ltd

www.st.com



MINI BOX PC

The MEN Mikro Elektronik BE10A space- and power-saving mini box PC has low power consumption that can be operated in a light, space-saving housing without fans, allowing for maintenance-free operation. Its versatile I/O possibilities make it suitable for IoT gateway applications in industrial automation.

The product is equipped with a Sitara AM57x processor, which is based on the ARM Cortex-A15 core. The box easily manages processing and communication tasks despite its low power consumption of a maximum of 15 W, at an operating temperature of up to 60°C.

The box PC offers flexible and task-specific configuration options for PC-based process automation or robotics control. Also, in more complex applications, like energy substations, the box PC can handle the communication between sensors and server or cloud. Deployed as a gateway device, it can exchange data with the control centre. In HMI applications, such as industrial control units, the product is interfacing between the screen and the peripheral devices.

One slot each for mSATA, microSD, PCI Express Mini Card und microSIM offers flexible expansion options for wireless functionality or storage.

The programmable real-time unit allows the product to support several industrial protocols like EtherCAT, EtherNet/IP, POWERLINK, PROFINET or SERCOS. They can be enabled by a simple firmware update.

With its compact and fanless housing, the product fits in any existing system environment as wall-mount, DIN rail or inside 19" systems and can also manage various tasks in industrial environments.

OEM Technology Solutions

www.oem.net.au

ALUMINIUM ENCLOSURES

With their aluminium profile technology, BOPLA's Intertego and Filotec enclosure series have high levels of modularity and sturdiness.

BOPLA has added the 4U height (188.75 mm) to the Intertego enclosure series, with depth and width that can be adapted to meet individual requirements. The base and lid sheets are made of aluminium and the diecast corners are made of a zinc alloy. The series provides good electromagnetic compatibility (EMC), and accessories make it possible to increase the screening performance.

The enclosures are designed for the installation of 19" components. In addition to use as a design-orientated desktop enclosure, it can be used as a 19" chassis. The series is supplied in graphite grey, but special colours are available on request. The protection class depends on the cover plates which are fitted — with ventilation openings it is about IP20, and about IP40 for the closed version.

The Filotec enclosures are mainly used for interface modules, for industrial PCs and in the electronic power supply sector. The range comprises over 100 enclosures in six product series. Aluminium profile enclosures are available in several different heights and lengths, as are profile variants. Depending on the model, the enclosures are fitted with a 1 or 1.5 mm membrane keypad area. Variants with an integrated heat sink and with moulded-on wall brackets are also available.

All Filotec variants provide protection class IP40 and use the same material. The anodised aluminium in the enclosures has a simple but high-quality appearance. BOPLA has now added the F 1632-xxx size to the range, designed for users who want to install large circuit boards in the enclosures. The internal dimensions are designed to take a 100 x 160 mm Euro card with a horizontal format.

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MAKING THE RIGHT PRODUCT CHOICES FOR HARSH ENVIRONMENTS

David Pike, Product Marketing

Electronic devices and systems located in harsh environments will always struggle to perform as required if they are not built with the appropriate components.

A comprehensive understanding of the challenges to be faced by a device is therefore required for effective product sourcing and buying for harsh environments. There are many environmental dynamics to consider: these include the extremes of temperature, mechanical stresses such as pressure or vibration, prolonged exposure to chemicals such as fuel and gases, radiation and strong electromagnetic forces, or simply water, especially with its corrosive high-salinity content in marine applications.

Product selection

The range of electronic components designed for harsh conditions is wide and extends from radiation-hardened semiconductors to doubly pinned passives to conformal-coated connectors to electrically isolated power supplies among many others including switches, relays and fans. Fundamentally, and it is a message of paramount importance to buyers, there is usually a good reason why a particular part in the bill of materials has been selected by the designer.

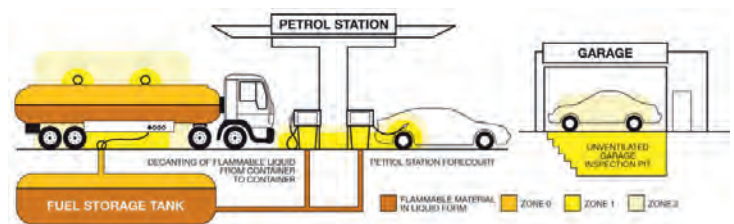
A simple example is the design engineer's selection of a bronze IP67-rated connector — protected against dust ingress and immersion in water — and its replacement with a cheaper aluminium device that also happens to meet IP67 but will not meet the demands of a saltwater environment. Another example is a power supply designed for use in an industrial automation application such as in a chemical- or food-processing plant. The product needs to be water-, ice-, oil- and dust-resistant, as well as being vibration- and shockproof, able to handle high temperatures and able to meet the appropriate rating for potentially explosive atmospheres.

Ratings

While IP ratings are reasonably well understood, perhaps less well known are the European ATEX ratings, which concern the control of explosive atmospheres and are very important in many industries including oil and gas, mining, power generation, food processing and manufacturing. ATEX ratings describe areas that contain flammable gases, mists and vapours or combustible dust; based on the level of risk, the ratings classify these areas that must be protected from sources of ignition into zones, classes and divisions. It is very important for buyers to know that ATEX ratings are not all the same and clearly understand the difference between zones to ensure effective product selection.

Materials

Materials are a key element in the selection of products and buyers need to be cautious when trying to make cost savings, as different materials offer very different properties. Major manufacturers such as TE Connectivity or Molex make standard



An example of zone classification in an explosive atmosphere environment.

interconnection product ranges in a wide variety of materials suitable for very diverse markets, as well as offering a wide range of mating cycles for heavy-duty applications. In addition, more bespoke interconnection products for highly specific harsh environments are available from manufacturers such as Amphe-nol, Bulgin, Harting and Hirschmann. Consequently, it is worth considering using a distributor with broad range of suppliers and expertise in harsh environments, especially when purchasing relatively small quantities of a part.

Overall, a thorough understanding of target conditions is important to make the right product choice, but even so, this will be a compromise between several competing requirements. For example, aluminium is a lightweight and electrically conductive metal that offers wide application use, but it is vulnerable to saltwater. Plastic is much less vulnerable and is also lightweight, but it is not electrically conductive and can be vulnerable to UV radiation. If very high tensile strength is required, then both of these materials would be a poor choice compared to stainless steel, but this would have a considerable impact on weight. In addition, materials can be vulnerable in environments that might appear safe at first glance; for example, highly acidic fluids and aggressive chemicals are present in the common domestic environment in the form of orange juice and cleaning fluids.

Helping with complexity

Overall, the selection of products for harsh environments can be a complex process — looking at attributes, materials or ratings in isolation provides just part of the picture. RS Components understands this well from its long experience in delivering components to a diverse range of businesses, in conjunction with a broad product range that will meet the demands of virtually all applications including some of the most specialist markets. Distributors such as RS can deliver a helpful and holistic service in selecting the right product for specific environments.

RS Components Pty Ltd
au.rs-online.com

3D-printed drone features embedded electronics

Singaporean researchers have 3D-printed a ready-to-fly drone with embedded electronics using aerospace-grade material. The drone was developed by Nanyang Technological University (NTU Singapore) and Stratasys Asia Pacific, a subsidiary of 3D printing company Stratasys.

A quadcopter with four rotors, the drone was designed, 3D-printed and flown by Phillip Keane, a PhD candidate from the university's Singapore Centre for 3D Printing (SC3DP). The electronics were incorporated in the drone during a 3D printing process which employs Stratasys ULTEM 9085 — a high-strength, lightweight,

3D-printable thermoplastic certified for use in commercial aircrafts.

In 3D printing, objects are created digitally layer by layer until completion. However, embedding electronics can be a challenge, as most will not survive the high temperatures of the 3D printing process. As part of the NTU project, commercial-grade electronics had to be modified and placed within the drone at the various stages of the printing process.

"We had to add some heat-proofing modifications to the components to ensure they could last," said Keane. "This involved adding new components to the printed circuit boards and also designing custom housings.

"The housings which were

pre-printed in ULTEM 9085 also provide a flat surface for the 3D printer to continue printing over them," Keane added. ULTEM 9085 is prized for a high strength-to-weight ratio and FST (flame, smoke and toxicity) rating, making it suitable for the commercial transportation industry — especially aerospace.

The components survived the high-temperature printing, which reached over 160°C and took just under 14 hours. There were just three pauses for the electronics to be placed within the chassis; the motors and the propellers were mounted after the entire chassis was completed.

In addition to being extremely rugged, the drone is capable of supporting over 60 kg of weight suspended from its structure. Keane said the next version of the drone will feature better durability, lighter weight and improved flight dynamics.

"This project exemplifies the power of Stratasys's flagship fused deposition modelling (FDM) 3D printing technology and perfectly demonstrates the strength of the ULTEM resin," said Fred Fischer, director – applications and products, Stratasys Asia Pacific. "We look forward to researching, developing and unveiling more possibilities with 3D printing and materials as we work with industry partners and academia."



Image courtesy of Nanyang Technological University



maxon product range

The solution is always a matter of the right combination.



maxon DCX motors are configurable online via maxons interactive web based configuration portal. This allows a customer to change the motors shaft shape and dimensions, the gearhead features, the mounting holes, the winding and even the connectors. As more mechatronic and automation engineers use the technology the products available online expand. Recently we have seen the addition of 12 mm, 14 mm and 16 mm micro DC motors as well as “mix and match” different motor and gearhead diameters.

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PASSIVE PROBE FOR OSCILLOSCOPES

The R&S RT-ZP1X passive 1:1 probe, from Rohde & Schwarz, broadens the application range of the R&S RTO and R&S RTE series oscilloscopes. Both the probe and the oscilloscope's front end are low noise, making this combination suitable for measuring the smallest of signals down to 1 mV/div, eg, for power integrity measurements on integrated circuits and components.

The probe is precisely matched to the R&S RTE (up to 2 GHz) and the R&S RTO1000/2000 (up to 4 GHz) oscilloscopes. The oscilloscope's low-noise front end keeps the noise floor under 650 μ Vpp (1 mV/div and 200 MHz bandwidth), even for a 1 M Ω input impedance. Other oscilloscopes achieve such values only for a 50 Ω input impedance.

With an acquisition rate of up to 1 million wfms/s, users quickly obtain meaningful measurement results, complete with histogram and all signal components. In the zoom view in 16 bit high-definition (HD) mode, even the smallest of signal details can be analysed and triggered.

To search for coupled interference signals, the oscilloscopes offer a hardware-based fast Fourier transform (FFT) that delivers the spectrum display practically in real time. This makes it possible, for example, to identify 10 MHz signals coupled to an adjacent clock line at a glance. Another feature is the zone trigger that can be used to graphically separate events such as out-of-limit conditions in the time and frequency domain.

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



REGULATED DC-DC CONVERTER

The Vicor DCM in a ChiP package is an isolated, regulated DC-DC converter, operating from an unregulated, wide range input to generate an isolated DC output.

With its high-frequency zero voltage switching (ZVS) topology, the DCM converter consistently delivers high efficiency across the input line range. Modular DCM converters and downstream DC-DC products support efficient power distribution, providing good power system performance and connectivity from a variety of unregulated power sources to the point-of-load.

Aimed at a variety of applications, including UAV, ground vehicle, radar, transportation and industrial controls, there are four 30 V input nominal modules (9–50 V range) in a 3623 chip package (1.52 x 0.90 x 0.29"). These converters have output voltages of 5, 24, 28, and 48 V, and power levels up to 160 W, achieving a power density up to 404 W/in³.

There is also a 28 V input nominal module (16–50 V range) in a 3623 ChiP package with a 3.3 V output at 120 W, a 375 W module with a nominal input voltage of 275 V (120–420 V) and 12 V output in a 4623 ChiP package, and a 270 V input nominal module (160–420 V range) in a 4623 ChiP package with a 48 V output at 500 W (1.89 x 0.90 x 0.29"), achieving a power density of 1014 W/in³.

Vicor Corporation
www.vicorpower.com



LTE CATEGORY 4 HIGH-SPEED MODULE

Quectel EC25 is a series of LTE category 4 modules optimised specially for M2M and IoT applications. Adopting 3GPP Rel. 11 LTE technology, it delivers 150 Mbps downlink and 50 Mbps uplink data rates.

Designed in the compact and unified form factor, the unit is compatible with the Quectel UMTS/HSPA+ UC20 module and multimode LTE EC20/EC21 module, which allows for flexible migration among them in design and manufacturing. It is backwards-compatible with existing EDGE and GSM/GPRS networks, ensuring that it can be connected even in remote areas devoid of 4G or 3G coverage.

The unit supports Qualcomm IZat location technology Gen8C Lite (GPS, GLONASS, BeiDou, Galileo and QZSS). The integrated GNSS greatly simplifies product design and provides quicker, more accurate and more dependable positioning.

A rich set of internet protocols, industry-standard interfaces and abundant functionalities extend the applicability of the module to a wide range of M2M and IoT applications such as smart metering, wearable devices, environmental monitoring, asset tracking, fleet management, security and alarm systems, and so on.

Elecom Electronics Supply
www.elecomes.com



PRECISION LOAD CELL

FUTEK's LSM300 Precision Load Cell (also known as the Belt Buckle Load Cell) offers a lightweight design with an easy side-mounting feature, making it suitable for OEM applications.

Utilised in both tension and compression measurements, the lightweight load cell weighs between 28 and 85 g. It measures 4572 x 127 x 3556 mm, making it suitable for small, confined spaces. It comes in 2024 aluminium or 17-4PH stainless steel.

Additional design features include an in-built overload protector, which provides the unit with protection during installation of over 10 times the capacity needed. The LSM series is also available with TEDS/IEEE1451.4 options which incorporate the calibration data to eliminate any data entry mistakes by the operator during installation.

The device uses metal foil strain gauge technology, as does the company's entire load cell product line. It can be modified or customised to meet the user's individual requirements.

Metromatics Pty Ltd
www.metromatics.com.au

CONNECTOR

TE Connectivity's rugged SmartSeal connector is designed to withstand the demands of the two-wheeler, ATV/UTV, leisure marine and recreational vehicle markets.

The product is a 44-position connector that can easily be adapted for lower pin count ECU applications by using blind plugs. It is compact and uses a lever slide lock mechanism that secures the connector to the ECU.

The product is constructed from heavy-duty thermoplastic, designed to withstand severe vibration and mechanical shock. The connector is environmentally sealed to prevent dust, dirt and moisture from contaminating connections. The connector uses TE's new high-performance single-piece terminals.

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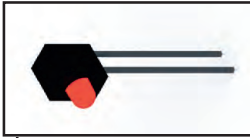
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SYSTEM HOST BOARD

The Trenton Systems TKL8255 system host board is a PICMG 1.3 compliant single-board computer that leverages the latest interconnects and bus topologies, supported by an Intel Xeon E3-1200 v5 (Skylake) or select Intel Core processors, to deliver high performance with expanded media and data storage capabilities.

By using the latest processor and chipset technology, the product is said to provide greater efficiency and performance per watt than previous PICMG 1.3-based systems. This means that existing PICMG 1.3 deployments can be upgraded to deliver increased processing performance with reduced power consumption while maintaining support for legacy applications.

Features include four memory slots for 288-pin DDR4 ECC DIMMs in two channels with support for up to 64 GB of memory, plus an onboard M.2 slot supporting the latest x4 PCIe 3.0 ultra-fast NVMe solid-state storage modules. Additional I/O includes support for multiple 10/100/1000 Gigabit Ethernet interfaces, multiple USB 3 and USB 2 interfaces, six SATA/600 storage interfaces and support for common legacy COMMs including RS232/422/485 and PS/2 keyboard and mouse. Fully digital video is provided by the Intel processor integrated HD graphics engine with support up to 4096 x 2304 resolution via two DVI and one DisplayPort connector.

The board maximises system ROI with long-life embedded components which drive extended SBC product availability for more than seven years. It is designed with a standard BIOS version that is maintained under strict revision control.

Interworld Electronics and Computer Industries
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CONCRETE THAT SHIELDS AGAINST ELECTROMAGNETIC ENERGY

Christopher Tuan and Lim Nguyen stand beside a test structure at Nebraska's Peter Kiewit Institute in Omaha.
Image credit: Craig Chandler/University Communication.

US engineers have developed concrete that shields against electromagnetic pulse (EMP), offering protection for electronics housed inside structures that have been built or coated with the concrete.

It all started when Christopher Tuan and Lim Nguyen, both based at the University of Nebraska–Lincoln (UNL), decided to study concrete that conducts electricity. They first developed their conductive concrete to melt snow and ice from surfaces, such as roadways and bridges, but later recognised that it had another important property — the ability to block electromagnetic energy.

“EMP is very lethal to electronic equipment,” said Tuan. “We found a key ingredient that dissipates wave energy.”

The team replaced some standard concrete aggregates with magnetite — a mineral with magnetic properties that absorbs microwaves like a sponge. Their recipe also includes carbon and metal components for better absorption as well as reflection. This ability to both absorb and reflect electromagnetic waves makes their concrete more effective than existing shielding technologies. The technology is additionally more cost-effective and flexible than current shielding methods, making it suitable for use in large structures.

Through a research agreement with American Business Continuity Group (ABC Group), a developer of disaster-resistant structures, the researchers have modified their shielding concrete to work with the company's shotcrete construction technique — a spray-on method of applying concrete that can be used to cost-effectively

retrofit existing buildings. To demonstrate the concrete's effectiveness, ABC Group built a prototype structure at its disaster recovery complex in Lakeland, Florida.

The product was found to protect building interiors from electromagnetic interference, such as radio waves and microwaves, as well as electronic eavesdropping. The material could protect military, financial or other structures that store critical electronics, such as data servers or aircraft.

“The concrete has the ability to provide what we call a multi-threat structure,” said Nguyen. “The structure has to be able to withstand an attack either by an explosive or an electromagnetic attack or other scheme.”

As a result of a licensing agreement with UNL, ABC Group has exclusive rights to market the shielding shotcrete product. Its EMSS-Electromagnetic Shielding Shotcrete is now commercially available.

“Our proprietary construction methods, which incorporate the Nebraska-developed technology, enable us to construct high-strength, blast-resistant structures that exceed military electromagnetic shielding requirements,” said ABC Group CEO Peter Fedele. “Our prototype building has been well received as a new shielding construction material by leading experts in the EMP community.”



RUGGED WATERPROOF VEHICLE MANAGEMENT PANEL PC

The APLEX Technology APC-3082 waterproof (IP65) vehicle management panel PC features an 8" 800 x 600 resolution, high brightness (600 nits) display that can be controlled from 0–100% brightness for day and night environments.

Supplied with an Intel Atom E3845 1.9GHz processor, the product provides an energy-efficient multicore platform for vehicle or marine applications. It has 4 GB of DDR3L memory and features an internal mSATA MO-300 SSD slot, plus an onboard micro SD slot for operating system and data storage.

Internal expansion includes one mini-PCIe full-size slot for 3G/LT/GPS cards, one mini-PCIe half-size slot for Wi-Fi/Bluetooth cards and one SIM slot. The external rear panel I/O uses fully sealed M12 IP65 connectors and includes DC power, two

USB 2.0 ports, one RS232/422/485 port and one Gb RJ45 LAN port for communication. It also has an HDMI video port for displays. An SMA connector is provided for external GPS antennas.

Front panel controls include up/down display brightness, up/down audio volume, a power button and an LED power indicator.

The product operates from a 9–36 VDC power source, allowing it to support both +12 VDC and +24 VDC vehicle power. It is housed in a rugged engineering-grade plastic case and is designed to be VESA mounted.

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PANEL INDICATOR LED

Marl's 698 Series is an 8.1 mm mounting, vandal-resistant panel indicator LED. Featuring a 'D' mounting hole to aid anti-rotation, black anodised

aluminium housing and ingress protection of IP67, making it weatherproof, the series is suitable for a variety of applications including portable equipment and status panel indication.

Manufactured with an internal resistor and internal potting, the device can be used in high-vibration and external applications. Bipolar circuitry makes the product suitable for AC or low-voltage DC in any orientation. It is available in a range of LED colour and voltage options.

Aerospace & Defence Products

www.aerospacedefenceproducts.com.au



REACTION TORQUE SENSOR

Futek's TTF400 Reaction Torque Sensor can be used for hinge fatigue testing, demonstrating how test and measurement professionals are able to replicate the stress hinges undergo by mimicking up to 100,000 times the movements the hinge will undergo in real-life scenarios.

Torque hinges, friction hinges and position hinges are all synonyms for a type of hinge that allows two parts to rotate

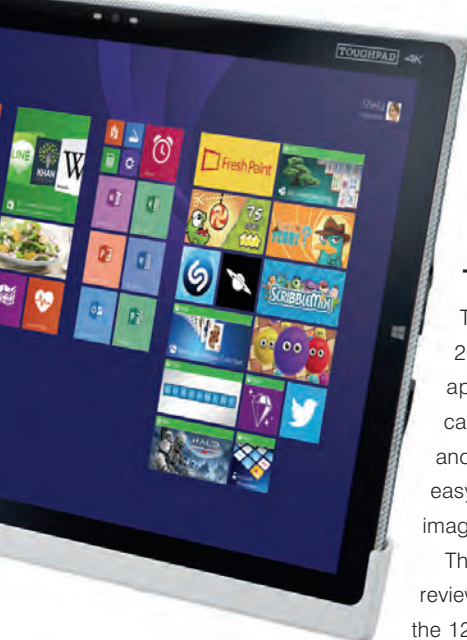
around one another when a load is applied. With a wide range of uses, fatigue and cycle testing must be performed to verify the hinge lifespan when integrated into a product. FUTEK's reaction torque sensor gives auditors the results they require for determining the lifespan of a hinge.

The sensor utilises metal foil strain gauge technology and has a capacity of 0.04 to 56 Nm. It is constructed in aluminium and features overload protection for low-capacity units, which helps to prevent overload damage that may occur during installation. Optional mounting plates are available.

The sensor easily integrates into OEM applications and is suitable for many and varied applications — hinge fatigue testing is just one of them.

Metromatics Pty Ltd

www.metromatics.com.au



TABLET

The Panasonic FZ-Y1 Toughbook is a 20" 4K tablet. It is designed for CAD applications, technical services, health care, photography, pro video productions and high-end retail. The product makes it easy to create, edit and transport drawings, images and videos.

The product allows an instant and detailed review of images or video footage. To protect the 12.5 mm-thin unit, the silver bezel and 4K display panel are mounted on a magnesium alloy frame and enclosed in a reinforced glass fibre case.

For collaborative working, the tablet incorporates a 10-point multitouch screen and a detailed 230 PPI IPS Alpha LCD display with a 15:10 aspect ratio, suitable for displaying blueprints and other A3-sized documents.

The tablet provides the performance of a desktop, with an Intel Core i5-5300U vPro processor, HDMI 2.0 input, Windows 10 Pro and a 256 GB SSD. The device can be turned into a field monitor for applications such as broadcast and movie shooting.

The lightweight, business-rugged tablet is built to handle a 76 cm drop to its back while operating and 30 cm drops to 26 angles when non-operational, helping to avoid downtime and deliver a better total cost of ownership for businesses.

Combined with accessories such as the optional Panasonic desktop cradle and carrying case, the device can be used as both a desktop PC and tablet. The cradle converts into a tilted stand to allow the tablet to be used in drafting table mode and offers additional connectivity port options. A VESA-compatible mounting adaptor plate is also available.

Panasonic Australia Pty Limited
www.panasonic.com.au

FIRMWARE FOR NETWORK TESTER

NETSCOUT has announced enhancements to its OneTouch AT G2 Network Tester with Wi-Fi features. The v5 firmware release gives the OneTouch AT powerful troubleshooting capabilities, letting technicians and network engineers quickly and easily validate the performance of high-capacity Wi-Fi networks where numerous access points are required. The firmware also lets users pinpoint the physical location of interfering sources.

The network tester offers both wired and wireless troubleshooting and can now distinguish between 802.11 and non-802.11 signal sources in each channel. Non-802.11 is a silent killer of bandwidth that causes serious, intermittent, slow Wi-Fi performance. The product can detect and classify the type of non-802.11 interferer, such as Bluetooth, microwave or other sources in the 2.4 and 5 GHz bands, letting field technicians isolate the cause and work to mitigate the issue.

It comes with free access to the Link-Live Cloud Service, a centralised management, collaboration and archival workspace for network connectivity test results. Link-Live provides an easy-to-use dashboard for better collaboration, reporting and results management.

NetScout
www.enterprise.netscout.com



The new BODY-CASE is the latest product series in the range of wearable enclosures by OKW and is ideal for applications on or near the body.

NEW BODY - CASE



www.okw.com.au









ROLEC OKW
Australia New Zealand Pty Ltd
Unit 6/29 Coombes Drive,
Penrith NSW 2750
Phone: +61 2 4722 3388
Fax: +61 2 4722 5300
E-Mail: sales@rolec-okw.com.au



INDUSTRIAL TOUCH MONITORS

Advantech presents its IDS31 industrial touch monitor series with flexible mechanical design. Featuring ruggedness, long life and extended availability, the product has been created to meet client needs.

The series is equipped with a clever mechanical design that allows for both touch and non-touch versions, which can even be adapted to alternate touch technologies such as surface capacitive or surface acoustic wave for low minimum order quantities and without the need for additional NRE costs. The design has been developed to minimise bezel frame dimensions and incorporates the VESA 75 x 75 or 100 x 100 mounting system. Quick sampling and a big product selection make the series suitable for industrial, professional and gaming markets where display differentiation is the key to success.

Ranging from 7" to 32" in both 4:3 and 16:9 sizes, the open frame chassis system is designed for rear mounting to existing panels or new designs alike. Each design has an optional black powder-coated cover (available with low MOQ) to enable the user to specify a closed frame construction allowing surface, pole, arm or other VESA mounting systems. The series provides a wide range of user-configurable options such as touch technologies, high brightness and an HDMI/Displayport interface.

The series is designed with narrow bezels and the reduced thickness makes for good aesthetics in the end product along with a wide viewing angle and contrast for both portrait and landscape usage. Its narrow bezels and slim design maximise its usable area and minimise the challenges of industrial integration. It is fitted with its own video interface card with DVI/VGA inputs and optional USB for touch-screen interface.

Advantech Australia Pty Ltd

www.advantech.net.au

TRANSPONDER COILS

TDK EPCOS Compact Z transponder coils are designed for passive entry, passive start (PEPS) car access systems.

With dimensions of 7.7 x 7.4 x 2.65 mm, the components are compact and feature a low insertion height. The B82451L*E402 series comprises seven transponder coils covering an inductance range from 1.0 to 10.0 mH. Depending on the type, the transponder coils feature a sensitivity of between 7 and 23 mV/μT at 125 kHz. The Q factor of the new components is between 50 and 58.

The injection-moulded plastic baseplate and laser-welded connections of the winding ensure that the coils are robust. The new components are also qualified according to AEC-Q200.

The product can be combined well with the EPCOS B82450A*A* and B82450A*E* transponder coil series for the x- and y-axes. With their footprints of just 11.4 x 3.5 mm and 8 x 2.7 mm respectively, these components are also compact. Using three discrete transponder coils offers flexibility of design and can save space on the PCB. All coils are RoHS compatible.

EPCOS

www.epcos.com



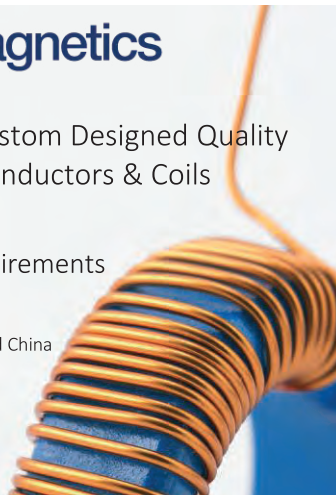
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DIN RAIL POWER SUPPLIES

RECOM has added DIN rail power supplies rated at 120 and 240 W to its existing range. The series supports brief peaks of 50% above rating and the modules can be connected in parallel to increase the output power available or for redundancy.

The modules operate at input voltages ranging from 85 to 264 VAC for worldwide usage and are equipped with an active PFC circuit for a power factor >0.95 . The REDIN120 is available with output voltages of 12, 24 or 48 VDC, while the more powerful REDIN240 supplies 24 or 48 VDC. Both modules are isolated at 3 kVAC/min between input and output and are capable of high efficiency values of up to 94.3%.

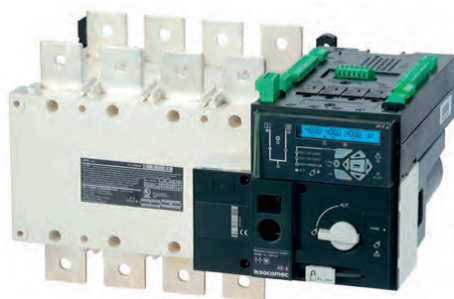
The modules run at operating temperatures ranging from -25 to $+70^{\circ}\text{C}$, with nominal output available up to $+60^{\circ}\text{C}$, and switch off automatically to protect the system if the maximum permissible temperature is exceeded or in case of overvoltage, overload and short-circuit. In addition to the standard red and green LED indicators, a floating relay contact generates a 'power good' signal.

The models feature a robust metal casing for back and side mounting on a DIN rail; side mounting is especially beneficial in switch cabinets with low installation depths. REDIN120 is very slim at 33 mm and REDIN240 is only marginally wider at 46 mm.

Both modules are certified according to UL508, UL60950-1 and IEC/EN 60950-1, and comply with EN 55022/55024 EMC Class B standards.

RECOM Power GmbH

www.recom-power.com



AUTOMATIC TRANSFER SWITCH EQUIPMENT

The Socomec ATyS p automatic transfer switch equipment from 125 to 3200 A provides dependable power transfer between the main source and the emergency source to essential or critical loads.

All devices comply with IEC60947-3 and AS/NZS 60947.6.1.

The product is a three-phase automatic transfer switch with advanced logic function and positive break indication. It has the functions designed for power management and communication.

In automatic mode, the product enables monitoring and the on load changeover switching between two power supply sources, in accordance with the parameters configured via an LCD display or via the communication.

The product is suitable for use in low-voltage power supply systems where a brief interruption of the load supply is acceptable during transfer.

NHP Electrical Engineering Products Pty Ltd

www.nhp.com.au

CONNECTORS FOR RUGGED DEVICES

The MiniMax series connectors, from Fischer Connectors, are designed for applications where space is limited or portability is essential, making them suitable for handheld or body-worn applications.

The connectors are IP68 rated, meaning they can be used in rugged conditions. They are said to increase the performance of miniature rugged devices, handling more mixed signal and power connections in a combination of up to 24 contacts with data transfer of up to 10 Gbps.

The high-performance connector is said to reduce weight by up to 75% and space by 45%. It can also come as a pre-cabled solution.

Soanar Limited

www.soanar.com



BETTER THAN EVER

THE SECOND LIFE OF SMARC

Peter Eckelmann, Product Marketing Manager, Embedded Boards, MSC Technologies

Recently the Standardization Group for Embedded Technologies (SGeT) announced revision 2.0 of the SMARC embedded module standard, and a number of companies showed early samples of related products at Embedded World 2016 in Nuremberg, Germany.



The resulting hype around this module specification is reason enough to take a closer look at this 'ultimate' standard for low-power processor modules and to highlight the differences between it and SMARC 1.1, Qseven and co.

The embedded module standards Qseven and SMARC are both under full control of the SGeT industrial group; therefore, many companies have sent delegates to the workgroups of both standards. Several members of the Qseven workgroup SDT.02 recently concluded that the Qseven standard was limited in its ability for essential extensions because of the 230-pin MXM-2 connector used for signal transmission down to the carrier board, which was fully used and unable to implement any additional signals. However, for applications in 'real' embedded designs there was an urgent

need for the addition of signals usable for embedded hardware, exceeding the capacity of the Qseven connector.

As an alternative, the next-wider connector MXM-3 with 314 pins was discussed, which had already been in use for the SMARC 1.1 standard. At the same time, the SGeT workgroup SDT.01 had been called together again chartered with nothing less than the discussion and definition of the next-generation SMARC standard. Many company delegates from the Qseven workgroup came to the conclusion that the market was too small for two competing standards using the same connector but with different pin-out, and therefore joined the SMARC workgroup SDT.01 in order to help with the definition of the ultimate standard for low-power processor modules.



COMPARED TO THE EARLIER SMARC 1.1 SPECIFICATION, MANY NEW INTERFACES WERE ADDED FOR REVISION 2.0.

solution to the cost/performance trade-off. The small format provides enough space for single-chip SoCs (systems-on-chip) such as the Intel Atom or the i.MX6 from NXP (Freescale), to which some DRAM chips and maybe a Flash device will be added. If the module is targeted at higher functionality next to Ethernet, then further controller chips have to be added which may require the space offered by the larger module format. This will certainly be the case when RF functions such as WLAN, Bluetooth or 3G/4G data communication are required, so that a radio module will be added for which the module standard even specifies the placement of the antenna connectors.

Compared to the earlier SMARC 1.1 specification, many new interfaces were added for revision 2.0. These include a second LVDS interface which can be used to drive high-resolution LCDs in a two-channel arrangement together with the first LVDS channel (which will allow TFT resolutions up to Full-HD), or alternatively to operate two fully independent displays on single LVDS channels. The new standard also includes an alternative use of the LVDS pins for DSI or embedded DisplayPort (eDP). In order to achieve this, the parallel RGB lines for smaller LCD had to be dropped, but these are no longer required for recent displays and modern applications.

Next to the existing HDMI graphics port, the new standard encompasses a combined HDMI/DP port which is designated DP++ because it jointly implements the signals for DisplayPort, HDMI and DVI. Used together with the HDMI and LVDS ports, it opens up the possibility to drive up to three independent display systems (on the premise that the CPU platform of the module in questions does support triple independent displays at all).

SMARC 1.1 only provided one Gigabit Ethernet port, which now has been increased to two because modern applications are likely to demand two LAN ports in order to drive two Ethernet subnets and to keep apart communication realms (eg, the sensor and management domains in IoT gateways). Real-time trigger signals have been added to both Ethernet ports to give them RT capability according to IEEE1588.

SMARC Rev. 2.0 now provides up to four PCI Express interfaces, one more than 1.1 which for suitable platforms will allow an optional PCIe x4 operation resulting in a substantial performance gain. For USB the situation is similar, where the addition of three USB 2.0 ports results in the availability of up to six USB 2.0 next to up to two USB 3.0 ports. This underlines the fitness of the SMARC standard for x86 platforms which the creators of SMARC 2.0 had in mind, because these CPUs are always hungry for USB ports. For ARM/RISC platforms there are two USB ports which optionally also support Client functionality, and again for x86, one of the two

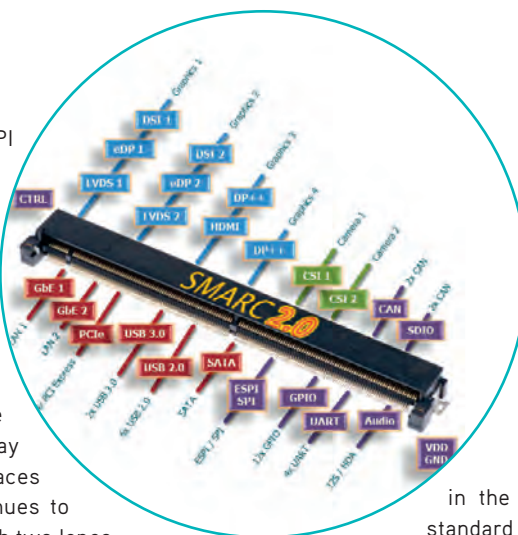
All important signals for embedded processor applications should remain available, but many older signals were removed in order to free up pins for new interfaces which provide faster speed and lower pin count resulting in an economic gain of functionality and performance. Therefore, the downward-compatibility from SMARC 2.0 to SMARC 1.1 was not an outspoken target and consequently has not been achieved (or only with very many limitations). However, what has been achieved is the absolute fitness of the standard for both ARM/RISC and for x86 processors.

The SMARC standard features two different module sizes (82 x 50 mm and 82 x 80 mm) and therefore provides the makers of processor modules with sufficient flexibility to arrange new module products with the right mix of features and to find their optimum

SPI buses was enriched with optional eSPI functionality. Two audio interfaces can be used in parallel: one for I2S audio, as used by ARM processors, and one for HD audio, which is the standard codec for x86 CPUs.

Support for the less popular 8-bit MMC/SD card interface has been dropped, while 4-bit SDIO continues to be available for popular SD cards. Also, the parallel camera interface had to give way for the implementation of the new interfaces described above. But the standard continues to provide two MIPI CSI-2 interfaces: one with two lanes and a second with four lanes. This makes SMARC 2.0 the standard with the widest and most flexible camera interface of all established COM (computer-on-module) standards. But that is not all: SMARC 2.0 also provides a SATA port, 12 GPIOs, two CAN buses and four UART serial interfaces, which are always very important for embedded applications.

One of the most futureproof characteristics of the SMARC 2.0 standard is the large number of 'reserved' lines which are available on the MXM-3 connector, which are intended for future use when new and additional interfaces are to be included (and probably unknown to us today). With this capability for future extensions, the SMARC 2.0 standard ensures that it can be improved later on without obsoleting today's carrier boards and/or modules. No hardware designed to the current SMARC 2.0 standard will be wasted when new revisions of SMARC are published. On the contrary, the standard provides for built-in upgradeability, thus protecting any investment into the current revision of the standard. Adding to the security of the right choice is the fact that all important module makers of embedded hardware were present



A SMARC 2.0 module from MSC with NXP i.MX6 — the MSC SM2S-IMX6.

in the SMARC workgroup of SGeT where the standard was defined, and have announced their own plans to offer products according to this standard.

MSC Technologies announced a first SMARC 2.0 module based on the ARM Cortex-A9 processors i.MX6 from NXP and has presented a suitable carrier board in the Mini-ITX format. The module MSC SM2S-IMX6 supports quad-, dual- and single-core CPUs as well as the recently introduced 'Plus' processors with their improved data throughput and higher graphics performance. The module comes in the smaller format 82 x 50 mm and provides up to 4 GB DRAM and up to 64 GB eMMC Flash. An integrated Micro-SD card slot enables the addition of Flash cards of almost any capacity, and this card or the eMMC Flash may be used for booting and may contain the operating system. The HDMI and LVDS graphics interfaces may drive displays up to a resolution of Full-HD.

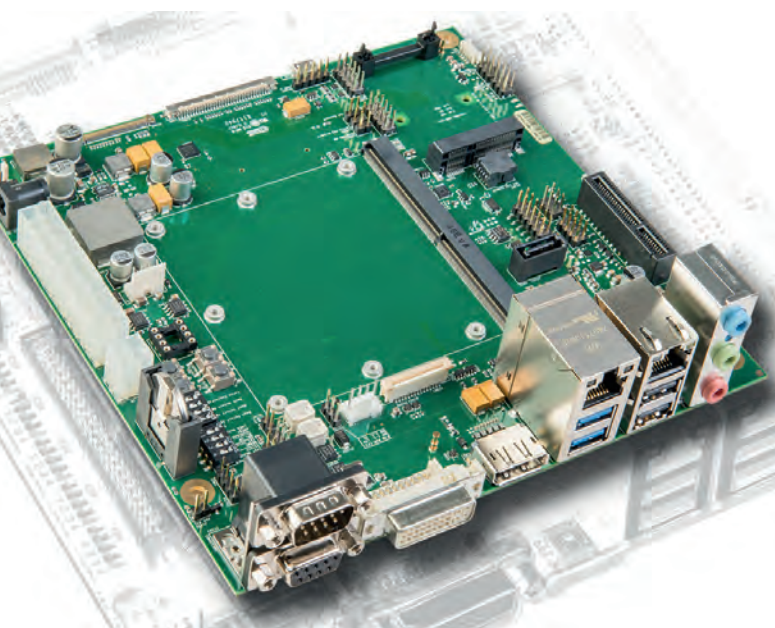
The module supports PCI Express Gen. 2.0 and SATA II up to 3 Gbps as well as 5x USB 2.0 Host and USB 2.0 OTG (Host/Client) next to Gigabit Ethernet, 4x UART, 2x SPI, 2x I²C and 2x CAN. The MIPI CSI-2 interface can be used as camera input. The module will be available in variants for the full industrial temperature range -40 to 85°C as well as for commercial temperatures.

The internal design of the SMARC 2.0 module uses the same hardware core as the Qseven and nanoRISC modules from MSC, which are based on the i.MX6 processors from NXP. Therefore the complete software support is available from the start, from bootloader to operating system to the drivers and tools. This includes Yocto Linux and Android, while Windows Embedded Compact WEC2013 and WEC7 and further Linux variants will be added later on.

The carrier board MSC SM2-MB-EP1 comes in the Mini-ITX format 170 x 170 mm and gives access to most features of the SMARC 2.0 standard. With its diversity of interfaces, it is suitable for the evaluation of SMARC 2.0 modules but may be used — perhaps in a less-populated version — for not-too demanding volume applications.

Samples of the MSC SM2S-IMX6 module will become available as soon as SGeT has published the full extent of the SMARC 2.0 standard.

"We consider SMARC 2.0 the best and most futureproof standard for embedded modules in small form factors, and appreciate the support of all leading computer-on-module makers for this new standard," said Jens Plachetka, manager embedded boards at MSC. "We have already begun the design of our second SMARC 2.0 module, which will be based on the next generation of Atom processors from Intel."



A SMARC 2.0 carrier board from MSC in a Mini-ITX format — the MSC SM2-MB-EP1.

Avnet Electronics Marketing
www.em.avnetasia.com



AUTOMOTIVE PROCESSORS

STMicroelectronics' Accordo 5 family of automotive processors meet users' display-performance and security demands in a low-power, compact platform. The devices enable the construction of digital instrument clusters and audio/video/navigation (AVN) head units by integrating the complete graphics, video and audio functionality on-chip to simplify assembly.

The devices provide features that have high value for car drivers, including smartphone mirroring that gives access to content such as music and navigation services on the phone safely through the vehicle's own user interface. The host processor and high-performance video and graphics engines can present complex information displays, such as simultaneous user-interface plus rear-view camera with navigation and video preview. There is also video playback for major formats including H.264 and DivX, 2D and 3D graphics with effects such as blending and overlays, as well as USB connections and SD-Card interfaces.

The chips also integrate a high-performance microcontroller that secures the interface between the head unit and the main vehicle network. Built-in features of the microcontroller include boot-code authentication, secure interconnect and high-performance data encryption.

STMicroelectronics Pty Ltd
www.st.com

PROTOTYPING BOARDS

The RS Components Gadget Renesas SAKURA-II and SAKURA-FULL are general-purpose programmable boards that offer a highly flexible platform suitable for a range of levels of software development experience.

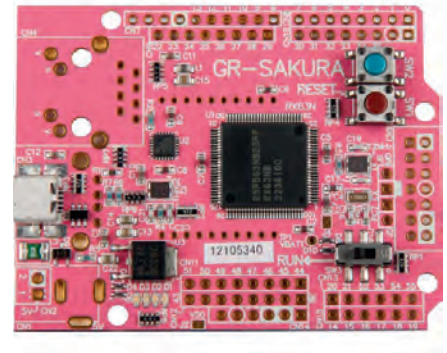
The product is designed for use in developing projects across a range of applications in industrial, consumer and office automation, as well as in robotics and the Internet of Things (IoT).

The development boards are based on the 32-bit RX63N microcontroller, specifically the R5F563NBDDFP in a 100-pin QFP package, with 1 MB flash memory, 128 KB RAM FPU and data flash of 32 KB. The MCU operates at 3.3 V and has a frequency of 96 MHz (using an external 12 MHz XO) with sub-clock speed of 32.768 kHz. The microcontrollers are also supported by development software including a compiler online, as well as software for developing Android smartphone applications.

The platform offers an Arduino compatible board footprint with C++ template and libraries and has Arduino UNO compatible pin-headers ready for use with Arduino shields. The boards also offer 51 GPIO pins, six analog input pins, micro-SD jacket, XBee wireless module header footprints, JTAG interface, +5 VDC power jack, user and reset switches, an Arduino Shield interface, and a range of interfaces including JTAG, mini-B USB-host connector and Ethernet.

The standard version is part populated with interface connectors, whereas the GR-SAKURA-FULL is fully populated with connectors, including: shield headers, RJ45 Ethernet LAN connector, JTAG header, +5 VDC power supply jack socket and a micro-SD card slot.

RS Components Pty Ltd
au.rs-online.com



HIGH-FREQUENCY CURRENT PROBES

The Ppram 769-Hioki high-frequency current probes are suitable for connection to oscilloscopes and waveform recorders. Applications include industrial electronics, inverters, electronic ballasts and switchmode power supplies. Select from a range of CT-style probes for frequencies to 100 MHz and currents to 500 A.

There are four models to choose from: DC to 50 MHz (30 A), DC to 100 MHz (30 A), DC to 10 MHz (150 A), and DC to 2 MHz (500 A). Features include insensitivity to external magnetic fields to 400 A/m, small rise times and good signal-to-noise ratios.

Probes can be powered from waveform recorders, or from FET probe oscilloscope power supplies. In addition, the probes can also be powered from Hioki 3269 power supplies (4 probes) or Hioki 3272 power supplies (2 probes).

Power Parameters Pty Ltd
www.parameters.com.au



WIDEBAND RF TRANSCEIVER

The ADI AD9371 wideband RF transceiver is highly integrated and offers dual-channel transmitters and receivers, integrated synthesisers and digital signal processing functions.

With a tuning range of 300 MHz to 6 GHz, 250 MHz signal bandwidth and power consumption of less than 5 W under standard operating conditions, the product delivers the combination of good performance and low power consumption required by 3G/4G micro and macro base station equipment in both FDD and TDD applications.

The product provides integrated transceiver technologies, a robust design environment and market-specific technical expertise to quickly move radio designs from concept to creation. The transceiver technologies reduce radio size, weight and power (SWaP), while the design environment offers board support packages, software and tools to help customers simplify and accelerate radio development across a range of applications, including wireless infrastructure, aerospace and defence electronics, and electronic test and measurement.

Other features include dual differential transmitters (Tx); dual differential receivers (Rx); an observation receiver (ORx) with two inputs; a sniffer receiver (SnRx) with three inputs; Tx synthesis bandwidth (BW) to 250 MHz; Rx BW: 8 MHz to 100 MHz; support for frequency division duplex (FDD) and time division duplex (TDD) operation; fully integrated independent fractional-N radio frequency (RF) synthesisers for Tx, Rx, ORx and clock generation; and a JESD204B digital interface.

Wireless Components

www.wirelesscomponents.com.au



ELECTRONICS ENCLOSURES

The sturdy aluminium enclosures in BOPLA's Bocube Alu series protect sensitive electronics not only against harsh environmental conditions but also against high-pressure water jets. This means that in addition to protection classes IP66 and IP67, BOPLA can ensure protection class IP69 for the enclosures.

Protection class IP69 can also be achieved for devices with an integrated capacitive touch screen. For this purpose, BOPLA developed a process for the integration of a glass plate into the enclosures. The narrow air gap between the glass plate and the enclosure is filled all the way round with sealant. The design successfully passed the IP69 protection class test.

The series consists of eight enclosure sizes. All components are made of metal and joined captive to the enclosure. The sturdy electronics enclosures provide mounting space for rectangular PCBs. The attractive and practical design includes a recessed front surface for extra protection of electronic components, lids which are captive and can be fitted in different ways, and a special holder for pressure compensation elements in the enclosure bases.

The enclosure screws are concealed. Natural-coloured anodised hinges and covers create an elegant contrast to the graphite-grey powder lacquering. Alternatively, the enclosures are available in light grey and the hinges can be supplied in special colours on request.

The enclosures have a high level of mechanical stability, good EMC screening and resistance to chemicals. They are resistant to UV and changes in temperature, so they are suitable for outdoor use in agriculture, traffic or the renewable energies sector.

ERNTEC Pty Ltd

www.erntec.net

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GRAPHENE TEXTILES

FOR WEARABLE ELECTRONICS

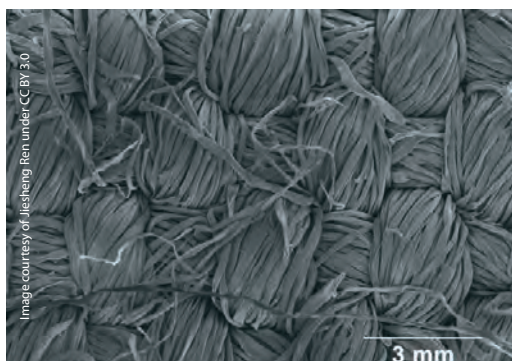
Researchers from the University of Cambridge and Jiangnan University have devised a method for depositing graphene-based inks onto cotton to produce a conductive textile. Their work demonstrates a wearable motion sensor based on the conductive cotton.

Cotton fabric is widespread in clothing and textiles as it is breathable, comfortable to wear and durable to wash — properties which also make it suitable for use in textile electronics. With this in mind, Dr Felice Torrìsi at the Cambridge Graphene Centre (CGC) and his colleagues developed a low-cost, sustainable and environmentally friendly method for making conductive cotton textiles by impregnating them with a graphene-based conductive ink.

The process begins with the placement of tiny graphene sheets, each less than one nanometre thick, in a water-based dispersion. These sheets of ink were chemically modified to adhere well to the cotton fibres during printing and deposition on the fabric, leading to a thin and uniform conducting network of many graphene sheets.

The adhesion of the modified graphene to the cotton fibre is similar to the way cotton holds coloured dyes and allows the fabric to remain conductive after several washes. Heat treatment after depositing the ink on the fabric further improved the conductivity of the modified graphene.

The graphene textiles stand apart from current wearable technologies which rely on rigid electronic components mounted on flexible materials such as plastic films or textiles. These offer limited compatibility with the skin, are damaged when washed and are uncomfortable to wear because they are not breathable. Furthermore, said Dr Torrìsi, “Other conductive inks are made from precious metals such as silver, which makes them very expensive



Electron microscopy image of a conductive graphene/cotton fabric.

to produce and not sustainable, whereas graphene is both cheap, environmentally friendly and chemically compatible with cotton.”

Reporting their technique in the journal *Carbon*, the researchers tested a simple graphene-coated smart cotton textile that was used as a wearable strain sensor. The textile was shown to reliably detect up to 500 motion cycles, even after more than 10 washing cycles in a normal washing machine.

“The sheet resistance of the conductive cotton fabric only increased from $\sim 1/0.9 \text{ k}\Omega/\text{sq}$ to $\sim 1/1.2 \text{ k}\Omega/\text{sq}$

after 10 washing cycles, exhibiting good washability,” the study authors wrote. “The conductive cotton fabric showed viability as a strain sensor even after 400 bending cycles, in which the stable change in the electrical resistance went from $\sim 1/3500 \text{ k}\Omega$ under tensile strain to $\sim 1/10 \text{ k}\Omega$ under compressive strain.”

The work opens a number of commercial opportunities for graphene-based inks, with potential applications in personal health technology, high-performance sportswear, military garments, wearable technology/computing and fashion. “Thanks to nanotechnology,” said Dr Torrìsi, “in the future our clothes could incorporate these textile-based electronics and become interactive.” This article is a modified version of a news item published by the University of Cambridge under a Creative Commons Attribution 4.0 International licence.



SPRAY PRINTING

SPRAY-PRINTED CRYSTALS

COULD REPLACE SILICON

Scientists from the University of Surrey have demonstrated for the first time a low-cost, scalable spray-printing process to fabricate high-quality isolated organic single crystals. The method is suitable for a wide variety of semiconducting small molecules, suggesting that it could be used to replace silicon with printable organic semiconductor inks.

Writing in the journal *Nature Communications*, the researchers explained that single-crystal semiconductors, such as silicon, serve as the backbone of several electronic devices. Unfortunately, inorganic single crystals tend to be grown from a melt at very high temperatures in special chambers filled with inert gas, using time-consuming and energy-intensive processes.

"Organic semiconductor single crystals, however, can be grown using solution-based methods at room temperature in air, opening up the possibility of large-scale production of inexpensive electronics targeting applications ranging from field-effect transistors and light-emitting diodes to medical X-ray detectors," the scientists said.

In collaboration with the UK National Physical Laboratory (NPL), the Surrey researchers showed how a variety of semiconducting small molecules can be dissolved in solvents to make semiconducting inks and then be deposited on virtually any substrate. This 'spray-printing' process combines the advantages of antisolvent crystallisation and solution shearing with the crystals' size, shape and orientation controlled by "the sheer force generated by the spray droplets' impact onto the antisolvent's surface", the researchers said.

"If we look at silicon, it takes almost 1500°C to grow semiconductor-grade crystals... and it will fetch a very hefty electric bill for just 1 kg of silicon — same as for running a tea kettle for over two days non-stop. And then, you would need to cut and polish those silicon 'boules' into wafers," said Grigorios Rigas, a first author on the study from the university's Advanced Technology Institute (ATI) and NPL.

"We can make single crystals in a much simpler way, entirely at room temperature, with a £5 artist spray brush," continued Rigas. "With a new class of organic semiconductors based on carbon atoms, we can spray-coat organic inks onto anything and get more or less the right size of crystals for our devices right away."

"The trick is to cover the surface with a non-solvent so that semiconductor molecules float on top and self-assemble into highly ordered crystals. We can also beat silicon by using light-emitting molecules to make lasers, for example — something you can't do with traditional silicon."

The crystals have been found to be high-quality structures, as confirmed by a combination of characterisation techniques. The method thus offers a powerful approach for controlling the shape and dimensions of single crystals, opening up "amazing capabilities for printable organic electronics", according to Rigas.



Westwick-Farrow Media
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www.wfmedia.com.au

Head Office
Cnr Fox Valley Road & Kiogle Street,
(Locked Bag 1289)
Wahroonga NSW 2076 Australia
Ph: +61 2 9487 2700 Fax: +61 2 9489 1265

Editor
Lauren Davis
wnie@wfmedia.com.au

Editorial Assistant
Amy Steed

Publishing Director/MD Geoff Hird

Art Director/Production Manager
Julie Wright

Art/Production
Tanya Barac, Odette Boulton, Colleen Sam

Circulation Manager Sue Lavery
circulation@wfmedia.com.au

Copy Control Mitchie Mullins
copy@wfmedia.com.au

Advertising Sales

Industrial Group Sales Manager
Nicola Fender-Fox – 0414 703 780
nfender-fox@wfmedia.com.au

Account Manager
Nic Stear – 0432 637 817
nstear@wfmedia.com.au

Account Manager
Sandra Romanin – 0414 558 464
sromanin@wfmedia.com.au

Asia
Tim Thompson – 0421 623 958
tthompson@wfmedia.com.au



Contact the editor

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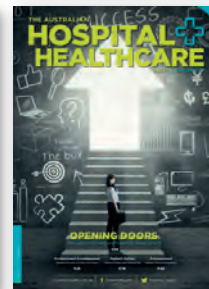
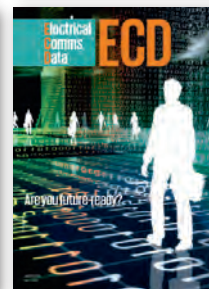
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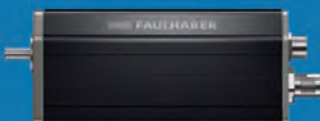
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