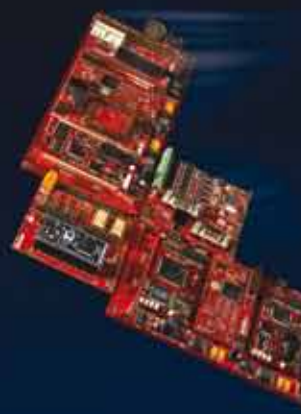
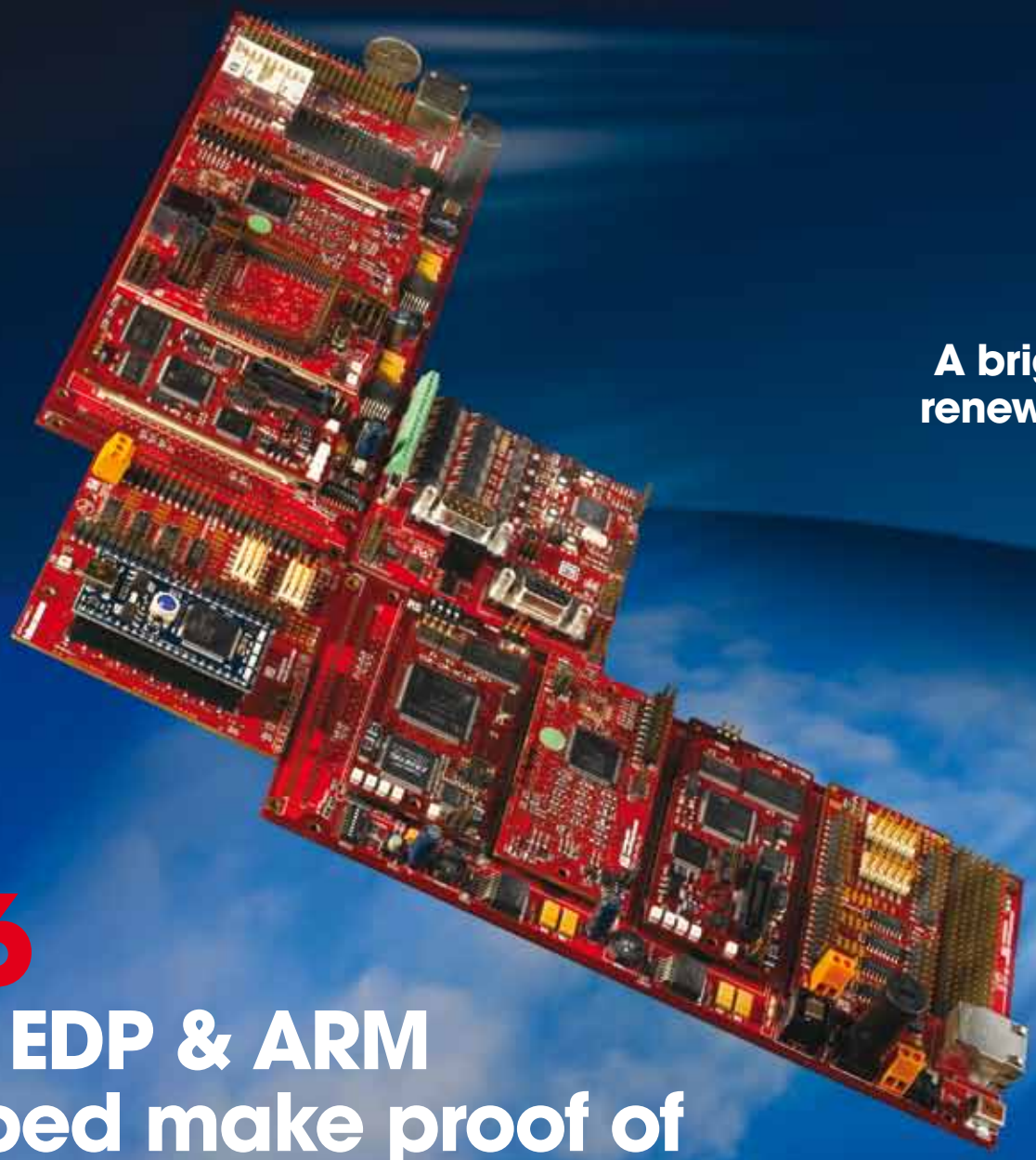
eTech

YOUR ELECTRONICS MAGAZINE

ISSUE 2





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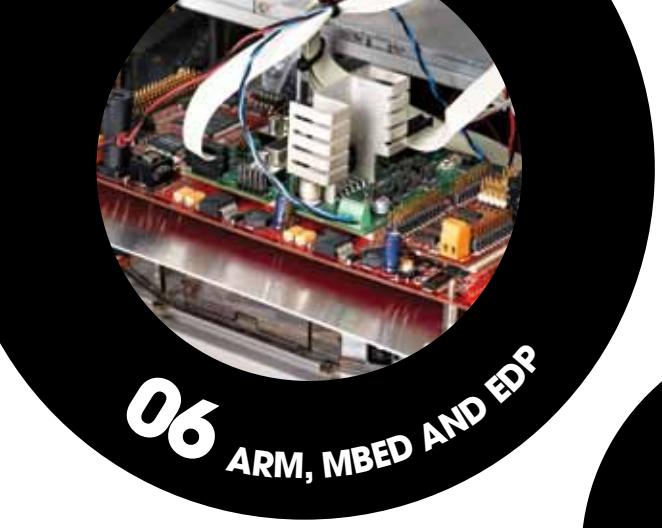
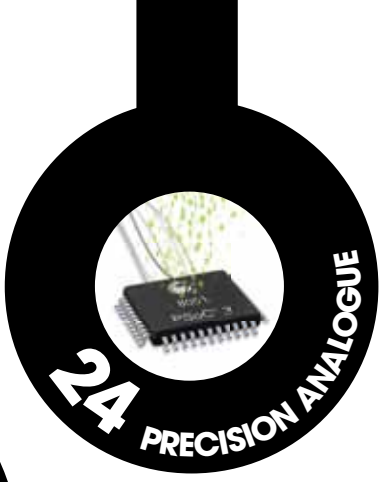
RS EDP & ARM mbed make proof of concept supersonic

rswww.com/electronics





The world of electronic design is under increasing pressure to offer competition kicking products in ever decreasing timescales. Short-cuts and inside information are essential to stay ahead of the game. That's why we strive to make RS your first choice for electronic components and solutions by continually introducing new technologies and partnerships to support designs from concept to prototype and production.

Our aim is to make the RS Components website the place where you start and finish your design. That's the thinking behind a very significant upgrade to our online presence which started with our new Electronics Centre initially launched across the UK and Europe in October. It's also why we're extending our universal Embedded Development Platform, EDP, to support ARM's new mbed virtual design environment, and driving through a host of improvements great and small to help you get your design off the CAD screen and into production more quickly and easily. The article on page 6 provides an overview of EDP and the start of more things to come.

In this edition, we've also put the spotlight on energy saving products, with technical articles looking at solar power as well as low power comms, processor, connector and display technologies.

We've received lots of positive feedback about our first edition of eTech and want to hear more from you. eTech is written by you as well as for you so, if you've got a great idea for a technical article or would like to offer an opinion in iSay (pg 4), drop me an email at etech@rs-components.com or visit www.rs-components.com/etech.

Glenn Jarrett
Head of Electronics Marketing

INSIDE eTech

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iSAY

ADRIAN RAWLINSON, MANAGING DIRECTOR OF MARL INTERNATIONAL, TALKS:

"Candelas, watts and lumens"

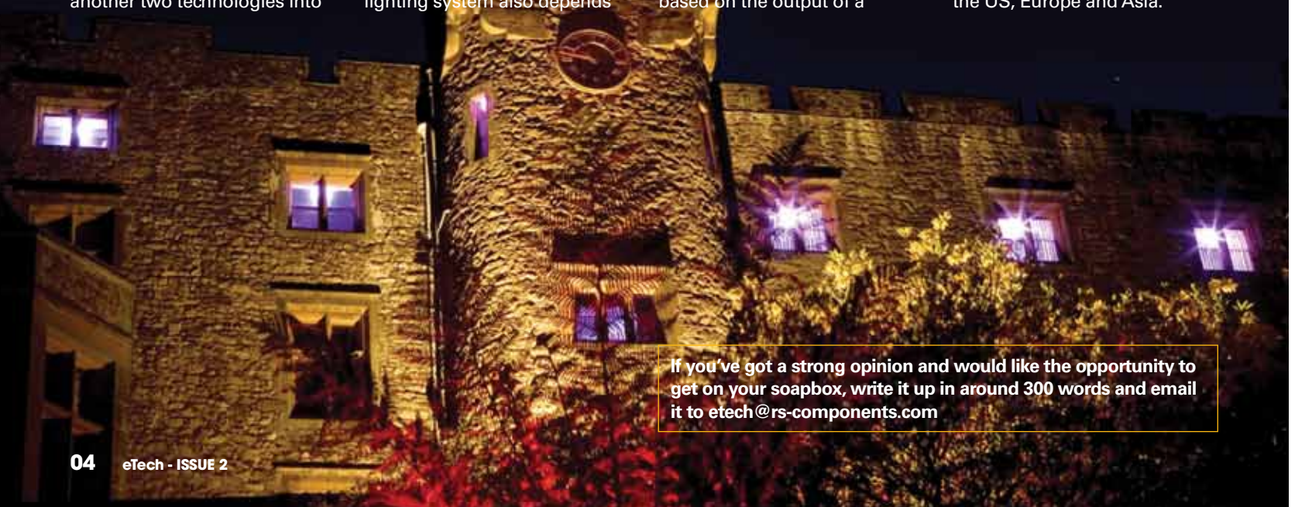
If you walk into a car showroom now and a salesman tries to convince you that his flash sports car was outstanding because it uses lots of fuel, you'd think he was daft. Yet that's still more or less what we do in the lighting industry. By and large, customers and manufacturers correlate the light output of a lamp to the power it uses.

The story more or less worked when there was one lighting technology, incandescent, which saw very little change in efficiency year on year. It wasn't too much of a stretch to accommodate a second – Cold Cathode Florescent Lamp - and fluorescent tubes are commonly sold as being 'equivalent to' an incandescent bulb of a specified power. Throw another two technologies into the mix: halogen and LED, and things start to get silly, especially as LED lighting in particular is seeing very rapid progress. A 6W LED today can produce twice as much light as its equivalent a year ago. LEDs also have very different characteristics than other forms of light, as they give a directional, as opposed to, spherical output.

The apparent efficiency of a lighting system also depends on the point at which you measure the power used. Incandescent lights are driven direct from a mains supply, fluorescent lights are driven through an inverter and LEDs need a rectified supply, normally low voltage.

I don't know whether to be amused or to despair at the idea that measures such as candela, lumens and mean spherical candle power are based on the output of a candle, but few buyers other than lighting specialists understand them.

Everyone is concerned about the energy used by lighting systems, but a sensible debate about which form of lighting does the best job in a specified set of circumstances is being constrained by the lack of a standardised method of measuring light output and power consumption across the US, Europe and Asia.



If you've got a strong opinion and would like the opportunity to get on your soapbox, write it up in around 300 words and email it to etech@rs-components.com

Over 4,000 more Tyco Electronics lines

More than 18,000 parts now available through RS online

Amongst the introductions, are over 270 more Universal MATE-N-LOK connectors, giving design engineers increased choice in selecting the right connector for new industry, HVAC and lighting applications. Over 240 AMPMODU micro-interconnect products have also been added, which are designed for cable-to-board, cable-to-cable and board-to-board applications along with 140 additional PIDG crimp terminals, and over 300 additional relays.

Also introduced are 85 connectors from the Tyco Electronics LED printed circuit board (PCB) mount lighting connectors, including hermaphroditic and poke-in connectors. The poke-in connectors are low profile, surface mount (SMT) two-position connectors ideally suited for LED strings and lighting controls. The hermaphroditic blade and receptacle connectors are new SMT connectors available in 2, 4 and 6 positions, intended for use with in-line board-to-board LED lighting applications.

To search the full Tyco Electronics range available from RS, visit rswww.com/te

Molex introduce 2,300 new lines

RS has now doubled your choice of Molex products

Highlights from the new range additions include the introduction of the C-Grid® / SL system into the RS offer. The C-Grid dual-row board-to-board system combines with the SL (Stackable Linear), a modular single-row wire-to-wire and board-to-board system. Together, these products offer the largest number of variations and cabling configurations in the industry. The popular Molex KK series, developed to meet the challenges of modularisation has been increased with over 250 new additions to this family, giving customers multiple pitch options and allowing thousands of configurations. The RS range of FFC connectors, designed for use in signal and data applications requiring flat flex cable, has doubled in size with more than 150 new products added. Further additions include increased Mini-Fit Jr and Micro-fit 3.0 ranges. You can see the full Molex range and supporting technical information at rswww.com/molex

1,400 more relays and switches from Omron now available from stock

RS now has the largest stocked range of Omron electronic components

RS has been working with Omron Electronic Components to develop a complete offer for design engineers to use, with a dedicated Omron web portals, plus implementation of buy-it-now web referral links from the Omron website to RS and expansion of the Omron product range available from RS.

Alex Grout, European Distribution Manager for Omron Components said "RS has spent a great effort and huge investment in our partnership. With the expansion of the weblinks, dedicated Omron portals and range developments, specifiers of our products can be confident that the widest range of Omron relays, switches, and connectors are available online from RS".

To learn more about the Omron Electronics range available from RS, including all the new introductions, go to www.omron-rs.eu.

Save energy with the new RS Light Energy Saver tool

Easy to use calculator shows your savings from using greener lighting

Now available across all European websites, the Lamp Energy Calculator has been developed to help RS customers increase their ability to deliver energy efficient lighting solutions for buildings. The calculator allows users to select their current lighting solutions, setting features such as lamp type, wattage and temperature output. Using these criteria, it will then identify potential alternatives from the RS energy efficient lighting range, and calculate the savings to be gained from running and replacement costs, as well as reduced energy usage costs.

First launched in the UK in May 2009, the calculator has been used by thousands of RS customers to help save energy and reduce costs. Combined with energy efficient product ranges including heating and plumbing, test and measurement, insulation, IT and renewable energy, RS offers a complete solution for energy efficient design and maintenance of buildings.

As energy efficiency continues to be a dominant industry trend for Electronic Design Engineers, go to rswww.com/energyRSource and find out how RS can help ensure that the design environment is as energy efficient as the latest application designs being worked on.

RS EDP & ARM

mbed make proof of concept supersonic

The RS generic Embedded Development Platform (EDP) now supports mbed, the new online development tool for rapid prototyping with ARM microcontrollers.

As part of its roadmap for EDP going forward, RS is establishing a close partnership with ARM aimed at allowing developers to take full advantage of ARM's web-based mbed embedded development concept.

RS has added mbed processor modules supporting the ARM7 and Cortex®-M3 architectures to its range of available modules for EDP. This gives EDP users access to the industry's first online platform for fast, low-risk prototyping of ARM based microcontroller systems.

The EDP and mbed concepts are ideally matched. ARM's mbed module containing the microcontroller has a 40-pin DIP form factor designed to allow the microcontroller I/Os to be connected to a solderless prototype board or a through-hole printed circuit board (PCB). The module connects to the EDP baseboard via an adaptor board that, together with the 40-pin mbed module, makes up the EDP mbed Command Module. With the module connected, programs are downloaded by dragging and dropping the program binary in the same way as using a Flash USB drive.

Perhaps the most powerful aspect of mbed-based development is its fundamentally online nature. Many of the programming resources and project-management functions developers need to call on are maintained in "the cloud", removing the need for a large initial investment in a suitable compiler, for example. Even the developer's workspace is maintained online, giving engineers the freedom to login from anywhere without needing to ensure access to project documentation stored locally. In addition, mbed development is independent of the developer's chosen platform – whether PC, Linux or Mac.

Developers can also access the mbed online library of functions. This provides an API-driven approach to coding, and pre-written drivers are also available saving developers learning microcontroller hardware details. Each peripheral also has the benefit of a turnkey "Hello World" example to quickly verify correct functionality. RS is taking a leading role in further development of mbed by working with ARM to provide resources dedicated to writing production-ready drivers. This will quickly increase accessibility for developers to high-quality functions optimised for the ARM Cortex embedded processor family.

Another benefit of mbed development is access to a large online community of developers sharing code and resources through mechanisms such as the mbed Cookbook online repository, wiki and the mbed forums.

Developers combining the EDP mbed Command Module with EDP application modules to complete rapid proof-of-concept work can take advantage of this online approach to reduce design-start costs and quickly acquire knowledge and code. In addition, customers will also be able to use the baseboard with the latest Cortex-M0 microcontrollers targeting ultra low-power applications, when these become available.

EDP Explained

Embedded design projects typically aim to have a proof-of-concept ready early in the project lifecycle. This requires some basic hardware, which is usually obtained by purchasing an evaluation board from the processor vendor or from a third-party developer. However, hardware modifications may be required, and the project must usually absorb the full purchase price. Such kits are rarely re-usable in subsequent projects, either because the right features are not provided or the technology may have been superseded.

A more cost-effective approach is to work using a modular development platform that can also be reconfigured throughout the longer term to meet requirements for initial hardware in future projects. The EDP fulfils this concept. It provides a baseboard into which are plugged processor modules and special-function modules as required by each project. This provides a trusted platform, suitable for long-term use,

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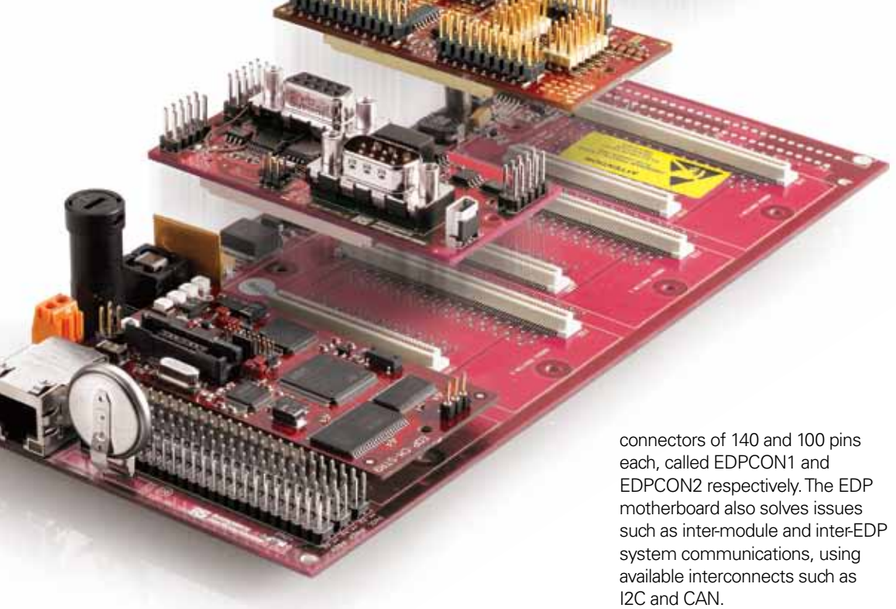

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which will not only save purchasing numerous development kits but will also save the time to make any adaptations.

Configurable Baseboard

The EDP baseboard, or motherboard, is an Extended Eurocard size (220 x 100 mm) board that provides four identical "stations" for the plug in modules. The motherboard allows microcontrollers and I/O devices to communicate through a standardised interface similar to PC/104 or STE buses. However, whereas PC/104 and STE tend to support only power-line, data, address and control signals, the EDP interface supports microcontroller applications by also catering for specialist pin functions relevant to typical 8, 16 and 32-bit microcontrollers. There are three I2C channels, two CAN channels, an SPI port, and various signal-measurement and signal-generation peripherals. There are also groups of pins to support interrupts in response to external events, groups of pins able to create pulsetrains, others dedicated to motor control, I2S, memory cards and many other common microcontroller IO types. Advanced interfaces such as SD/MMC are also supported.

All of these signals are contained within two 0.8mm dual-row connectors of 140 and 100 pins each, called EDPCON1 and EDPCON2 respectively. The EDP motherboard also solves issues such as inter-module and inter-EDP system communications, using available interconnects such as I2C and CAN.

Plug-in Command Modules

This architecture allows a wide variety of processor modules, based on various microcontrollers, to be built by mapping the device I/O pins onto the EDPCON1 and EDPCON2 connectors. The microcontroller then appears to be a virtual CPU to another I/O device fitted on the bus, such as a digital or analogue peripheral module. It is possible to map almost any microcontroller to this format. The first Command Modules to be introduced for EDP have supported the Infineon XC167, STMicroelectronics STR9, and the Microchip Plug-in Module for microcontrollers and dsPIC devices (PIC-PIM) spanning 8-bit, 16-bit and 32-bit families.

Plug-in Functional Modules

Of course, since the EDP is conceived to provide a configurable platform for proof-of-concept work, its success is also dependent on providing a diverse range of peripheral functions that are also in EDPCON-compatible modules. The first modules to be developed as part of the EDP programme include analogue and digital I/O modules, a communications module, and two motor-control modules.

The EDP modular concept lends itself to the development of an increasing range of application modules going forward. RS is actively pursuing development of new modules; recent announcements include a new SD Card module and plans for modules to enable EDP-based wireless development. Users can also build their own modules, if required, by referring to the EDPCON bus specification.

A key challenge facing embedded-systems developers is to build drivers for each of the functions to be implemented. The time taken to write and debug a driver, at the proof-of-concept stage, can delay the project; particularly if the driver will not work. Later in the project, it may be necessary to develop certain drivers further to achieve the full functionality and robustness.

EDP solves both of these challenges by including all necessary drivers for each function. Moreover, the drivers are written from the outset to be production ready. Hence, developers can progress their projects without debugging drivers at the initial hardware stage or refining the drivers for production later in the project.

EDP Hits the Open Roadmap

By introducing EDP, RS has delivered a solution that enables today's design engineers to meet the increasingly acute cost and time-to-market demands on embedded systems design. As a common platform, the EDP reduces design and construction times from weeks to days. Project cost savings are achieved by removing the need to purchase and adapt to multiple manufacturer-specific development kits. Ultimately, EDP sets developers free to try more new ideas and push boundaries to create more successful, highly differentiated products. A new, two-station EDP baseboard will be introduced in the near future, to further reduce the cost of building initial embedded-systems hardware. o

RS is also inviting participation in the EDP developer community from academic institutions. Universities interested in gaining access to development kits for research and teaching can contact us at etech@rs-components.com

To see more on the EDP go to rswww.com/edp

LECROY - WAVEACE SERIES OSCILLOSCOPES

Oscilloscopes offering a powerful combination of large, informative displays at an affordable price.

■ Our WaveAce oscilloscope series simplifies your work and shortens the time taken to find and debug problems. The WaveAce™ combines long memory, a colour display, extensive measurement capabilities, advanced triggering and excellent connectivity to improve troubleshooting and shorten debug time. With both 2 and 4 channel models, bandwidths from 40 MHz to 300 MHz, sample rates up to 2 GS/s and waveform memory up to 9 kpts/Ch (18 kpts interleaved) the WaveAce exceeds all expectations of a small affordable oscilloscope.
RS Online search term: Lecroy Waveace digital

FAIRCHILD MOTION-SMART POWER MODULES (SPM™)

Integrated 3 Phase Motor Drive Solutions for BLDC PMSM/BLAC and ACIM.

■ The Motion-SPM in DIP packaging offers a high performance simplified solution for commercial and industrial inverter motor designs, Each SPM integrates six IGBTs, six diodes, three HVICs, one LVIC and a thermistor in a single compact module (60mm * 31mm). Compared to discrete IGBT solutions, the integrated SPM requires less than half the board space, while providing low voltage control and a high voltage output stage rated at 10A-75A at 220Vac. This compact, ceramic and DBC-based transfer moulded-type package optimises heat transfer from the IGBTs.
RS Online search term: Fairchild FSAM*

TEKTRONIX – CURRENT MEASUREMENT

High sensitivity current probes for accurate power and load analysis.

■ **The TCP300 and TCP400 series AC/DC Current Measurement family is a highly advanced current measurement system for today's current measurement needs. Tektronix current probes provide industry-leading measurement sensitivity to a minimum of 1mA, which is critical for accurately measuring low level currents and frequency components. When connected to Tektronix Oscilloscopes with TEKPROBE Level II, TekConnect (with TCA-BNC) or TekVPI (with TPA-BNC) interfaces, current measurements and calculations are made simple and easy. Additional measurement power is available with add-on software such as the TDSPWR2 power measurements package.**
RS Online search term: Current Probes, Tektronix

AGILENT - U1701A HANDHELD CAPACITANCE METER

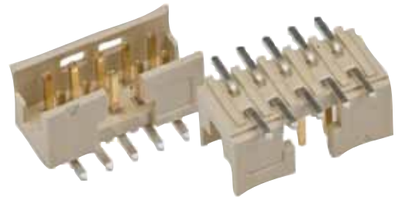
A Capacitance Meter in the palm of your hand.

■ **Agilent's new U1701A Capacitance Meter now allows random checks across the production floor and performance checking at your inspection or sorting stations. With a wide measurement range and many features, the U1701A puts a new level of convenience into capacitance meters. It has up to 25 sets of high/low limits to store and choose from in compare mode. The U1701A also lets you breeze through capacitor sorting without the need to set and reset the standard reference for different capacitors under test. Handy functions, include tolerance and relative modes, Hold, Min/Max/ Average recordings and PC data logging.**
RS Online search term: Agilent capacitance

TEXAS INSTRUMENTS - NEW 60V STEP DOWN DC/DC CONVERTER

60V step down DC/DC converters, for light load efficiency and automotive applications.

■ The TPS54160 from Texas Instruments is a step down regulator with an Integrated Switch. The input voltage range is 3.6-60Volts. Output voltage range is 0.8-58V with a maximum output current of 1.5A. The TPS54160 has excellent efficiency in light load conditions and is from the 0.5A to 10A SWIFT™ Converter family.
RS Online search term: TPS54160



FCI - FFC & FPC CONNECTORS

Ever extending options for flex circuit FFC/FPC connectors.

■ FCI, a leader in flex FFC/FPC connectors continue to bring you unique solutions that give you the footprint and the quality level you need for your application. FCI were the first to introduce a flex connector with a back side flip actuator that allows you to insert the flex cable and lock the actuator with one hand. Products include flex connectors for LIF (low insertion force) and ZIF (zero insertion force), top and bottom contact options, vertical and right angle orientations, surface mount and through hole terminations in contact spacing options down to 0.3mm.
RS Online search term: FCI FFC

ARDUINO DUEMILANOVE ATMEGA328 MCU STARTER BOARD

Atmel Development boards.

■ The new Arduino Duemilanove is an ATmega328 starter board which contains everything needed to start designing straight away. It has 14 digital input/output pins (6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button. The platform is open-source, implements the Processing/Wiring language and provides a free IDE; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.
RS Online search term: Duemilanove

TDK-LAMBDA - 300W MEDICAL POWER SUPPLY

300/400 Watts, digital power solution for medical applications.

■ TDK-Lambda has introduced their new digitally controlled 300-watt power supplies designed specifically with medical applications in mind. With a 4kVAC reinforced input to output isolation and an output-to-ground isolation of 1500VAC, the EFE300M meets the rigorous international safety standards of IEC 60601-1 for medical equipment. Designed with space limitations in mind, the 3 x 6" footprint, 1.6" height is ideal and the low profile connectors allow maximum airflow for optimised cooling efficiency. Other features such as a redundant operation capability and high current standby make the EFE300M equally suitable for highly integrity applications including instrumentation, routers and security networks.
RS Online search term: tdk-lambda efe300*

CREE - XLAMP MC-E SERIES LEDS

Lighting class, high lumen multichip LED's.

■ **Cree leads the industry in brightness and reliability for power LEDs with its XLamp LED family. Cree is enabling the lighting industry with efficient, environmentally friendly LED light. MC-E X-LAMP LEDs can reduce LED system complexity and size by combining 4 LED chips in one package. Compared to discrete LEDs, they reduce the distance between LED die, creating a small optical source for excellent optical control and efficient colour mixing. They have a maximum output of 430 Lumens bringing high performance and quality of light to a wide range of applications, including parking, roadway and pedestrian outdoor areas, portable and personal lighting, retail display lighting and emergency vehicle lighting.**
RS Online search term: MCE4WT

APTINA 10MEGAPIXEL COLOUR IMAGE SENSOR

A High-Speed, Low-Power Sensor for Camera Designs.

■ **The MT9J003 is a 1/2.3-Inch CMOS Digital Image Sensor, built with Micron's exclusive DigitalClarity® technology, this sensor features exceptionally low noise levels and low-light sensitivity. It supports full HD—1080p at 60 fps, delivering CCD image quality (based on SNR and low-light sensitivity)—along with the low cost, low power, high performance, small form factor, and fast time-to-market. With very low power consumption and variable functions such as gain, frame rate, and exposure, this sensor outputs high-quality images at high speeds. It is easily programmed through a simple two-wire serial interface.**
RS Online search term: Aptina 10MP

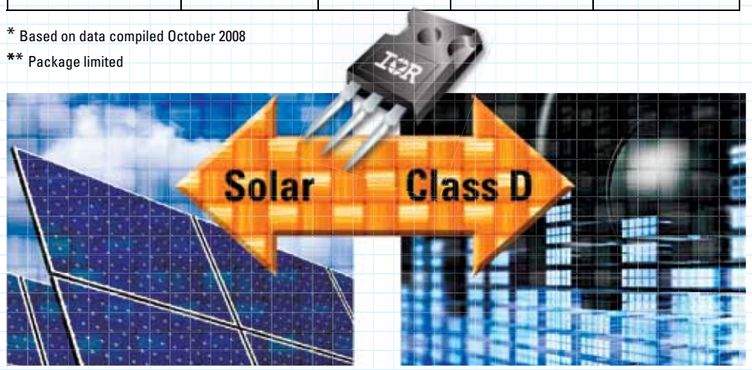
Lowest $R_{DS(on)}$ in TO-247 Package*

N-Channel MOSFETs

Part Number	B_{VDSS} (V)	$R_{DS(on)}$ (mΩ)	I_D @ 25°C (A)	Qg typ (nC)
IRFP4004PBF	40	1.7	195**	220
IRFP4368PBF	75	1.85	195**	380
IRFP4468PBF	100	2.6	195**	360
IRFP4568PBF	150	5.9	171	151
IRFP4668PBF	200	9.7	130	161
IRFP4768PBF	250	17	93	180

* Based on data compiled October 2008

** Package limited



With performance improvement of up to 50% over competing devices, the new TO-247 MOSFETs from International Rectifier can help extend battery life in motor applications, improve efficiency in solar inverter systems, and deliver the wattage required for high power Class D audio systems.

Applications

- High Power Synchronous Rectification
- Active O'Ring
- High Power DC Motors
- DC to AC Inverters
- High Power Class D

Features

- 40V to 250V in TO-247AC Package
- Industrial grade, MSL1
- RoHS compliant

Your FIRST CHOICE for Performance

International
IOR Rectifier
THE POWER MANAGEMENT LEADER

For more information visit us at rswww.com/IR

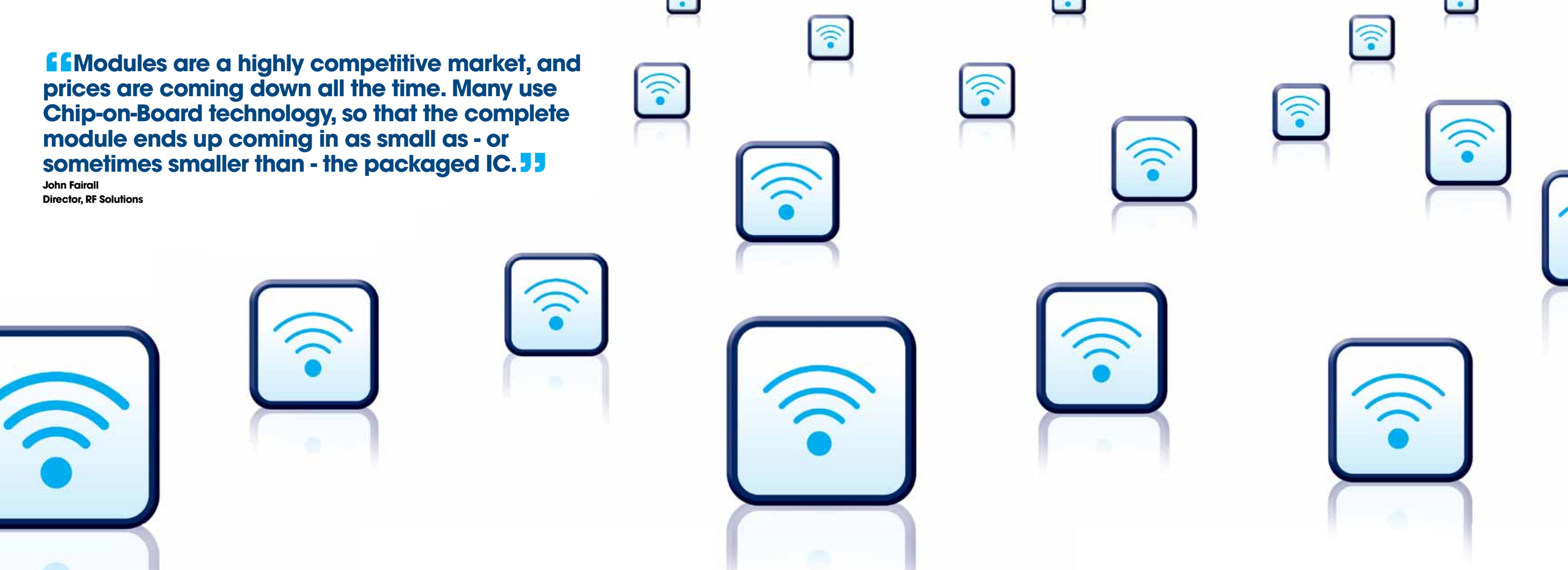
Just add WIRELESS!

Trends in consumer electronics often create a climate of expectation in the wider electronics market, and so it is with wireless communications. It would be really hard to buy a laptop without WiFi and all but the simplest mobile phones now come with Bluetooth as standard. Since the pieces of electronics that most customers use most often now have wireless connections, there is an increasing expectation that all the rest of their personal gadgets and professional tools will offer no less.

Continued page 14 >

“Modules are a highly competitive market, and prices are coming down all the time. Many use Chip-on-Board technology, so that the complete module ends up coming in as small as - or sometimes smaller than - the packaged IC.”

John Fairall
Director, RF Solutions



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The task of adding wireless communications to a system may appear daunting, with the RS website listing support for no less than eight different standards, as well as several proprietary alternatives. Which of these multiple alternatives is the best for any given project, and what are the implementation challenges?

The candidates

For the purposes of this discussion, we’re going to assume that the requirement is for wireless communications with a range of 10-100m, with the capability to penetrate solid objects. For short range line-of-sight data or remote control applications, there is a range of solutions based on infra-red that can be readily accessed. Longer range connections normally require the use of the cellular infrastructure, which is a whole subject in its own right. On this basis, the main alternatives are WiFi, Bluetooth, ZigBee, RFID or proprietary solutions. According to John Fairall, Director of the company RF Solutions, the main parameters to consider are power, physical size, range and data rate. RF Solutions offers products based on all of the major standards, and his advice is that developers shouldn’t necessarily adopt any of them. “The major benefit of choosing an independent standard is that it offers access to a wider market. For a system where you control both ends, all four of the major standards will burden you with features and performance that you don’t need, and will probably be more costly than a proprietary solution,” he says.

He continues, “However, if your product needs to communicate with a laptop or to surf the web through an access point, then wireless LAN is a great idea. If it needs to connect to a mobile phone, Bluetooth would be an excellent choice. Similarly, ZigBee is building critical mass in home automation, sensor networks and remote metering, and RFID is widely used in logistics. If these are your target markets, and interoperability would be attractive to your customers, then that should drive the decision.”

Implementation

All of these technologies are offered as discrete components or modules. Although vendors usually offer reference designs to help the developer, they are best avoided by development teams without RF design experience. “RF design is full of pitfalls, and unexpected things like the density of the fibreglass mounting board can be a real issue,” says Fairall. “A reference design simplifies the development for a suitably qualified specialist. Those choosing this path should either lean on the supplier for enough application support to troubleshoot their design, or expect to hire in a consultant to advise on its completion.” This requirement probably makes the discrete path uneconomic for products with volumes of less than 10,000 pieces per annum.

In truth, though, with the outstanding module solutions currently emerging, there is little need to brew your own. Fairall continues, “Modules are a highly competitive market, and prices are coming down all the time. Many use Chip-on-Board technology, so that the complete module ends up coming in as small as or sometimes smaller than the packaged IC.”

Modules can be highly configurable, with parameters including frequency selectable by the customer. Some offer standard RS-232 interfaces. “With the smart versions, all you need to do is squirt data in and RF comes out,” according to Fairall.

Proprietary solutions

A wide range of low-power applications just need simple point-to-point or networked communications, that can be run from a battery. Such applications include alarm and security products and home automation. Using a proprietary solution leaves the developer in complete control of the whole system, eliminating the commercial and technical downsides of allowing customers to introduce third-party products into the mix.
Texas Instruments SimpliciTITM network protocol is one example of the low-power RF protocols available for simple, small RF networks (less than 100 nodes). Designed for easy implementation with minimal microcontroller resource requirements it runs out-of-the-box on TI’s low-power microcontrollers and RF transceivers. Despite the modest resources required, SimpliciTI network protocol supports peer-to-peer communication, the option to use an access point to store and forward messages and range extenders to extend the range of the network to four hops.

Energy Harvesting

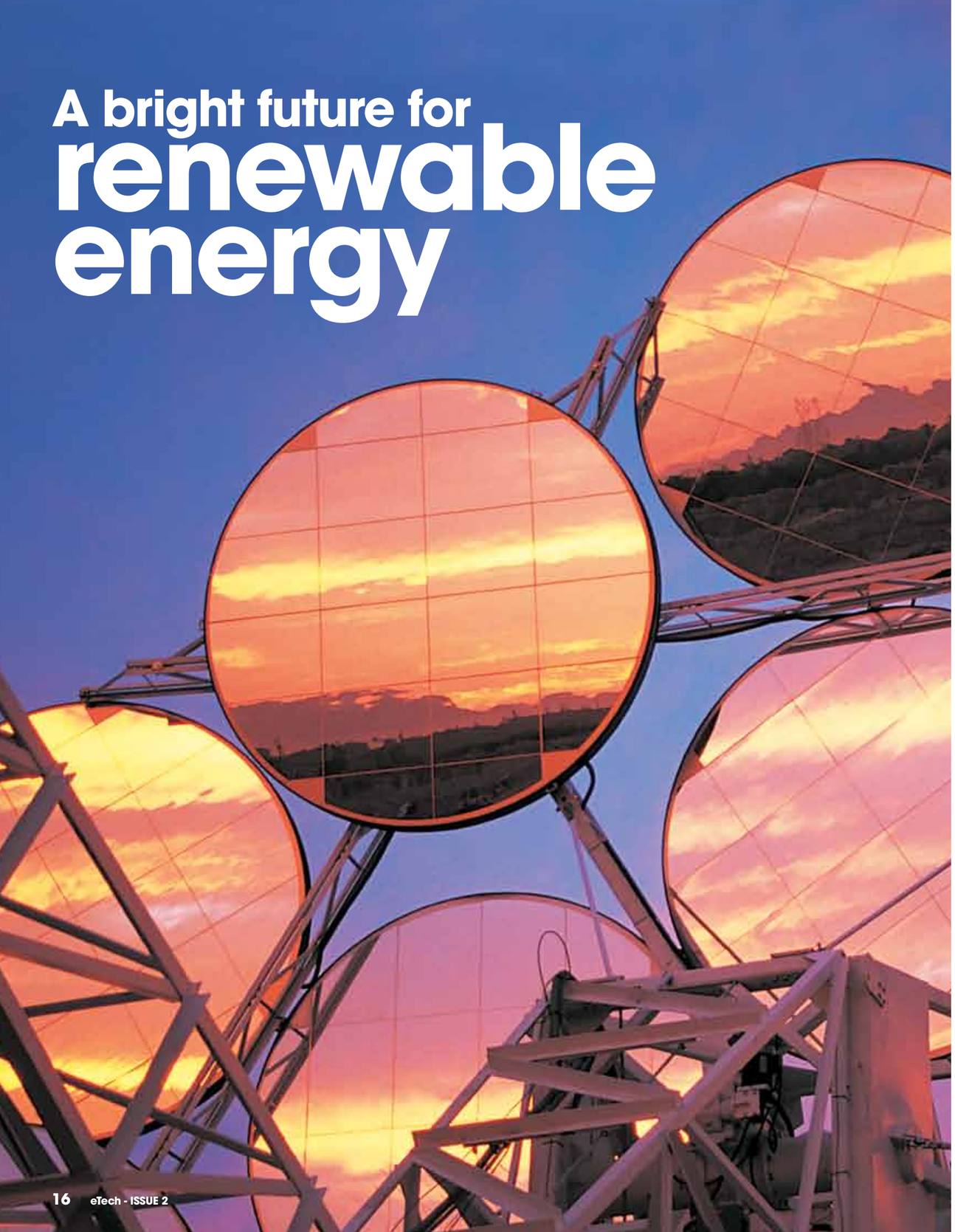
A particularly neat idea is to harvest energy from the surrounding environment to power a wireless link, eliminating the need to use a batter altogether. This makes the system entirely maintenance-free and reduces costs by eliminating the need for wires of any form. EnOcean GmbH develops and manufactures such self-powered wireless sensors, which harvest heat or light from the environment, or the energy used for example to depress a switch to generate enough electricity to allow the transmission of a short pulse of control data. Their self-powered wireless switches consume about 50 µWs for a complete command which takes less than one millisecond, and has a range of 300 meters in the open. If this sounds too good to be true, take a look at the Trial Pack offered by RS (stock number is 189-065).

Conclusion

For a great many customers looking for a simple point to point or point to multipoint link, a proprietary protocol offers the simplest and lowest cost solution. The major standards, WiFi, Bluetooth, ZigBee and RFID are only needed if the market demands them. Either way, it is only worth considering discrete implementations for high volume designs, where the team has access to the appropriate expertise. In most cases, modules offer the shortest time to market and the lowest design risk, usually with no or very little penalty in terms of size, power consumption and bill of materials cost. Truthfully,the latest modules make it easy to incorporate a wireless link into almost any electronics product at low cost and with little design effort.

For the latest information on wireless technology available from RS, visit the Electronics Centre at rswww.com/electronics

A bright future for renewable energy



The potential for photovoltaic solar energy is high but requires careful design consideration in order to attain maximum efficiency.

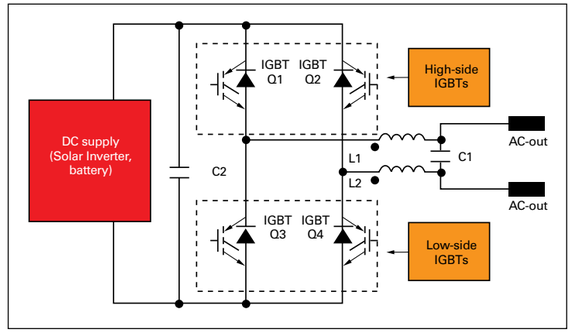


Fig.1 The solar-power inverter taps high voltage IGBTs in a full-bridge topology

Conservation in general is now high on the global agenda and as part of the overall drive for efficiency, the momentum behind alternative forms of renewable energy is growing. One of the most viable and buoyant technologies is solar power derived from photovoltaic cells. There are now numerous examples of how PV energy can be employed; from portable phone chargers, to arrays of solar roof panels generating enough energy to supply a home or small business.

The latter is the subject of much interest at the moment, as efficient installations are capable of supplying surplus energy back into the power grid under the right circumstances, thereby providing not only a form of renewable energy for the owner, but also a modest return on investment. However, along with much interest there is also much debate, as the deployment of PV technology is susceptible to losses at various stages in the power chain. To combat this, manufacturers throughout the supply chain are becoming polarised over the best system architecture to implement.

The power generated by solar panel arrays is a direct current and so using PV technology to supply an AC voltage at mains power levels requires a DC-AC inverter. A debate rages over how best to implement the inverter technology: Centralised or distributed?

With a distributed approach (which is gaining favour over the more traditional centralised topology) a dedicated inverter is positioned close to each solar panel's output. The main benefit of this approach is that no individual cell's performance can negatively impact the overall system's performance – a major criticism of the centralised approach. While the duplication of inverters does carry a higher cost, advocates of the distributed approach argue that the increased efficiency coupled with the improvement in system reliability due to the removal of a single point of failure outweighs the higher unit price over the system's lifetime.

Both centralised and distributed topologies have their merits but both share the need for efficient inverter technology. Without an efficient inverter, any gains made through improving the system's performance could be in vain. However, the requirements of the inverter(s) used will differ based on the topology and it is here that the technology within the inverter plays a key role.

The input voltages to the inverter will depend on the topology chosen and, in turn, the efficiency of the inverter will depend on its design based on those system requirements. It is well established that insulated-gate bipolar transistors, or IGBTs, offer advantages for this type of inverter design. These devices present the best of field effect transistor (FET) and bipolar junction transistor (BJT) technologies in a single device; allowing them to be controlled by a voltage, as with a MOSFET, but offer the higher current-passing capabilities of BJTs. As a result, their use in power delivery has increased rapidly and while there is now a wide range of IGBTs to choose from, it is clear that one size does not fit all applications. This is illustrated not only by the differences between inverters within a centralised or distributed topology, but the optimised selection of the IGBTs within those inverters.

To create the AC waveform, the DC input from a solar cell or battery passes through a full-bridge inverter, as shown in Figure 1. This requires four high-voltage IGBTs; Q1 and Q2 (referred to as 'high-side'), and Q3 and Q4 (referred to as 'low-side') transistors.

One technique to create the AC sine wave is to pulse-width modulate the high-side transistors, at 20kHz, and commutate the low-side IGBTs at the desired power grid frequency (typically 50 or 60Hz). This effectively means that, during the positive half-cycle, Q1 is pulse-width modulated at 20kHz while Q4 remains on (Q2 and Q4 are off) and, similarly for the negative half-cycle, Q2 is modulated and Q3 remains on (Q1 and Q4 are off). Clearly, the characteristics of the high-side and low-side IGBTs differ based on this architecture, so it is important to choose devices from a supplier who understands these requirements.

International Rectifier's (IR) portfolio of IGBTs and MOSFETs provides for this scenario, as Figure 1 shows. For the high-side IGBTs, switching time is crucial and so selecting a fast switching IGBT can minimise switching losses. A new range of IGBTs launched recently by IR, the 600V Trench IGBTs, have been optimised for high-side switching at 20kHz and target inverters used in uninterruptable power supplies (UPS) and solar panel inverters. In fact, using these devices can deliver up to 30% efficiency gains in these applications.

The low-side devices need not be optimised for switching speed in the same way and in this application the recommended devices would be standard speed IGBTs, constructed from a planar process as opposed to the trench devices used for the high-side. These devices have been optimised for low speeds and low conduction losses and therefore represent the most efficient solution.

The use of PV solar panels is increasing rapidly, yet the technology offers a great deal of scope in terms of efficiency improvements. Developing more efficient inverters is a critical stage in the advancement of PV technology, as well as other forms of renewable energy.

For more on IR's portfolio of IGBTs and MOSFETs for PV technology, go to rswww.com/ir

In our increasingly portable world, reducing power consumption, weight and cost conflicts with the need to provide a sophisticated user interface on even the simplest measurement or test system. The mobile phone industry is a wonderful proving ground for new technologies that can reconcile these conflicting requirements, and OLED display technology is the latest idea that was pioneered in this market and is now being offered to the general display user.

OLED – the backlight-free display option

OLED explained

OLED is an emissive technology, each pixel emitting its own light – so when it is off, it produces no light and consumes virtually no power. Unlike backlit LCD displays therefore, OLEDs produce a true black, and their contrast ratio is much higher, typically 10,000:1 compared with 400:1 for an LCD display. They are also brighter, partly because they don't require the polarizers which filter out up to half the light from the backlight with an LCD display.

Aesthetically OLED is better than LCD. OLED not only achieves increased brightness and contrast, but offers a much wider viewing angle - up to 170 degrees up/down and left/right, compared to 150 degrees on all but the most advanced TFT LCDs. The response time of an active matrix OLED display is typically 50µs versus 25ms of LCD, meaning full motion-video is smoother and greyscale rendition is far superior.

Lower cost

OLED manufacturing capacity globally is limited, and the displays are manufactured in much lower volumes than LCDs at the moment. Accordingly, OLED displays are currently sold at a premium to LCD products. The manufacturing process is in fact simpler though, so eventually, they are expected to be much lower in cost than other comparable display technologies. One variant, Polymer-OLED can be printed onto almost any substrate with inkjet printer technology, meaning ultra-thin displays become achievable, with the potential for roll-up displays in the future.

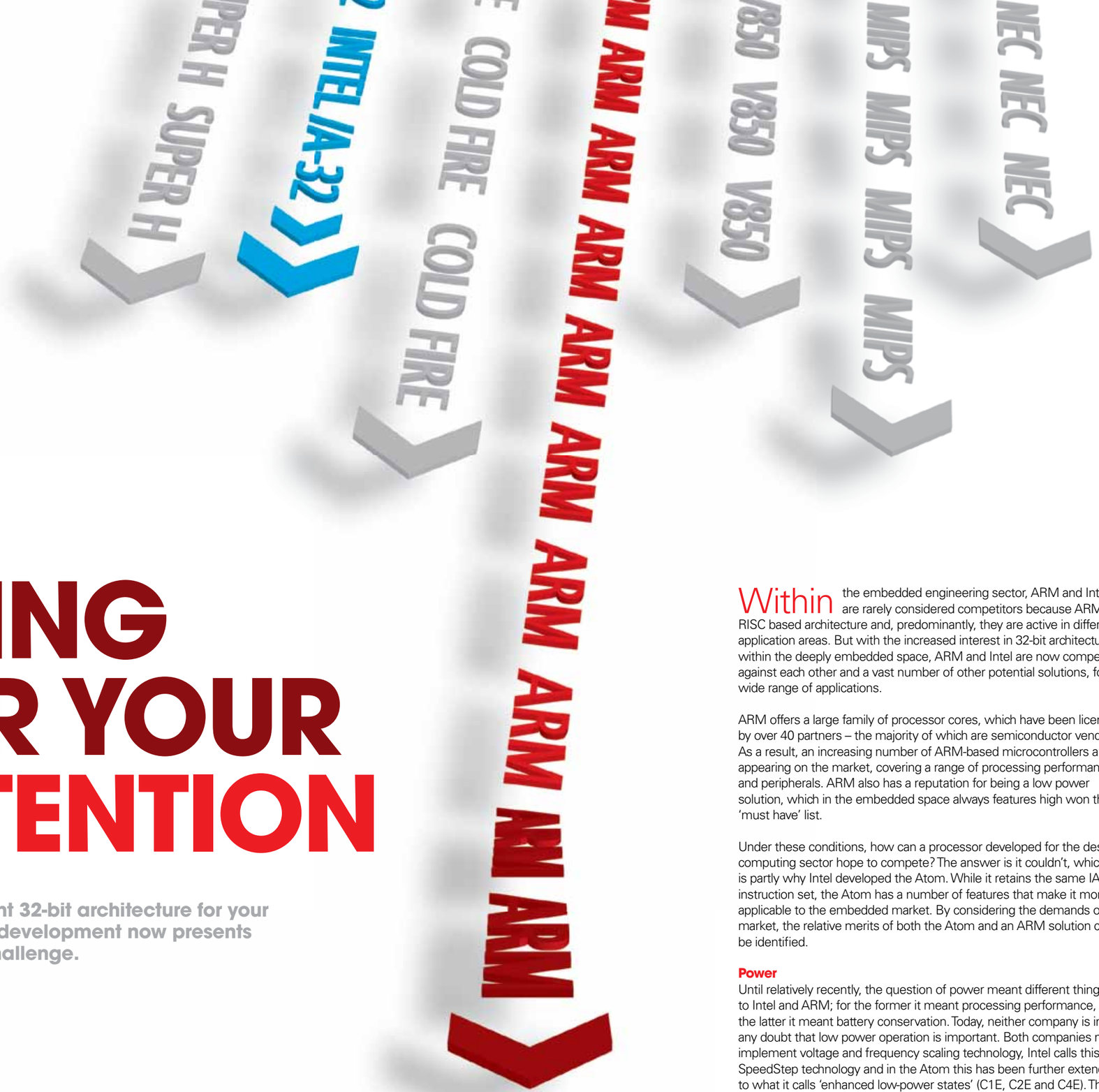
Despite its higher price and other issues such as shorter lifetimes, OLED adoption is growing rapidly. iSupply forecasts an eight-fold increase in take-up between 2009 and 2015 and LG has announced a 15" TV using OLED instead of TFT LCD. Designers can keep abreast of this new technology and evaluate it in their own project with the expanding RS range of displays from the world's leading OLED manufacturers including 4D Systems, Bolymin, CMEL, Powertip and Univision.

RS now offers displays, both active and passive matrix, spanning a range of sizes (0.79" to 7.6") and resolutions (64x48 to 800x480).

See the latest displays and evaluation kits online at rswww.com/electronics

VYING FOR YOUR ATTENTION

Choosing the right 32-bit architecture for your next embedded development now presents an even wider challenge.



Within the embedded engineering sector, ARM and Intel are rarely considered competitors because ARM is a RISC based architecture and, predominantly, they are active in different application areas. But with the increased interest in 32-bit architectures within the deeply embedded space, ARM and Intel are now competing against each other and a vast number of other potential solutions, for a wide range of applications.

ARM offers a large family of processor cores, which have been licensed by over 40 partners – the majority of which are semiconductor vendors. As a result, an increasing number of ARM-based microcontrollers are appearing on the market, covering a range of processing performance and peripherals. ARM also has a reputation for being a low power solution, which in the embedded space always features high won the 'must have' list.

Under these conditions, how can a processor developed for the desktop computing sector hope to compete? The answer is it couldn't, which is partly why Intel developed the Atom. While it retains the same IA-32 instruction set, the Atom has a number of features that make it more applicable to the embedded market. By considering the demands of the market, the relative merits of both the Atom and an ARM solution can be identified.

Power

Until relatively recently, the question of power meant different things to Intel and ARM; for the former it meant processing performance, for the latter it meant battery conservation. Today, neither company is in any doubt that low power operation is important. Both companies now implement voltage and frequency scaling technology, Intel calls this SpeedStep technology and in the Atom this has been further extended to what it calls 'enhanced low-power states' (C1E, C2E and C4E). These are sequentially more extreme states of frequency and core voltage scaling, to the point of a Deep Sleep state, where the clock can be stopped completely. Through these low power modes, the Atom is now capable of operating at levels comparable with other processors targeting deeply embedded applications. ARM, of course, has always pioneered low power technology, which may, in part, account for its success in mobile phones. As its architectures have increased in performance, it has striven to maintain that reputation but it is clear that the application software has a significant impact on the overall system performance.

Software

Developing software for an Intel Atom is, arguably, much simpler than developing software for other deeply embedded processors, because it is Windows-compatible. This means it can run the same operating system used by the majority of desktop computers, so porting an application developed on a PC to an Atom based hardware platform should be relatively straightforward. It does require that the OEM purchases a Windows licence for every unit deployed, however, which may not be commercially viable. But there is an alternative. Windows Embedded Standard is the componentised version of Windows XP and is comprised of around 12,000 individual software components. This allows for an optimised software environment which contains only those components necessary for a given application, making the platform more reliable. Windows Embedded Standard also carries a lower licencing fee than a desktop product (although there are restrictions on how it may be used).

The eco-system surrounding the ARM architecture is much larger in terms of solutions targeting embedded applications and so offers potentially even more scope for an optimised solution. This, coupled with the vast number of semiconductor vendors supporting the ARM architecture, may present a more attractive solution for OEMs targeting deeply embedded applications, many of which fall in to the industrial sector – an area where the Intel architecture has seen some success in the form of Single Board Computers (SBCs).

SBCs

Applications within the industrial sector are the 'sweet spot' for SBC vendors, but it's interesting to learn that until the advent of the Atom processor, Intel devices didn't support the industrial temperature specification. This meant that Intel based SBCs for industrial applications needed to either be screened for compliance with the industrial temperature specification, or be cooled – both of which represent an increased cost. However, the Atom is the first Intel IA-32 processor to be supplied to industrial temperature specification, which means its use in SBCs has escalated. Such as the offering launched by RS from Congatec and AValve.

ARM based devices are developed by semiconductor vendors to meet the industrial specification, making them much more accessible in this application area. Many vendors support their ARM implementations with hardware and software development kits.

When choosing a 32-bit processor architecture, there is an increasing number of vendors competing for the same design wins, many of which will be ARM based, many of which may use proprietary core. Only one will be Intel based, but with its renewed focus on embedded applications, the Atom deserves to be compared against the rest. Ultimately, while ARM, Intel and others continue to develop leading edge solutions for the embedded space, it is the engineering community at large who will remain the winner.

Visit rswww.com to see the latest ARM development kits, ATOM processors and ATOM based SBCs from Cangatec and AValve.

The Fleet behind the Flagship

The big FPGA houses enthuse about their flagship high-performance devices to anyone who will listen, but innovations among the low and mid-range devices have much more to offer engineers tackling general-purpose designs.

The word FPGA encourages thoughts of hugely complex devices offering the ultimate in resources and performance to a minority of specialist designers able to exploit them. But behind the flagship silicon, mainstream FPGAs are a competitive design option for general-purpose applications demanding low power, low cost and high performance.

FPGA vendors are competing hard to conquer general-purpose markets. Each of the major suppliers – Xilinx, Altera and Lattice – is positioning low-cost, low-power device families supported by easily accessible development kits allowing engineers to implement relatively straightforward designs benefiting from the fast time to market and efficient lifetime-management achievable through FPGA-based design.

Features Philosophy

Features conceived to target the enormous variety of cost- and power-sensitive opportunities in industrial, scientific, medical and some consumer applications include specialised on-chip functions, power-management features, and low-cost packages. Whereas the largest FPGAs require multiple power rails to support diverse system-on-chip functions, today's general-purpose devices such as the Xilinx Spartan-3A and Altera Cyclone® IV families simplify power distribution by operating from only two power rails thereby helping to save cost, engineering time and board space. FPGAs are regarded as being relatively heavy users of power, but FPGA vendors are closing the gap using innovations and process improvements.

As a result there is now a growing body of general-purpose FPGA devices that provide a viable upgrade path for CPLD-based designs. In the past, designers have had to balance the extra flexibility and performance of an FPGA against factors such as higher cost and complexity. But designers can now get the best of both worlds without trading valuable CPLD properties such as high pin-to-pin performance and instant-on functionality. Lattice, for example, has positioned its LatticeXP architecture for high-volume, low-cost applications by using a combination of SRAM and Flash technology and optimising the feature set to include configurable serial and parallel ports, on-chip PLLs, embedded block RAM, and a combination of logic-only and combined logic/RAM blocks.

There is also a noticeable difference in security mechanisms, compared to high-performance devices typically featuring on-chip AES encryption/decryption. Techniques such as Xilinx's Device DNA design-level security provide lower-cost protection against threats such as reverse engineering, cloning, tampering, or overbuilding. Device DNA, using principles similar to those of a cash machine transaction, is designed specifically to be effective in cost-sensitive, high-volume applications. Connectivity is a central aspect of many embedded designs, and bandwidth requirements can range from low-data-rate serial communications, through industrial Ethernet speeds, to Gigabit Ethernet and higher. Flexible connectivity is a known FPGA strength, and families such as the Xilinx Spartan-3 and LatticeXP2 families deliver high bandwidth per price by supporting high-speed I/O standards such as LVDS enabling off-chip communications at high Mbit/s rates.

For applications requiring higher bandwidth, Altera's Cyclone® IV family and Xilinx Virtex-6 provide integrated transceivers enabling communication at up to 3.125Gbit/s suitable for protocols such as Gigabit Ethernet, PCI Express, Serial RapidIO® and XAUI. At the same time, Altera claims that Cyclone IV consumes up to 30% less total system power than comparable devices requiring an external transceiver.

Low-Cost Tools

By optimising device performance, features and cost, FPGA vendors have delivered silicon that can compete for slots on production boards against alternatives such as ASSPs and microcontrollers. In addition, new generations of development tools, including fast-starter kits, evaluation boards, application-specific boards and reference designs are also emerging to further reduce the barriers to FPGA design starts in the general-purpose space. Family-specific kits such as Xilinx's Low-cost Spartan-3A development kit, as well as application-oriented products such as the Altera USB-Blaster™ kit, usually provide everything the designer needs to get started. They also take advantage of each vendor's well-established and robust FPGA design software, which walk engineers through a methodical and easy to understand sequence to complete the design.

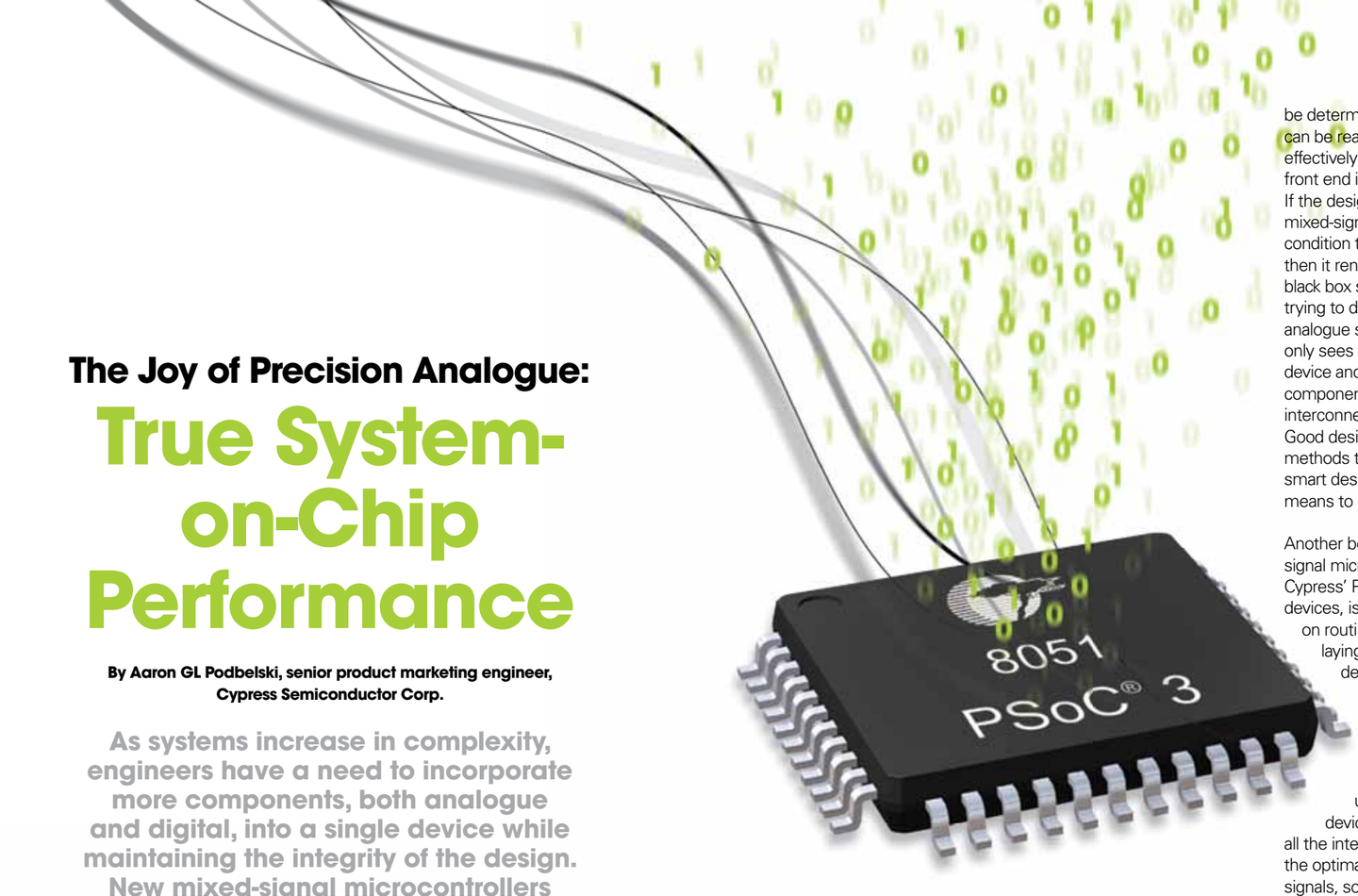
A key characteristic of the new breed of development tools supporting the latest ultra-competitive FPGA families is a low purchase price. The selling prices allow many of these kits to be ordered without requiring purchase authorisation, effectively making access to FPGA technology as easy as starting a microcontroller design.

Unprecedented Accessibility

Low-to-mid-range FPGAs are now more accessible than ever for general-purpose applications. RS supports engineers looking to take advantage of these features in new designs, by increasing access to general-purpose devices, simplifying purchasing even for small quantities, and supporting low-cost starter kits from all the major FPGA vendors.

Our FPGA range is growing rapidly. Go to rswww.com/electronics to see the latest additions.

"A key characteristic of the new breed of development tools supporting the latest ultra-competitive FPGA families is a low purchase price."



The Joy of Precision Analogue:

True System-on-Chip Performance

By Aaron GL Podbelski, senior product marketing engineer, Cypress Semiconductor Corp.

As systems increase in complexity, engineers have a need to incorporate more components, both analogue and digital, into a single device while maintaining the integrity of the design. New mixed-signal microcontrollers are emerging which integrate more precision analogue components than previous generations. Utilizing these next generation mixed-signal microcontrollers allow for designs which reduce BOM costs, save board space, protect IP, and provide more flexibility for change throughout the design process. Now mixed-signal microcontrollers have ADCs with a precision upwards of 20-bits, amplifiers with lower offset voltages, and 0.1% voltage references.

Previous generations of mixed-signal microcontrollers allowed for an increased level of integration in a design, but often those featured analogue components did not have enough precision for many designs. Low-end analogue designs benefited from the integration, but mid- and high-end designs still required external analogue components. Newer generations of mixed-signal microcontrollers have improved their analogue components, and therefore are allowing mid- and some high-end designs to take advantage of the benefits of a device incorporating both digital and analogue signals.

The more capable the mixed-signal microcontroller is, the more likely the design can be a true system-on-a-chip. By incorporating ADCs, DACs, comparators, mixers, amplifiers, filters, and voltage references a single mixed-signal microcontroller can be the complete analogue front end of a design and the control system. A design could have the input of two sensors, amplify and condition the signals, then quantify them to be displayed on an LCD that is directly driven by the device. An example of this would be a temperature compensated gas meter, a design which would be a complete system-on-a-chip.

One of the main benefits of using a mixed-signal microcontroller is analogue IP protection. A complex analogue design which uses individual components can be reverse-engineered by competitors. The list of components used can easily be determined, and the signals can be read by an oscilloscope effectively turning the analogue front end into a reference design. If the design effectively uses a mixed-signal microcontroller to condition the analogue signal then it renders that design into a black box situation. A competitor trying to determine how an analogue signal is being handled only sees the input into the device and has no insight into the components used, how they are interconnected, or their settings. Good designs utilize novel methods to solve a problem; smart designs employ novel means to protect their IP.

Another benefit of certain mixed-signal microcontrollers, such as Cypress' PSoC 3 and PSoC 5 devices, is that they solve worries on routing signals. When laying out traces on a PCB, designers need to take careful consideration of noise-inducing signals and properly shield sensitive ones. The software tools used to program these devices automatically route all the internal signals to provide the optimal integrity for analogue signals, so a system designer has more time to focus on other portions of the project.

In general mixed-signal microcontrollers allow for cost savings in a design. The integration of ADCs, DACs, comparators, amplifiers, mixers, voltage references, analogue MUXs, etc., provide a BOM reduction. As a device incorporates more commonly used analogue components, then the external components are obviously not needed and money is saved. In the same respect, as these components are no longer on the board, the PCB can be reduced in size to save more money. Additionally, with fewer components on the board, routing is simplified, allowing a designer to worry less about noise issues with traces and spend less design time. As mixed-signal microcontrollers start to increase the precision and accuracy of the included analogue components, more designs can utilize the money savings from using these devices as systems-on-chips.

A digital cooking thermometer is a good example of how new high-precision mixed-signal microcontrollers can provide a concise solution over previous generations. In this example, a type K thermocouple will be used for the temperature probe, which provides an output of ~40µV/°C. Since the output is small for the range needed, a very precise reference is required to accurately capture the signal. The thermocouple output is an absolute measurement, so a cold junction reading is required as well, which is performed by a thermistor (as a thermistor provides a ratiometric measurement).

Previous generations of mixed-signal microcontrollers required the use of some external components to properly measure a thermocouple. Because the internal voltage reference inside of older mixed-signal microcontrollers is accurate to 3% on average, an external precision reference is required. A 0.1% accurate voltage reference is commonly used for this purpose. The voltage reference is used as a scale reference point and is fed into the controller's ADC as well as into the thermocouple input. The ADC then alternates between reading the thermocouple and the voltage reference in order to provide a proper reading. Because the thermocouple's output is small, an amplifier may be used to increase the signal depending on the resolution of the ADC. The output of the thermistor is read as a thermal reference and the output of the thermocouple is added to this measurement. Figure 1 shows this setup.

For the new mixed-signal microcontrollers the setup for measuring a thermocouple's output is far simpler. Some of these mixed-signal microcontrollers have a highly accurate voltage reference, such as Cypress' PSoC 3, which has a 0.1% voltage reference. In this case, the external reference is not needed. The ADC can use the internal reference for measurement so the designer does not need to worry about accounting for the additional setup to accurately read a thermocouple, which is shown in Figure 2. If the device being used also has a high-resolution ADC, then the amplification stage can be removed since the conversion will provide enough granularity of the signal. The Cypress PSoC 3 device has a 20-bit Delta-Sigma ADC which can measure a 1.0V range signal down to 1µV. The use of a high-precision mixed-signal microcontroller allows designers to spend less time on the design, as it is less complicated. This in turn saves board space and money.

Overall, new generations of mixed-signal microcontrollers allow designers to simplify their designs, protect their IP, reduce the need for external components, and increase the amount of value they are receiving from a device. The increased quality of the analogue components in these devices provides designers with more choices in how a design can be accomplished and allows for unique methods to solve a problem. The thermocouple example discussed shows how various levels of mixed-signal microcontrollers can solve an issue, and how the newer generations allow an even more simplified design. Mixed-signal microcontrollers are becoming more prevalent in a wide variety of designs, and the latest generation of these devices, with their increased analogue performance, validates this growth.

RS has a wide range of mixed signal microprocessors now available. To find out more, visit rswww.com/electronics

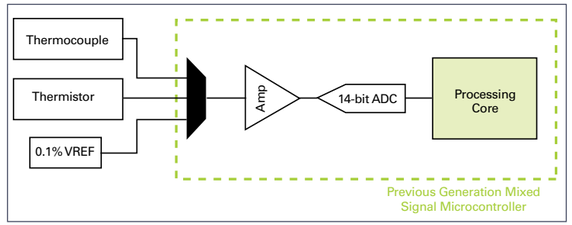


Figure 1: Block diagram of a thermocouple reading based on less precise mixed-signal microcontrollers.

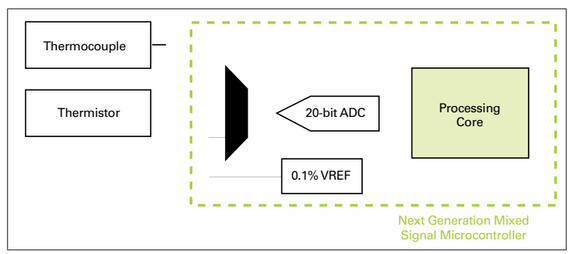
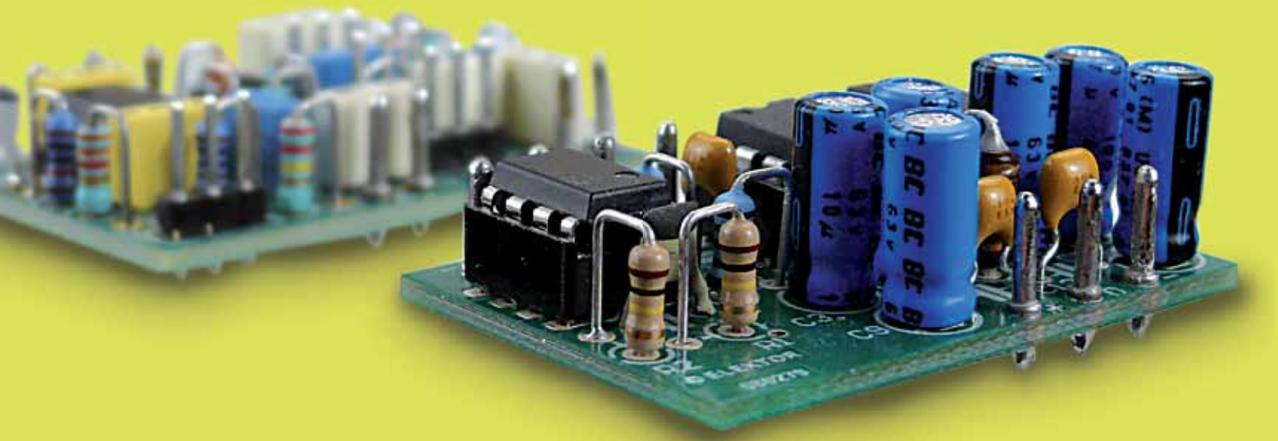


Figure 2: Block diagram of a thermocouple reading base on new high precision mixed-signal microcontrollers.

IN ASSOCIATION WITH elektor

Part 2: Power in the Pocket

POCKET PREAMP



Ton Giesberts (Elektor Labs)

The PWM power stage discussed in the previous edition of eTech can be used perfectly well on its own. But a matching preamplifier with power supply would complete this amplifier nicely. That is why this edition's Mini Project presents the sequel: the Pocket Preamp.

In the previous edition of this series of articles we described a small PWM amplifier. What is missing from this are tone and volume controls. Since most people are spoilt these days with surround sound systems equipped with an equalizer as an absolute minimum, we made this preamp with a 3-way tone control, instead of the more customary bass/treble control.

Main Specifications
- 3-band tone control
- Symmetrical supply
- Compact
- Connector layout matched to associated boards

Tone control

The tone control has an adjustment range of ±12 dB for the low and high frequencies and ±9 dB for the mid frequencies. The latter is more than enough, because our ears are more sensitive to mid-range frequencies. The circuit will also remain reasonably straightforward with these values. If these adjustment ranges are too small then there is very likely something wrong with the loudspeakers. A control range of 12 dB means that, because of the relatively limited power of the output stage, there is an imminent danger of overdriving it, particularly for the low and middle frequencies. After all, an increase of 12 dB implies an increase in power by a factor of 16!

The circuit

The volume control (P1) is connected directly to the input of the preamplifier (see Figure 1). This is the best place to prevent the tone control stage from being overdriven. The first amplifier stage (IC1a) is non-inverting and has a gain of 4 times as calculated from:

R3 / R2+1

At a supply voltage of ±9 V, a signal of more than 1 V (i.e. a little over 1.2 Veff) can be processed without distortion, when the tone controls are in their centre positions. It will be obvious that when either the high or the low tone control is at its maximum value, the maximum permissible input signal is a lot smaller at only 300 mV (for the applicable frequencies, of course). At this point the output of the tone control is just below the point of being overdriven (but it will already overdrive the power amp, so take care!).
The operation of the tone controller is not all difficult to understand. The part around IC1b is an inverting amplifier with three feedback circuits connected in parallel for the tone control. Resistor R12 ensures that the output cannot swing to the power supply rail in the event of contact bounce by the wiper of P2. Incidentally, R1 functions in a similar way for volume control P1. C8 and C1 suppress RF (high frequency) interference.

P2 is the bass control. C2 determines the frequency range that will be controlled. Simply put, at higher frequencies, C2 effectively shorts out P2. The amplification is then determined by the ratio of R5 and R4. The ratios of P2 to R4 and R5 determine the minimum and maximum control range respectively. The maximum gain for example is:

(P2+R5) / R4

and amounts to about 5.5 times (15 dB, DC). R6 is necessary so that the other frequencies can be adjusted with P3 and P4. C7 primarily determines from which frequency the high tone control operates. C5 and C6 ensure that the tone control has a steeper response. Components R9 and C4 have the same functions for the mid frequency control as R6 and C7 for the low and high controls. C3 has the same function as C2, but filters the high frequencies much later. Together with C4 it sets the range of the mid control. In the end, the control ranges of the mid and high adjustments are not only determined by, for example, the ratio of P3 to R7 and R8, but the other components in the feedback circuit also play a role. That is why the ratios between P3 and P4 to R7/R8 and R10/R11 are greater than would be expected from the actual control ranges. The low tone control has quite a wide bandwidth, because we assume that small loudspeakers will be used. If this tone control is going to be used with a larger amplifier and speakers, a larger value for C2 may result in a better sound. Output resistor R13 prevents problems in the event an excessive capacitive load is connected.

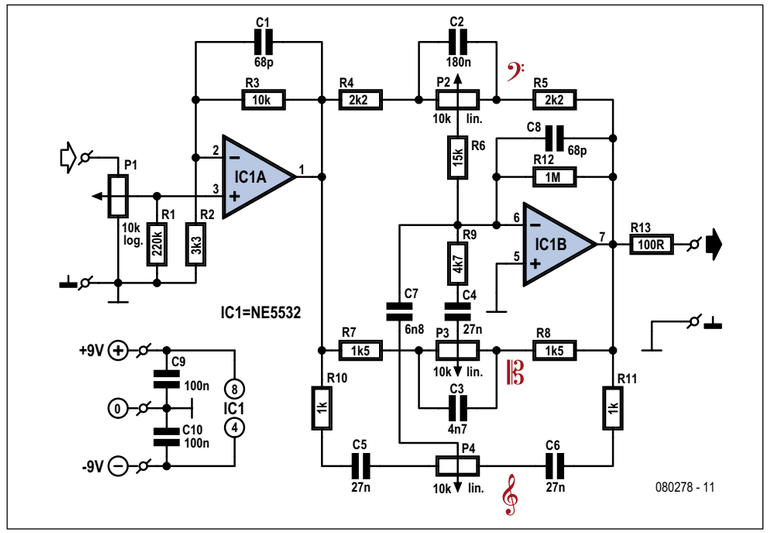


Figure 1. The preamplifier is quite straightforward for a volume control with triple-band tone control.

Power supply

The power supply is symmetrical. This way we can avoid relatively large coupling capacitors and their detrimental effects on sound quality. The disadvantage is that a negative supply voltage is required. The easiest solution is a circuit that inverts the positive power supply.

We selected a DC/DC converter from Maxim, the ICL7662 (see Figure 2). This IC works as a charge pump and can operate with voltages up to 20 V. Pin-wise and functionally the IC is compatible with the more common ICL7660,

Continued page 28 >

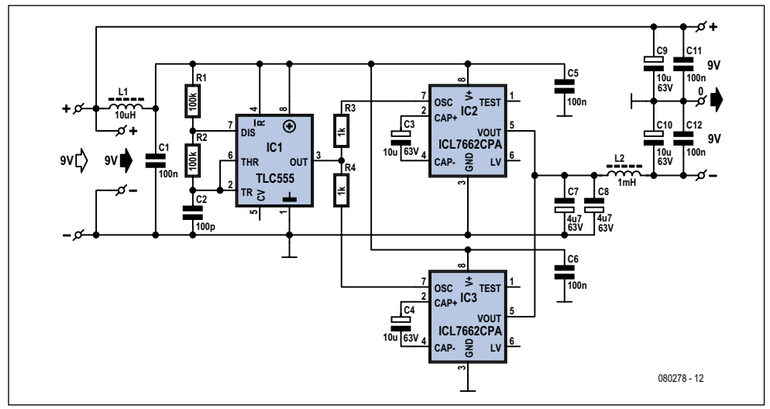


Figure 2. A voltage converter is used to convert a single power supply voltage into a symmetrical power supply.

< Continued from page 27

which can operate up to 10 V (the 'A' version can handle voltages up to 12 V). These parts can also be used here without any problems. The biggest advantage of this is the simplicity; only two external capacitors are required. A small disadvantage is that the output voltage is not regulated.

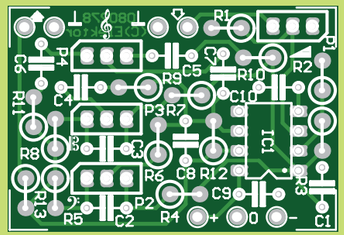
The unloaded output voltage is equal to the input voltage, but negative. As the output current increases the output voltage will reduce however. To increase the stability of the output voltage two ICs are connected in parallel. If you load a single IC powered at 9 V with a resistance of 100 Ω, the output voltage drops to about –4.6 V. With two ICs in parallel this drops to only –6.3 V. With your preamplifier as a load the output voltage drops only 0.35 V (the NE5532 draws about 7.5 mA). You could also use other opamps that have a lower current consumption, but their quality is often inferior; the NE5532 is an excellent audio opamp.

In our prototype we initially connected four ICs in parallel, but with three or four not much more is gained. There was however a strange effect: the ripple in the output was found to vary slowly between a minimum and a maximum value. This was caused by the asynchronous operation of the internal oscillators. In addition, the frequency of this power supply ripple was 10 kHz so it could become audible. That's why the ICs are driven with an external clock furnished by a 555 IC. The frequency of the 555 is set to 40 kHz, so that the ripple at 20 kHz is just outside the audible range. An advantage is that the inductor in the output filter can be much smaller, which results in a much smaller resistance loss for this coil. The inductor we used for L2 has a rated series resistance of 12 Ω. L1 and L2 are standard axial noise suppression chokes, which are fitted upright here. The latter is also true for the four resistors in the circuit; this saves space.

We won't dwell on the circuit around the 555. It is the standard astable configuration. IC1 drives the clock inputs of the two converters, each via a 1 kΩ resistor, to prevent potential problems at power-on (risk of latch-up). The ripple across the filter capacitors C7 and C8, which are connected in parallel for a lower series resistance, is almost completely removed by output filter L2/C10/C12. On an oscilloscope only a very small amount of the switching frequency of the power amplifier can be seen.

Component List

Preamplifier board



Resistors

R1 = 220kΩ	(159-004) RS P/N
R2 = 3.3kΩ	(157-480)
R3 = 10kΩ	(150-928)
R4,R5 = 2.2kΩ	(151-088)
R6 = 15kΩ	(151-145)
R7,R8 = 1.5kΩ	(151-094)
R9 = 4.7kΩ	(151-000)
R10,R11 = 1kΩ	(157-446)
R12 = 1MΩ	(151-123)
R13 = 100Ω	(157-610)

P1 = 10kΩ potentiometer, logarithmic (361-7033)
P2,P3,P4 = 10kΩ potentiometer, linear (361-7033)

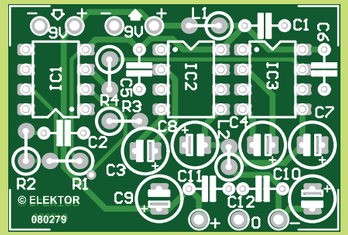
Capacitors
(lead pitch 5mm / 0.2")
C1,C8 = 68pF ceramic (653-0030)
C2 = 180nF polyester / MKT (334-209)
C3 = 4.7nF polyester / MKT (312-1661A)
C4,C5,C6 = 27nF polyester / MKT (312-1447A)
C7 = 6.8nF polyester / MKT (622-4145)
C9,C10 = 100nF polyester / MKT (463-1765)

Semiconductors
IC1 = NE5532 (DIP-8) (810-188)

Miscellaneous
PCB, # 080278-1
(www.thepcbshop.com)

Component List

Power supply board



Resistors
R1,R2 = 100kΩ (151-303) RS P/N
R3,R4 = 1kΩ (157-446)

Capacitors
C1,C5,C6,C11,C12 = 100nF ceramic, lead pitch 5mm (0.2") (652-9995)
C2 = 100pF, lead pitch 5mm (0.2") (405-7662)
C3,C4,C9,C10 = 10µF 63V radial electrolytic, lead pitch 2.5mm (0.1") (521-3504)
C7,C8 = 4.7µF 63V radial electrolytic, lead pitch 5mm (0.2") (520-1040)

Inductors
L1 = 10µH axial (vertical mounting) (191-0481)
L2 = 1mH axial (vertical mounting) (191-0712)

Semiconductors
IC1 =TLC555 (DIP-8) (638-942)
IC2,IC3 = ICL7662CPA+ (DIP-8) (Maxim IC) (207-0118)

Miscellaneous
PCB # 080279-1
(www.thepcbshop.com)

Test results
The most interesting test results for the tone controller are of course the individual frequency response curves for the tone adjustments. Figure 3 shows the maximum, minimum and neutral positions (the positions of the bass and treble controls remain unchanged). In the neutral position a slight attenuation of less than 1 dB at 20 kHz can be seen. This is mainly caused by RF suppression capacitors C1 and C8. At 20 Hz the variation in gain is ±14 dB (±12 dB at 40 Hz) and at 20 kHz it is about ±12 dB.

The distortion with an input signal of 0.5 V is less than 0.005 % (1 kHz, 22 kHz bandwidth, volume control to maximum, tone controls to

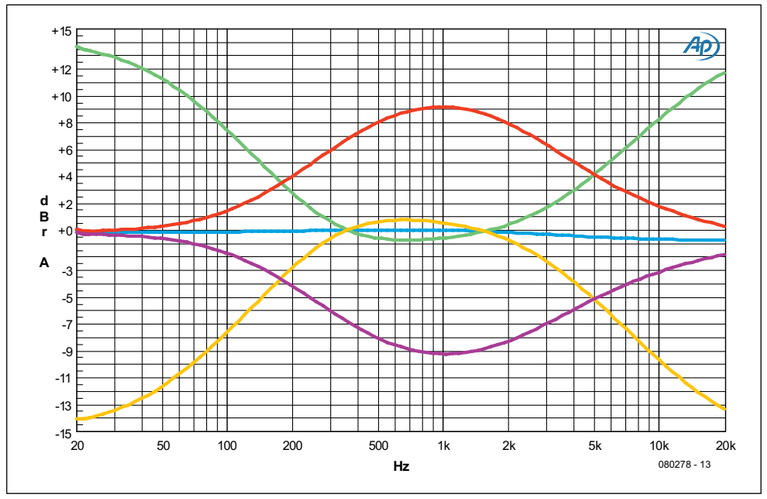


Figure 3. The curves show the effects of the different maximum settings of the tone control.

neutral). The current consumption of the entire circuit is 56 mA at 9 V, 12 mA up on the PWM amplifier by itself. With an 8 Ω loudspeaker and the amplifier overdriven slightly, the current consumption peaks at about 162 mA. This really is too much for a 9 V battery. With multiple channels we therefore recommend that you use an AC power adapter.

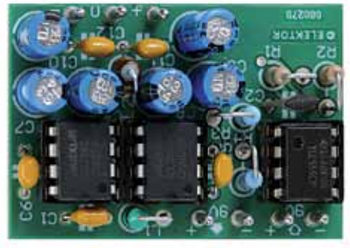
During the tests we didn't actually use potentiometers for the tone controls, but instead went for rotary switches and resistors. This is because the interest is mainly in the performance at the neutral positions and at the upper and lower limits. So, each potentiometer is reduced to two resistors and a rotary switch. The tolerance of potentiometers is usually quite large; ±20 % is typical, and inevitably has an effect on the frequency ranges and maximum and minimum gains. With multiple channels the individual deviations can result in audible differences. If you have the opportunity to check whether the individual channels of stereo potentiometers are matched then it is certainly recommended that you do this. With more than two channels, the use of rotary switches with multiple poles may be considered, but this is an expensive solution.

Construction of the three boards
The connections for the three boards have been placed in the same positions as much as possible. The output of the preamplifier is in the same corner as the input to the power amplifier. The power supply connections of the preamplifier are in the same place as the power supply outputs of the power supply board. The 9-V input of the power supply board is looped directly to the two connections for the power amplifier. The position of these corresponds to the power supply connections of the power amplifier. On the power amplifier, next to the power supply connections, there are also the connections for the power supply switch (S1). This is only for the power amplifier. It is better to insert a switch in series with the input to the power supply board. You can then short out the connections for S1.

Mounting holes were deliberately not included on all three of the boards so that everything is as compact as possible. For a reliable mounting option you could consider a couple of plastic supports with slots. The boards can then be mounted one above the other. The best order is the power supply board at the bottom, the tone control above that and the power amplifier at the top.

(080278-1)

Kit set
As indicated in the parts list, you can order the bare printed circuit boards for this project from www.thepcbshop.com.



LINDSTROM® TWEEZER SET

■ **Two-piece set of the most popular tweezers supplied in an ESD wallet. Items are hand crafted from stainless steel to give perfect tip symmetry and balance which ensures tips always meet and line up perfectly.**

RS Online search term: **361-3104**

LINDSTROM

TIME ELECTRONICS 8-DECADE RESISTANCE BOX

Offers a wide resistance range for general laboratory work.

■ **A high accuracy resistance box, with a low temperature coefficient. Clear visual indication is provided with colour coded digits, and is ideal for Platinum Resistance Thermometer simulation. A special multiple gold contact arrangement ensures low contact resistance. Accuracy is 0.1% to 10% depending on range, and zero residual resistance is less than 90mΩ.**

RS Online search term: **610-297**

RS ULTRANE 550 HAND PROTECTION

For use in assembly, finishing, clean room and electronics manufacturing.

■ With excellent abrasion resistance for enhanced durability, superior breathability thanks to the material, enhanced finger sensitivity due to the reduced thickness, and a hand-specific design providing precise fit. To EN388 4131. Supplied in bags of 10.

RS Online search term: **475-849 (small), 475-823 (medium), 475-855 (large)**

DINO-LITE COMPACT DIGITAL MICROSCOPES

Ideal for electronics assembly, repair and quality inspection.

■ Dino-Lite is a compact digital microscope with a lot of new possibilities compared to the traditional microscope. The Dino-Lite can be connected to a computer and allows you to record moving and still images.

Dino-Lite comes in different versions, developed for specific applications. Depending to the version, magnification ranges from ~10 to 200 to 500x. LED lights are built-in, in white, polarized, and ultraviolet combinations. Most versions have calibration and measuring options, and housings are either composite or aluminium alloy.

RS Online search term: **Dinolite**

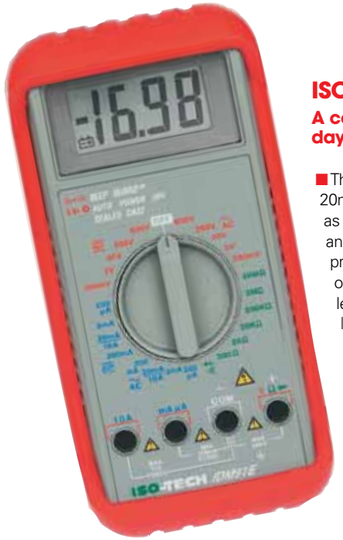
AC DIGITAL VOLTMETER/ AMMETER

■ **A 3 & ¾ digital display with 40 segment bar graph. Available in both standard and negative LCD formats, with colour options of red, green and white. Options available measuring AC & DC voltage up to 300Vdc and current up to 40A. 48x48mm sizing makes them ideal for upgrade from older moving coil panel meters.**

RS Online search term: **Trumeter *APM***

ISO-TECH IDM91E MULTIMETER

A cost-effective digital multimeter for day-to-day use.



■ This very popular multimeter has a large 20mm digit high contrast display for clarity, as well as diode test, continuity beeper, DC and AC Volts and Current measurement. The protective holster includes a tilt stand for use on a bench, as well as storage for the test leads when not in use.

RS Online search term: **159-2140**

POLYURETHANE POTTING COMPOUND

■ Twin pack format enables mixing of the resin and hardener within the bag thus preventing air entrapment and providing ease of application for user. This dark grey, two part flexible encapsulant is designed to provide environmental protection whilst not causing component stress by shrinkage during curing process. Cure time is 16 hours at 25°C and once cured is flame retardant and gives good adhesion to a wide variety of materials.

RS Online search term: **199-1395**

ELECTRONIC CUTTERS

■ **Lindstrom® are well known within the electronics industry to be of the highest quality. They are made to exacting standards using the finest quality materials and are used in high-end electronics application such as aviation, computer, telecoms and medical.**

RS Online search term: **Lindstrom cutters**

LINDSTROM

PRECISION CLEANING EQUIPMENT

■ RS has a full range of products for use in precision electronic applications from swabs and wipes to cleaning fluids and air dusters. We also have a wide range of RS branded cleaning products to offers a cost effective but quality solution.

RS Online search term: **Precision cleaning equipment**

BI-COLOUR BACKLIT LCD METER

■ **A compact, panel mount, 3.5 digit LCD 200mV FSD voltmeter with dual colour 'stop/ go' backlit display. During normal operation the display is green, however if the reading exceeds a programmable threshold the display will turn red to warn operators.**

Easy setup via DIP switch and 2 buttons. Open-collector alarm output mirrors backlit status for remote monitoring or process control. 40x72mm panel cut-out and supplied complete with mounting bezel and accessories.

RS Online search term: **667-3991**

The (Hidden) Power Behind the Test System

Engineers typically feel little pressure to renew their trusty laboratory power supplies. Although digital oscilloscopes and function generators are frequently upgraded to test high-speed, feature-rich new designs, engineers believing "they don't make them like this anymore" can be happy to connect the board to the same PSU that has served the department for 20 years or longer.

However, the latest models offer some important benefits and valuable new features that help to reduce setup and execution time and provide greater control and flexibility for testing modern assemblies.

Design priorities for modern electronic products are changing, and these changes affect the expectations placed on laboratory PSUs. The consolidation of functionality into ICs to reduce product size and cost and to add extra features, is increasing the need for engineers to perform actions such as device characterization and validation on the bench. There is also a trend towards portable and battery-powered equipment, which is increasing the importance of accurate measurement of power consumption.

Precision Power

Multiple output channels allow the PSU to be connected to modern boards that often have several power domains operating at different voltages, for example to supply power-electronic components, analogue voltage rails, ICs operating from a variety of voltage levels, or devices with independent core logic and I/O voltages. The latest models deliver a significant advantage over many older types by providing more flexible over-voltage and over-current protection capabilities. PSUs offering independent over-voltage and/or over-current settings, for individual outputs, allow engineers to power boards without using several power supplies.

Agilent's latest products include robust fault-detection capabilities, as well as guaranteed specifications for its benchtop, modular and application-specific PSUs, giving engineers a high level of confidence in the latest equipment.

As another example, showing how the latest units can respond automatically to protect the device under test (DUT) in the event of a fault, the fuse-linking capability included in Hameg's range of laboratory PSUs caters for boards having interdependent power domains. In a motor-control system, for example, if a short circuit causes one supply rail for the driver bridge to shut down, it is desirable also to turn off the complementary supply. The PSU can be programmed to shut down these two rails while continuing to supply the controller board to and so allow the circuit to be tested.

Moreover, with the growth in markets for alternative energy sources, an increasing number of engineers need to be able to test devices such as solar cell assemblies. PSUs such as the Hameg HMP series cater for this growing need by allowing users to create complex V/I profiles specific for each cell. The ability to simulate events such as brown-outs or the injection of voltage or current peaks, or to individually program current versus time behaviour for any channel, also allows engineers to create robust tests for battery-charging circuits.

Smaller is Better

To save desk space and help engineers work more efficiently, Hameg has designed its range to allow engineers to use one PSU to fulfil as much as 85% of the general-purpose power supply requirements they deal with on a daily basis. Its HMP family comprises four units, offering two- and three-channel configurations, in 200W and 400W classes, capable of supplying up to 40A. This approach will allow some companies to provide a PSU cost effectively on each engineer's desk. This can save the need to laboriously retrieve and return equipment from storage and will help companies avoid accumulating a large assortment of different power supplies.

On the other hand, buyers facing many diverse requirements need flexibility and choice. Agilent, for example, can offer over 200 configurations including benchtop DC supplies such as the single-output 601X, 603X, 606X, 65XX, 66XX families as well as its N5700/N8700 compact, high-power system supplies in a variety of standard U sizes. This is one of the widest power-product ranges in the industry, conceived to satisfy as many customers' needs as possible.

Enhancing Usability

Most of today's circuit boards operate from generally lower voltages than previous generations. As far as laboratory PSUs are concerned, more precise control is necessary to maintain stable voltage and current at lower nominal levels. Thurlby Thandar Instruments (TTi) has responded to this by emphasising user-interface enhancements that help engineers achieve a valuable increase in control over the instrument. The user interface of TTi's new PL series of PSUs, for example, has been designed to satisfy customers' wishes for equipment combining the stability of digital control with the simplicity and speed of traditional analogue control knobs. These provide true analogue control knobs but also implement internal digital circuitry to perform functions such as locking voltage and current settings at the press of a button to provide optimal security and stability. Another important digital function allows users to define the output-voltage adjustment range. The instrument also then configures the control knob response automatically so that one full turn of the knob will span the entire user-selected range. This function, called V-span, allows engineers to create a voltage source that is adjustable over a very small range, if required.

Mixed-Mode Regulation

PSU manufacturers have implemented mixed-mode regulation to deliver the best aspects of both linear and switching principles. On the AC side, a compact switching regulator performs efficient bulk power conversion. In the DC output channels however, precision linear regulators are used to produce a stable, accurate voltage free of switching harmonics that could otherwise only be removed by applying impractical levels of filtering. Mixed-mode architectures feature in power supplies from most leading vendors.

TTi has further developed this topology for its PowerFlex range, which uses a modified form of mixed-mode regulation to provide higher levels of current when the voltage is set to lower values. This is valuable for powering advanced, high-performance equipment such as motherboards and rack-mount cards populated with low-voltage processors.

Conclusion

While tried and tested equipment has its attractions, engineers risk underestimating the contribution that modern laboratory PSUs can make to improving efficiency, streamlining test design and execution, saving capital expenditure and, ultimately, reducing time to market for new generations of products.

To see the full range of laboratory PSUs available from RS, visit rswww.com/electronics

Graphical display is a winner for Powelectrics

A well structured user interface which makes imaginative use of a flexible graphical display can be a huge advantage in the market, as Powelectrics found when they launched Metron2, an affordable telemetry outstation and the first of its kind to feature a graphical display. The design netted the company a significant global contract with a major multinational – and won its designer, Oliver Start, the Young Engineer of the Year award, sponsored by RS, at the British Engineering Excellence Awards.

According to Powelectrics Sales Director David Oakes, the achievements in the design of the Metron2 were twofold. "Traditionally, industrial products requiring installation have a poor level of user feedback, which means that the installer is working almost blind. The LCD graphical display on the Metron2 makes the commissioning process clear and simple, using a logical menu system. The display also offers local access to measurements if required." he said. "At the same time, Metron2 is designed to compete at the price sensitive end of the GSM/GPRS telemetry market. It proves that a compact, reliable and functional telemetry system offering a great user experience can now be realised at low cost." Powelectrics consulted extensively with users at all levels at the final design of the menu system and the layout of information on the display, a point which particularly impressed the BEEA judges.

Glenn Jarrett, Head of Electronics Marketing from RS, congratulated Oliver Start on his success in the awards saying, "The user interface and other features conceived by Oliver and developed by him to a tight budget gave Powelectrics a significant advantage. Achieving a design of this quality within just a few years of graduation and joining the company is an exceptional achievement."

Powelectrics made extensive use of the RS next day delivery service during the prototyping phase of the Metron2 project.

According to Dave Oakes, "Like all designers, we explore many alternative options before specifying the display and other key components. Slow arrival of samples can be a huge frustration – and can add considerably to the time to market over the life of a project. With RS, we can be absolutely sure that anything we order from stock will be with us the next day."

Commenting, Glenn Jarrett said, "To maintain the rate of innovation for which our industry is justly famous, it is crucial to encourage young men and women to enter the electronics engineering profession. These awards play a key part in recognising the crucial role that they play." He continued, "Oliver Start took the Metron 2 project from concept, developed them into prototypes, and brought to production a highly innovative solution that is already showing great commercial potential. He is an excellent example of the kind of young engineer we need to encourage in industry."

Quantum is the key to beat fraudsters

By Richard Nock, Bristol University

The growth of Internet-based commerce has highlighted security limitations in card transaction systems, leading to improvements in cryptographic standards and techniques. However, the currency of conventional cryptography is computing power; with enough computational ability, the key can be broken to enable fraudulent transactions.

One such project aims to perfect a new generation of security systems for card transactions. In this article, Bristol University PhD student Richard Nock describes his work with the Faculty of Engineering's Professor John Rarity and Dr Naim Dahnoun on the university's Quantum Key Distribution (QKD) project, which aims to provide a basis for secure e-commerce capable of resisting attacks using aggressive code-breaking algorithms.

The time is approaching when ultra-miniature processor circuitry will begin to follow the rules of quantum physics, rather than those of classical physics. At this point, quantum algorithms such as Shor's algorithm will be able to perform number-crunching tasks such as those used to break security keys much more quickly than the computers we know today; this will make conventional cryptography obsolete almost overnight.

Quantum Key Distribution (QKD) systems establish a different currency for cryptography, based not on computing power but on the physics of light. QKD provides a means of generating a perfectly secure key between two parties. Because the key's security is not dependent on computational difficulty and computational time, QKD effectively takes the breaking of key codes out of the realm of the quantum computer and also provides a means for the communicators to detect an eavesdropper in the quantum channel whilst generating a key. This will allow banks and institutions to combat many types of fraud, including "Card Not Present" frauds, by enabling secure communications and money transfers using guaranteed-secure keys between the two parties.

Quantum Key Distribution

My PhD is in researching and creating the technologies required for making a QKD system plausible for consumer markets. The final aim of the research is to have a system where QKD transmitter chipsets could be embedded in phones, PDAs and other smart devices, to communicate with a corresponding receiver in Quantum Automated Teller Machines (ATM) allowing anyone to generate secured keys for use with facilities such as online shopping.

A typical QKD system consists of the QKD Transmitter, usually called Alice, and the QKD receiver, known as Bob. The Quantum communication channel is via light. The Bristol system communicates through free space, but an optical fibre could be used. The system must also have a classical channel, which could use a standard such as Ethernet/Wi-Fi, Bluetooth, USB, RS-232 or similar, to carry non-secure communications.

Light is encoded such that there are four polarizations 0°, 90°, 45° and 135°. The 0° and the 90° polarizations are the rectilinear bases with 90° representing a logical zero and 0° representing a logical one. In a similar fashion 45° and 135° are the diagonal bases with 45° and 135° representing logical zero and one respectively. Alice transmits random bits, on random bases, and Bob receives by also selecting at random the basis to measure in. After transferring a sufficiently large number of bits Alice uses the classical channel to transmit the bases she used to Bob. Bob then analyses the received data, discarding data where they did not select the same bases. Alice should also release part of the actual data she sent such that Bob can estimate an error rate. This subset of the key is then discarded as it has been on a classical open channel. The remaining bits with matching bases is now the Key, and Bob shall transmit which ones matched back to Alice, again not transmitting the actual data.

The error rate is how we verify the QKD channel is secure. Due to the physics of light, if an Eavesdropper (Eve) is passively looking at the photons, she will disturb their state, losing any data encoded upon them. Hence Eve's presence increases the error rate. Another exploit would be for Eve to replicate a Bob receiver, and then retransmit photons to the real Bob. This would also introduce more errors as Eve's receiver will have to choose the receiving basis randomly, which will also increase the error rate. By monitoring of the error rate, we can ensure the bits we have between Alice and Bob are secure.

Research Objectives

Current development is on an FPGA and Microcontroller-based Alice, and a Bob receiver comprising an FPGA and an Embedded PC running Linux. Building on earlier work by researchers in the department, I have implemented some improvements to the Alice transmitter aimed at enabling a smaller, lower-cost implementation whilst improving bit rate and key/basis storage space.

My next goal is to reduce the size and cost of the QKD system, in which Alice currently measures around 10cm x 12cm and Bob is in a 19 inch rack mount case. The new Bob will be reduced in cost and size by building a DSP & FPGA based implementation. RS is providing development environments for the chosen DSPs, the Texas Instruments C2000 and OMAP.

It is still too early to predict exactly when a QKD system could be viable at consumer price points. Practically, current cryptography offers adequate security at a relatively low cost; hence QKD remains largely an academic pursuit. In reality, however, the race between QKD and quantum computing is happening now, and the outcome is critically important to commerce and finance worldwide.

If your university is interested in working with RS and would like more information, email etech@rs-components.com

CONNECTORS FOR RENEWABLE ENERGY

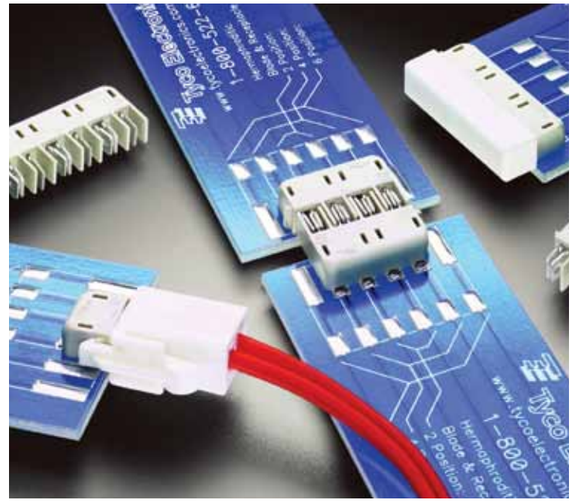
Renewable and sustainable electrical and electronic systems are often characterised by high levels of DC current and the need for low energy losses. These requirements pose specific challenges when it comes to developing interconnect and electromechanical products for this market. In expanding its 35,000 strong portfolio of connectors from 70 suppliers, RS has introduced a number of solutions aimed at this application area.

Energy efficient lighting

Lighting in commercial and domestic buildings uses a lot of electricity and there is growing interest in using LEDs as an energy efficient and long lasting light source. RS is supporting this application with a new family of Tyco hermaphroditic blade and receptacle wire-board and board-board connectors, supporting the increasingly popular strips of LED lights that are being produced to give effect lighting and to replace fluorescent tubes. Rated at 6A and 125VAC/DC, they are ideal for this class of applications.

High DC Currents

Sustainable systems such as electric and hybrid cars require small, light and cost-effective connectors that can cope with the very high DC currents. Tyco offers a broad range of multi-point contact systems that meet these specifications, from the cost effective AMP MCP system to higher performance interfaces with larger number of contact points. The Tyco Kilovac range of hermetically sealed contactors (relays) has been used in electric vehicles for many years, and the manufacturer has extended the range with new versions addressing the needs of the latest applications.



Solar energy

Solar energy is another growing market with exacting requirements to meet. Solar panel installations feature a series of connectors between the module and the inverter, often linking multiple panels in the same installation. The requirement here is for a low loss, easy to use push in – pull out connector that meets the demanding safety and environmental requirements of this application. Each connector needs to be well protected against UV radiation and water alike, have the required UL/ DIN / VDE strain relief and should feature a safety clip that prevents unmating without the appropriate tool to meet NEC 2008 standards. The systems need to be low loss, so that as little as possible of the hard-won renewable electricity is dissipated as heat downstream of the panel. Multi-Contact is a market leader in this field. Its solutions meet IEC 60529 for protection of the contacts against accidental touching when unmated. A recently introduced innovation is a plug that interrupts the flow of current when withdrawn and activates an anti-arcing circuit.

RS is continuing to expand it's connectors portfolio to address renewable energy and many other new applications. Visit rswww.com/electronics to find a solution that addresses your specific requirements.

LUNCH BREAK

WIN a PS3 Slim 120GB with our killer sudoku

How to play:
As with standard sudoku, every row and column and 3 x 3 square must contain the numbers 1 through 9 exactly once.

The grid is composed of shapes with a dotted outline. At the top of each shape is a number, this signifies the sum of the cell. For example; if there is a shape composed of two cells with a '3' in the corner, the total of those cells is '3'. From that you can tell that the values of the cells must be '1' and '2' or '2' and '1'.

It is not permitted to repeat a number in a shape. If you have a sum of 8 across three cells, this cannot be '2', '4', '2' as the '2' is then repeated in the shape.

No numbers are placed in the grid to start with, unlike in normal sudoku; however you can work out every number with no guesswork but applying logic alone to reach the unique solution for each puzzle.

18		8		10	8		14	11
	7		16		19			
	13			23		17		
11	12	13				10	8	
		5	21				9	17
8					4			
12					10	13		10
9	18			12		13		
		9			17			

Name: .....

Job Title: .....

Ship-To-Number: .....

Tel: .....

E-mail: .....

Send your completed Sudoku to:
RS Components Ltd, eTech Team, DPN 24, Corby, Northamptonshire, NN17 9RS. All entries must be received by 1st June 2010 and the winner will be notified by the end of June 2010.

Terms & Conditions:
This competition is being run by RS Components Ltd. To enter the competition, all information on the entry form must be supplied. Entry is free, no purchase is necessary. It is the responsibility of the participant to gain permission from his/her employer to enter this competition. The prize is as stated. No cash alternatives are available. The competition is open to all RS Components catalogue recipients, except employees of RS Components or their families. The closing date for entries is 01/07/2010. The date of the draw will be in the month of August 2010. The winner will be selected at random by RS Components and will be notified by 1st September 2010. Responsibility cannot be accepted for lost entries, damaged or delayed in transit to the porters address. Illegible, altered or incomplete entries will be disqualified. Details of the prize winner can be obtained from the promoter after the date of the draw by sending an SAE to RS Components, eTech Team, DPN 24, Corby, Northamptonshire, NN17 9RS or by visiting www.rs-components.com/etech.

Correctly match these IT-terms with the following descriptions:

AMAZONED	STORAGE CAPACITY EQUAL TO 200,000 BRITISH LIBRARIES
EXABYTE	LOSING ONES JOB TO ONLINE BUSINESS
BETAMAXED	2 QUERY WORDS PRODUCING ONLY ONE RESULT
SPAMISH	SOFTWARE REQUESTING A THANK YOU REPLY
CLICKS AND MORTAR	UNIT DEFINED AS 0.127mm OF MOUSE MOVEMENT
MEATSPACE	LARGE DATABASE TRAWLING
GOOGLESTALK	REGISTERING DOMAINS ONLY A FEW KEYSTROKES FROM POPULAR SITES
TYPOSQUATTING	WHERE YOU SUBSTIUTE WORDS TO AVOID WEB STOPS I.E V!AGRA
MICKEY	USING GOOGLE TO FIND FORMER FRIENDS
DATAMINING	REAL LIFE AS OPPOSED TO CYBERSPACE
POSTCARDWARE	BUSINESSES TAKEN OVER BY ONLINE PRESENTATIONS
GOOGLEWHACK	OVERTAKEN BY SUPERIOR TECHNOLOGY

General technology fun Quiz

1 What does html stand for?

a. _____

2 The world's most powerful particle accelerator is the LHC, what does this stand for?

a. _____

3 What is the full name for the international protocol standard for lighting control?

a. _____

4 What home video title released by Artisan Entertainment became the first publicly available DVD-18? (That is, the first two-sided, dual-layered disc.)

a. _____

5 What classic screen actress co-invented spread-spectrum wireless technology?

a. _____

6 What does pdf stand for?

a. _____

7 Only one of the stable chemical elements is named after a person, which one?

a. _____

8 What temperature is the same in Celsius as Farenheit?

a. _____

9 What corporation was the first to move to Silicon Valley in 1938?

a. _____

10 Who invented the Integrated Circuit in 1958?

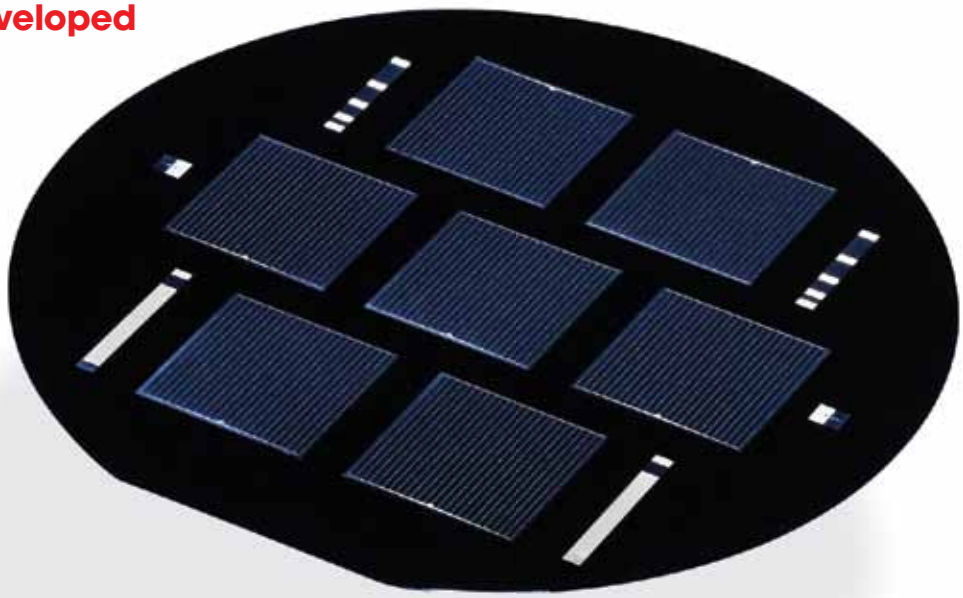
a. _____

Answers can be found at www.rs-components.com/etech

Fraunhofer

Fraunhofer ISE develops new photovoltaic technologies

Researchers at the Fraunhofer Institute for Solar Energy Systems ISE have developed new methods and cell concepts for the manufacture of n-type silicon solar cells. As a result, higher efficiencies and power production levels are also possible for commercial solar cells. The prototype exceeded an efficiency of 23 %.



Fraunhofer ISE's group manager Dr. Martin Hermle explains the difference between the new technology and current products. "Most commercial silicon solar cells are currently p-types, but the new n-type silicon used for the novel solar cell structures developed at ISE has better properties for photovoltaic electricity production, such as greater tolerance for most impurities. In practice, there are two options: either greater efficiency, or lower manufacturing costs because you can use less expensive silicon." In addition, p-type Czrochalski (Cz) silicon suffers from light-induced degradation, which does not occur with n-type silicon.

Silicon solar cells consist of two areas with different thicknesses for different conduction: n stands for negative, p for positive. The thicker layer, the substrate material, is considered the base and determines the cell's type – such as p-type for conventional solar cells. Such cells have a p-type base and a thin n-conductive layer – the emitter, or the charge carrier. In n-type solar cells, the emitter is p-doped, either through boron diffusion or the addition of aluminum.

For some time, experiments have been conducted on n-type silicon as a base material, but production technology was very complicated. For instance, the main problem in using n-type solar cells, in which the emitter is on the side facing the sun, was the passivation of the emitter, which was usually doped with boron. Such surfaces cannot be optimally passivated with conventional layers, such as silicon oxide SiO2 or silicon nitride SiNx. In collaboration with the Technical University of Eindhoven, the problem of front passivation was solved through the use of aluminum oxide Al2O3.

Jan Benick, who is working on his doctorate in the group for high- efficiency silicon solar cells, managed to develop a highly efficient cell process especially for n-type cells that uses boron diffusion to make the emitter; the efficiency is 23.4 % on 2x2 cm² – the highest efficiency ever reached for this cell type.

Christian Schmiga, project leader in the group for high-efficiency silicon solar cells, has also reached 18.2 % efficiency on 12.5x12.5 cm² by using much simpler process stages close to industry practice, including a screen printing process to apply the aluminum alloy emitter.

Fraunhofer ISE continues to further develop process technology for n-type solar cells so that industrially manufactured silicon solar cells can reach efficiency rates exceeding 20% quickly.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