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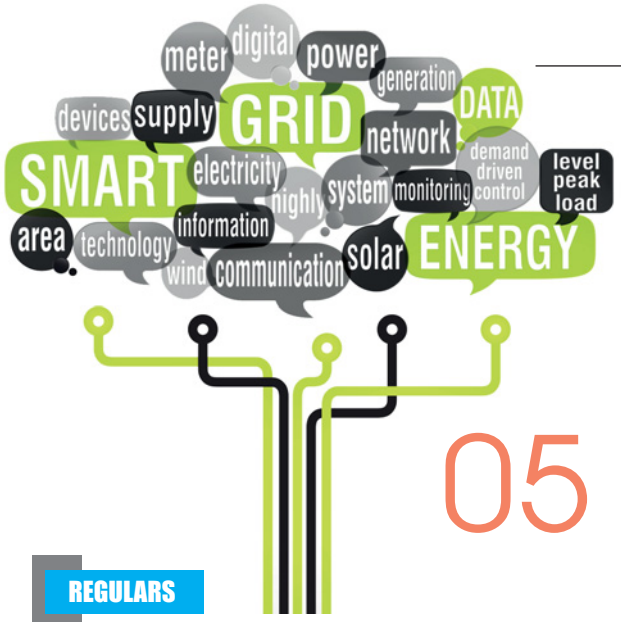

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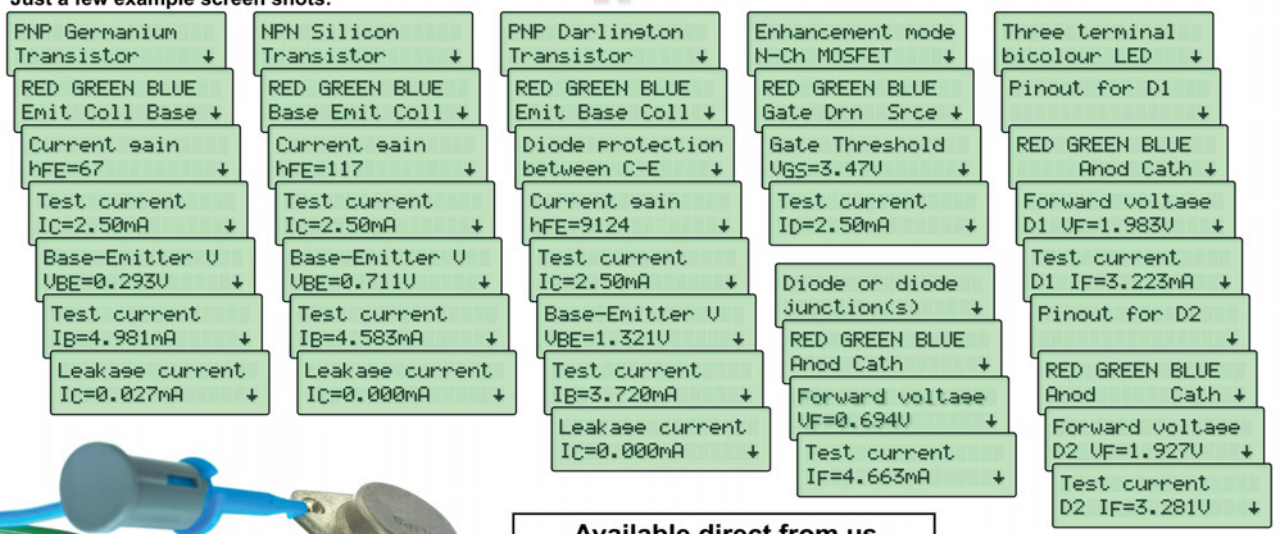

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SMART METERS: BEYOND THE HOME

Years of government initiatives and advertising campaigns by energy suppliers have changed people's behaviour toward energy efficiency. As a result, many of us have invested in smart meters to monitor the amount of electricity used at home so we can reduce our energy bills. Since 2010, the UK government has been increasingly proactive in convincing businesses to be more energy efficient. This culminated in the creation of the Energy Act 2013, which includes a financial incentive for lasting reductions in electricity demand.

For businesses to achieve this, facilities managers must first invest in smart meters to accurately monitor and ultimately reduce electricity usage. Instead of simply connecting meters and neglecting them – as many of us do – it is important that managers use these to gain insight into not only energy usage but also power quality.

Modern smart meters can tell engineers how much reactive power (kVArh) is generated from a plant's energy supply by identifying the difference between working power and total power consumed. Reactive power is the extra power consumed in a circuit that is not useful. It is created as a result of normal impedance in a system and, in effect, is the amount of wasted power in a system that the user still needs to pay for.

To tackle high levels of reactive power and improve overall efficiency, business leaders should invest in equipment to safely filter reactive currents from systems. For example, the REOWAVE passive CNW 898 filter is an industrial unit that reduces reactive power to improve overall power quality and drive down energy bills. It also increases the service life and reliability of electrical systems in the process.

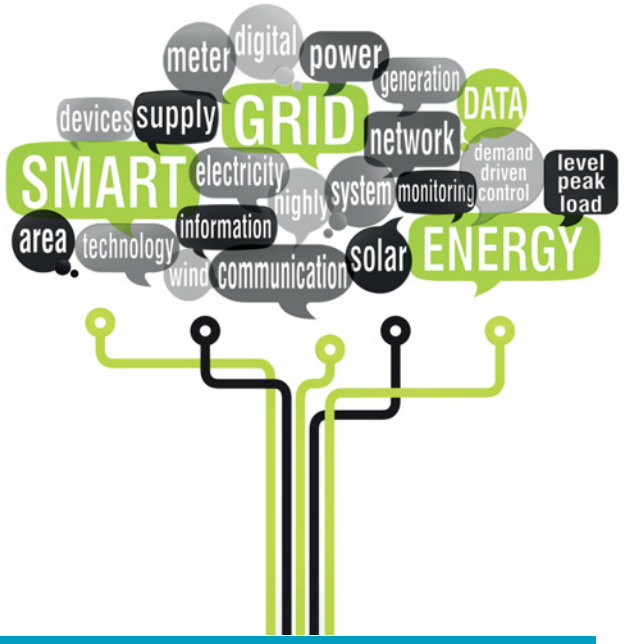
However, reactive currents are not the only problem plant managers need to be aware of. As counterproductive as it may seem, smart meters can actually generate their own power quality problems in unprotected systems. Smart meters transfer data over power lines using ripple control technology, which has been linked to electromagnetic interference (EMI).

In effect, the very device being used to help improve energy efficiency itself contributes to problems that increase wastage.

Fortunately, Power Line Communication (PLC) filters can be used to remove this interference from the network. It is important that plant engineers accurately specify the frequency range when selecting a filter in order to effectively eliminate interference. Typically, a filter that complies with EC Directive 89/336/EEC will provide sufficient filtration, such as the 50kHz to 20MHz range of REO's CNW 161 filter.

> Modern smart meters can tell engineers how much reactive power is generated from a plant's energy supply by identifying the difference between working power and total power consumed

Investing in smart meters is just the first step engineers and managers should take in driving down energy costs and improving efficiency. If businesses want to benefit from the financial incentives offered by the UK government, they must ensure that their systems effectively act on the insight provided by smart meters. ●



Steve Hughes is Managing Director of power quality specialist REO UK (www.reo.co.uk), manufacturer of resistive and inductive wound components for use with static frequency converter drives in lift and HVAC applications

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‘MAGNIFYING GLASS’ FOR QUANTUM MECHANICS CREATED BY GERMAN SCIENTISTS

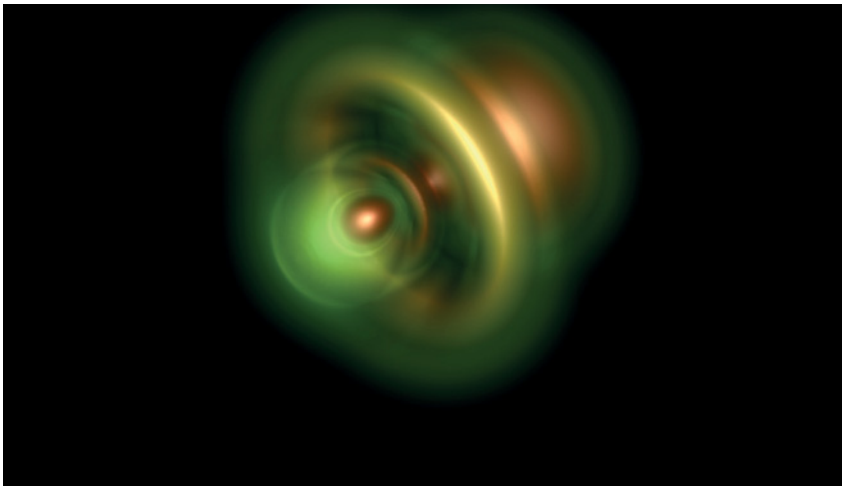
With a new improved measurement method, laser physicists in Munich can now accurately measure quantum mechanical events at a rate of up to 850 zeptoseconds (10^{-21}s). For the first time they were also able to determine how the energy of an incident photon is quantum-mechanically divided between two electrons of a helium atom, a few attoseconds before the emission of one of the particles.

"With the measurement of the electronic correlation, our experiments solved a promise of attosecond physics, namely the temporal resolution of a process which is inaccessible with other methods," says Reinhard Kienberger, professor of the Chair of Laser and X-Ray Physics at TU Munich.

With its two electrons helium is the only multi-electron system that can be calculated completely quantum-mechanically, allowing reconciliation between theory and experiment.

The researchers shone an attosecond-long, extreme ultraviolet (XUV) light pulse onto a helium atom to excite its electrons. At the same time, they fired a second infrared laser pulse, lasting about 4fs (10^{-15}s). The electron was detected by the infrared laser pulse as soon as it left the atom, following excitation by XUV light. Depending on the exact electromagnetic field of this pulse at the time of detection, the electron was accelerated or decelerated. Through this change in speed, the physicists were able to measure photoemission with zeptosecond precision.

The research was funded by the Max Planck Society, the German Research Foundation (DFG) via the Cluster of Excellence Munich-Center for Advanced Photonics (MAP), the Austrian Science Fund and the European Community (through two ERC grants and the Marie Curie program). In addition to the TU Munich and LMU Munich, as well as the Max Planck Institute of Quantum Optics in Garching, the Technical University of Vienna and the Universidad Autónoma de Madrid participated in the project.



Once an electron leaves a helium (two-electron) atom, it is possible to calculate the probable position of the remaining electron. Its likeliest position is shown in the image as the brightest area around the atomic nucleus (not seen)
[Image: M. Ossiander/TUM, M. Schultze/MPQ]

NEW BENDABLE ELECTRONIC PAPER DISPLAYS THE FULL COLOUR RANGE

Researchers at Chalmers University of Technology in Sweden have developed the blueprint for a new bendable, full-colour-emitting electronic paper. Scientists Andreas Dahlin and Kunli Xiong placed conductive polymers on nanostructures in a combination perfectly suited to creating electronic displays as thin as paper. The material is less than a micrometre thin, it is flexible and gives all the colours a standard LED display does.

Colour-producing e-paper is less than a micrometre thin

"The 'paper' is similar to the Kindle tablet, but it's not lit up like a standard display, it rather reflects the external light which illuminates it. Therefore it works very well in bright light, such as in the sun, in contrast to standard LED displays that work best in the dark. At the same time, it needs only a tenth of the energy a Kindle tablet uses," said Dahlin.

The best application for the displays will be well-lit places such as outside or in public places to display information. This could reduce the energy consumption and at the same time replace signs and information screens that aren't currently electronic today with more flexible ones.

AI TO PLAY A ROLE FOR THE NAVY

Roke Manor Research (Roke) will be the first to integrate artificial intelligence (AI) software into a Defence Science and Technology Laboratory (Dstl) sponsored maritime combat system demonstrator. Named 'Startle', the machine situational awareness software continuously monitors and evaluates potential threats using a combination of AI techniques. It is inspired by the way the human brain works, emulating the mammalian conditioned-fear response mechanism.

Rapidly detecting and assessing potential threats, the software significantly augments human operator situational awareness in complex environments. If integrated into existing warship sensor suites, it will process multiple sources of information to assess and confirm potential threats.

"Traditional methods of processing data can be inefficient so we have looked at the human brain's tried-and-tested means of detecting and assessing threats to help us design a better way to do it," said Mike Hook, lead software architect on Startle at Roke.

"The first two phases of the project have proven that we've been able to successfully apply these techniques to real data from complex scenarios. The clever part comes in the way these potential threats are detected and the way our software redistributes resources to decide if they are real – all in the blink of an eye."

In addition to maritime defence systems, Startle can also be adapted for autonomous vehicles, and health and monitoring applications.

IMPROVING PV EFFICIENCY, RELIABILITY AND FLEXIBILITY

TECHNOLOGIES AND TECHNIQUES FOR ULTRA-EFFICIENT PHOTOVOLTAIC INVERTERS

By Dr Ralf Hauschild, European LSI Design and Engineering Centre, Toshiba Electronics Europe

Power electronics system costs are influenced by their power loss. Reducing power dissipation enables lower cooling costs or the use of smaller magnetics at higher switching frequencies. When designing power electronics systems, energy efficiency is a primary goal, particularly for photovoltaic (PV) inverters.

This article reviews evolving requirements for PV and the benefits of micro inverters (MI). It introduces techniques and technologies to help designers deliver cost-effective solutions that provide efficiency improvements while reducing BOM cost and size.

The PV market changed substantially in recent years and is expected to continue with future growth. According to Solar Central, worldwide energy generation by PV grew to 184GW in 2014. However, the average module cost fell to <$0.70/W, creating pressure on PV systems manufacturers.

This pressure is not only on cost but also on a system's ability to provide extended functionality to generate the most energy possible while maintaining high reliability and efficiency under difficult environmental conditions.

These opposing requirements (lowest costs / best functionality) require new and innovative solutions. Different approaches (centralised inverter, string inverter, MI or power optimiser) offer outstanding new features relating to controllability of a system subject to building or tree shading on the panels.

The DC-to-AC inverter is an essential component of any PV system. The power transistor switching losses heavily influences its efficiency. Correct selection of circuit topology and components is critical to optimum efficiency.

To improve efficiency, wide bandgap devices based on GaN or SiC are often used. However costs remain considerably higher than Si components. For a cost-effective system, design innovations are required to achieve the ultimate efficiency when using silicon-based components.

Based on a half-bridge, the analysis below shows how inverter efficiency can be optimised by significantly reducing switching losses. As an example, we review the commutation of the current flow from the freewheeling diode of the blocking upper switching transistor to the lower switching transistor.

The switching losses are determined by two loss mechanisms. Firstly, the reverse recovery charge (Qrr) causing a peak current in the activated and conducting lower transistor. Secondly, the charging current peak flowing when the blocking upper transistor's output capacitance (COSS) is being reloaded.

The circuit topologies in Figure 1 (SRB and A-SRB) will greatly reduce switching losses.

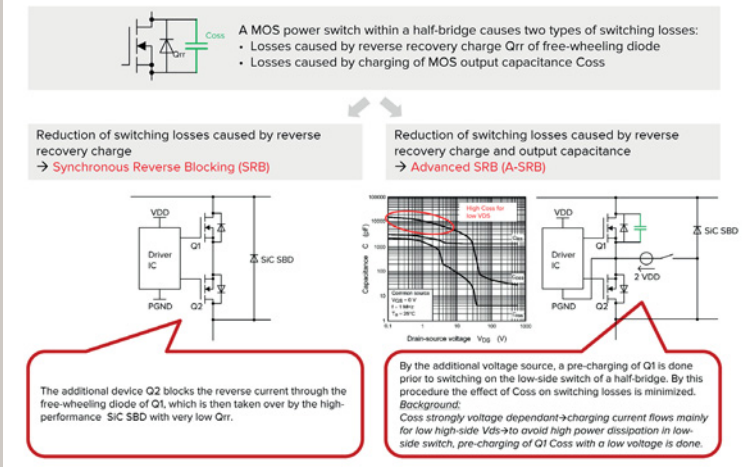
SRB adds a second switching transistor (Q2) in series that blocks the reverse current in the freewheeling diode of the actual switching transistor Q1. Controlling Q2 is synchronised to Q1. The reverse current passes through a parallel silicon carbide (SiC) Schottky diode with a high breakdown voltage and an extremely low reverse recovery charge so that effects of Qrr are significantly reduced. The freewheeling diode's polarity is chosen so no high voltage can build up across this transistor. Therefore, a low-voltage (60V) type is sufficient.

With A-SRB, the losses caused by reloading the output capacitance of Q1 are significantly reduced by pre-charging Q1 to a lower voltage. The output capacitance COSS is highly dependent on the drain-source voltage VDS. An increase of VDS from 0V to 40V reduces the capacitance by a factor of 100. During the switching process, this causes the charging current to flow at low VDS. However, since a low voltage across Q1 leads to a high voltage across the conducting lower transistor within the half-bridge, a high power loss is generated due to the charging current peak.

If COSS (Q1) is pre-charged to a certain voltage (before switching on the lower transistor in the half bridge) the majority of the charging current does not flow through Q1 and cannot cause losses. A charge pump in the gate driver IC generates the voltage for pre-charging.

A-SRB is a newly developed Toshiba technology that dramatically reduces switching losses in applications including PV inverters, DC/DC converters, PFC, or motor control.

To demonstrate A-SRB's effectiveness, device level SPICE simulations of an H4 inverter bridge were performed with and without A-SRB. Figure 2 shows the efficiency improvements for different power levels and switching frequencies. The switching transistor is a Toshiba DTMOS IV with low RDS(on) (100 A, 600 V). Since A-SRB reduces switching losses, the efficiency improvement increases with frequency. The maximum efficiency gain for bi-polar modulation is about 6%.



Different PV inverter system approaches have advantages and disadvantages for different operating conditions. String inverters are a common solution where a series of solar panels connect to a centralised inverter. This is very cost-effective and offers advantages if all modules are in the same plane with the same unshaded view of the sun. If the central inverter fails, no energy can be used.

Using power optimisers on each panel offers benefits as each panel can be optimised for its own MPP (Maximum Power Point) so shading and different orientations are taken care of. This system costs more than the string solution and still involves high DC voltages and currents. As with the string solution, the centralised inverter remains a single point of failure.

Many drawbacks of these systems are addressed through using micro inverters (MIs). Separate inverters and local MPP tracking optimise the generated energy. This addresses shading and orientation issues and eliminates the single-point-of-failure associated with centralised inverters. As there are no high DC voltages or currents on the panel, system security increases.

Although the initial cost of an MI system is higher, it offers a number of benefits including the ability to install panels on angled roofs or facing different directions without reducing performance.

An MI system can be easily scaled as MI systems are not reliant on identical panels, making it possible to combine different modules for expansion. Each panel can be individually monitored for performance or aging.

Since MIs are installed near the panels, they are exposed to the harsh environmental conditions over their entire lifecycle, which creates reliability challenges. MIs aim to achieve a service life of 20 years, similar to solar panels.

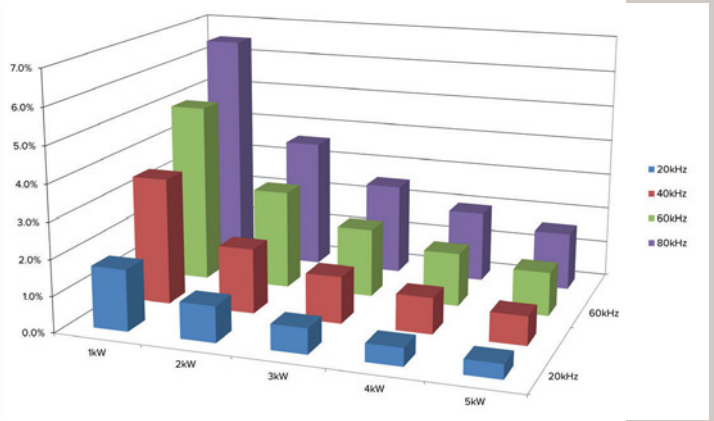
Based on A-SRB, Toshiba developed a system solution for PV inverters up to 5kW, consisting of four main components, the inverter bridge with A-SRB technology, one MCU for controlling the entire system, and two analog front-end ICs (AFE) for controlling the DC/DC converter input stages and output inverter. In addition to the A-SRB efficiency gains, the two AFE ICs contribute to a compact, cost-optimised system.

The system shown in Figure 3 is one of several possible implementations. Using the versatile AFE IC TC7716FTG, one- or two-stage input converter topologies, including LLC resonant and Flyback, can be implemented.

The AFE IC can control six switching transistors and is in a QFN-32 package containing a 12-bit ADC to acquire the input-side current and voltage parameters. Via a UART interface, the AFE transmits current and voltage data to the MCU and receives PWM signals required to drive the switching transistors. The control algorithm and MPP tracking is implemented in software in the MCU. The IC integrates multiple protection features including OCP, OVP, UVLO and thermal shutdown.

The core inverter that provides A-SRB functionality can be realised in different ways, depending on the power rating. For MIs with input power under 300W, Toshiba offers the T1JM4 module solution integrating a complete half-bridge, including gate drivers with A-SRB, switching transistors and SiC Schottky diodes. For PV inverters with higher power ratings up to 5kW, discrete gate drivers and switching devices can be provided as a kit.

The TC7717FTG AFE IC with integrated 12-bit ADC detects input



and output current and voltage parameters of the inverter bridge. Housed in a 40-pin VQFN package, it communicates with the MCU via SPI.

The MCU is based on an ARM® Cortex®-M4F core and avoids a costly external DSP. The system-in-package (SIP), housed in a LQFP176 package, also contains an additional computing unit to generate control signals for the inverter bridge. In addition to a 32-bit timer for precise mains frequency measurements, this also includes all the calculation functions for PID current control. Harmonics up to the seventh order can be calculated.

The highly integrated Toshiba inverter solution provides all necessary control, communication, measurement and intelligence. It offers all the elements for a scalable and competitive PV inverter.

Summary

To extract maximum efficiency from any power system, consideration must be given to managing losses effectively. Toshiba's complete solution allows designers to benefit from the efficiency gains of A-SRB and also develop bespoke solutions rapidly and confidently. The fully integrated A-SRB technology is applicable to MI and other power applications including DC/DC converters, reactive power compensation and motor drives.

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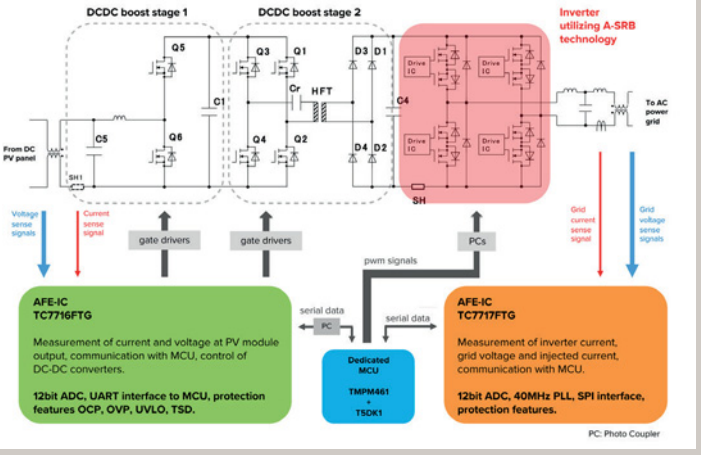

The 1kB Challenge

BY **LUCIO DI JASIO**, MCU8 BUSINESS DEVELOPMENT MANAGER AT MICROCHIP TECHNOLOGY

I am not a big Twitter fan but I do use it, mostly to discover stuff related to my passions for embedded control, programming languages and aviation in general. Hackaday.io tweets in particular are irresistible for me. Show me a picture of a few components wired up on a prototyping board and I won't be able to resist the urge to tap on it and check out the related project.

The Hackaday.io website is well organized, and yet it encourages free flow of ideas and a creative mix of hardware and software development. I can spend hours browsing the seemingly endless list of projects offered. In fact, to control my addiction I recently decided to remove the bookmark from my browser reading list to preserve my productivity and sanity. [Note to self: unfollow Hackaday.io?]

Too late! Just before the Christmas holidays a new tweet captured my attention. It was the launch of a new challenge: "What would you do with only 1kbyte of code"? (https://hackaday.io/contest/18215-the-1kb-challenge).

This proved too much to resist for me. It had been such a very long time since I took actual part in a contest, being on the other side of the table, so to speak, that I jumped in with both feet!

From The Compost Drawer

Perhaps it was nostalgia for the days when 1kbyte of code was considered a long program, the obvious association with assembly programming, flashbacks of spending days to reduce an application size by a couple of bytes only to squeeze in a last-minute bug fix – ahem, I meant "feature"!

If this sounds like torture to you, you might be right. Deep inside me and every other programmer who has learned to program in assembly, and loved it, there must be a strong masochistic vein. But that's who I am, and I learned to accept it!

It did no take me much time digging deep in my "compost" drawer, to find a very (very!) old prototyping board that seemed perfect for the challenge. It was meant to be a voice synthesizer, capable of producing a single word (or smaller segments/variations of it) in a single chip. Now, I know what you are thinking. Yes, there are/were custom chips for that, but where's the fun in that? How about using a standard 8-bit microcontroller to do it instead?

Turns out, as the quick archeological dig in my HD archives revealed, the project – named PICSPEAK – was exactly 22 years old (ouch!). The PIC microcontroller I used was one of the 'primordial' PIC16C56 models with 1k words of memory; mind that was OTP (one time programmable), not Flash technology, and had no analogue features of any kind on-chip, except for a rudimentary (external) RC oscillator and a robust power-on-reset circuit. Fourteen strong I/Os and a timer where all I had available to start with, so I had to construct a poor-man's D/A converter out of eight of those I/Os and a R-2R resistor ladder. Impressively enough, after adopting some unorthodox approaches to sound compression and reproduction, I had gotten the little board to utter a single (Italian) word.

> "I realized how much I learned to depend on the new rapid development tools, such the MPLAB Code Configurator (MCC), to generate the peripheral drivers, if only to back port those to assembly with speed and confidence

6-pin Transistor Package

Looking for something more modern to port the code to and, if possible, to increase the fun factor, I opted for a little 6-pin microcontroller, the PIC10F322 in a SOT23-6 package, mounted on a miniscule prototyping board.

The new target (PIC10) device, despite being much smaller than the original, features a more advanced PIC core (known as the mid-range 14-bit core), greater analogue integration and even latest-generation core-independent peripherals. Nonetheless, the original source code could be re-compiled almost untouched for the new target device, once imported in the MPLAB X development environment (https://github.com/luciodj/PICSPEAK).

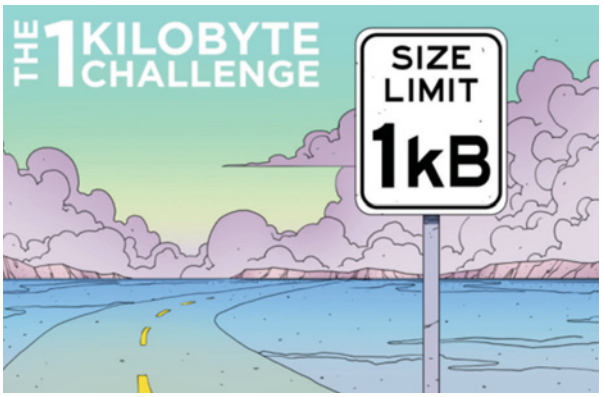

Figure 1: The Hackaday.io 1kB Challenge poster

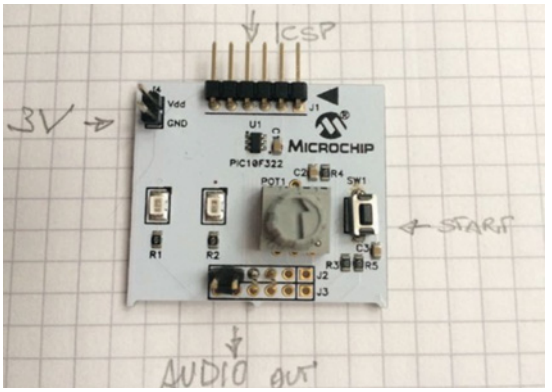

Figure 2: The PIC10F322 evaluation board; note that U1 (top centre) is the actual microcontroller in charge

New Possibilities

The little 6-pin device still had no conventional D/A converter, but among the many peripherals a 10-bit PWM was available to replace the 24-external-resistors ladder. A suitable internal precision 16MHz oscillator was available to clock the time base, and both internal pull-ups and proper BOR circuits were available on-chip to remove the need for all remaining external components.

Interestingly, the more modern PIC architecture offered interrupts and more levels of hardware call stack, allowing for deeper subroutine nesting, but I ended up not using any of those features. Maintaining the original code structure, I instead re-arranged the data tables (in Flash this time) to compact the code and simplify the look-up mechanism. In the end, the code size was reduced to just 432 words of 14 bits each, equivalent to 756 bytes of program memory, well within the contest limit.

You will find all the project logs, pictures and details on the Hackaday.io project page at (https://hackaday.io/project/18384-picspeak).

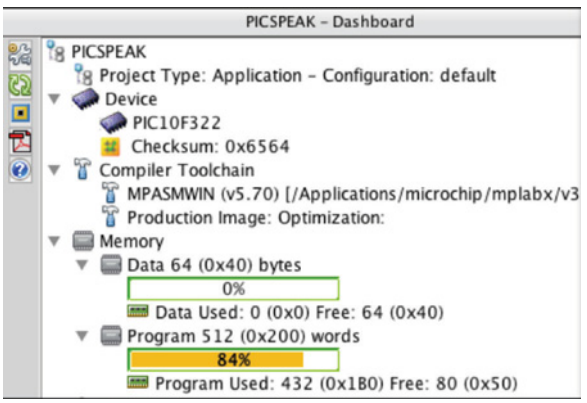

Figure 3: 432 14-bit words or less than 756 bytes of code used

Lessons Learned

I could not resist experimenting with the new core-independent peripherals integrated in the little PIC10 device. The numerically-controlled oscillator (NCO) in particular seemed very promising. As a frequency synthesizer, I speculated, it could be used to shift the playback frequency of a single samples' table, reducing the need to store separate tables to reproduce all the required vowel sounds.

Unfortunately, that did not pan out as expected. While the NCO frequency shift proved the most effective, the poor sample quality used, and probably some more serious issues with my assumptions about the very nature of the vowel sounds fizzled, made me abandon this development branch to eventually return to the more traditional fixed time-base.

As a side note, I had a lot of fun reviewing a "tool" I had developed using Borland Turbo Pascal (a complete IDE and Pascal compiler/ debugger in 64K bytes of x86 code!) to slice and

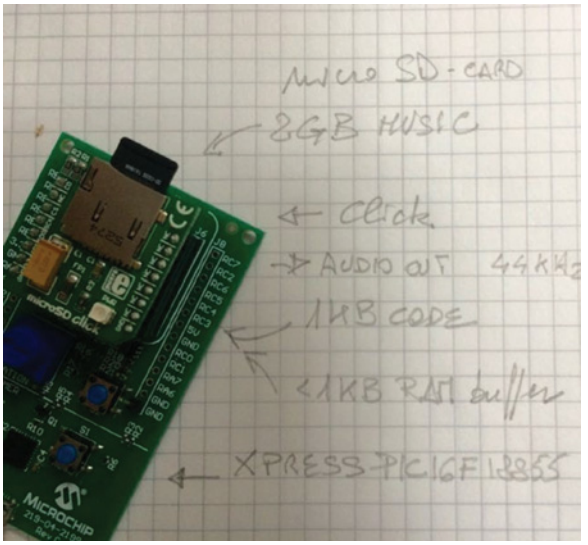

Figure 4: The Xpress Evaluation Board with a microSD Click board

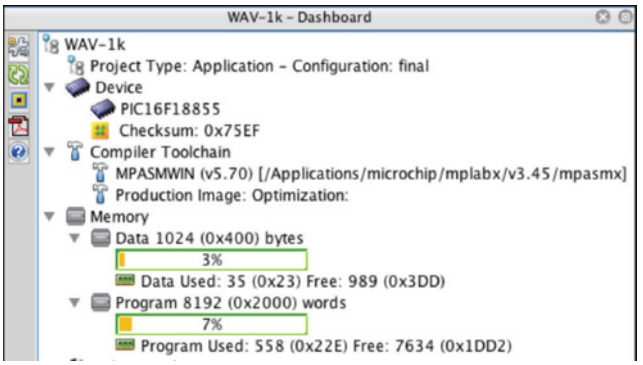

Figure 5: Less than 1kB of Flash and 1kB of RAM

compress sound bytes recorded with my glorious Sound Blaster board. Funny how today I would never consider writing such tools from scratch; I would instead use Python (import wav) an open-source application such as Audacity (http://www.audacityteam.org), or even more simply use the power of modern spreadsheet applications such as Libre Office (http://www.libreoffice.org) to graph and edit the sound waveforms.

In 1KB Of Code And 1kB Of RAM

As I worked on the code porting and pushing the little voice synthesizer on GitHub (https://github.com/luciodj/PICSPEAK), I started wondering about another audio project that I had been playing with for a similar number of years.

I am referring to the little audio player that would use only 1kB of RAM to play back, PCM uncompressed, and wav files stored on a micro SD card.

Over the years, I had been developing the code for an early PIC18 model to access the FAT12 and FAT16 file systems on a Compact Flash card. Then I ported it to SD cards and the PIC24 microcontrollers, where it was featured in the *"Programming 16-bit microcontrollers in C"* book, a.k.a. the *"Flying PIC24"* book (http://flyingpic24.com). Later, I ported it to the early PIC32 models, adding use of the DMA system (http://exploringpic32.com).

Eventually, I returned back to an 8-bit implementation (PIC16F17xx), where the RAM buffers had to be squeezed to fit in the 1kB of RAM available on such small devices, and a proper on-chip 8-bit D/A converter was used (https://github.com/luciodj/WAVPlayer).

Since the file system uses 512-byte sectors, to use continuous playback double-buffering techniques would have immediately busted that design limit. So I did a rewrite of the file system core routines to use in-place buffering and an original (partially) overlapping buffers scheme first described in an old blog post of mine (http://blog.flyingpic24.com/2014/05/29/the-smallest-wav-player/).

Unfortunately, though, the code had been developed in C, and even with the latest and greatest optimization techniques, I could not squeeze it below the 8kB (Flash) size limit. Would it fit in 1kB if rewritten in assembly?

Linear Memory

So WAV-1K, my second project candidate for the 1kbyte Hackaday.io challenge, was born (https://hackaday.io/project/18914-wav-1k).

I started working from the latest WAV Player project recently ported to the EXPRESS evaluation board and presented as part of my *"In 10 Lines of Code"* book (https://github.com/luciodj/In10LinesOfCodeExtra/tree/master/19-XPRESS-Player.X).

The PIC16F18855 microcontroller featured on the Express evaluation board belongs to the PIC16F1 generation of PIC microcontrollers with linear memory addressing. This was an essential pre-requisite, since large buffers must be handled efficiently in this application, and there is no way to squeeze them into the old (80-bytes) banks of the PIC16 early generations without a significant complexity and performance penalty.

The hand-translation process to assembly proved a bit harder than expected. On top of my expected rustiness in assembly programming, my use of the low-level programming language had decreased steadily with the years, becoming close to nil, and I realized that I had actually never used the new linear addressing pointers and the new instruction set of the PIC16F1 core. Those few new instructions had been handled for me exclusively by the MPLAB XC8 compiler since the new architecture was introduced, and this was the first time I was actually experimenting with them by hand.

After a few hours, pace quickened, and I completed the first port in a couple of days (well, nights) of work.

Soon the target of 1kB loomed, so close in fact that after only a couple of iterations (and removing much of the debugging code, including serial port logging et al) I managed to get a basic version of the application to produce good (FM radio) quality audio (8-bit, mono, 44kHz) using only 558 14-bit words of code, equivalent to 976 bytes of Flash memory!

Essential Skills

Assembly programming skills remain essential even today to squeeze that last drop of performance out of an embedded control device. Besides the challenge and the nostalgia, there is nothing like a few hours of (painful) assembly coding to remind us how precious is the help of a high-level language (compiler).

Progress in microcontroller design has been steady over the years, and both projects showed how even small changes in the PIC core over the years have made the architecture more agile and yet fully backward-compatible.

Lastly, I realized how much I learned to depend on the new rapid development tools, such the MPLAB Code Configurator (MCC), to generate the peripheral drivers, if only to back-port those to assembly with speed and confidence; or is that a new addiction I should worry about?

Until the next one! Meanwhile, take a look at the other excellent contest entries and, possibly by the time you read this article in print, we'll know the names of the winners! ●

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Using flash memory in embedded systems

BY **DR DOGAN IBRAHIM**, PROFESSOR AT THE NEAR EAST UNIVERSITY, CYPRUS

Most microcontrollers may have high performance, but in general they suffer from the lack of large non-volatile data memory. And there are many embedded applications, such as image processing and remote data collection, that require the storing of very large amounts of non-volatile data. One solution to this problem could be to use SD cards where many gigabytes of memory could easily be added to an embedded system.

However, the main disadvantages of using an SD card in an embedded system are increased overall system costs, increased system complexity and reduced robustness. An SD card interface requires additional hardware such as a card holder, a card, interface electronics and complex software to handle writing to and reading from the card. The advantage of the card interface is that very large amounts of memory can be added to the system. Also, the stored data can be read on other devices such as a PC, for example.

A preferred alternative in most embedded applications is an external non-volatile flash memory chip. Nowadays, flash memory chips are available with very large capacities and their interfacing and use are comparable to SD cards.

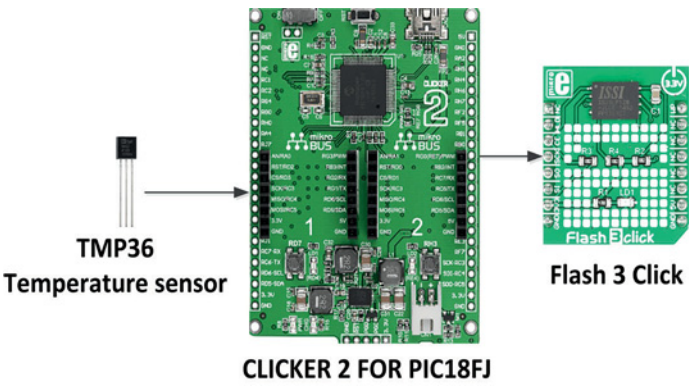

Figure 1: Typical modern FES device

NAND And NOR Technologies

There are two main types of non-volatile flash memories: NAND and NOR. NOR memories date back to 1980s; they were marketed by Intel and used in EPROM and EEPROM memory chips. Nowadays, most flash memories are of this type.

Non-volatile NAND flash memories were also introduced in 1980s, by Toshiba. Table 1, comparing the two, shows why, with their inferior specs, NOR memories are relegated to storing program code, leaving the heavy (and faster) lifting to the NAND devices. These memories are slow to read/write and erase. Additionally, NOR memories are more reliable, but have fewer erase cycles than NAND memories.

Perhaps the biggest advantages of NAND memories are twofold: life spans are more than ten times longer than that of NOR memories and their interface requirements are easier to manage.

Feature	NOR	NAND
Capacity	Up to16MB	Up to 128MB
Performance	Slow	Fast
Erase cycles	Up to 100,000	Up to 1,000,000
Reliability	Medium	Low
Life Span	Low	10 times more than NOR
Interface	Full memory interface	Only I/O interface

Table 1: Comparison of NOR and NAND flash memory features

Some Popular Flash Memory Chips

Many types of flash memory chips can be used in embedded systems. Some of the popular ones include:

- **A29010A-55F:** A 32-pin 128K x 8 byte flash memory that operates on 5V. It interfaces to a microcontroller using parallel interface. Because of its very low capacity, it is only useful in small external non-volatile memory situations.
- **AT25SF041:** An 8-pin 512K x 8 byte flash memory that operates between 2.7-3.6V, interfaces to a microcontroller using the standard SPI bus. Because of its low capacity this chip is useful in applications where only small amount of flash memory is required.
- **A25LQ32AM:** An 8-pin 4M x 8 byte flash memory that

	Block No (64KB)	Block No(32KB)	Sector No	Sector Size(Kbytes)
	Block 0	Block 0	Sector 0	4
		Block 1	Sector 1	4
Memory	Block 1	Block 2	Sector 2	4
Density		Block 3	Sector 3	4
128 Mbi	Block 2	Block 4	Sector 4	4
		Block 5	Sector 5	4
	.....	.....	.....	.....
	.....	.....	.....	.....
	Block 255	Block 510	Sector 4094	4
		Block 511	Sector 4095	4

Table 2: IS25LP128 flash memory organization

operates between 2.7-3.6V, and interfaces to a microcontroller using the standard SPI bus. This chip is useful in medium-range memory requirements.

- **TC58NVG2S3E:** A 48-pin 512M x 8 byte flash memory that operates between 2.7-3.6V and uses a parallel interface to a microcontroller. This is a very fast and high-capacity flash memory, suitable for applications requiring large amounts of non-volatile data storage.

Temperature Logging Example

In this example we will see how to read the ambient temperature every second and then store it on a flash memory chip for one minute.

The system is shown in Figure 1. Analogue output temperature sensor TMP36 is used, a small temperature sensor chip with three terminals, similar in size to a small transistor. The sensor chip has a wide operating voltage range (2.7-5.5V) and measures temperature from -40°C to +125°C. The sensor should be connected to an ADC converter. The temperature in °C is given by the following equation:

T = [(analogue voltage in mV) – 500/10

where T is the measured temperature. So, using an ADC with +3.3V reference and 10 bits of resolution (1024 quantization levels), the temperature will be given by:

T = [(D * 3300/1024) – 500]/10

where D is digital output data of the ADC converter, read by the microcontroller.

The Clicker 2 for PIC18FJ development board is used in the design for simplicity. This board contains a PIC18F87J50 mid-performance microcontroller with an external 8MHz crystal for timing. The microcontroller is operated at 48MHz after programming the on-chip PLL with a multiplying factor of six. The output of the sensor chip is connected to analogue input channel 0 of the microcontroller.

The basic features of the Clicker 2 for PIC18FJ development board are:

- On-board PIC18F87J50 microcontroller
- 128KB program memory
- 3904 bytes data memory
- 52 programmable GPIO inputs or outputs
- 2 SPI interfaces
- 2 UART interfaces
- 2 microBUS socketsUSB mini connectors.

The Flash 3 Click board is used in the design (see Figure 2). It contains the flash memory chip IS25LP128, manufactured by Integrated Silicon Solution (ISS), capable of holding the data safely up to 20 years. This is a 128-bit non-volatile flash memory that can be used as a 16MB memory chip. It interfaces to a microcontroller using standard SPI bus.

There are two reading speeds: 50MHz and 133MHz. The operating voltage is between 2.3V and 3.6V.

The Flash 3 Click board is microbus-compatible and is connected to socket 1 of the development board. Thus, the memory chip can be controlled using the microcontroller's standard SPI interface.

The IS25LP128 is accessed through a 6-wire interface consisting of a serial SPI data input (MISO), serial SPI data output (MOSI), serial SPI clock (SCK), chip enable (CE), hold (HLD) and write protect (WP).

As shown in Table 2, the memory array of IS25LP128 is divided into uniform 4kB sectors or 32/64kB blocks where a block consists of 8/16 adjacent sectors respectively. There are a total of 4096 sectors (0 to 4095), each having a size of 4kB, or 256 blocks (0-255), each having 16 sectors, or 512 blocks (0 to 511), each having eight sectors.

An on-board LED (at I/O port RD4) is toggled to indicate when

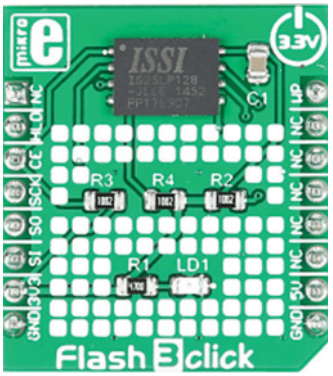

Figure 2: Flash 3 Click board

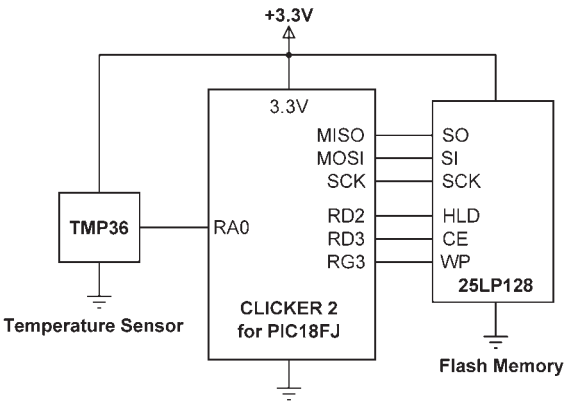

Figure 3: Project circuit diagram

data is written to the flash memory. The circuit diagram of the project is shown in Figure 3. Note that power to the temperature sensor chip and flash memory are provided by the Clicker 2 board.

The Software

The mikroC Pro for PIC compiler and IDE are used in the design. A library of functions (called 'flash 3 library') are supported by the mikroC for reading and writing to a flash memory; using this library simplifies the programming task considerably.

The following functions are provided by the flash 3 library (there are some additional low-level library routines but these are not required for normal read/write operations):

- flash_3_Init initializes the flash 3 library. This function must be called before the others.
- flash_3_write writes the number of specified bytes starting from the specified address of the flash memory.
- flash_3_read reads specified number of bytes starting from the specified address of the flash memory. The mode of reading can either be normal or fast.
- flash_erase erases a specified sector in memory, or all of it.

In this project the ambient temperature is read and stored every second on the flash memory chip as two-digit integers. The program runs for just one minute for demonstration purposes. Listing 1 shows its algorithm in a simple Program Description Language (PDL) form, while Listing 2 shows the complete program.

At the beginning of the program the interface between the flash memory and microcontroller is defined and I/O ports configured. The SPI bus and flash memory libraries are initialized by calling functions SPI_Init_Advanced and flash_3_init respectively. The entire flash memory is then erased so it's ready for writing. The remainder of the program is executed in a for loop 60 times with one second delay at each iteration. Data is read from the ADC and converted into real temperature. This data is then written to addresses 0 and 1 of the flash memory, the LED is toggled and the address variable is incremented by 2 so the next write starts from address 2 at the next iteration.

It is important to note that the flash memory must be erased before any data can be written on it. This is done at the beginning of the program.

```
BEGIN
        Configure the I/O ports
        Initialize the SPI bus library
        Initialize the flash memory library
        Erase the entire flash memory
        Set ADDRESS to 0
        DO FOR 1 MINUTE
                Read temperature from
channel 0
                Convert temperature into °C
                Write 2 bytes starting from
address ADDRESS
                Toggle the LED
                Increment ADDRESS by 2
                Wait 1 second
        ENDDO
END
```

Listing 1: Program PDL

```
include "flash_3_hw.h"
sbit FLASH_3_CS at LATD3_bit;
sbit FLASH_3_HLD at LATD2_bit;
sbit FLASH_3_WP at LATG3_bit;
#define LED RD4_bit

void main()
{
 unsigned int temp;
 unsigned char i, temperature;
```

```
uint8_t outtxt[5],txt[4];
float mV;
unsigned long address = 0;
ANCON0 = 2;
TRISD3_bit = 0;
TRISD2_bit = 0;
TRISG3_bit = 0;
TRISD4_bit = 0;

SPI1_Init_Advanced(_SPI_MASTER_OSC_DIV64,
_SPI_DATA_SAMPLE_END,_SPI_CLK_IDLE_LOW,
_SPI_LOW_2_HIGH);

flash_3_init();
flash_3_erase(flash_3_chip_er,0);

for(i = 0; i < 60; i++)
{
temp = ADC_Read(1);
mV = temp*3300.0/1024.0;
temp = (mV - 500.0)/10.0;
temperature = (int)temp;
ByteToStr(temperature, txt);
ltrim(txt);
if(strlen(txt) == 1)
{
txt[1] = txt[0];
txt[0] = '0';
}
flash_3_write(address, txt, 2);
LED = ~LED;
address += 2;
Delay_Ms(1000);
}
}
```

Listing 2: The software

The stored data can be read using function flash_3_read of the flash 3 library. In this project, two bytes are read every time for a temperature reading, since the temperature was stored as two byte integer numbers. ●

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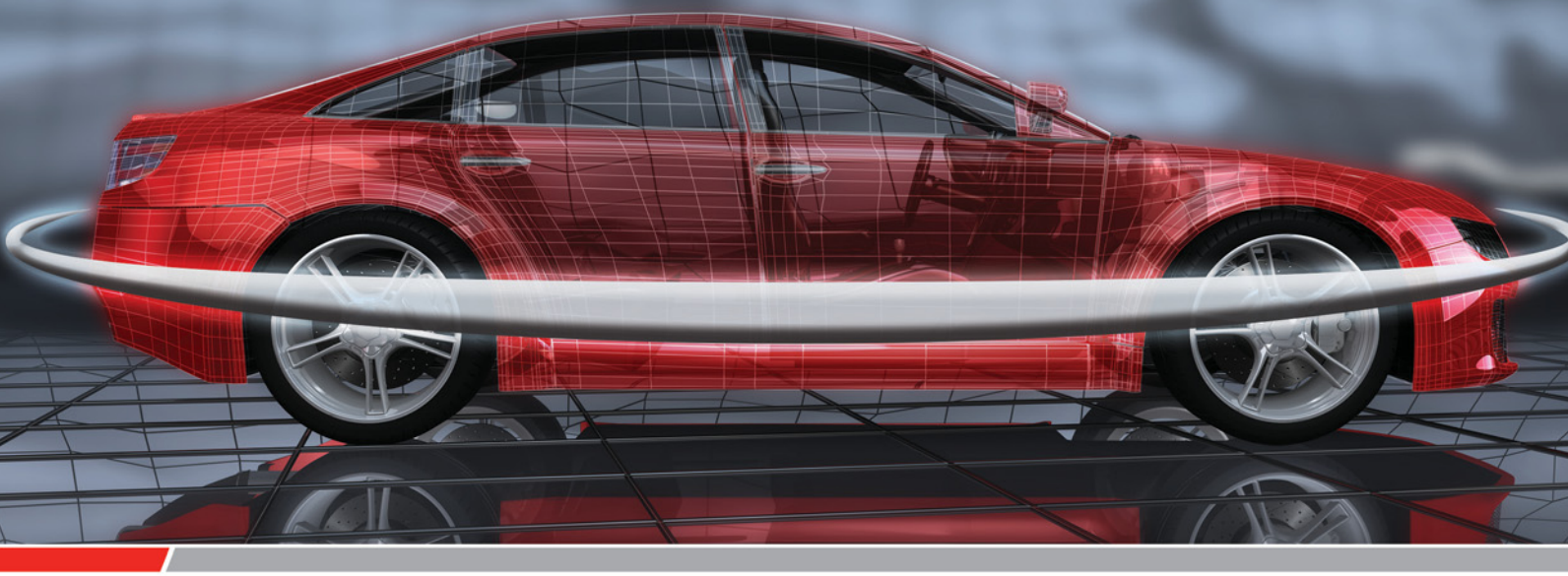

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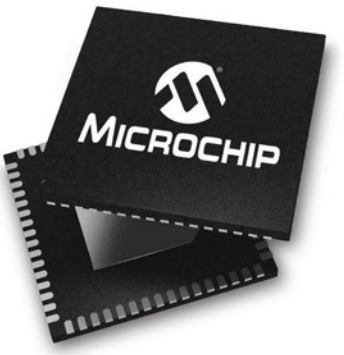

Application Examples

- Body control
- LTE/3G connectivity
- Ambient LED lighting
- Rear-view camera
- HMI
- Exterior LED lighting
- Top-view camera
- Infotainment head unit
- Smart sensors

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Adaptive voltage scaling and dynamic voltage frequency scaling

BY **OLIVER KING**, CHIEF TECHNOLOGY OFFICER OF MOORTEC

Adaptive Voltage Scaling (AVS) and Dynamic Voltage Frequency Scaling (DVFS) play a significant role in optimising in-chip conditions. AVS reduces power needs by changing the operating conditions in a closed loop within a device, whereas DVFS is a power management technique where voltage is increased or decreased depending on the chip's dynamic (voltage, temperature) and static (process) conditions.

DVFS takes into account the semiconductor process, and it can be used over time to account for a device's temperature and even ageing. It is possible, for example, to reduce power consumption to achieve a desired speed of operation; it is also possible to take into account process variations across a die, which is already being done in large SoCs today.

On the other hand, a closed-loop AVS system uses structures within the chip to provide data to adaptively track the behaviour of the silicon. By using a delay chain with the same operating voltage as the surrounding chip, the voltage/frequency relationship for that chip at that frequency is calculated by measuring the frequency of the delay chain.

Using DVS or DFVS means process-related variations can be compared and temperature fluctuations monitored during operation. A relationship can be observed between voltage and frequency, and then actively used to manage the reduction of power consumption for the circuit under certain conditions. This also enables designers to optimise – and maximise – chip performance and reliability.

Specific Applications

In addition to using AVS for in-chip variability compensation, the scheme can also be used to set thermal alarms and initiate fan operation. Operating at higher speed (performance) will obviously lead to shorter life of the device, whereas operating at (lower) optimum speed will improve its longevity and reliability.

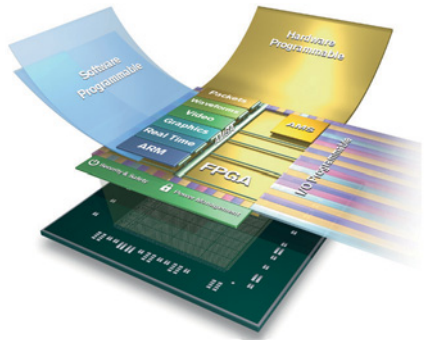
DVFS, on the other hand, can be used in a number of in-chip applications such as wafer sorting based on Look Up Tables (LUTs). It can also check the chip's functionality by reducing its supply voltage in regular steps, as well as to find the lowest centre-functional-voltage, thus determining its right level for optimum power and reliability.

When designing for speed and low power in SoC devices, increased process variability of advanced-node CMOS technologies has become a significant factor. Self-determination of device temperature, supply voltage levels and its own manufactured process characteristics are becoming important to the development community, primarily for performance-optimisation schemes on a 'per die' basis.

> Voltage monitors provide the means to accurately measure core domain supply voltages on advanced node digital MOS devices

These days it is also important to measure the ageing of silicon, and analyse critical timing and supply conditions on advanced node devices, especially in FinFETs. Voltage monitors, therefore, provide the means to accurately measure core domain supply voltages on advanced node MOS devices. They are specifically targeted to enable high-performance AVS schemes, and provide means for accurate IR drop analysis. The monitor is capable of observing multiple supply domains, and it can generate low-voltage alarms as well as provide real-time supply data.

Monitors are now a critical component to advanced node chip design. Like other design arenas such as automotive, telecommunications, aerospace, industrial and technologies within the home, the inevitable direction of progress is to satisfy the designers' appetite for higher sensor placement densities, higher accuracy, higher resolution and easy-to-integrate solutions, in response to competition in the marketplace and consumers' expectations of higher performance and better reliability from their devices. ●



Optimising SWaP-C in embedded vision systems

BY **AARON BEHMAN** AND **ADAM TAYLOR** OF XILINX

A growing number of smart systems in the automotive, medical, industrial and scientific spaces are dependent on high-quality image capture and processing, often at high speed and in full colour. The preceding article of this series (*Electronics World,* February 2017) discussed selection criteria for image sensors. This article examines key challenges and decisions encountered when developing the image-processing system. Time to market can often be a critical pressure that determines which aspects of the system are developed in-house, representing value-added activity, and which are purchased as commercial off-the-shelf (COTS) blocks or subcontracted for development. Focusing on value-added activities and leveraging IP modules at the hardware, software and FPGA levels are key enabling factors to meeting time to market.

As far as technical challenges are concerned, embedded vision systems are typically developed for applications where size, weight, power and cost – often called SWaP-C – are driving factors. One way to improve SWaP-C is through tighter system integration, particularly in the processing system.

Image-Processing Pipeline

Almost all embedded vision systems incorporate an image-processing pipeline that interfaces with the selected sensor and performs the operations required to produce an image suitable for either further processing or transmission over a network. A basic image processing pipeline may include the elements shown in Figure 1.

Within this image processing pipeline, various algorithms are applied to the received images, depending upon the application being implemented. There are a number of commonly-used algorithms for processes, including sharpening the image, improving contrast, or detecting features, objects or movement.

These algorithms should be developed within a framework that allows the shortest possible time to market and promotes re-use of proven IP, while reducing non-recurring and recurring engineering costs. A number of frameworks are worth considering:

- **OpenVX** – Open-source application for development of image-processing applications;
- **OpenCV** – Open-source computer vision, comprising a number of libraries aimed at real-time computer vision based on C/C++;
- **OpenCL** – Open-source computer language based upon C++ for developing applications for parallel-processed applications as seen in GPU, FPGA, etc;
- **SDSoC** – Xilinx-designed environment that allows developers to initially implement algorithms written in C/C++ in the ARM processing system of a Zynq or UltraScale+ MPSoC device, profile the code base to identify performance bottlenecks, and then use High Level Synthesis (HLS) to translate those bottlenecks into hardware-enabled IP that runs in the programmable logic (PL) portion of the device.

Use of these frameworks coupled with HLS in a FPGA or All Programmable SoC design flow allows for efficient development of embedded vision applications, quickly demonstrated with hardware in the loop.

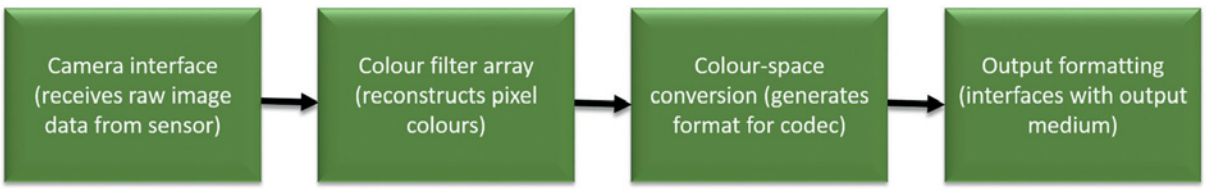


Figure 1: Image-processing pipeline

> Use of these frameworks coupled with HLS in a FPGA or All Programmable SoC design flow allows for efficient development of embedded vision applications, quickly demonstrated with hardware in the loop

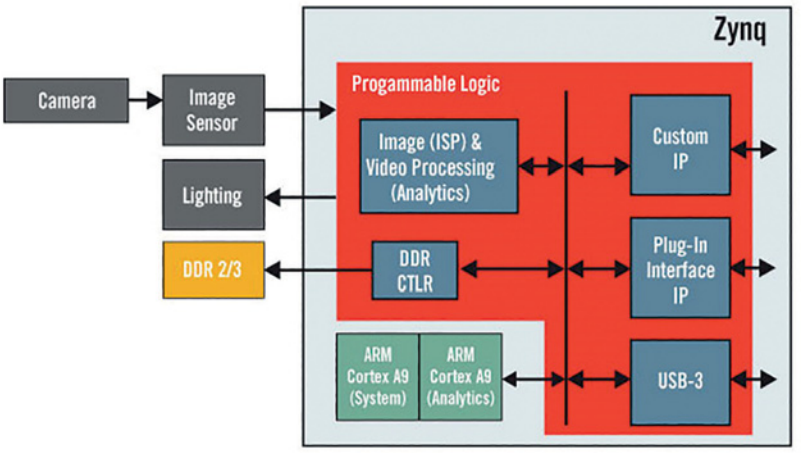


Figure 2: Image-processing resources in Zynq All Programmable SoC

Processing Choices

Once the image completes the processing pipeline, where the data is output from the system is also important. At the highest level there are three broad choices. One of these is to output the image to a display using a standard like VGA, HDMI, SDI or DisplayPort. On the other hand, the image (or information extracted from it) may be transmitted elsewhere, such as to the cloud for example, for further processing. A third option is to store the images on non-volatile media to be accessed at a later date.

For the majority of these high-level choices at the completion of the imaging chain, it is important to consider the image format to be used. This presents the choice of encoding the image using an industry-standard compression algorithm such as H.264 (MPEG-4 Part 10 Advanced Video Coding) or H.265 (High Efficiency Video Coding). Implementations of these algorithms are often called codecs, and allow for more efficient utilization of communication and network bandwidth or a reduction in the storage footprint, at the cost of a small loss of fidelity. In applications where such a trade-off is not acceptable, the image can be transmitted or stored in its raw format, or encoded in a lossless format.

Most codec implementations use a different colour space to that output by typical colour image sensors. The most commonly used colour space within embedded vision is red, green, blue (RGB). This contains the RGB information as output from the image sensor, commonly used as an output for simple interfaces like VGA.

YUV contains Luma (Y) and chrominance (U & V), and is used for most codecs and some display standards. Commonly used formats are YUV4:4:4 and YUV4:2:2. With 4:4:4 each pixel is represented by eight bits, making for a 24-bit pixel. With a 4:2:2 format, the U and V values are shared between pixels, allowing for a more memory-efficient 16-bit pixel depth.

One further decision with a considerable impact on the image-processing chain and SWaP-C is the choice of where the majority of image processing will be implemented. This may be within the embedded vision system itself, which enables faster response times but also requires higher processing and memory resources, leading to higher power demand. This will be the most common approach for embedded applications like ADAS or machine vision.

Alternatively, performing processing in the cloud requires the embedded vision system to be capable of capturing the image and transmitting it using network-enabled technology. This approach can be suitable for applications such as medical imaging or scientific research, where processing can be very intensive and real-time results are not required.

To implement the processing chain, the heart of an embedded vision system requires a processing core capable not only of controlling the selected image sensor but also receiving and implementing the image processing pipeline, and transmitting the images over the network infrastructure or to a chosen display. These demanding requirements often result in a selection of FPGA or All Programmable System on a Chip (SoC).

Xilinx Zynq All Programmable SoCs combine two high-performance ARM A9 processors with FPGA fabric. The Processor System (PS) can be used to communicate with a host over Gigabit Ethernet, PCIe or other interfaces like CAN while also performing general system housekeeping. The programmable logic (PL) section exploits the parallel nature of FPGA fabric to receive and process the images extremely efficiently.

If the images must be transmitted over a network, on-chip Direct Memory Access (DMA) controllers can be used to efficiently move image data from the PL to DDR memory in the PS. Once within the PS DDR memory it can also be accessed using DMA controllers of the selected transport medium. It is worth noting that the A9 processors can be used to perform further processing on the image within the PS DDR, and that the Zynq architecture also allows processed images to be moved from the PS DDR back into the image pipeline in the PL, thus giving maximum flexibility to choose the most efficient processing strategy. Figure 2 illustrates the tight integration of processing, memory control and interface functions within the Zynq device. ●

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TCXO performance qualities

BY **TOMMY REED**, VP OF TECHNOLOGY AT BLILEY TECHNOLOGIES

Thermally Compensated Cystal Oscillators (TCXO) are widely used where an accurate frequency source is needed. They are less expensive and smaller than oven-controlled oscillators, proving an ideal solution for portable systems.

Some design considerations include:

- **PPM performance:** TCXO temperature performance is better than that of a normal crystal oscillator. Improvements between 10 and 40 times are typical. Accuracy better than ±1.5ppm over a 0-70°C temperature range is difficult to achieve since they then fall into a high-precision category where costs increase significantly.
- **Power dissipation:** TCXO's power dissipation is greater than an ordinary oscillator's because of its additional circuitry. It should be remembered that it will also take a short time after start-up for the oscillator to stabilise; typically of the order of 100ms, or even longer.
- **Package:** TCXOs come in a variety of packages, depending on their design and end-user requirements. Their most common form is on a small printed circuit board in a flat metal package, which is then mounted on the main circuit board of the equipment. As the crystal itself is sealed, this means that sealing of the overall TCXO package is not critical, or even required, for most applications.

  Package sizes such as 5mm x 3.2mm x 1.5mm or 5mm x 3.5mm x 1mm (see right) are widely used for TCXOs, with smaller packages available, if required.
- **Output format and level:** Many TCXOs drive digital circuits, most produce what is called a 'clipped sine wave', suitable for logic circuits – although a logic buffer may be needed to ensure the signal is sufficiently squared. Often, the output is an open-collector circuit. If a sine wave output is required, it must be chosen at the outset and will limit the choices available.
- **Power requirements:** Actual power requirements will depend on the device; many operate from a 3V supply and draw as little as 2mA, although this will, of course, depend on the particular device chosen.

Common TCXO Types

Although temperature-compensated crystal oscillators are normally referred to in this manner, occasionally more terms are used, mainly due to the variety of techniques used for temperature compensation:

- **ADTCXO:** This is an Analogue Digital TCXO, widely used in cell phones; it uses analogue technology for temperature correction. It has the advantage that changes take place slowly and no phase jumps occur, as with some all-digital types.
- **DTCXO:** As may be guessed, this is a digital TCXO. It uses a temperature sensor, digital circuitry and a lookup table to perform the logic and mathematical functions. The resulting digital correction figure is converted to an analogue signal with a digital-to-analogue converter (DAC).
- **DCXO:** In this form of oscillator any correction is calculated by the equipment's host processor. In this way, the TCXO is not a separate entity; rather its processing is incorporated into the overall system, saving costs and space.
- **MCXO:** This form of TCXO uses a microprocessor to provide an increased level of processing for more accurate compensation under a variety of circumstances. While performance is a little better, this version costs more than the other forms. ●

Typical TCXO packaging

IAIN GALLOWAY, TECHNOLOGY STRATEGY ENGINEER AT NXP SEMICONDUCTORS, EXPLORES THE TECHNOLOGIES, BENEFITS AND SECURITY RISKS OF CONNECTED SMART CITIES

RED LIGHT, GREEN LIGHT: MANAGING TOMORROW'S SMART CITIES

The US Department of Transportation last year launched the Smart City Challenge to spur a new wave of innovation in urban infrastructure. The results can now be seen in Columbus, Ohio, where the urban transformation is powered by state-of-the-art, futureproof semiconductors.

But what are the challenges on the ground for a fully-connected, seamlessly-communicating urban infrastructure? What are the opportunities they present, and what's needed to make them happen?

Case Study: MiFare

MiFare is a brand of connected smartcard payment ICs for public transport. The current MiFare DESFire technology is found in over 10 billion cards and terminals worldwide in over 750 cities; it's being the driving force behind public transport and contactless payment systems around the globe.

However, the technology is shifting: the next generation of smartcard chips (MiFare DESFire EV2) will be able to securely isolate and operate in multiple modes simultaneously, incorporating EAL5+ security. In practice, this means that several different payment systems – say, ferry, subway, parking, etc. – can be loaded onto the same card, each firewalled from the others. New and updated microprocessors will be responsible for this, enabling management of multiple, isolated application programs in memory. Each account will receive independent response from the processor, based on requests and calls made from the card reader.

> With the increased processing requirements of high-level encryption, it's crucial that all microprocessors have some kind of cryptographic acceleration modules in their hardware whilst still being flexible

The capabilities of so-called Smart Life Solutions are very exciting, and we are beginning to see different apps such as micropayments, access control, transport and ticketing accommodated on a single device or card. New, securely authorized apps can also be added at a kiosk or Near Field Communication (NFC)-enabled smartphone without a master key being shared. This will allow new services, such as bicycle rental or booking concert tickets for example, to simply be added to an existing "city card", making the experience seamless for the end user.

The technology innovations go beyond carrying chips such as MiFare on the smartcard; the hardware could be built into a ring, watch or other wearable device, and some technologists are even looking at embedding them into fingernails.

Case Study: V2X

One of the most iconic aspects of smart cities is V2X (vehicle-to-everything) communication, and in particular the V2X radio system. This allows vehicle-to-vehicle and vehicle-to-infrastructure communication using the 5.9GHz dedicated short-range communications (DSRC) radio system, known as

WAVE, based on the IEEE 802.11p wireless standard.

IEEE 802.11p is an extension of WiFi or 802.11, designed specifically for intelligent transportation systems (ITS), so it doesn't do the time-consuming handshaking other systems such as laptops do when connecting to WiFi. That means V2X chipsets connect to other vehicles or infrastructure very quickly, even moving at high speeds. V2X enables communication between vehicles (V2V) and between vehicles and roadside infrastructure (V2I), at up to 260km/h. It can connect to the closest infrastructure radio within a kilometer, with encryption and authentication natively via software.

DSRC intelligent traffic systems also use a standardized messaging protocol where the communicating processors expect specific types of messages.

V2X Applications

V2X is fast and built for short range, and can be used in smart cities for many different purposes, beyond safety and emergency services. Here are a few examples:

Vehicle-to-vehicle connectivity, in one example, lets the car broadcast an authenticated message to the vehicle behind to, say, apply brakes in an emergency, a message that can be passed on to several cars, informing each one of an incident so to instantly react. This is a simple case already implemented by car manufacturers, expected to transform driving and prevent road accidents.

Such messages can also be part of a larger traffic system that may be able to prevent traffic jams simply by asking individual drivers to adjust their driving speed.

It's often difficult for cars to pass large trucks or vehicles, since it's hard to see past them. However, with V2X there's enough radio bandwidth for such large vehicles to broadcast video of the road ahead to the back of the queue. So, even though drivers may not have direct visibility, these video feeds will help judge the conditions better and assess if it's safe to pass. This 'transparent truck' technology is fast and precise enough that it can be used on busy city streets as well as at highway speeds.

But, how does this broadcasting to the rear work? Simple: since precise position information can also be part of the message, a car's electronics can readily determine if it's immediately behind a broadcasting vehicle.

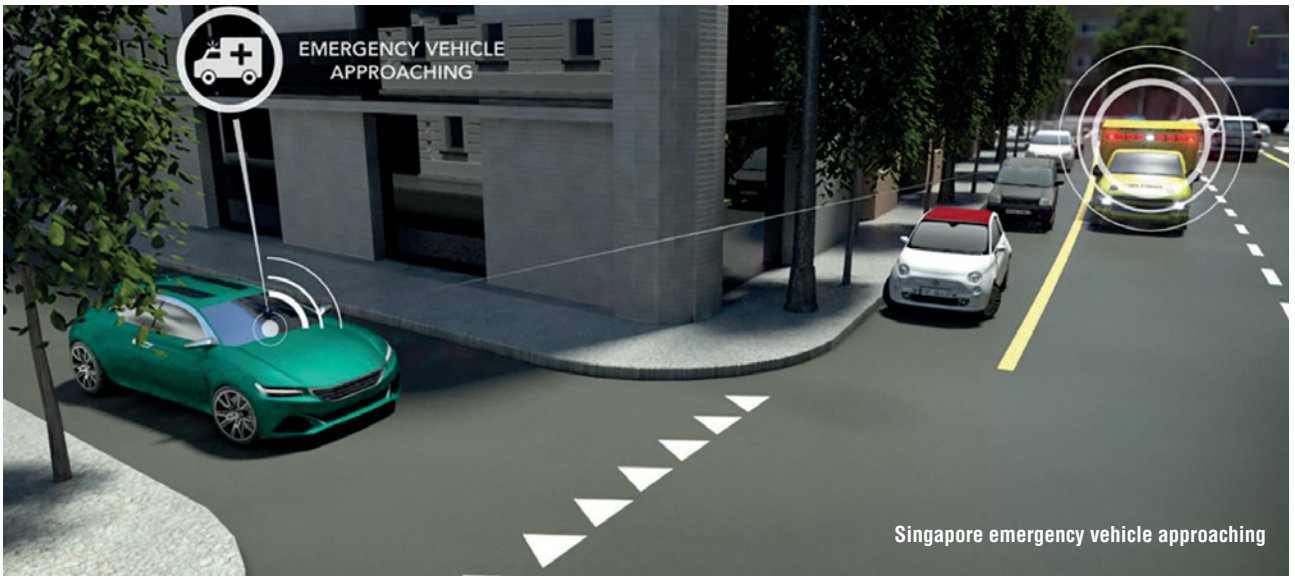
This capability of NXP's RoadLINK messaging has already been demonstrated with the so-called platooning of vehicles. Information from a lead truck is broadcast back to the rest, creating a lock-step chain of trucks, much like a multi-aircraft military formation, where only the leader has to navigate – everyone else just stays in line at the proper spacing.

What's more, the speed of communication and responsiveness of NXP RoadLINK is so high that it allows extremely tight distances between the platooning trucks. The system's autonomous acceleration and braking technology is sophisticated enough to operate with a 0.5s interval between the vehicles – which when travelling at 80kph (50mph) translates to a distance of 10m (30 feet). The resulting responsiveness of the trailing truck is estimated to be 25 times faster than the average human reaction time of one second, saving critical time in case of emergency braking.

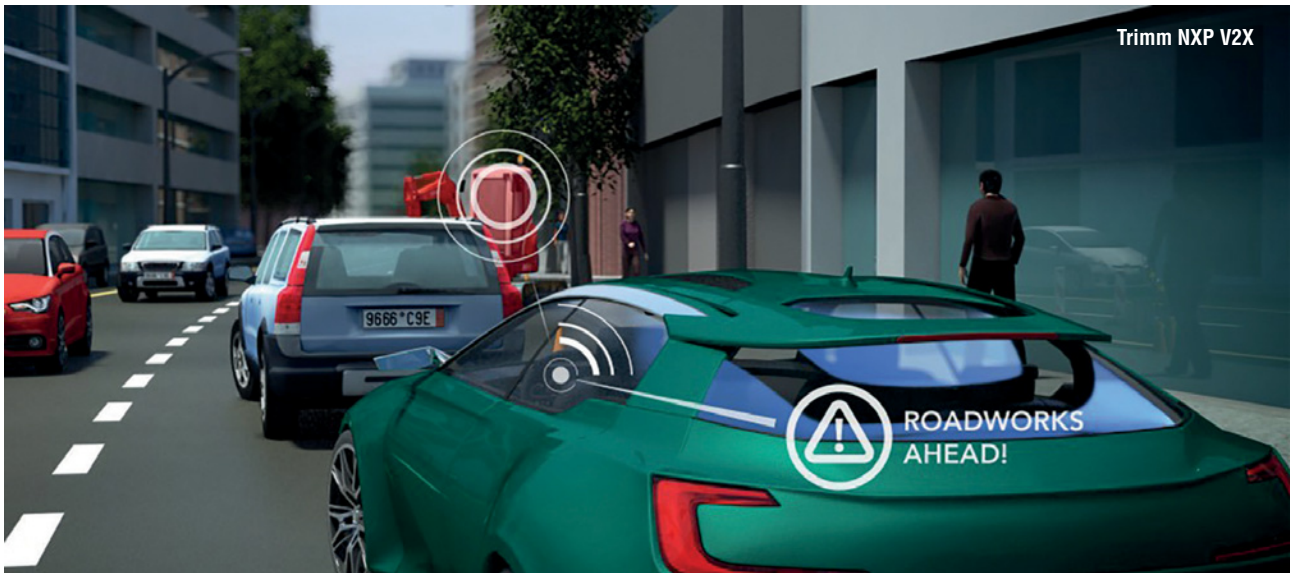
This kind of technology is fuel-saving, safe and efficient, and it can alleviate traffic in big cities. That long line of platooned trucks, for instance, could broadcast to the traffic system that they're travelling as one unit, and ask the smart infrastructure to hold a green light until they're through.

No User Is Left Out

The concept of requesting the traffic lights to hold for a while longer is just a small example of what vehicle-to-infrastructure can do. With V2X technology, an ambulance



Singapore emergency vehicle approaching



can signal other cars the direction it is travelling in, as well as publish the nature of the emergency to the rest of the infrastructure before arrival at the hospital. The traffic lights could then configure to give the ambulance a clear path, and inform drivers on the ambulance's route to pull over until the emergency vehicles have passed. This way incident locations and hospitals can be reached much quicker.

V2X also benefits the vulnerable road user, such as pedestrians, and especially the elderly, the infirm and children. Soon RFID readers will be embedded into city traffic lights to recognize these individuals using their own wearable low-cost RFID tags. By registering the RFID tag wirelessly, the traffic light can stop cars, giving these road users extra time to cross, and alerting nearby vehicles to the time it may take.

Managing Tomorrow's Security

As cities become smarter and more widely connected, the issue of security becomes paramount. After all, if infrastructure relies heavily on smooth and trustworthy communication between so many different sources, keeping those signals locked down and tamperproof is crucial. Therefore, tight security must be at the forefront when implementing smart city technologies.

There are multiple areas where security needs to be maintained too. In the RFID scenario, broadcasting signals cannot be for all. Likewise, it's imperative that the encryption keys that validate traffic light statuses aren't made available to the public.

Authentication is key here and of utmost importance. In systems based on radio, as with V2X, it is theoretically possible for anyone to buy a radio and broadcast messages into the system. Thankfully, the V2X system is designed to distinguish between encrypted, authenticated messages and interlopers.

With the increased processing requirements of high-level encryption, it's crucial that all microprocessors have some kind of cryptographic acceleration modules in their hardware whilst still being flexible. This allows for optimization of processing time and power consumption and, very importantly, allows the processor to focus on its application and not be consumed running and managing security algorithms. The best approach is a mix of adaptable hardware acceleration and software-based encryption blocks, responsive to the demands of state-of-the-art cryptography.

In fact, encryption on the IEEE 802.11p standard is not done at the physical hardware layer of the electronics itself; the encryption algorithm used between these radios is always managed at the software level for fast connection. In the case of the NXP RoadLink chipset, the processors have the advantage of hardware acceleration and tamperproof key storage. This means the processors can be updated with new algorithms via software updates, future-proofing the hardware's security abilities.

Just as importantly, unexpected, non-insecure messages will need to go through. For example, if a privately-owned delivery drone flies overhead, cities will want to receive messages from it about its location and intentions.

Just Around The Corner

There are already at least two car manufacturers with V2X chips fitted in their 2017 models, bringing this technology at the commercial stage.

However, technology adoption is unpredictable and can often move faster or slower than expected. There is currently enough of a practical case for its use in commercial vehicles and city infrastructure to warrant wide and fast implementation, providing the security needs have been met. The rest is just a matter of how fast our cities recognize the benefits and adopt the compatible technology. That's where initiatives like the Smart Cities Challenge can help: accelerating adoption, adapting to real-world feedback and demonstrating the practical benefits. ●

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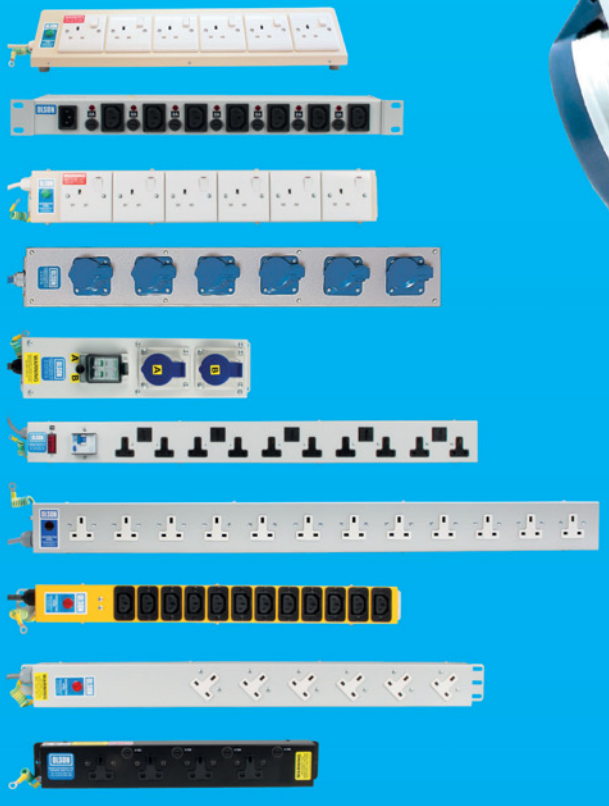

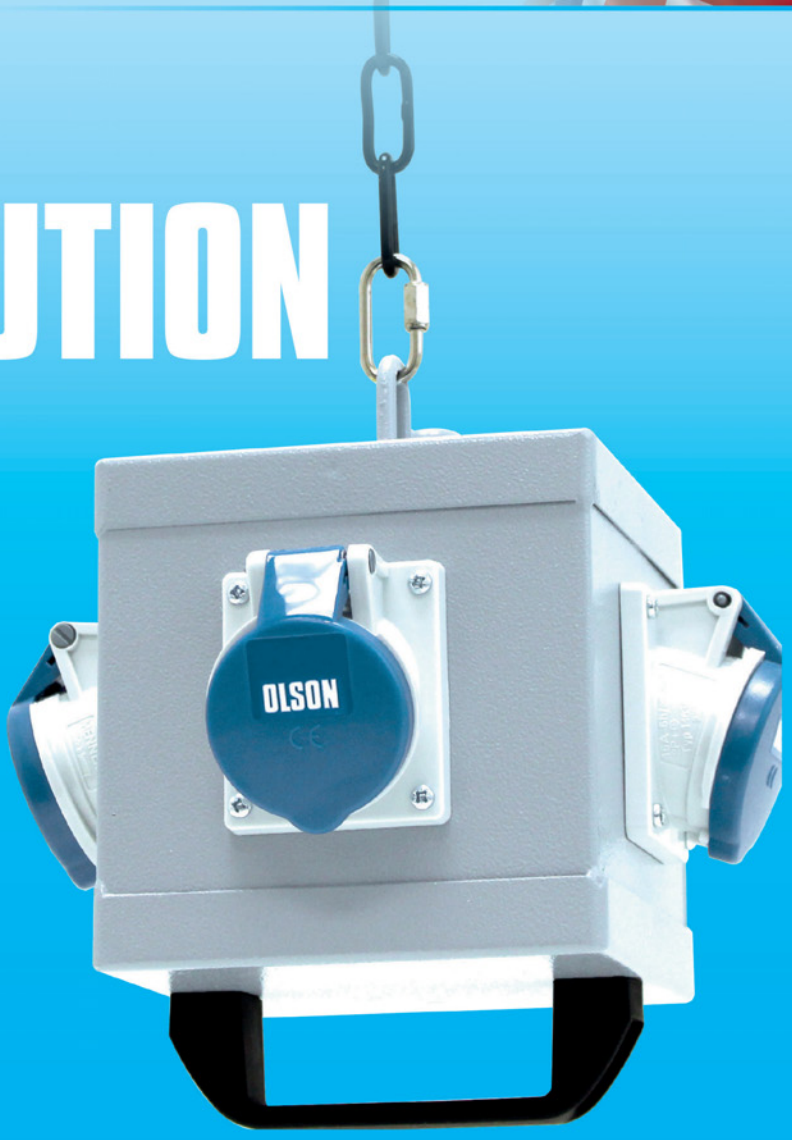

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PROCESSORS – THE REAL GAME CHANGER

SIMON DUGGLEBY, TECHNICAL MARKETING MANAGER AT RS COMPONENTS, CHARTS THE HISTORY OF CPUS IN THE GAMING INDUSTRY

The integrated circuit (IC) has shaped the last half-century and still looks set to shape the future, but it owes a lot of its success to pioneering applications, not least of all game consoles.

The IC in general, and the microprocessor in particular, have shaped the modern world. When, in the early 1970s, Intel introduced the 8008, the first commercially available 8-bit CPU, it changed everything. It was rapidly adopted to re-imagine old applications and introduce new products that didn't even have a market at that time.

The leisure industry as it exists today was very different 40 years ago, but it has never been afraid to embrace new technology. Intel's innovation inspired two engineers, who at that time were working on an electronic scoring mechanism for bowling alleys, to develop what would become the first game console to use a microprocessor with removable media. As a result, the game console and cartridge were born and the world would never be the same.

> Game consoles pre-date the Internet and still employ some form of removable data storage, but today that is predominantly used to access Blu-ray DVDs, while games are more likely to be accessed online through some form of storefront

The Rise, Fall And Rise Of The Cartridge

The Fairchild Channel F (F is for Fun!) is credited with being the first cartridge-based games console, closely followed (and ultimately surpassed) by the Atari 2600. But it was the Channel F (formerly known as the Video Entertainment System, or VES) that creatively matched a microprocessor in the console with ROM in the cartridge, making it possible to swap between games quickly and easily. It also launched the business model of matching relatively expensive consoles with relatively inexpensive game cartridges.

Atari followed suit, but both suffered from being pioneers in a rapidly evolving market. Fairchild decided to make its console a 'closed shop', by forcing its development team to choose only Fairchild components. This effectively priced it out of the market. Atari kept prices low by using commodity ICs, but tried to limit access to 'authorised' cartridges. As soon as a legal loophole was discovered that allowed third parties to develop their own compatible games, distributed on cartridges, there was a race to the bottom in terms of quality and price. The market almost disappeared until Nintendo revived it with

the Nintendo Entertainment System, or NES, in 1983.

Both the VES (Channel Fun!) and the NES were based on 8-bit processors. Originally, the Fairchild console used Intel's 8080 until switching to the Fairchild F8. The NES used the original MOST Technology 6502 (later being purchased by Commodore International and subsequently licensed to many others).

Together with the Zilog Z80 (used in the Sega Master System), the 6502 empowered the second wave of game consoles, but arguably the NES also introduced another innovation, the graphics processor. At the time, the Z80 could display more colours than the 6502, and Sega had twice as much memory as the NES (which, at the time, was probably more expensive than the CPU). However, the addition of the Picture Processing Unit allowed the NES to compete, graphically, with the Sega Master System, thanks to its effective use of memory. Both systems used cartridges, based on (still relatively expensive) ROM. But the importance of the graphical user experience was now set.

Eat, Sleep, Play, Repeat

By creating a new and large market for ROM, the gaming industry played a part in driving volumes up and prices down for memory, which would have a positive impact on many other markets. The game console also formed the most compelling after-market accessory for the TV, which would help drive innovation in that application space, too.

The burgeoning home console industry soon realised that more is better, and they rapidly transitioned to a 16-bit architecture. Sega's Genesis/Mega Drive opted for the Motorola 68000 (with a Zilog Z80 providing backwards-compatibility), while the Super NES used the custom-designed 65C816 16-bit device. However, perhaps the biggest innovation of the SNES was the system's flexibility, allowing some of the processing power to be located inside the cartridge. This took the form of the Super FX chip, a graphics co-processor that built on the effectiveness of the Picture Processing Unit.

By the time the first PlayStation hit the shop, the games console market was into its fifth generation. The first PlayStation employed a 32-bit MIPS R3000 processor (also used by Silicon Graphics at the time, a company that would later buy and still later sell MIPS). This helped shape the future of the MIPS architecture, which eventually adopted an IP-licensing model and is now owned by Imagination Technologies.

Sony now works closely with AMD to develop the semi-custom processors that power its eighth-generation console, the PS4. At its heart is AMD's Accelerated Processing Unit: a heterogeneous processor that integrates 64-bit CPUs with a GPU. It has a total of eight x86-64 cores, while the GPU has 18 compute units and can hit a theoretical maximum of 1.84TFLOPS.

Game consoles pre-date the Internet and still employ some form of removable data storage, but today that is predominantly used to access Blu-ray DVDs, while games are more likely to be accessed online through some form of storefront.

Accessibility to low-cost, high-performance processors and open-source software platforms such as Android and cloud-based games are creating a new wave in gaming, called microconsoles. These systems have become popular on crowd-funding sites and can be as small as a USB drive. Wireless connectivity such as Wi-Fi and Bluetooth can now be integrated into co-processors or companion devices, making microconsoles a new form of small, inexpensive and reasonably engaging gaming platforms.

Changing The World

Large markets always exert some influence on manufacturers, and with games consoles there is evidence of this in two key areas: the graphics processor and the user interface.

As well as pioneering the use of removable media in the form of cartridges, early consoles also fostered the development of user interfaces. From simple paddles to keyboards, and ultimately to dedicated controllers, the next

Fairchild channel-F

PlayStation SCPH 1000 with controller

Raspberry Pi 3 board and case

Sega Genesis Mk2, 6 button

phase in user interfaces will bring augmented (AR) and virtual reality (VR) to the mass market.

Unlike other user interfaces, AR and VR have not been developed with just the gaming industry in mind, but they have definitely been influenced by its capabilities. The latest consoles provide the perfect processing environment to bring AR and VR 'to life'. While high-end PCs will offer developers more creative freedom, the game console will likely provide the mass market entry point to this latest engaging interface technology. There are already many examples of AR and VR being used by surgeons to conduct intricate operations, sometimes remotely. This will undoubtedly continue and extend to other areas of our lives, such as driving a car, or exercising.

This evolution in the user experience must also acknowledge the role the gaming industry has played in terms of constantly improving graphics capabilities. Since the first graphics co-processor was conceived by console makers, it has developed into an entire industry, so established that it has given rise to the General Purpose Processing on Graphics Processors, or GPGPU, movement.

The ability of GPUs to carry out a vast number of parallel computations has been leveraged by the scientific community, who now use GPGPU in the fields of chemistry and physics, as well as the financial markets who use the power of GPUs to enable the (albeit controversial) practice of high-frequency trading.

It is not an overstatement to say that without game consoles, GPUs and AR/VR might not have emerged, leaving many other industries today bereft of these highly beneficial technologies.

Maker Movement

The commercial game console has never been an open platform, allowing anyone to develop their own games. Indeed, controlling access to removable media has been a part of its business model since the first console emerged in the early '70s. Today, game development is often outsourced and professional game creation (or Interactive Media, as it's also known) is a huge industry in its own right, whichever console is targeted. It requires highly skilled creative professionals using cutting-edge design software, and is now taught at the degree level in many universities. For those keen to explore this world, there are free and open-source platforms (such as Blender) that provide the perfect place to start.

Emulators have been around for many years; essentially, they allow one hardware platform to look like another through software abstraction. Thanks to projects like Raspberry Pi, makers can now recreate the golden age of game consoles using emulation software. Examples include the aptly named Raspberry Pi emulator, which is built on Raspbian (a Linux distribution created for the Raspberry Pi). As such, it can be downloaded and executed on a Raspberry Pi simply by writing it to an SD card. Boot up, sit back and enjoy the games that made consoles so popular!

Raspberry Pi's latest version, the Raspberry Pi 3 Model B Single Board Computer, or SBC (RS Components stock No 896-8660) features a 64-bit Quad Core ARM Cortex-A53 processor along with a lot of connectivity, yet still costs less than £30. It's a fantastic way to get someone interested in electronics and writing software.

For those who are even more creative, the Arduino platform is now being used to create game consoles. A perfect example is the Gamebuino, a handheld console based on Arduino that can be extended in the same way as any other Arduino-based design. Unlike commercial consoles, Gamebuino and others like it encourage game development and can provide the ideal entry-point for young engineers and game developers alike. RS Components currently stocks over 100 Arduino-based development kits and shields.

Boldly Into The Future

Gaming in general, including on PCs, is still big business and continues to drive innovation in the semiconductor industry, building on a strong heritage of close collaboration. And as new technologies such as virtual and augmented reality start to pervade the gaming arena, it is a relationship that looks set to get ever stronger. ●

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RS-232 IS HERE TO STAY

BY **MARK PATRICK** OF COMPONENTS DISTRIBUTOR MOUSER ELECTRONICS

RS-232 is over 50 years old, yet it's still going strong, being incorporated into many new products, leaving newer standards such as the Universal Serial Bus (USB) behind.

Different engineers may have different opinions, but it is generally agreed that designers' familiarity with RS-232 plays a major role. A simple search for RS-232 products on the Mouser website shows close to 6,000 results, in categories including connectors, circuit protection, embedded solutions, semiconductors, electromechanical, optoelectronics, passive components, power, sensors, test and measurement, thermal management, tools and supplies, and wire and cable, among others.

> "It is generally agreed that designers' familiarity with RS-232 plays a major role

RS-232 is not the only older connectivity standard that remains popular; other mature standards include RS-422, RS-423, RS-485, I2C and Serial Peripheral Interface (SPI). Compared to these, USB is relatively young, with development started only in 1994 by a consortium of seven companies. January 1996 saw the initial publication of the USB 1.0 specification, with the subsequent USB 1.1 version gaining wider adoption. USB 2.0 and USB 3.0 followed in 2000 and in 2008, respectively.

Serial Interface Standard's History

The EIA's Radio Sector first published RS-232 in 1962 as a serial standard to allow data terminal equipment and data communication equipment to communicate. Since its original introduction it has also been known as EIA RS-232, EIA 232 and TIA 232 (Electronic Industries Alliance and Telecommunications Industry Association), respectively.

Originally RS-232 was used to connect a PC to a modem. The original IBM PC and others had RS-232 ports as standard. To stay up to date with evolving technologies and changing applications, the standard went through several revisions, in 1969, 1986 and 1997. These changes eased it into various new applications, including electric typewriters, PC peripherals, programmable logic controllers (PLCs) and automation equipment.

The RS-422 and RS-423 standards were developed to extend the range of RS-232 connections up to 1,500m and 1,200m respectively. RS-422 was still used by the Apple Macintosh until the 1998 introduction of iMac with its USB ports.

Like RS-423, RS-485 can also connect devices up to 1,200m apart. Because the RS-485 driver is not always in transmitting mode, it can be used to implement simple two-wire linear networks. RS-485 is mainly used in automation, building automation, computer equipment and lighting systems.

Why RS-232?

So why do design engineers still choose RS-232 for new products?

One main reason is its cost. RS-232 implementations don't need any licensing or membership fees. In contrast, for non-members of the USB industry organisation USB Implementers Forum (USB-IF), the USB logo trademark license fee costs $3,500 for two years, with vendor identification costing $5,000.

Applications and speed are also major factors when choosing a serial standard. The Maxim Integrated website states: "Despite the development of newer digital interface standards, the humble RS-232

serial port is still a very popular means of data transfer. Robust and easy to use, the RS-232 interface is still an attractive alternative to more demanding and temperamental digital interfaces."

The RS-232 standard specifies a point-to-point link between two devices that can support a data rate of up to 920kbit/s with a maximum cable length of 50ft. One way to overcome the length limitation is to transmit the data over a different medium.

RS-422 offers a much faster data rate of 10Mbit/s for up to 10 unit loads in a multidrop configuration. The use of differential voltage connections makes the standard ideal for noisy environments.

RS-485 also allows for data rates up to 10Mbits/s, but is different in that the transmit mode can be turned off. This allows multipoint configurations, i.e. multiple transmitters and receivers on the same line. The RS-485 bidirectional interface can support a network of 32 devices.

Prevalence

Today, RS-232 can be found in many different applications, especially in embedded systems, control and automation, and computer networking, while more modern standards like USB dominate in the high-volume PC and mobile markets.

Despite that, older serial standards are still being designed into emerging applications, such as the Internet of Things (IoT) with its underlying philosophy of connecting everything to the Internet. Billions of sensors and hubs will require a low-power, reliable connection that is easy to design and implement – and older serial standards can be the ideal choice for this type of application.

The DIY community is another area where older serial standards like RS-232 have seen a rise in popularity. This collection of hobbyists and enthusiasts make use of small embedded computers like Arduino for its easy-to-use programming language and development environment, as well as readily available sample code.

These computer boards can be expanded to offer additional functionality through various expansion boards, available to buy pre-made or by using downloadable reference designs to build your own.

The Arduino website also offers in-depth tutorials. One example taken from this site uses a MAX3323 single-channel RS-232 driver/receiver chip to communicate between a computer and a software serial connection on the Arduino board. The step-by-step instructions teach the user how to build the breadboard to host an RS-232 chip and code a simple software program required for the connection.

An RS-232-to-USB adaptor, such as those available from FTDI, can be used to connect an Arduino board to modern PCs due to the lack of an RS-232 port on the PC. Some driver issues with the cables, as well as with different versions of Windows, mean interoperability can be a problem. This can be especially true with a PC running Windows 8.

Comparison Of Older Serial Standards

Both RS-422 and RS-485 offer performance advantages over RS-232, especially in terms of data transmission speed and distance; I2C and SPI standards offer further performance advantages.

I2C was originally developed by Philips Semiconductors (now NXP), and widely adopted by other major silicon manufacturers. The standard is a multi-master, multi-slave, single-ended protocol that can communicate at up to 3.4Mbit/s in high-speed mode, but only over a distance of several meters because of capacitance limits on the line. The standard requires no licensing fees, but a fee is payable to NXP for the allocation of slave addresses.

The System Management Bus (SMBus or SMB) is a derivation of the I2C bus developed by Intel in 1995. The standard differs from I2C electrically and in its timing, protocols and operating modes. SMBus is mainly used in PCs and embedded systems for

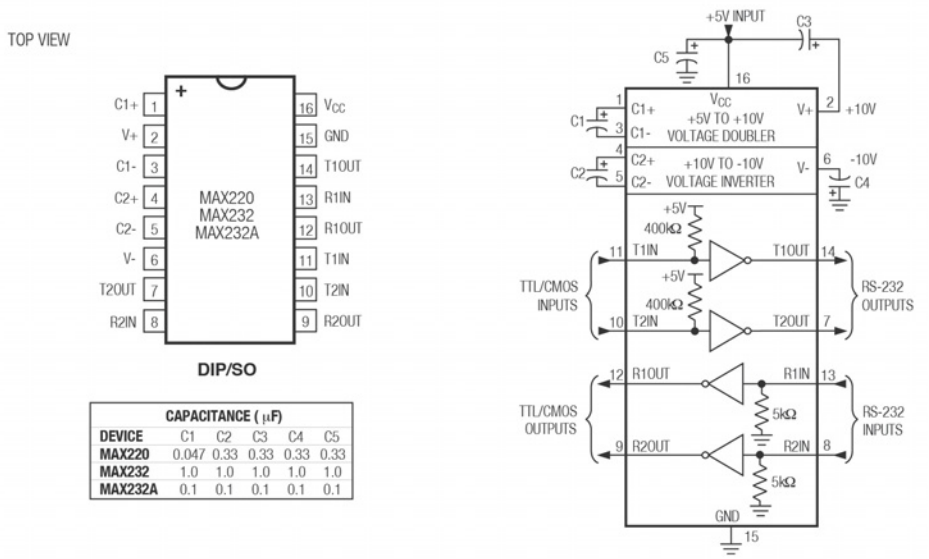


Figure 1: MAX220, MAX232 and MAX232A pin configuration and typical operating circuit

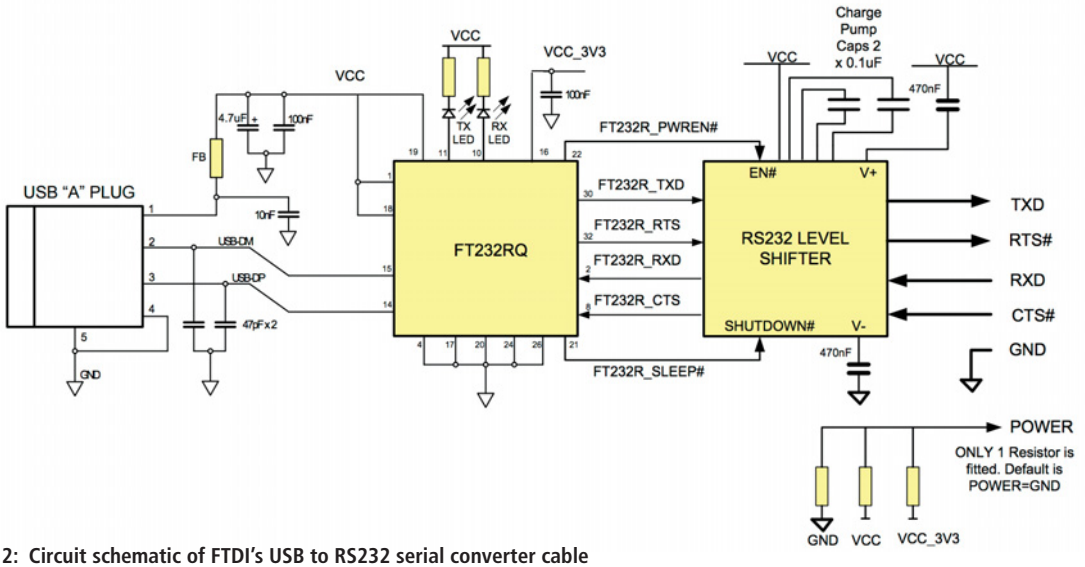


Figure 2: Circuit schematic of FTDI's USB to RS232 serial converter cable

simple management of components such as fans. The SMBus itself has an offshoot, PMBus, which offers higher performance, and is mainly used for digital control of power supplies.

Finally, the Serial Peripheral Interface (SPI) offers a bigger step up in performance, which is offset by a corresponding increase in complexity, including IC packaging with more pins. The main applications for SPI are digital memory cards and LCD displays.

Past, Present And Future

These are only some examples of serial communications standards; plenty of others that have come and gone. One example is the Apple-developed Firewire, which is now difficult to find in contemporary designs.

More modern standards include USB, Ethernet, Fibre Channel, SCSI and its variants, PCI and PCI Express, as well as ATA and its various offshoots.

> The RS-232 interface is still an attractive alternative to more demanding and temperamental digital interfaces

Many of these contemporary standards offer big speed and distance performance advantages over older standards like RS-232, but are also far more complex to design in and are less flexible. For example, RS-232 can operate at up to 15V, while USB is restricted to 5V.

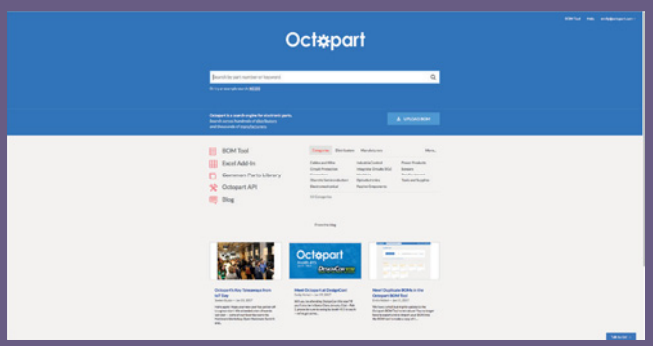
Having communication standards that are as simple and flexible as possible has a definite appeal to engineers who deal with much more complex subsystems all the time. So while more modern standards have either come and gone or found their respective niches, the pure simplicity of serial standards such as RS-232, RS-422 and RS-485 should ensure that they stay relevant to electronics engineers for a long time to come. ●

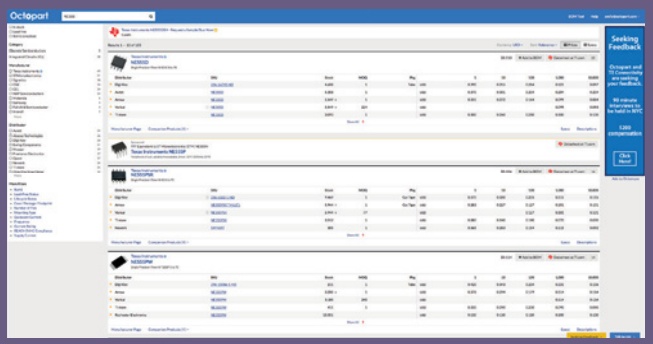
THIRTEEN FREE ELECTRONICS DESIGN TOOLS AND PCB DESIGN SOFTWARE KITS

ELECTRONICS DESIGN ENGINEERS FROM DESIGN CONSULTANCY BYTESNAP DISCUSS SOME OF THE MOST USEFUL FREE ELECTRONIC DESIGN SOFTWARE TOOLS AVAILABLE TODAY. IF YOU NEED TO PREDICT PCB CHARACTERISTICS OR MANIPULATE SCREENS AND ICONS, HERE IS THEIR USEFUL LIST

1 2 Findchips and Octopart – component search and price checker

Findchips and Octopart allow to quickly check the price and stock levels of components from a number of suppliers. These tools can sum up the bill of materials (BOM) and show price breaks across multiple suppliers for all recognised components. However, reported prices and stock levels should be approached with caution as they often differ from those actually at the supplier.





3 Microstrip Impedance – predicting PCB characteristics

For predicting PCB characteristics to work out stack-ups and track thicknesses, we highly rate Microstrip Impedance, which has a good set of PCB track models – more than some other, similar, tools.

The graphics also make it clear what's meant by terms such as "embedded microstrip" and "asymmetric stripline" for example, the latter being one that some other tools do not support.

4 Notepad++ – source code editor

Notepad++ is a free source-code editor, packed full of features, such as file comparisons, or macro editing which allows repetitive operations on a file. It can also perform ASCII-to-HEX and HEX-to-ASCII conversions to decipher any embedded letters or messages.

The tool has tabbed file browsing and probably most important of all, syntax colouring for many languages.

Notepad++ supports the syntax of most programming languages through auto-complete. Although it has a small footprint, it offers high level of customisation, which is great for productivity as it helps speed up the development process.

Running in the MS Windows environment, its use is governed by the GNU Public License (GPL).

5 Paint.NET – image/photo editing

This tool's clean, straightforward user interface, fast performance and powerful features make it a staple in our software development toolkit.

It's packed with features – special effects, re-colouring and gradient tools, to name a few. Some even say that Paint.NET's Layers function stands up to some more expensive programs such as Photoshop.

A particular feature we like is the tabbed document interface where, instead of text, tabs show a live thumbnail of the image.

Paint.NET's generous keyboard shortcuts and endless Undo and Redo functions (only limited by the amount of available disk space) make it a popular option among engineers (and non-engineers alike) for manipulating screens and icons.

There's a lot of support for Paint.NET users, with a strong, active community and plenty of tutorials. A built-in updater ensures working with the newest release.

For us, Paint.NET sets the bar pretty high for what a free software program should be.

6 GIMP – image editor

Another, seriously-powerful program to rival premium image editors is the legendary GIMP (GNU Image Manipulation Program).

Although it may lack some of the speed and polish of Photoshop, GIMP has maintained its huge popularity through continuous development and its impressive performance. It has come a long way since its initial release in 1996, and despite the odd bug and performance slowdown, for us the pros outweigh the cons, including:

- Modern, user-friendly UI;
- Wide-ranging colour management features;
- Small file-footprint compared to premium image-editing programs;
- Extensive toolkit – including newly-improved Text Tool;
- Latest GEGL image-processing engine means support for high bit-depth images and OpenEXR high-dynamic-range image files;
- Vibrant support community online;
- It's open source and free!

It's also praised for being highly customisable, with an extensive library of plugins and scripts, and its integration with C++, Python, Perl and several other programming languages.

Be sure to use the most stable version though, as the latest release might not be deemed the most stable by GIMP's chief developers.

GIMP is currently available on various operating systems, including GNU/Linux, Windows and OS X.

7 Audacity – audio editing

Audacity is a comprehensive software kit for editing audio files and adding sound effects. It works with several file types, including OGG, WMA, MP3 and WAV for import and export.

For the functionality it offers, Audacity has a very light footprint – giving high performance without stressing your CPU. A serious bonus is its unlimited levels of the Undo function.

Its impressive list of features make it desirable for recording and mixing, and for most post-processing tasks, including podcast and albums.

Beyond its included assets, Audacity also supports .vst files, offering access to a huge range of both free and paid effects across the net.

Having said that, we'd welcome a user interface refresh, since it looks rather dated and some find it clunky to navigate. Also, be aware that on Windows and Mac, you'll need to install the LAME audio encoder to save your file as an mp3.

Don't be put off if you find this digital audio workstation daunting at first; there are several helpful Audacity tutorials on line. Push through and you'll be rewarded with a pro-level digital audio editor, with cross-platform support for Windows, Mac, GNU/Linux and other operating systems.

8 HxD – binary image editing

HxD is a fast hex editor which, in addition to raw disk editing and modifying main memory (RAM), handles files of any size. The user interface is straightforward to navigate.

HxD offers a lot of functionality, including:

- Search and replace;
- Export;
- Concatenation or splitting files;
- Statistics;
- Checksums/digests;
- Insertion of byte patterns;
- File shredding.

HxD is available on Windows as both a portable or installable program.

9 Tera Term – serial terminal

Tera Term is a Windows-based terminal emulator that we principally use for monitoring debug streams from boards under test. In addition to being an unencrypted serial port terminal emulator, it also supports remote SSH connections. It has a macro function offering a degree of automation that can even be used for basic factory tests.

Tera Term can save debug logs to a file and you can use it alongside a CLI on the host processor to manipulate the target.

10 HDD Copy Tool – hard disk duplication and image creation

HDD Copy Tool is a Windows utility for low-level, sector-by-sector, hard disk duplication and image creation.

HDD Raw Copy tool produces an exact replica of a SATA, IDE, SAS, SCSI or SSD hard disk drive. The program can be used with any USB or FIREWIRE external drive enclosures. It also works with MemoryStick, SD, MMC, CompactFlash media and other Flash cards via a card reader.

11 GSpot – codec identification

We find this lightweight, Windows-based freeware program really useful in helping identify the codecs used in video files. GSpot uncovers a lot of valuable file data, including audio/video codecs, stats, frame-by-frame video data, size and container. In addition, the software also confirms whether the required DirectShow filters or Video for Windows codecs are installed and configured for proper playback.

Initially, GSpot was designed to support AVI when it was created in 2002, but has since been expanded to provide full support for OGG.

GSpot also provides limited support for versions of QuickTime, Windows Media Video, MPEG and other commercial container formats. On fourcc.org it's listed as one of the few remaining FOURCC identifiers.

Admittedly, the UI could be more user-friendly, but GSpot hits our sweet spot for bringing renegade video files to heel.

12 USBView – USB device browser

This graphical user interface (GUI) application presents you with a lot of information about the USB devices connected to your PC, such as descriptors, VIDs (Vendor IDs) and PIDs (Product IDs) allocated by the vendor. This is great for improving workflow efficiency, since USBView helps determine which drivers should be loaded, based on the VID and PID information.

USBView is currently only available on the Windows platform.

13

Wireshark – network protocol analyser

WIRESHARK

This freeware is a network debugging tool, allowing you to see what's happening on the network at a 'microscopic' level. Its website claims Wireshark to be "the world's foremost and widely used network protocol analyser". We're Wireshark fans for a number of reasons, including:

- It shows the whole network protocol – ports, IP addresses, MAC addresses, checksums, retries, etc. – not just the payload;
- When debugging the application it needn't run on the target device, it will work as long as the computer is on the same network;
- You can filter the packets that are received to more easily track down issues;
- When creating bespoke protocols, Wireshark can be used to identify what's been sent is what's been put in the individual network packets;
- When dealing with new protocols, this tool has a way of capturing and analysing what's been received for validation of what's been processed;
- New protocols are being added all the time;
- As a multi-platform tool, Wireshark is widely accessible – running on MacOS, Linux, Windows, NetBSD and several other operating systems;
- Assistance available from its online support community if you run into problems.

There are resources such as guides, videos and a Wiki to get you up and running on Wireshark.

Don't forget to always check usage policies/terms and conditions for these tools before use.

UNCOVERING HIDDEN ASPECTS OF ELECTRONICS CORROSION PROTECTION

JULIE HOLMQUIST, TECHNICAL WRITER, AND **JAY ZHANG**, TECHNICAL SALES MANAGER, BOTH AT CORROSION PROTECTION COMPANY CORTEC, DISCUSS SOME SIMPLE STRATEGIES FOR PROTECTING ELECTRONICS IN MANUFACTURING

Corrosion protection is an important aspect in manufacturing electronics, and OEMs do their best to ensure components and final products stay clean and corrosion-free. Nevertheless, despite tight controls, corrosion can still pose problems during the manufacturing process and after shipment. The introduction of Vapour phase Corrosion Inhibitor (VpCI) technology in a few strategic areas offers effective solutions.

Cleanliness And Reliability

There's no doubt that electronics manufacturers take various measures to keep their premises, equipment, systems and components clean and contaminant-free. Clean rooms, air showers and various control procedures are all strategies to ensure that no microscopic contaminants remain on electronics to foster a corrosion initiation site and potentially cause failure. A variation as simple as a discolored circuit board could be a possible link to corrosion and failure.

Unfortunately, discoloration and actual corrosion can still occur after electronics exit the highly controlled area of a plant, leaving quality engineers wondering what went wrong with the process. While often a corrosive shipping environment is at fault, it is helpful to take advantage of innovative packaging technologies and look at additional ways corrosion can be prevented from slowing manufacturing and wasting raw materials.

VpCI Technology

VpCI is a unique method for combating corrosion, a technology that uses amine salts of carboxylic acids to deposit microscopic protective film that is self-regulated by equilibrium and molecular attraction to metal surfaces. VpCI molecules are so tiny that they do not interfere with electronic functions. Further, they evaporate off the surface of the metal when not confined in an enclosed space.

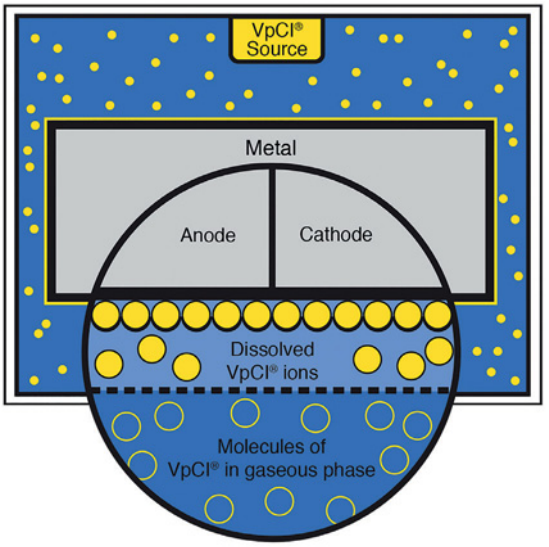


Figure 1: VpCI molecules vapourize from a source material, such as a packaging film, fill the enclosed space and adsorb on metal surfaces to provide a monomolecular layer of corrosion protection. When the package is opened, the VpCI layer evaporates, leaving the electronics clean and ready to use

VpCI molecules work by vapourizing from their source material and dispersing throughout an enclosed space until they reach equilibrium. As the molecules come in contact with metal, they adsorb and form a highly effective protective-layer against corrosive elements. If the enclosed space must be briefly opened, allowing some of the molecules to escape, other molecules from the VpCI source soon flow in to replace any displaced molecules and form a new protective layer; see Figure 1.

VpCI technology can be adapted to many applications – including a simple cup or pouch filled with VpCI powder, VpCI-impregnated foam, VpCI-fortified coating, VpCI film, VpCI paper or a VpCI-desiccant combination. These varying applications allow the VpCI to be applied to suit the special circumstances and needs.

VpCI can also be combined with other properties for special requirements, such as ESD film (Figure 2) and bubble sheeting (Figure 3), or conformal coatings, to protect the sensitive electronics.

Preventive Packaging

In some cases, it may actually be the packaging that is to blame for the appearance of corrosion.

Finding effective corrosion protection solutions for packaging may be one of the biggest challenges in electronics manufacturing. Once a product leaves the facility, it is beyond the protection of precise quality controls of the manufacturing process.

While electronics may not experience corrosion failure once in service, they are still vulnerable to corrosion from extreme temperature variations and consequent moisture condensation during transit. For this reason, a common packaging method is to place desiccant in the packaging to absorb moisture that builds up during shipment. For some high-tech equipment, this well-known danger leads to extensive packaging efforts that may nonetheless fail.

One large company had trouble preventing corrosion on equipment shipped worldwide, despite extensive efforts to safeguard it by vacuum wrapping and treating with desiccant. The corrosion problem went away when the company began protecting its equipment with VpCI film wrap and foam pads, which exposed metal components to protective VpCI vapours inside the packaging. The process proved much simpler and more cost-effective.

In another case, a telecommunication equipment company experienced 86% failure on its packaging shipped from North America to the Far East; the corroded equipment required return and repair. While the barrier bag packaging was initially labour-intensive to apply, another problem arose when customs officers opened the bags for inspection, destroying the protective environment. The company decided to compare this method with protection using VpCI film and emitters. When test results showed corrosion on four out of six units using the previous packaging, with no failure on VpCI packages, the company adopted the latter strategy. Labour cost went down by 63%, while material costs dropped by 54%.

Another example is a mobile phone company that combined vapour barrier material, desiccants and antistatic bags to protect cellular-phone enclosures, PCBs and accompanying equipment. Again, the use of assorted VpCI emitters, VpCI antistatic bags and VpCI foams helped the company save on packaging material and labour.

An important factor in adapting VpCI technology to electronics packaging is the use of its electrostatic discharge (ESD) protective capabilities. Without protection from ESD, electronics can easily be damaged from friction during shipment.

But, by combining VpCI technology with its static dissipative properties, electronics manufacturers can make use of both protective methods in one recyclable packaging medium, such as film or (for extra cushioning of sensitive materials) bubble wrap.

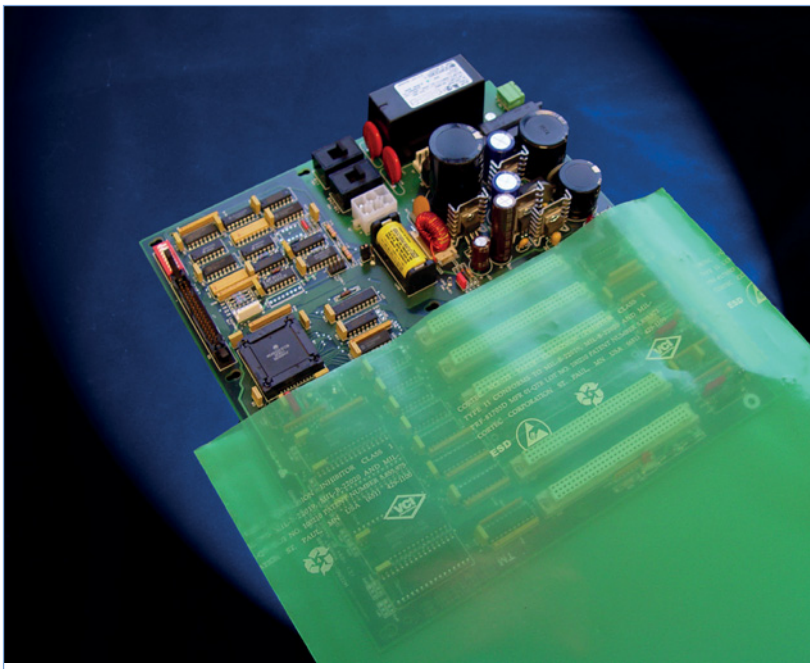


Figure 2: The use of ESD VpCI film is an excellent strategy for reducing corrosion claims and reducing packaging labour and material costs

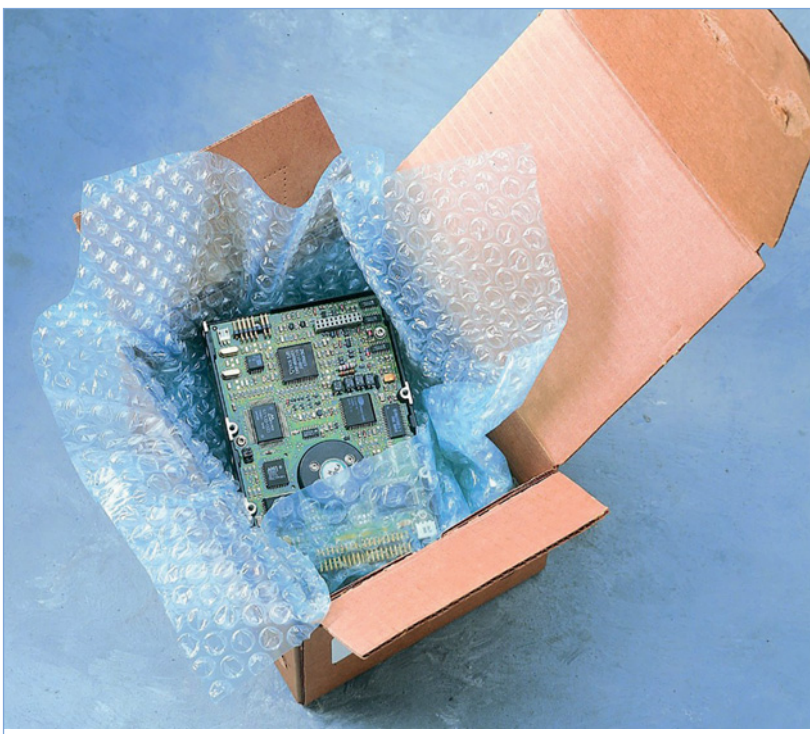


Figure 3: VpCI technology can be combined with ESD properties in the form of bubble wrap to provide cushioning, and ESD and corrosion protection for sensitive electronics

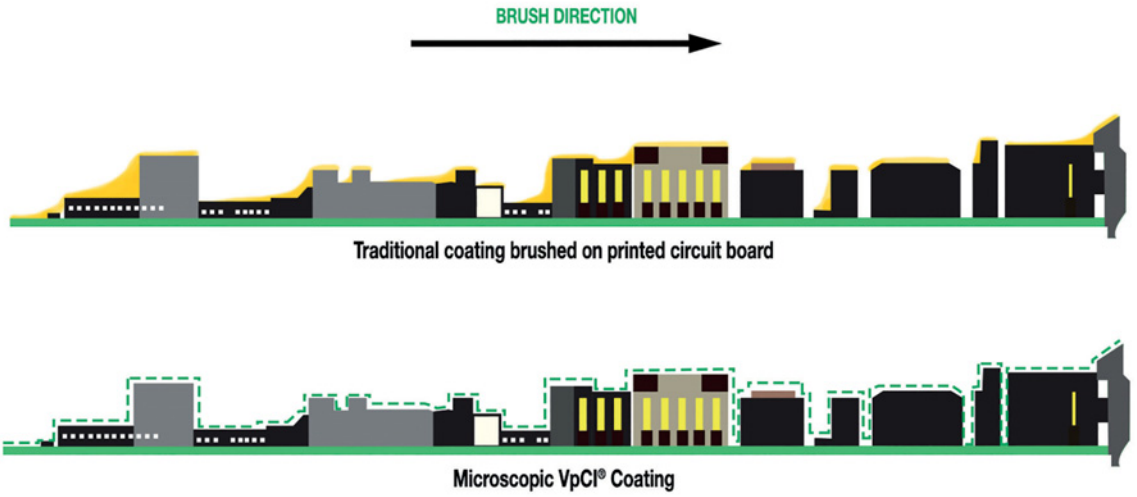


Figure 4: Brushing a protective coating on a printed circuit board can result in gaps in the protective layer or encourage contamination. In contrast, VpCI packaging and conformal coating deposit a continuous microscopic layer of corrosion protection that guards against micro-corrosion

Corrosion Protection In Manufacturing

Although wise packaging strategies can cut down on labour costs, material costs and corrosion claims, the manufacturing plant itself can still benefit from additional techniques, despite already strict controls on the cleanliness process.

Some electronics manufacturing steps produce a very corrosive environment, particularly in the wet process area where chemicals and fumes abound, as in the etching of PCBs. In environments like these, manufacturers may be challenged by corrosion on the electrical panels that control the manufacturing, resulting in failure and interruptions to production.

Corrosive elements also attack the metal pieces of equipment that produce electronic components – for example, chemical etching equipment and dry film developing machines in the wet process area – and can therefore lead to shorter asset service life.

Protecting the electronic equipment and machines that run the system is a simple and cost-effective way to save on plant maintenance costs and promote top efficiency of continuous-process machines. VpCI emitters – self-adhesive cups or foam devices filled with VpCI – are a low cost and effective way to protect enclosed spaces like electrical cabinets, filling them with a VpCI vapour that condenses on metal surfaces to protect from corrosion. Circuit boards and electrical contacts can also be sprayed with a VpCI cleaner/protector that creates a thin film without altering electrical resistance properties. For wet process equipment, applying a water-based corrosion inhibitor spray on exposed metal surfaces will leave a thin clear film to protect against the attacks of corrosive chemicals and moisture.

Another interesting consideration is the preservation of raw material during in-process storage. In particular, freshly etched copper, such as that on PCBs, is more vulnerable to oxidation. If oxidation occurs, the PCB will need another round of chemical etching. Because copper panels must be a certain thickness in order to function properly, this etching can only go so far before the manufacturer needs to scrap the material.

Instead of risking this costly loss of material, manufacturers facing corrosion problems after etching may want to consider the simple step of interleaving a stack of freshly-etched PCBs with VpCI papers in between each layer while awaiting the next step in the manufacturing process.

Important Advance

VpCI technology has been an important advance in corrosion protective packaging for the electronics industry. VpCI compatibility with electronics and ESD film material is an important factor in its usefulness, enhanced by its ease of application and disposal as recyclable packaging material.

Its possibilities for corrosion prevention during manufacturing demonstrate simple but innovative strategies for lowering maintenance and repair costs and cutting down on scrap. By combining innovative technology with practicality, VpCI technology lowers costs in ways that might normally be overlooked. ●

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MODULES FOR SERVERS GO COMMON

COMPUTER MODULES ARE NOW SUFFICIENTLY DEVELOPED FOR USE IN SERVERS, ALSO RECOGNIZED BY THE STANDARDS BODY PICMG, WITH THE RECENT PUBLICATION OF THE COM EXPRESS TYPE 7 SPECIFICATION. BY **CHRISTIAN EDER**, DIRECTOR OF MARKETING AT CONGATEC

The use of modules in servers has not been common until now, partly because server technology developers have their own ideas about the specific hardware design of their systems, and partly because they have the volume to justify developing dedicated systems. This is why there are currently a large number of dedicated systems with homogeneous designs in carrier networks and server farms.

However, now that performance has increased to a point that can support server virtualization, server functions will increasingly be specified in software, abstracted from hardware.

The main key phrases in this context are software-defined networks (SDN) and network functions virtualization (NFV). Because specific designs are no longer necessary, this trend is leading to hardware standardization, enabling projects such as the Open Compute Project (OCP) – driven by server farm operators such as Google and Facebook – to achieve greater efficiency, flexibility and scalability.

> Standardized computer modules are now perfectly suited to flexible design and requirements-based scaling of server performance

A core aspect here is hardware modularization. Basically, each server module can assume any task; it is only a matter of deciding where the module will reside in the network and what its performance will be. Innovation cycles in processor performance continue to be fast, and cost pressures on services are constantly increasing, forcing system developers, network operators and service providers to look for ways to implement performance upgrades as simply and cost-effectively as possible.

Cost-Effective Performance Upgrades

Standardized computer modules are now perfectly suited to flexible design and requirements-based scaling of server performance. With standardized modules, systems can easily be upgraded, even over the course of several processor generations, and without any hardware changes. This reduces the costs of an upgrade to the cost of exchanging the modules, which is much cheaper than exchanging complete single-board computers (SBCs) or entire blades.

A previous challenge was lack of a module standard to

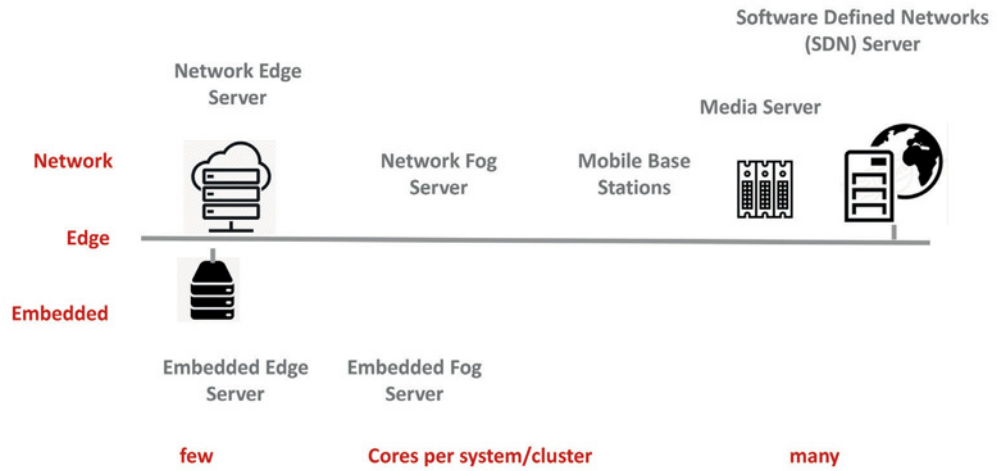

Figure 1: COM Express Type 7 modules are suitable for embedded cloud, edge and fog servers, as well as telecommunications and server farm equipment such as base stations, media cloud servers and SDN/NFV infrastructure

support native 10-Gigabit Ethernet (10GbE). That changed with the introduction of the PICMG specification COM Express Type 7. Modular server designs with redundant 10-Gigabit Ethernet switching can now be developed with all the benefits of computer modules.

Carrier-Grade Servers

Carrier-level applications include virtualized infrastructure computers; dedicated platforms for cloud, edge and fog servers operated by the carrier; cellular phone towers; and storage and content distribution systems that require efficient solutions for more performance and ease of scalability. Enterprise-level application fields are primarily found in research centres for content distribution, where service providers for IPTV, cable and (mobile) clouds operate server farms close to the edge of the carrier network to deliver device-specific transcoding and supply content on demand, as well as in security applications such as Video Surveillance as a Service (VSaaS).

Embedded Servers

IoT and embedded OEMs can also profit from the new server-on-modules. Application areas include cloud, edge and fog servers operated by an OEM or end user, and servers that reside at the edge of the network but run outside the carrier networks. There are also a number of classic application fields including, for example, robust microserver designs for robot controllers, test and measurement systems, higher-level factory automation and Industry 4.0 server nodes.

Another useful application for the modules is in industrial-grade OPC servers, which often form the interface between Office applications and industrial production, and are managing increasing amounts of data.

COM Express Type 7 Interfaces

Server-on-modules conforming to the COM Express Type 7 specification feature up to four 10GbE interfaces, a complete set of NC-SI sideband signals and additional PCI Express lanes. The new modules, therefore, differ significantly from the Type 6 specification: Numerous interfaces had to give way to new interfaces; all audio and video interfaces were deleted, as well as four of the eight USB 2.0 ports, the ExpressCard interface and two of four SATA ports. This freed up 60 pins on the AB connector and 42 pins on the CD connector for the new interfaces.

The 10GbE interfaces are designed as 10GBASE-KR single backplane lanes (see IEEE 802.3/49) to keep them from being tied to pre-defined physical interfaces. Subsequently, the PHY, which defines the physical transmission layer, is not on the module but is instead implemented on the carrier board. This means that the data transmission method (be it copper or fiber optic cable) needs to be defined only during implementation on the carrier board.

For even greater flexibility, the interfaces can be implemented as interchangeable SFP+ modules. It is also possible to combine several 10-Gigabit Ethernet signals. Four 10GBASE-KR lanes can be combined in a PHY for 40GBASE-KR4.

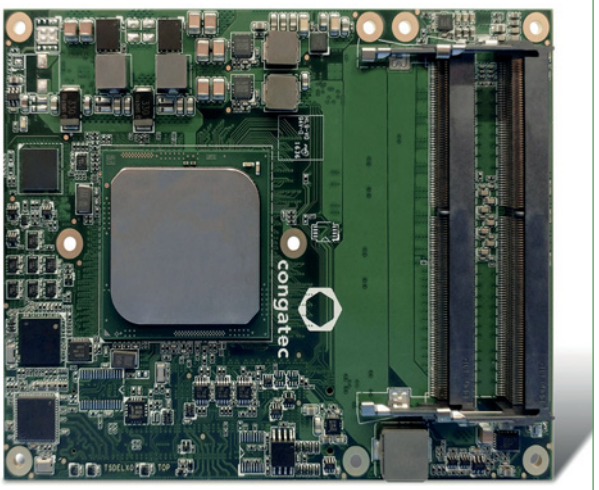

Figure 2: Congatec's new COM Express Type 7-compliant server-on-module comes with Intel Xeon processors (codename: Broadwell DE)

The COM Express 10GBASE-KR interface feature set provides a software-definable pin for each of the four interfaces. This physical pin can be configured as an input or an output and is controlled by the corresponding Ethernet controller. A typical application is implementation of a hardware-based timing protocol in accordance with IEEE 1588 for powerful real-time applications.

Mass Storage Interface

The omission of two SATA ports may seem confusing at first because server applications always need larger mass storage capacity. However, the trend is for SATA drives increasingly to be replaced by solid-state drives (SSDs). Because SSDs are much faster, the SATA interfaces are now becoming bottlenecks and

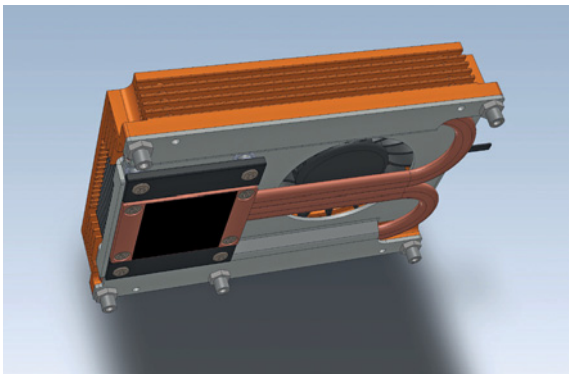

Figure 3: For the new COM Express Type 7 server-on-modules, Congatec also offers matching heat-pipe-based cooling solutions

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are being superseded by NVMe (NVM Express or Non-Volatile Memory Host Controller Interface specification – NVMHCI; see www.nvmexpress.org), which PCI Express uses to connect mass storage devices. Type 7 clearly supports this development with its greater number of PCIe lanes.

Feature Set

The new COM Express Type 7-compliant conga-B7XD server-on-modules are designed as headless modules with ten different server processors: from the 16-core Intel Xeon D1577 processor to the Intel Pentium D1519 processor for industrial temperature ranges (-40°C to +85°C). They offer up to 48GB of 2400MHz DDR4 RAM with or without error correction (ECC), as required by the customer.

The distinguishing feature of the new Congatec server-on-modules is their high network-performance with 2 x 10Gigabit Ethernet. For connecting powerful system extensions, including flash memory, they also feature up to 24 PCI Express Gen 3.0 lanes and eight PCIe Gen 2.0 lanes. Conventional storage media can be connected via 2 x SATA 6G. Four USB 3.0, four USB 2.0, an LPC, an SPI, an I2C bus and two UARTs are also available as additional I/O interfaces. OS support is offered for all common Linux distributions and Microsoft Windows variants – including Microsoft Windows 10 IoT. Support of remote management technologies completes the feature set.

Single-Source Cooling Solutions

The new server-on-modules consume up to 65W, so for improved chip reliability and extended service life, system developers will have to pay special attention to efficient cooling. A good design should provide enough cooling so the Turbo Boost can be used to supply additional processing power. Turbo Boost enables over-clocking of the processor, but only if it remains cool enough.

To facilitate thermal management for developers, the COM Express specification defines a standard heat spreader. Its flat surface allows it to be easily integrated into server designs and also enables fast technology upgrades without any mechanical and/or electrical system architecture changes. This also makes it much easier to follow the constantly changing roadmaps of the chip manufacturers.

However, even with the specification, designers must take into account the necessary thermal material stack between the module and heat spreader. The location and material is often unique to each module family and manufacturer. Suitable specification-compliant heat spreaders and heat sinks are supplied by OEMs such as Congatec, tailored for each module to make the job of integrating the new server-on-modules easier for developers. Congatec also supplies an evaluation carrier board for the server-on-modules; the circuit diagrams and layout are also available for free and for customized designs. ●

WHITE PAPER

A detailed white paper on the COM Express Type 7 specification is available for download from Congatec (http://www.congatec.com/us/technologies/com-express/com-express-type-7/type-7-whitepaper-registration.html). The original COM Express 3.0 specification can be obtained from the PICMG.

WHAT IS PICMG?

The PCI Industrial Computer Manufacturers Group, or PICMG, is a non-profit consortium of companies and organizations that collaboratively develop open standards for high-performance telecommunications, military, industrial and general purpose embedded computing applications. The group has more than 250 members, specializing in a wide range of technical disciplines, including mechanical and thermal design, single-board computer design, very high speed signalling design and analysis, networking expertise, backplane and packaging design, power management, high-availability software and comprehensive system management.

PICMG was founded in 1994 with the goal of extending the PCI standard to non-desktop applications. Equipment built to PICMG standards is used worldwide, and anyone can build or use equipment without restriction, except for some military applications.

Key standards families developed by PICMG include CompactPCI, AdvancedTCA, MicroTCA, AdvancedMC, CompactPCI Serial, COM Express, SHB Express and HPM (Hardware Platform Management).

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RITTAL LAUNCHES TWO NEW VERSIONS OF LED SYSTEM LIGHTS

Rittal's series of specially-designed lights will include 600 and 400 lumens of light output (luminous flux), to add to the current 1200- and 900-lumen versions. This means that Rittal can now offer lighting solutions to suit all sizes of enclosure, from small housings right up to large systems.

The new lights are designed to enable control and switchgear manufacturers to provide lower light output for smaller enclosures. The 600-lumen version meets the standard requirement for the large TS 8 enclosure while the 400-lumen lights are suited to wall-mounted enclosures, such as the Rittal AE compact enclosure series.

An optical cover made of transparent plastic, in which a Fresnel structure is integrated, provides optimal illumination, focusing the light so that the entire enclosure can be illuminated.

www.rittal.co.uk

CN-L HIGH-CURRENT LATCHING RELAY

The latching type CN-L relay has been developed by Panasonic to conduct the complete power requirements in a vehicle. This relay can be used to disconnect the battery to cut the power off in case of a short circuit, as a main relay for Li-ion battery protection or as a switch for a dual power supply. It has been designed especially for automotive applications and features a high shock and vibration resistance.

Modern vehicle topologies increasingly use dual battery systems to support features like sailing mode or fast recuperation. To protect them, latching-type relays are a highly applicable solution, especially considering the power consumption. The CN-L relay is a reliable solution for 12V battery systems.

The latching type CN-L relay is designed for a continuous current of 150A and an overload of 1500A for 0.5s.

www.panasonic-electric-works.co.uk

BULGIN LAUNCHES M-SERIES AUTOMATION INTERCONNECTS

Bulgin has launched a new range of industrial automation components, designed to offer flexible connectivity solutions for a variety of rugged automation applications.

The M-Series interconnects from Bulgin includes a range of sizes and pin configurations – from 3 to 19 pins – designed for use in industries requiring exceptionally reliable and robust connections, from automotive production and machine building to food and beverage processing.

A variety of connector types and keying options are available from Bulgin, including A-, B- and D-coded configurations.

In addition to straight and right-angled field-installable versions, Bulgin's M5, M8 and M12 variants also offer PVC/PUR overmoulded cable options to provide end-to-end automation connectivity for almost any situation.

www.bulgin.com

T&M EQUIPMENT FROM ROHDE & SCHWARZ AT EMBEDDED WORLD 2017

Exceptional quality and innovation doesn't have to be expensive. Rohde & Schwarz will prove this at Embedded World in Nuremberg later this month at booth 4-218, with new entry-level T&M solutions. The T&M giant will also show its latest R&S RTO2000 high-performance 6GHz oscilloscope, ideal for IoT applications and debugging fast communications interfaces. Other Rohde & Schwarz innovations include new accessories specifically targeted at power integrity measurements.

To address the area of power integrity measurements Rohde & Schwarz's new accessories consist of two new probes to be used with its R&S RTE and R&S RTO2000 oscilloscopes. The R&S RT-ZPR20 is a highly sensitive and extremely low-noise power rail probe with bandwidth of 2GHz. The large offset range of ±60V enables analysis of the smallest signal interferers during power integrity measurements.

www.rohde-schwarz.com

INDUSTRY'S SMALLEST ISOLATED RS-485 TRANSCEIVER

Intersil announced the industry's smallest isolated RS-485 differential bus transceiver designed to provide 4Mbps bidirectional data transmission.

The high-speed ISL32704E delivers industry-leading electromagnetic interference (EMI) and common-mode transient immunity (CMTI) in a small 4mm x 5mm QSOP package that is 70% smaller than competitive devices. It also provides 600VRMS of working voltage, which is approximately 50% higher than the closest competitor.

The ISL32704E RS-485 transceiver leverages giant magnetoresistance (GMR) technology to provide galvanic isolation that keeps the communications bus free from common-mode noise generated in electrically-noisy factory and building automation environments. It is ideally suited to equipment-to-bus interfaces in IIoT networks that connect programmable logic controllers (PLCs) to instruments, robots, motor drives, data acquisition and digital I/O modules.

www.intersil.com

NEW SCOPE OFFERS FOUR TRUE DIFFERENTIAL CHANNELS

Pico Technology just launched its PicoScope 4444 high-resolution differential oscilloscope. The instrument features four true differential input channels and a range of accessories for measurements from millivolt to 1000V CAT III applications. It addresses the perennial problem of making accurate voltage waveform measurements on circuit elements that are not ground-referenced, without the risk of short circuits that could damage the device under test or the measuring instrument.

Building on the success of PicoScope 4000 Series high-resolution oscilloscopes, the PicoScope 4444 gives electrical engineers the freedom to make differential voltage measurements in the presence of common-mode signals. The new instrument has 14-bit resolution on four channels and 256 megasample capture memory, so is ideal for precise analysis of complex waveforms ranging from biomedical sensors to current probes and 1000 V CAT III power distribution circuits.

www.picotech.com

INDUSTRY'S SMALLEST 12V, 10A DC/DC STEP-DOWN POWER SOLUTION

Texas Instruments (TI) introduced a pair of 12V, 10A, 4MHz step-down power modules that are 20% smaller than any other 10A power module-based solution available today. The easy-to-use SWIFT TPSM84A21 and TPSM84A22 DC/DC modules integrate power MOSFETs, shielded inductors, input and output capacitors and passives into a tiny, low-profile footprint. In addition, the modules offer industry-leading performance, with as little as 1% overshoot in transient conditions without special magnetics or additional capacitors.

By using the step-down power module together with TI's WEBENCH Power Designer, engineers can get their space-constrained point-of-load (POL) telecom, networking and test and measurement power-supply designs to market faster.

The highly integrated TPSM84A21 and TPSM84A22 require just one external voltage-setting resistor for a complete 12V step-down power solution.

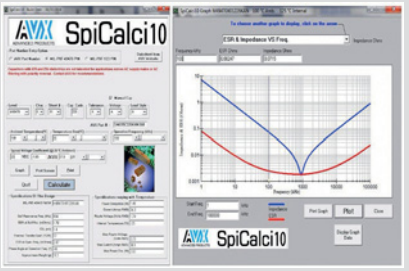
www.ti.com

AVX UPGRADES SMPS MLCC SIMULATION SOFTWARE

AVX has released a new version of its SpiCALCI simulation software, an engineering tool that calculates performance characteristics and parameters for its advanced switch mode power supply (SMPS) multilayer ceramic capacitors (MLCCs) to help electrical design engineers select the best part for their application.

SpiCALCI 10, which replaces the previous version, features all of the new SMPS MLCCs that AVX has introduced over the past 18 months (many of which are sole-sourced), in addition to updated links to the latest datasheets on the new AVX website, and product photographs designed to help engineers better visualize product selections. Other new features include an enhanced part-selection process that makes it easier to find a valid part, and the option to view and save the output information that is used to generate graphs.

www.avx.com



WELDING ROBOTS DRESS PACKS FOR MAXIMUM CABLE PROTECTION

Igus offers fully-assembled dress packs for rapid replacement of energy chain systems on welding robots. These are custom-designed, drop-in replacement and complete solutions that can be connected quickly and easily to the robot, thereby minimising production downtime.

The Igus dress packs consist of a multi-axis triflex R energy chain, filled with chainflex cables and hoses for supplying energy, data and other media. The standard dress packs can then be adapted to customers' individual requirements: different bus systems can be selected, as well as preferred hose manufacturer and a wide range of cable cross sections. It is also possible to have the cables harnessed directly by Igus according to 24 manufacturer standards, including Stäubli, Yaskawa Motoman, Universal Robot and Kawasaki, with original plug connectors.

Igus also offers QuickRobot, an easy-to-use online configurator to help find the right solution.

www.igus.co.uk

PROGRAMMABLE LINEAR HALL-EFFECT SENSOR IC

The new A1377 from Allegro MicroSystems Europe is a programmable linear Hall-effect sensor IC designed for applications that require high accuracy and high resolution without compromising bandwidth.

The new device uses segmented, linearly-interpolated temperature-compensation technology which greatly reduces the total error of the device across the whole temperature range. As a result, it is ideally suited to linear and rotary position in automotive applications such as actuators and valves.

The A1377 is available in a through-hole, small form-factor, single in-line package (SIP), and has a broad range of sensitivities and offset operating bandwidths. The accuracy and flexibility of this device is enhanced with user programmability, via the supply voltage (Vcc) and output pins, which allows it to be optimised to the application. It also provides voltage output proportional to the applied magnetic field.

www.allegromicro.com

ANRITSU AND IMST DEMONSTRATE TESTING CAPABILITIES FOR LORA DEVICES

Anritsu will be demonstrating its testing capabilities for LoRa devices for R&D and manufacturing at Mobile World Congress on the 27th February to 2nd March in Hall 6, Stand 6F40.

In a joint collaboration with IMST, Anritsu will show its preliminary version of a LoRa test measurement suite, including RF transmitter and receiver tests of LoRa devices for production lines. The demonstration of the first one-box test-solution for LoRa measurements will be done using the Anritsu MT8870A Universal Wireless Test Set and the IMST LoRa module iM880B-L, a LoRa Alliance certified product.

The MT8870A Universal Wireless Test Set and the MS2830A Vector Signal Analyser / Vector Signal Generator support the key RF transmitter and receiver measurements to guarantee device quality. The ultra-long range radio iM880B-L module is based on Semtech's patented LoRa technology.

www.anritsu.com

OMRON LAUNCHES ENHANCED AND COST-EFFECTIVE MOSFET RELAYS

Omron Electronic Components Europe has launched two new, cost-effective, general-purpose MOSFET relays featuring enhanced performance, including improved dielectric strength at a very competitive price. These general-purpose devices are suitable for a huge range of applications, including building automation, security, communications systems, industrial control and battery-powered systems.

The Omron G3VM-61VY2 and G3VM-351VY are cost-effective MOSFET relay solutions for a wide range of 60V and 350V AC or DC switching applications. A significant feature is their high dielectric strength at 3750V between inputs and outputs. Both devices offer an enhanced specification compared to existing Omron solutions.

The G3VM-61VY2 has a higher continuous load current of 500mA, with an on resistance R_{on} of just 2Ω. The G3VM-351VY offers a faster turn-off time than previously, of 0.5ms maximum, 0.1ms typical.

http://components.omron.eu

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