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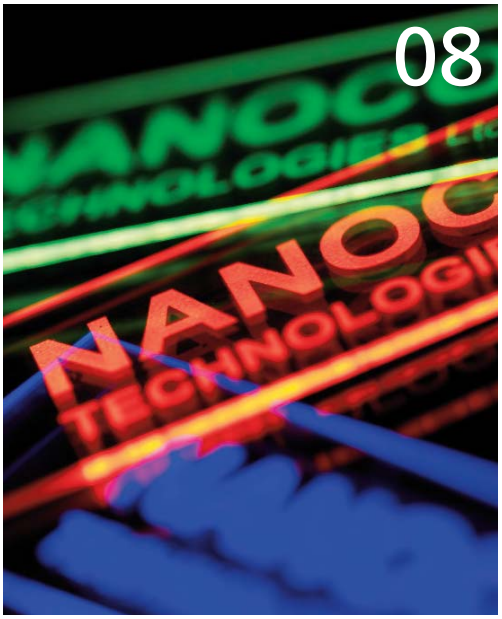

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Assembled Order Code: AS3179 - **£22.95**

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ELECTRONICS WORLD

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We May Have Found the Paddle

It's here and it's now and it is on everyone's lips – the state of the economy and the state of the electronics industry. I have already written on this subject many times, but I just simply can't leave it alone: I think there's plenty of good news around and I wanted to highlight some of these so we don't get lost in the doom and gloom.

Almost daily we keep receiving news from various companies in our industry with investments, job expansions and joint cooperations.

The Optoelectronic Manufacturing Corporation (OMC) has announced an investment to double capacity of its backlight manufacturing facility based in Cornwall. Contract manufacturer Sunburst Electronics reported that it is expanding its capacity too. HumiSeal, a manufacturer of conformal coating solutions, has announced a $1m investment in its research and development capabilities.

A major EU investment has given a surge into a printable electronics facility in County Durham. A rapidly expanding SME LM Technologies has recently opened two new offices in the UK and added new members of staff.

Frontier Silicon has initiated a $10m investment in a new DAB semiconductor development.

We are receiving good news from other sectors too: the Dow Jones and Nasdaq are up; some banks have reported relatively reasonable starts to the (new financial) year; new builds have started in the US; Chinese imports have begun again (which has instigated some companies to start thinking to ramp-up their productions) and there's that $1 trillion 'ambulatory' funds that the G20 have agreed on, to stimulate the global economic recovery.

Need I go on? We are by no means out of the woods, and there may well be bad news to come yet, but, as one economic observer recently said: "If you want to be optimistic, you could say we have found the paddle".

Editor
Svetlana Josifovska

Power Supplies

DC to DC Converters: POLs: AC inverters: HV Supplies

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RO- HV 30-1
30W compact High Voltage (30kV) variable voltage power supply. Factory preset for either polarity. Rugged construction makes this ideal for laboratory, test and portable applications.

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TELEMEDICINE TAKES ROOT IN GERMANY

Telemedicine has gathered significant momentum in Germany, where doctors are increasingly using latest electronics and communications technologies to check on patients' health, and dispense prescriptions and advice.

In turn, medical companies are responding by building in such technologies into their devices. For example, manufacturers of cardiac pacemakers and defibrillator implants are now beginning to offer devices that can be monitored remotely via the Internet. At predetermined intervals these devices transmit operating data to a secure Internet platform; data that can be remotely checked by a doctor or a nurse.

A telemedicine project known as "Sister Agnes" has already been functioning successfully in North Germany for several years now, initiated by the Institute for Community Medicine at the University of Greifswald. "Sister Agnes" is a community nurse equipped with a tablet PC who makes house calls to patients.

The state of Mecklenburg-Vorpommern is also the setting for one of the most recent telemedicine projects in Germany, which involves the remote treatment of patients suffering from glaucoma. Each glaucoma patient has their medication being adjusted at home by electronics, following a self-test of the so-called "teletonometry" – the measurement of the intraocular pressure. A modem then transmits the data over a phone line to an electronic patient record that can be accessed by a doctor, who may request medication adjustment.

The telemetric monitoring of patients with a chronically weak heart has, likewise, moved well beyond the pilot stages in the German system of healthcare. The latest example is the AOK Plus telemonitoring project, launched in Saxony at the end of June last year. Here, patients suffering from severe cardiac insufficiency can be monitored using a set of digital scales and a digital blood pressure meter. The readings are sent in encoded form to a telemedicine centre, which gives patients advice and guidance over the telephone.

Wireless transmissions of blood sugar readings can help many patients, and it is widely used in Germany already. Equally, this type of communication can also help in the treatment of stroke patients. Much of the pioneering work in this field has been done by the South German stroke network TEMPiS.

■ SanDisk and Toshiba have joined forces to co-develop a multi-level cell (MLC) NAND flash memory using 32nm process technology. The aim it to produce a 32Gb 3-bits-per-cell (X3) memory chip. The co-development is expected to quickly bring to market advanced technologies that will enable greater capacities and reduce manufacturing costs for products ranging from memory cards to Solid State Drives (SSD).

"The development of our third-generation 3-bits-per-cell technology on 32nm within one-and-a-half years after the introduction of the first generation of 3-bits-per-cell on 56nm shows the incredibly fast pace necessary to be a world-class producer in today's industry," said Sanjay Mehrotra, co-founder and president, SanDisk.

■ Researchers are exploring the capabilities of laser technology to provide a low-cost, chemical-free method of making printed circuit boards (PCBs). The two-year project, entitled Laser Printed Electronics (LPE), aims to provide the UK electronics sector with a simple, low cost, flexible and environmentally-friendly production method for PCBs. De Montfort University Leicester (DMU) academics are taking part in this project, which will last two years and cost £341,426, of which £182,346 comes from the Technology Strategy Board's High Value Manufacturing Call.

DMU's Rapid Prototyping and Manufacturing Group will develop a deposition system based on a novel combination of laser printing and fibre laser consolidation of the deposited material.

■ Ever-increasing numbers of products, suppliers, channels and geographies, coupled with a lack of real-time visibility, are hampering high-tech manufacturers' supply chains and hurting their bottom lines, reports a recent Infosys/Microsoft survey.

The survey was conducted among high-tech manufacturing firms in Germany, Japan and the US and found half of the business decision-makers reported increasing complexity in their supply chains. In addition, 65% reported experiencing a supply chain disruption that took hours or longer to reporting the incident.

"The economy may be down, but the number of products, suppliers and geographies that high-tech manufacturers have to manage has gone way up," said Tyler Bryson from Microsoft. "This complexity is becoming an increasingly serious industry issue."

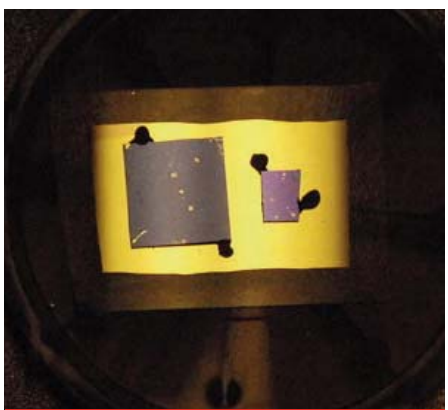
Graphene-Based Frequency Multipliers Will Lead to Faster Chips

Researchers at the MIT (Massachusetts Institute of Technology) have built an experimental graphene chip that behaves like a frequency multiplier. The device can take an incoming signal of a frequency, for example the clock speed of a computer chip, and produce an output signal that is a multiple of that frequency.

These findings could lead to super fast ICs beating down the old, standard, silicon technology.

Frequency multipliers are typically used in communications, however they require many components, produce noisy signals – which then need filtering, and consume a lot of power. Instead, graphene is just an atom-thick layer of carbon, each atom acting as a single transistor, with considerably lower power consumption and heat generation, and it doesn't necessarily need other components.

"In electronics, we're always trying to increase the frequency… [but] it is very difficult to generate high frequencies above 4 or 5GHz," said Tomás Palacios, assistant professor at the MIT, leading the team. "Researchers have been trying to find uses for this material [graphene] since its discovery in 2004, [and] the new graphene technology could lead to practical systems in the 500 to 1,000 gigahertz range. I believe this application [a frequency-multiplier device] will have tremendous implications in high-frequency communications and electronics."



Graphene microchip
[Photo: Donna Coveney]

The technology is expected to be commercialised within two years.

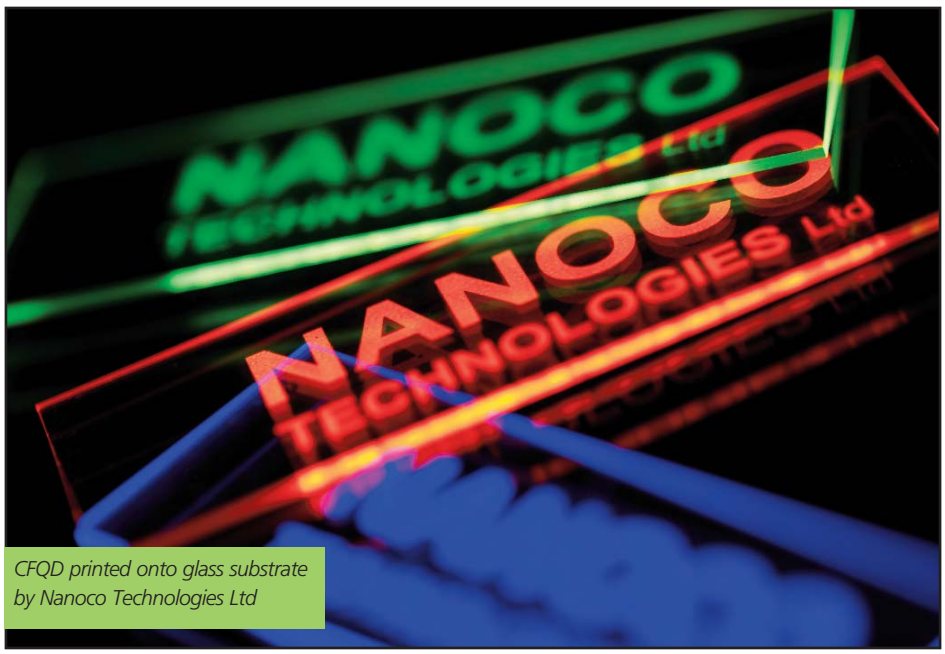
EXPLORING ELECTRONIC DEVELOPMENTS IN

BY MARTIN KEMP

The Nanotechnology Knowledge Transfer Network (NanoKTN), one of the UK's primary knowledge-based networks for Micro and Nano-technologies, was set up by the Technology Strategy Board to promote and facilitate knowledge exchange, support the growth of UK capabilities, raise awareness of nanotechnology and provide thought leadership and input to the UK policy and strategy.

The NanoKTN's activities are built around focus groups which identify the gaps in the supply chain, as well as identifying the UK's potential in innovation. This information is reported back to the Technology Strategy Board to input into their UK Nanotechnology Strategy and also provides leverage for channeling government funds into specific areas of need.

For further information on the NanoKTN and its activities visit www.nanoktn.com



CFQD printed onto glass substrate by Nanoco Technologies Ltd

THE LAST year has seen worldwide investments into clean energy rise by 4.4% and in 2008 inward investment exceeded $150bn for the first time. It is clear that next generation energy will have an impact on both static and mobile applications, and nanotechnology holds the promise to provide a significant number of advances in clean and renewable energy. In order to see real commercial successes in this area, networking and interaction between all parts of the supply chain is essential.

On March 4th 2009, the NanoKTN hosted Nano4Energy in partnership with the Carbon Trust, a one-day conference in Nottingham to look at the commercialisation of nanotechnologies in the development of clean, next generation energy solutions. Manufacturers, industry professionals and investors came together at the conference to look at nano-applications with significant potential such as batteries, supercapacitors and next generation photovoltaics.

A diverse selection of presentations from UK technology start-ups showed the exciting potential of nanotechnology to develop new and ground-breaking devices. Presentations looked at the developments of nano-electronics in recent years, an area that has now been recognised as a fast and powerful means of advancing green technology.

Keynote speakers explored a number of green energy solutions and nanoelectrical products, including energy-efficient batteries, electrochemical reactions and nanoscaled technology such as quantum dots.

Michael Edelman, CEO of Nanoco Technologies outlined the pioneering work the company is carrying out with quantum dots, enabling the production of cheaper, more efficient electronic devices using printable fluorescent semiconductors.

Quantum dots are semiconductor nanoparticles of II-VI, III-V, or IV-VI chalcogenides (selenides or sulfides) of metals like cadmium or zinc (CdSe or ZnS). Their small size (about 50 atoms across) produces novel electrical and optical properties not seen in the bulk material. One such property is photon emission, the colour of which depends not on the material but on the particle size.

The flexible and unique characteristics of quantum dots make them critical to electrical circuits and optical applications. The electrical conductivity of a quantum dot can be altered via an external stimulus, such as voltage or photon flux,

GREEN TECHNOLOGY

and the size means the materials behave differently, giving quantum dots the ability to behave in ways not seen in electronic science and technology applications before.

Industry professionals are encouraging the use of quantum dots as they are highly efficient when used in both optical and electronic devices; they consume low levels of energy and considerably reduce manufacturing costs.

Nanoco is continually working with major R&D and blue-chip industrial organisations to develop applications incorporating semiconductor nanoparticles and quantum dots. Nanoco and its partners are already using quantum dots in a range of energy-efficient, next generation electronic applications such as photovoltaics, displays and solid state lighting. They are also commercially available in solid state lighting, QD-EL displays, solar cells and new areas of biotech.

Downsizing dimensions in electronic devices can offer improvements in both performance and production costs. When scientists learn to adapt the properties created as a result of micro technology production, to industries producing environmentally-friendly and green technology, new levels of performance and energy efficient technology will exist.

Bac2, a leading developer in the fuel cell and electronic industries, recently launched a low-cost polymer called ElectroPhen that has electrically-conductive properties due to its nanoscaled electro-active hybrid polymer matrix. The patented material is formulated from readily available raw materials, and the nanostructure can be chemically fine-tuned to give a range of electrical conductivity for an array of potential applications. Unusually, the conductivity increases with increasing temperature, opening significant new opportunities.

So, nanomaterials are already starting to have an impact on the green energy technology sector. Nanostructured solar cells based on thin film, or dye sensitised titania, will open new possibilities for low-cost, large-area, printed photovoltaics. Energy harvesting of heat will be possible using materials based on diamond, and hydrogen will be stored for fuel cells in solid state by using novel materials like carbon nanotubes or graphene. As Richard Feynmann famously said in 1959, "there's plenty of room at the bottom".

Nanotechnology
Knowledge Transfer Network

Dr Martin Kemp is Materials Theme Manager at the Nanotechnology Knowledge Transfer Network (NanoKTN). The NanoKTN is one of the UK's primary knowledge-based networks for Micro and Nanotechnologies. ***www.nanoktn.com***

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- Complete with battery, probes and user guide.
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Probes included

Look! New Probes Included!

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Feature Summary

- Connect your components any way round! Now with premium probes!
- Automatic component identification.
- Automatic pinout identification, it tells you which lead is which!
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Look! New Probes Included!

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- Connect your Triac or Thyristor any way round.
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TIME TO ACT

Malcolm Penn is CEO and chairman of market analyst firm Future Horizons, based in the UK

WITH COMPANIES from across the world reporting falling demand and record losses, it is easy to lose focus and assume that we are all surrounded by doom and gloom. However, there is actually a lot of good news out there in the industry that point towards the early signs of a recovery.

In the last quarter we have seen several big moves in the industry that show exactly the kind of optimism and positive thinking that will see companies through to the recovery period.

Crises feed uncertainty and uncertainty affects behaviour, which in turn feeds the crisis. Uncertainty is both objective and subjective; objective being the 'known unknowns' and subjective being the 'unknown unknowns'.

"THERE IS, ACTUALLY, A LOT OF GOOD NEWS OUT THERE IN THE INDUSTRY THAT POINT TOWARDS THE EARLY SIGNS OF A RECOVERY"

When the 'unknown unknowns' dominate as they do now, the result is extreme prudence, bordering on outright paralysis on the part of investors, consumers and businesses.

"Better safe than sorry" may make sense for individuals but it has catastrophic macroeconomic consequences for the world, triggering enormous spreads on risky assets, a credit crunch in advanced economies and major capital outflows from emerging countries. It affects consumption and investment decisions and, together with a massive inventory reduction and destocking, has been the fundamental reason for the dramatic collapse in demand since September 2008.

The knee-jerk response is to restructure with a cutback in spending, from discretionary expenses and staffing to investment and asset divestiture. Cutting too deeply, however, will leave firms poorly positioned, especially if growth resumes sooner than expected.

Holding onto, even hiring, good people in the downturn, when talent is more readily available is infinitely more preferable than frenzied re-hiring once the market has turned, when supply will be stretched and competition fierce; and there is the added problem of managing and training the inexperienced new recruits from a position of managerial weakness pared back to the bone.

History has shown it is not the strongest who survive, nor those with the best technology, but the ones most responsive to change. It is vital, therefore, to dig beneath the surface for a clearer picture of where the markets are heading. Extrapolating at best is dangerous; extrapolating the worst-case scenarios can be catastrophic. Nothing – good and bad – continues uninterrupted forever.

Now is the time for cool heads and firm action. Indecisiveness will achieve nothing and result in falling behind those who are prepared to step forward and make the sensible, but necessary, decisions to grow their companies. There is no point fretting over the things that we have no power to change, but the worst thing you can do now is to do nothing.

There have been several big announcements in the semiconductor industry in the last few months, with mergers and the Intel and TSMC announcement taking centre stage. These sorts of decisions might be interpreted by some as a gamble now, but are, in fact, the sort of decisions that made companies such as Intel and TSMC the multi-billion dollar giants that they are today.

The focus should always be on product development and what this industry does best, innovation. This industry always innovates its way out of recessions and into growth, and this time will be no different.

Future Horizons celebrated its 20th birthday on the 1st of April; its analysts have lived through all of the industry's previous 11 recessions, bar the very first, and although we, like anyone, cannot predict exactly when things will get better, it is certain that they will, most probably on current trends as soon as the end of this year. By keeping focus now and not losing sight of innovation, companies will come out of this recession stronger. The fundamental question to ask is: "What shape your company will be in Q3/Q4 this year if the market suddenly showed some signs of life?"

Part of keeping a cool head is listening to the industry and what others are doing. No matter how hard the decision or choice, I guarantee someone else will have already had to make a similar call and done the research, followed it through and learnt the lessons. The key is making sure to attend the events and forums, and having the confidence to ask the industry for advice. Speaking to your contemporaries about their thoughts will help you make the difficult decisions with confidence.

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Future Horizon's 18th International Electronics Forum – *"Making Tomorrow's Future Today ... Secure Your Position For The Next Upturn Now" – takes place May 6-8 in Geneva, Switzerland. It will focus on the business and product strategies necessary for success:* ***http://www.futurehorizons.com/page/9/international-electronics***

CHOOSE YOUR LINUX AND OPEN SOURCE PARTNER CAREFULLY

MORE THAN any other technology before, the Open Source and Linux world is one where the choice of systems integrator to implement a solution is a difficult one to get right.

The Linux world is one that has traditionally been ignored by the larger systems integrators because of its slow organic growth and the niche has largely been filled by two man bands dreaming of making their fortunes and enjoying their moment in the spotlight. Neither of these scenarios has contributed much to the success of Linux in the enterprise. The market has, therefore, predominantly been shaped by mid-sized organisations that could develop their own infrastructure, using their ex-UNIX in-house skills to replace ageing UNIX kit with commodity PCs running Linux. But this has made choosing the right Linux and Open Source partner for your organisations a real challenge.

The Software Vendor

If you want the most informed partner then surely the people who provide the software are going to be the best and most knowledgeable, right? Well in most circumstances that is of course correct, however in the Linux and Open Source world one must remember that lots of the software included on the CD from the vendors or manufacturers (e.g. Red Hat or Novell), itself comes from other sources that's in the nature of the Open Source beast. So no, they may not be particularly well informed on all elements of the software they ship.

MORE OFTEN THAN NOT THE VENDOR'S SUPPORT MODEL IS VERY TOP-HEAVY AND EXPENSIVE INSURANCE SCHEME THAT, EXPERIENCE SHOWS, SELDOM DELIVERS

Also remember that software development requires a different approach to that adopted by solutions delivery and ongoing support teams. If you have a problem the answer from the developer normally revolves around "fixing it in the next version" of their product. However, a solutions provider can use his independence from a manufacturer to choose the correct software component from any source to meet their customers' requirements. As far as support and maintenance are concerned, many customer organisations will trust the software manufacturer for software updates, but then look elsewhere for their support. More often than not the vendor's support model is very top-heavy and expensive insurance scheme that, experience shows, seldom delivers.

The Systems Integrators

Systems Integrator is a very broad term covering everything from hardware partners to true systems consultancies and integrators such as Dimension Data or Logica.

True systems integrators recognise the value of competencies in each of the disciplines required to execute a successful project. The successful ones tend to be up-front about their skills and clear where they require the use of third party experts. To that end the most important element of the solution that a systems integrator can provide is a professional project manager.

If you can afford it and this is a large project then this is the route for you. You pass some of the risk of failure to the project manager and let him orchestrate the components. Some of these organisations have access to a huge library of information gleaned from years of project implementation and the appropriate procedures to reduce the risk of failure. Each project team is often made up of experts in their field, because the size of the organisation allows them to consolidate business and projects, with functions split out for each expert.

The Hardware Partners

Another type of integrator is the hardware partner – mainly HP and IBM. They have recognised that with shrinking margins they need to offer some value added services or die. Their wish to include some level of customer service, combined with the relatively slow take-up of Linux in the past, has meant that, in reality, their internal investment typically amounts to just one or two locally-based people with a limited knowledge of Linux, although both HP and IBM have offshore centres of excellence.

The hardware partners and other similar types of integrators cannot consistently generate enough Linux project business to employ dedicated local experts, indeed BT use generalists. In this case your "Linux engineer" is probably also the engineer for lots of other products that the integrator carries.

An added complication is that as Linux is open source system (Red Hat and Novell make extensive use of non-commercial software components), so some of those traditional and proprietary skills are not so easily transferable – although there is a thriving online mutual help community – something which is in sharp contrast to the more traditional corporate computing environment.

If you have a simple implementation with the main investment into hardware, then this is probably the right partner for you. But if your project includes any level of complexity, such as setting up a SAN, Oracle solution, clustering or blade systems, then either ask them to engage with an expert third party company who really understands Linux in this environment, or be prepared for a lot of trial with error and potential failure.

There are stories of customers who have bought large scale IBM blade implementations to run clustered RedHat and Novell/SuSe solutions who have found that neither IBM nor any of their top-tier partners could make their systems work, so be careful in your choice of partner.

The Mid-Tier Support Specialists

Each country appears to have one or more mid-tier specialists that provide specialised and expert support around Linux. These are normally

Peter Dawes-Huish, CEO and Founder of LinuxIT Europe Ltd, takes a look at some of the options open to different size organisations when selecting a Linux and Open Source partner

open source advocates and business consultants who offer good independent advice based on their customers' needs rather than being tied to, or evangelising, a particular technology or solution.

The Linux server world is still a specialised area and these companies have had to define their extra value proposition more clearly than the software vendors or system integrators. Additionally, they will have the skills and experience to integrate your Linux solution with your other existing IT systems.

The mid-tier specialists focus on support and consultancy for Linux systems. Their target audience and where they can deliver most value to the customer is those organisations with 50-250 servers running Linux. At this level most organisations are experiencing difficulties of managing the basic operations including updates, patching, as well as the challenges of meeting business critical uptime reliability. Their support offerings can range from the break/fix to a fully managed service model. Linux is moving into the mainstream but the traditional support mechanisms from software vendors and hardware partners have often been found to be lacking. A local presence with the option of a partnership model, based upon shared goals, can be met with real Service Level Agreements (SLAs) and on-site assistance when required. The model of problem ownership and resolution of problems related to the complex interaction of hardware, software and operating system are best met by these organisations.

The Open Source Evangelists

There are many open source evangelists who buy into the idea of the faintly anarchistic position of Linux. These organisations typically have less than 10 employees and yet profess to offer all kinds of services from 24-hour support (man on mobile phone) to consultancy (read 'engineering'). These organisations are often very active in the public sector and academic world. Open source advocates ignore most of the real world and live in the world of delivering basic IT infrastructure, which these days are often just services on systems such as DNS or DHCP.

If you are a small organisation with one to two servers, this is probably the right company for you. They will appreciate your small budget and be able to tailor an open source alternative to Microsoft at a fraction of the price. You are paying for their expertise not for software but this simple setup can be brought to you at a price.

Our experience is that once past the one to two servers then the solutions are unreliable and not resilient. The relationship becomes strained when your systems are either a test bed for the "guru's" latest interest in an open source project or he doesn't understand that the systems crashing twice a day is more than a mere inconvenience to you.

This is simply because these guys are often not as good as they think they are. They live a troglodyte existence working with other open source gurus, because they believe that contact with proprietary software will taint them. They have a tendency towards arrogance – they are experts and know best, but do not be afraid to challenge them and don't be baffled by the techno rubbish; if they cannot talk to you in plain simple business terms then don't work with them.

How to Spot an Open Source Evangelist

Look for extensive reference to Open Source on their website, also see if they are involved with community project interaction. Also look for "faux" press releases, such as the delivery of a firewall or DNS server. The website may look impressive and try to leverage big customers' names. But do ask if the customer that they reference from the Times top 100 bought anything other than a few days engineering or a DNS server. This is the equivalent of the newsagent that sells a box of matches to a nurse putting up a sign saying "suppliers to the NHS". Of course you've got to smile but it's probably best to move on.

Typically they would be strong advocates for Linux projects with strange names that were coined to be amusing and lend very little to a commercial environment. An amusing example might be "Baboon-nix". Worse still, if they lead the project or user group then steer clear, these will always provide advice to avoid "Microsoft the devil" and only use Baboon-nix even if it doesn't really work.

Conclusions

As ever, the best choice of Linux and Open Source partner for your organisation will depend on the size and complexity of your project and the kind of relationship you are looking for. Each of the partner types has its place, but the ancient Roman saying of "buyer beware", still holds true today.

If you are a major corporate, with a skilled internal IT department or dedicated IT support contract, then the software vendor's upgrades and support may be all that you need.

If your internal IT departments are already overloaded, or have other priorities, and you have larger time- or business-critical projects, then the strength in depth offered by the larger systems integrators could be the lowest risk option.

If you are the sort of organisation that likes a "one stop shop" from the major hardware vendors, then you have already made your decision – just be prepared to demand the level of support you need and back it up with enforceable SLAs.

If you are a mid-sized organisation, or an independent part of a large one, looking for real expertise and the ability to integrate your open source projects with your existing IT infrastructure, then go for the mid-tier specialist.

And finally, if you are a small organisation, or operate in a specialist niche, then find a good local small independent – just be careful it doesn't end up as more of an adventure than you'd have liked. ■

ITT'S D-SUB CONNECTORS NOW AVAILABLE FULLY ASSEMBLED IN 48 HOURS

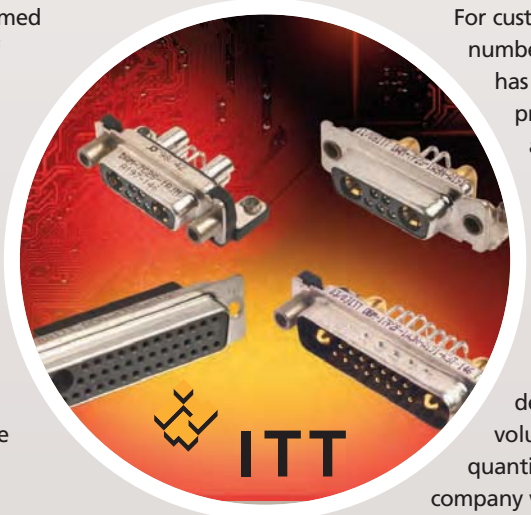
PEI-Genesis, the international franchised distributor specialising in connector assembly services, has expanded its portfolio of products from leading manufacturer ITT Interconnect Solutions (Cannon and VEAM) to include the company's huge range of D-subminiature connectors.

Available in a vast array of different types to suit almost any D-subminiature requirement, the ITT connectors are now in stock at PEI-Genesis and are offered with an unrivalled 48-hour assembly service.

The D-subminiature connectors are all RoHS compliant and can be specified in standard configurations ranging from nine to 104 ways or with a combination of power and signal contacts to meet customers' specific requirements.

Manufactured to the highest quality standards to ensure optimum performance and reliability, the connectors are available with turned or stamped-and-formed contacts in a wide variety of termination styles, such as crimped, solder bucket, insulation displacement, wire-wrap and press-fit.

In addition to general-purpose commercial products, the ITT D-subminiature range includes filtered versions for applications requiring EMI/RFI protection, corrosion-resistant stainless-steel versions designed to withstand harsh environments, and high-spec hermetically sealed MIL-DTL-24308 connectors for use in military and aerospace systems.



Working in close collaboration with ITT Interconnect Solutions, PEI-Genesis is able to achieve the 48-hour connector assembly service through a huge investment in piece-part stock, coupled with the in-house development of machines to automate the connector assembly process. In addition, the company vigorously pursues a programme of continual improvement and constantly evaluates its processes to eliminate any bottlenecks.

Founded in Philadelphia in 1946, PEI-Genesis has enjoyed consistent double-digit growth in its European operations since first establishing a presence here in 1998. To support its continued expansion throughout Europe, PEI-Genesis has recently relocated from Basingstoke to new premises adjacent to Southampton Airport. Providing a total floor space of 65,000 ft^2, the new premises are more than three times larger than the company's previous building and now serve as its European headquarters and state-of-the-art connector assembly facility.

PEI-Genesis has made a substantial investment in refitting the building and believes that it has created the finest connector assembly facility in Europe. The new premises provide over eight times the stocking capacity of the previous building, and PEI-Genesis has also taken the opportunity to double its assembly capability in terms of equipment and machines. All assembly work is carried out under the company's ISO 9001:2000 quality system.

For customers who do not know the exact part number of the connector they require, PEI-Genesis has a specialist engineering team who can provide advice on the correct product to use for a particular application. This technical expertise is complemented by a website (www.peigenesis.co.uk) that provides a wealth of useful resources, including an inventory checking facility that enables part numbers and actual availability to be viewed online.

PEI-Genesis is completely geared up to dealing with a large number of relatively small-volume orders, so there are no minimum order quantities on any of the products. Indeed, the company will build just one connector if that is all the customer needs. Where customers have ongoing contracts, PEI-Genesis offers the facility for holding a buffer stock of say one month's requirement of piece-parts, ready for assembly and despatch within 48 hours.

By building a genuine and effective partnership, PEI-Genesis and ITT Interconnect Solutions (Cannon and VEAM) have made it possible to obtain the exact connector for a particular requirement in the shortest possible timescales.

For further information, visit **www.peigenesis.co.uk.**

To complement our existing Cannon ranges we now assemble ITT's D-subminiature and Combination D-Subminiature connectors.

For all enquiries or to order copies of the connector solutions guides contact:

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THE CATT QUESTION

In the October 2008 edition of Electronics World, on page 29 there's an article written by John Ellis titled "*Transmission Line Model; An Introduction to the World of RF*". His transmission lines contain only sine waves. His article ends with a simulated transmission line into which he injects a sine wave. He is not alone. The non-sinusoidal excitation is generally excluded from electromagnetic theory by the use of the mantra: "Any (periodic) waveform can be broken down into sine waves of various frequencies". Alternatively: "Any (periodic) waveform can be represented by sine waves of various frequencies" or even that physical reality consists of a series of sine waves.

When I made the above statement recently to a professor, omitting the word "periodic", he corrected me. However, recently in an email to me Nobel Prize winner Brian Josephson wrote that for a non-periodic waveform we used the "Fourier Integral". When I questioned him as to what that meant, he replied that we could handle a non-periodic waveform if we repeated it. Josephson introduces the idea of frequency (sine waves) when he discusses "The Catt Question". ("The Catt Question" is as follows: When a voltage step travels down a transmission line at the speed of light guided by two conductors, where does the negative charge come from on the bottom conductor to terminate the electric field between the conductors?)

When he writes about "The Catt Question", Sir Michael Pepper, "knighted for services to physics", also introduces frequency. Remember that "The Catt Question" is about a single voltage step.

There is a general idea, stated to me by Professor Howie, then Head of the Cavendish, that "physical reality is composed of sine waves". The entrenched idea that classical electromagnetic theory refers only to sine waves is very important, since it submerges "The Catt Question" in complexity and confusion. The truth is that "The Catt Question" exposes a fundamental problem for classical electromagnetism which has been hidden by the general commitment to sine waves. It is very simple, and discusses a single voltage step travelling at the speed of light guided by two conductors. Unfortunately, experts in electromagnetic theory cannot "see" a single step, but in their brains they convert it into an array of sine waves. This makes it too difficult for them to grasp the fundamental, simple problem – "The Catt Question".

For decades, none of the results of my pioneering work on interconnecting high speed logic, beginning in the 1960s, including the extensive material published in Wireless World and later in Electronics World has gained a foothold in university text books, or college or university curricula. This includes all of the content of books on my websites, including the one published by Macmillan.

I decided to jettison my experience and ask a very simple question about classical electromagnetism, now called "The Catt Question". It took some years to get any response at all from leading academic luminaries or from the relevant learned institutions, but in the end I got response from Sir Michael Pepper FRS and Dr Neil McEwan, Reader in Electromagnetism, later replaced by Nobel Prize winner Brian Josephson. Pepper and Josephson are both professors at The Cavendish and both Fellows of Trinity College, Cambridge. In their replies, they totally contradicted each other. Josephson said the negative charge came from the west and managed this somehow without any charge travelling at the speed of light. Pepper said that charge from the west would have to travel at the speed of light, which was impossible. He said that actually the negative charge came from the south, from inside the conductor.

I took this contradiction to the Master of Trinity College, Lord Rees, asking him to do something about it in his administrative capacity. He replied: "I shall however need to get up to speed on the scientific question you raise before being able to respond intelligently..." I replied that I approached him in his administrative capacity, not in his technical capacity. That was two years ago, and he has done nothing.

I wrote to the President of The Royal Society, who also happened to be Lord Rees, saying that two Fellows of the Royal Society totally contradicted each other in their responses to "The Catt Question". In that capacity, Rees has not replied.

The behaviour of the IEE (now IET) and also of the New York IEEE, was similarly irresponsible. On 4 September '95, Professor Secker, chosen by the Chief Executive of the IEE to deal with "The Catt Question", wrote: "...The favoured explanation aligns with the statement to which you refer, attributed to Professor Pepper...", but seven weeks later, on 25 October '95, he wrote: "Dr McEwan really has the answer." Thus, he was backing both the views whose contradiction was the cause of Catt writing to Secker's boss in the first place, and his boss instructing Secker to reply!

THE "CATT QUESTION" EXPOSES A FUNDAMENTAL PROBLEM FOR CLASSICAL ELECTROMAGNETISM WHICH HAS BEEN HIDDEN BY THE GENERAL COMMITMENT TO SINE WAVES"

Further, although in that September the Chief Executive of the IEE chose him as the appropriate expert to reply, after seven weeks of repeated pontification and obfuscation, Secker wrote in October '95: "I should explain that I am no expert in the area to which the 'Catt Anomaly' refers...". The Chief Executive refused to supply a replacement for Secker.

As I wrote to Lord Rees, it appeared that he and the rest had four options:

1. Say that you have no relevant administrative duties or power in The Royal Society. In which case, please advise me as to who has administrative responsibility.
2. Say that you regard the matter as unimportant.
3. Say that the two parties, Josephson and Pepper, or in the case of The Royal Society Howie and Pepper, have told you that either: (a) they do not in fact disagree, or (b) the matter is unimportant.
4. Say that a conference is required."

This has been reiterated to all administrators concerned for more than a decade. Obviously, a conference is required.

(I noted that G De Santillana, in his book "The Crime of Galileo", published in 1955, writes that the main mistake in handling Galileo [the Earth moves] was to approach it administratively, which is your mistake over The Catt Anomaly. ".... If a decision had to be taken, a council was in order. To deal with the question on an administrative level was not only an arbitrary procedure, it was an inexcusable mistake, which is the necessary premise to the graver mistake of the trial sixteen years later...." - De Santillana, p137)

Even the mere announcement of a conference would give courage to such as May Chiao, who so far will not answer my letters, let alone publish something about "The Catt Question" in her journal "Nature Physics".

For decades, the same fear, leading to suppression, has been demonstrated by all other journal editors throughout the world.

The decades-long exercise called "The Catt Anomaly" arose because it is impossible to publish advances in electromagnetic theory. The referee system ensures that. Referees are wedded to the status quo, which is the basis for their careers and reputations.

Had it been possible to publish advances in electromagnetic theory resulting from the experience of interconnecting high speed logic 40 years ago, the need for "The Catt Question" exercise would not have arisen. So what is the major advance, "Theory C"?

Traditionally, under "Theory N", when a battery is connected via two wires to a resistor or lamp, the battery delivers electric current/charge into the wires. Once the wires gain current/charge, they create magnetic and electric fields between the two wires. Now more than a century ago, when confronting a challenge similar to that of interconnecting high speed logic, Heaviside said: "We reverse this ...." [Theory H]. The battery delivers electromagnetic field between the connecting wires. In its turn, the field causes electric current/charge in/on the wires. He called the field, travelling at the speed of light, "energy current". However, Heaviside's work on electromagnetic theory disappeared from the record. He was unreferenced in any text book for more than half a century.

There the matter rested for a century, until I realised that the core problem was for the battery to deliver energy/power to the resistor or lamp. If the battery delivered the electromagnetic field, it was generally agreed that the field carried the energy/power directly into the resistor or lamp. (After all, sunlight is "Energy Current".) Under the new "Theory C", electric current/charge played no role in the key activity, that of delivering energy/power from battery to resistor or lamp.

So, under "Theory C", what are electric current and electric charge? What is the role of the interconnecting wires? The answer is that when travelling along in the dielectric between the wires, some of the energy current (or electromagnetic field) penetrates into the wires. Since the dielectric constant of copper or any other conductor can be shown to approach infinity, the velocity of penetration, which depends on the inverse of the dielectric constant, approaches zero. Also, the impedance of a conductor approaches zero, so that very little of the energy current enters the conductors (in the same way as, if we have large and small resistors connected in series, very little power is dissipated in the small resistors). Maxwell's Equations link field and electric current/charge, and the so-called (but non-existent) current and charge are merely mathematical manipulations of the electromagnetic field.

Now let us analyse the situation that has developed. Today's Electromagnetic Theory remains as if digital computers and high-speed logic never existed. It is frozen in around 1950. My work on high-speed logic interconnection in the 1960s and beyond could have been expected to bring new insights into electromagnetic theory, and it did. However, none of these insights could be published, including all of the contents of my two books now on the Internet. They failed to get past journal referees, who are all frozen in the era before digital electronics.

Now the rejection for publication of any of this new material is not an administrative matter, since the decision as to whether such material is valuable or not is technical. However, we then come to the "The Catt Question", which is about classical theory, not Catt theory, the contradictory replies show that the old, pre-1950 Electromagnetic Theory which controls academia is not fully specified. It follows that something has to be done administratively. Following the analysis of Galileo by De Santillana, it is clear that a conference is required. But here we arrive at the core problem, which extends far beyond electromagnetic theory. Lord Rees, Josephson, Sir Michael Pepper have no inkling that with reputation comes responsibility. They have no grasp of the fact that given their high reputation and administrative responsibility, they have a duty to do something to resolve the problem which has arisen, that leading experts totally contradict each other on a rudimentary detail of electromagnetic theory.

"TODAY'S ELECTROMAGNETIC THEORY REMAINS AS IF DIGITAL COMPUTERS AND HIGH-SPEED LOGIC NEVER EXISTED"

More generally, there exists within the scientific community no functioning administrative structure capable of dealing with the problem. All of those whom we expect to be responsible, merely rest on their laurels, basking in fame.

The behaviour of all our institutions when confronted by "The Catt Question" delivers a bleak message for the future of science. Institutionalised failure to deal with "The Catt Question" and other fundamental lacunae threatens the survival of science.

Ivor Catt
UK

PHYSICS OR MATHS PROBLEM?

Ivor writes in Wireless World March 1980: "Consider a high speed (125) railway train with sloping front passing an observer. As the front face passes, the observer will see a negative slope dh/dx."

Ivor has the shape of the depicting diagram as representing a train. He has h axis as vertical and x axis as horizontal; h is a function of x, and the function goes straight along and drops by a slope given by differentiation as dh/dx and he notes it as negative because it slopes down.

Ivor in his second diagram has h as vertical axis and t as horizontal axis, and the function goes straight along before going up as a slope given by differentiation as dh/dt and says it is positive.

All of this is correct so far, and if we multiply these two slopes we have by the chain rule:
(dh/dx)(dx/dt) = (dh/dt)
negative x negative = positive.

But this is where Ivor then goes wrong, instead of doing the above chain rule calculation, he says this dx/dt is positive. He falsely identifies dx/dt as the velocity of the train, when in fact it is only the shape traced out by a point-particle, same as point-particles were tracing out shapes in his two diagrams.

There are many people who don't care about the accuracy of the maths and just bodge it. What Ivor engages in next is to try to bodge to correct the mistake he makes with dx/dt.

When I pointed out the problem, he had to look up what the chain rule meant. Ivor cannot accept that dx/dt is not the velocity of the train and an abuse of maths to use it as such, he thinks it is a physics problem, not a maths problem. He says he accepts the chain rule, but cannot see that dx/dt is not the velocity of the train and continues to insist it is. He then thinks the solution to

this problem he has manufactured is related with Maxwell's equation as: "What underlies the minus sign in Maxwell's Equations seems to be a mistake in the convention on how we measure time. We seem to think that as time goes by, we gain time. This is indicated in our numbering a series of hours 1, 2, 3, 4 etc. The truth is that every hour we lose time – we lose an hour. So, more rigorously, we should number the hours 12 o'clock, 11 o'clock, 10 o'clock etc."

So, in order to correct the mistake he makes, he thinks time being counted backwards solves it.

Roger Anderton
UK

THE HUNT FOR ELEMENTARY PARTICLES

Basic elementary particles may be calculated from the following formula:
M = me.(knπ)3,
where M is the searched mass of the particle, me is the electron mass or energy equal to 0.5109 Mev, n is a quantum integer number equal to the series of 1, 2, 3, 4 etc and where k is a small correction factor in the interval of 0.940 to 1.0000 where k = 1 is the normal value.
The equation produces the following series of mass values:
In the interval of n = 1 to 5 in Mev:
16 (WIMP), 105.7 (myon), 420 (kauon, base), 938.3 (proton), 1784.1 (tauon)

N = 6 to 22 in Gev:
3.0 (eta), 5.1 (b-meson), 8.0 (zeta), 11.5, 15.8, 21.1, 27.4, 34.8, 43.5, 53.5, 64.9, 77.8, 92.4 (Z, Nobel prize awarded 1984), 108.7, 126.7, 148.6, 168.6…

The maximum particle mass is dependent of energy available. Observe that this formula is only valid for the base particle in each particle spectra, hence not for the electron, for mesons or for neutral particle forms. For these latter particle forms, see my particle theory Matter Unified on the following website http://oveted.freehostia.com.

Ove Tedenstig
Sweden

Myk Dormer

GARNISH!

I HAVE NOTICED an interesting and rather disquieting trend. As our technology becomes more and more capable, and as more memory storage, processing power and communication bandwidth becomes accessible, the unnecessary little add-ons and flourishes in a given product design seem to expand, but only to absorb this newly available capacity – leaving the actual 'core function' of the device no more capable than its predecessors.

This is most obvious, and best documented, in personal computer operating systems. Just look at the mouse pointer on your PC desktop. How many pixels does that little image use? If you're using an up-to-date operating system, it probably moves smoothly, but how much extra processing though goes into it? It's probably in colour; it may well have a shadow, or apparent 3D detailing. A cross, or a circle, would do the job just as well.

Now look elsewhere: computer desktop icons are rendered in exquisite detail; complex sound or music effects can be associated with simple operations; backdrops, wallpapers and skins are executed with near-photographic resolution. High-bandwidth websites flood my screen with video, animations, images and sounds. Even my mobile phone greets me at switch-on with a cheery little melody and a few seconds of high-resolution, animated effects.

None of these attractive, decorative details actually do anything useful. They take man-hours of effort to implement, use megabytes of storage space, but contribute nothing to the utility or function of the product. Perhaps they serve an advertising function, but I suspect that every user who once was impressed by a pretty log-in screen is already snarling at the time that same screen wastes, before they can start actually using the device.

While it would be amusing to continue my apparently Luddite ranting, there is a sound engineering reason behind it: we live in a world of limited resources. Moore's Law will probably remain valid for some years to come, offering ever increasing amounts of storage and processing power. The bandwidth over which the stored data requires to be transmitted is, however, a finite resource, while radio link bandwidth is even more limiting, requiring ever greater transmitter power to achieve a given range with higher and higher data rates.

"NONE OF THESE ATTRACTIVE, DECORATIVE DETAILS ACTUALLY DO ANYTHING USEFUL. THEY TAKE MAN-HOURS OF EFFORT TO IMPLEMENT, USE MEGABYTES OF STORAGE SPACE, BUT CONTRIBUTE NOTHING TO THE UTILITY OR FUNCTION OF THE PRODUCT"

In the low power radio industry the tip of this iceberg is already becoming evident. More and more wireless devices are integrating complex user interfaces, or data formatting protocols. Such radio modules appear easier to use, because the actual baseband link is hidden under kilobytes (in some cases, megabytes) of software, but for simple, real world, applications there is a price to pay in unnecessarily complex data packet structures and unnecessarily power-hungry and, relatively expensive, digital hardware.

For example, a wireless link that offers TCP/IP compatible 32-bit addressing may be attractive to the system engineer, but at the point where it is being used in a simple control link, that same added function is lengthening transmit burst length (or, if data rate is raised, transmitter power) and reducing battery life.

It is easy to be seduced by (unused) extra functionality, or sometimes even purely decorative detailing. It is far less glamourous to design a solution that fits the actual needs of an application, but does no more.

There is an old adage that says "an engineer does for a penny what anyone could do for a pound". Keep it simple.

Myk Dormer is Senior RF Design Engineer at Radiometrix Ltd ***www.radiometrix.com***

The Rising Tide of Risk in WIRELESS DESIGN

IT WAS NOT so long ago that designers building wireless systems spent much of their time and effort integrating RF, analogue and digital components on a system board. But in today's relentlessly competitive market with shrinking product lifecycles, this is placing a premium on time and product differentiation. As you probably know, "Me too" products don't win market share.

Success comes with product designs that offer better performance, unprecedented features and longer runtimes in smaller, sleeker form-factors. These factors add to that the pressure on designers to create those blockbuster products that contain a wireless aspect, integrating RF, analogue and digital filtering, and control functions on a single chip.

So it isn't surprising that to meet customer needs, equipment manufacturers, operators and content providers are constantly stretching their resources to deliver increasing performance levels at a dizzying pace. In the process, we've seen unfortunate cases of cell phone designs that have experienced some setbacks. A faulty component for example can cause phones to arbitrarily disconnect calls and reboot, which can lead to a temporarily pull of handsets off the shelves. This illustrates the ripple effect that one faulty wireless component can have throughout the wireless value chain.

The Rising Tide of Risk

What are the avenues for manufacturers of wireless products to stay ahead of the rapidly changing needs of consumers, while ensuring the delivery of flawless designs to those very same consumers? The answer requires us to take a look inside those products, specifically at the integrated circuits (IC) that lie at the heart of all functionality.

Semiconductor companies are creating innovative wireless chips that combine mixed-signal digital and baseband analogue functions along with multimedia so that consumers can listen to MP3 audio, access the Internet, record and watch video and take high-resolution digital photos. In the case of the cell phone, this is further compounded by a seemingly endless array of wireless standards. A visit to any wireless provider's storefront is proof that emerging multi-band 3G handsets often integrate other wireless technologies such as Bluetooth, Wi-Fi, WiLAN and GPS into an already highly dense IC and system-in-package (SiP) solutions.

Virtuoso AMS designer simulator

Wireless IC designers will have to continue to add new functions to this mix, thus making the predictability of the design increasingly difficult. Traditional design processes have become more fragmented and verifying that the IC will perform as expected is precarious at best and often ineffective. More often than not, designers will resort to manual processes to deal with the signal integrity issues that invariably arise when one integrates analogue and digital functions.

Consider for a moment the mixed-signal/radio frequency (RF) component of a cell phone design. While it only makes up five to ten percent of the chip, it is often responsible for over half of silicon re-spins and an unknown number of product rollout delays. These highly complex chip designs also complicate the process of simulating a chip's performance before it is fabricated, making it increasingly difficult for designers to identify where potential problems lie.

How to Face the Challenge

Not long ago wireless designers spent much of their time and effort integrating RF, analogue and digital components on a system board. The rapid evolution of CMOS technology now allows designers to create a wireless system integrating RF, analogue and digital filtering and control functions on a single chip. Complicating the design process is the proliferation of a seemingly endless array of wireless standards. As mentioned earlier, emerging 3G handsets now integrate a lot more wireless connectivity and other technologies into already highly dense solutions.

As a result, wireless design has become a multidisciplinary task. A growing number of RF, analogue and digital functions must now reside, if not on the same chip, at least within the same package. More so than ever, RF, analogue and digital designers must work side-by-side to build a solution that meets ambitious performance, cost and time-to-market goals. These same designers must also take verification into account early in the process since it is essential in ensuring time-to-market and first-silicon success.

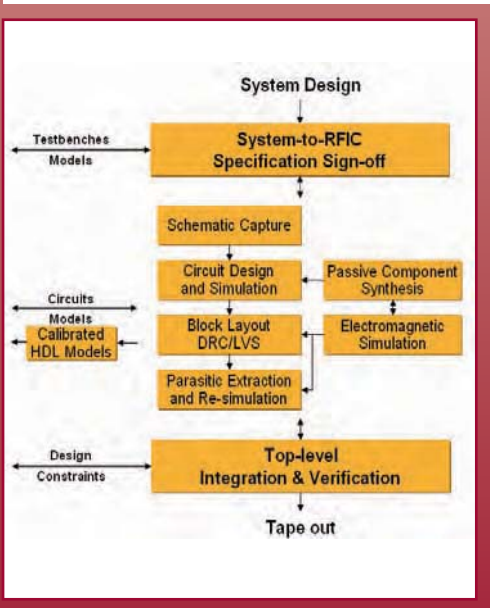
Wireless designers attempting to accomplish this task face a formidable set of challenges. As ICs grow in complexity and integrate higher levels of analogue and mixed-signal content, full chip verification becomes increasingly difficult and time consuming. Cross-domain verification presents a serious challenge that often requires manual intervention. At the same time, the massive quantities of data and long runtimes associated with modelling, parasitic

Tom Costas, Senior Product Marketing Manager at Cadence Design Systems analyzes how to create flawless chip designs when facing so many present-day challenges

extraction and re-simulation extend product development cycles.

Clearly, traditional wireless design flows are no longer sufficient to address these many challenges. Designers will need a comprehensive simulation strategy and modelling plan to meet their design goals. They need to verify full chip functionality at the transistor level as part of a system-wide functional verification methodology. They also need to perform advanced design exploration analysis to identify the parasitic effects and find an optimal solution. IC inductor synthesis and EM verification must be performed early enough in the design cycle to ensure accurate modelling.

As larger, more complex wireless designs continue to push the limits of traditional tools and the boundaries they create between the mixed-signal/RF components, designers will face growing challenges in simulating these. Think about it, aside from the fact that digital and analogue designs are approached differently, crossing that boundary between them often times is the weakest link in the process of simulating the chip. That boundary is where differing abstraction levels describing the digital portion meet real world voltages and currents on the analogue side.



Design flow-chart

Wireless designers will be caught between those rising design complexities. Merging design requirements will drive an urgent need for a simulation platform based on shared technologies. Designers will need the ability to draw on different simulation engines as needed to complete specific tasks throughout the design cycle. Simulators for those various technologies will have to address the growing need for high-performance, silicon accurate, simulation capabilities required to achieve working silicon for increasingly complex designs. For these capabilities, an innovative core of shared technologies will be necessary to address evolving development challenges and minimize the ramp-up time in adopting new use models.

Robust device modelling capabilities become critical to ensure silicon accurate results. Designers will have to rely on multiple (or multi-mode) simulation capabilities, where they can combine comprehensive built-in models for industry standards with in-house and third-party models, as well as Verilog-A compact device models. The goal would be that all of the simulators use the same device models and equations, ensuring no model correlation issues between the simulation results. Another benefit of the common equations is that new device models updates are available with all the simulators at the same time. A Verilog-A engine would provide consistent results when using Verilog-A component and device level models.

For the wireless designers, market forces and technology advances have combined to accelerate IC complexity beyond the capabilities of traditional simulation capabilities. A huge risk gets even bigger.

Easing the Adoption of Technology

With this pressure filled atmosphere surrounding designers, what are they to do? Certainly they are not in a position to invest their precious time optimizing design flows. It comes down to filling the need for new tools and technologies that can help them meet crushing time-to-market pressures by allowing them to quickly ramp up their design infrastructure and achieve more predictable results. They need not only the right technologies, but EDA vendors who can work with them hand-in-hand to help solve their problems. But how?

At the forefront must be the identification of key challenges a wireless IC designer faces. Then, by packaging tried-and-true methodologies into a comprehensive suite of IC design tools, design flows and standardized IP, and demonstrating those capabilities on a representative reference design. Designers can then map new techniques to their applications, thus quickly ramping up their design infrastructure.

Wireless IC design needs a transformation as many more standards and technologies are packed into chips and SiPs. What would happen if those design flows and IP needed to quickly integrate voice, video and MP3 functions, and a proven reference design were readily available? And what if the EDA vendor could help the designer quickly map those methodologies to the designer's specific needs? Clearly the wireless designer would be poised to harvest the benefits in producing a fully verified system-on-chip (SoC) or multi-chip solution for a new wireless appliance in much less time with less risk of failure.

The complexity of IC design is clearly here to stay. Invariably, users will demand new functions and higher performance that will lead to even greater integration, verification and simulation challenges. We believe by taking a new, more customized approach to wireless IC design, the EDA industry can help IC designers and the entire wireless supply chain reduce the risk of failure in IC design and, in the process, allow engineers to tap the creativity and imagination that will lead to exciting new product innovations. ■

Active RFID system and applications

RFID IS AN exciting field in automated contactless data capturing techniques, and it can be applied in many and various applications. Some RFID system applications are being described in this article. In addition, the current architectures of RFID system are also discussed.

The growing use of RFID system requires more advanced transponders and tags. RFID is a form of automatic, contactless, data capturing technique using radio frequency (RF) electromagnetic waves.

An RFID system consists of a transponder, reader and a host computer (software application) that is typically connected to a database or network, as shown in **Figure 1**. Readers are units that are positioned so, to recognize the transponders. However, in some cases, the readers can be handheld. The readers could be more advanced and more efficient, with better capabilities and functionality to serve the requirements of the specific application.

Software engineering provided many a good solution for RFID issues, including communication collision between tags, typically found when hundreds of tags are used in the same 'dense' environment.

Today there's a growing trend not to use bar codes but RFID tags instead. In order to enable the complete implementation of an RFID technology and the transition from bar codes to RFID tags, there are a number of issues involving cost, security and standards that need to be addressed.

Although RFID tags have advantages when compared to their much simpler, older 'sibling' – the bar code, the manufacturing costs go in favour of the bar code. The main cost of an RFID system and its implementation is dictated by the cost of the RFID tags.

A tremendous effort has been put in by RF engineers and researchers around the world in order to lower the cost of RFID tags and readers. One could easily say that the most important goal is to build an efficient, low-cost, good performance, RFID system.

RFID System Architecture

Typically, an RFID system consists of three major parts, regardless of the type used (active or passive). These three major parts are linked in a particular 'relationship' with each other, but this could be simplified into a master and slave relationship. In fact, it is a control relationship, as the reader is a master to the tag on one hand, but also the reader itself is a slave to a host computer or an application (see **Figure 2**).

Reader

The reader is the most important part of the RFID system because it controls the tag and, in the passive type of RFID system, it gives energy to power up the transponder. The reader in an RFID system itself consists of three main parts: the control unit, the RF interface and the antenna; sometime there are additional components, however, as shown in **Figure 3**.

Tag

This is the second part of any RFID system and it is usually the part that needs to be identified. The tag consists of an electronic chip with an integrated antenna and some other components. These 'other' components vary, depending on the requirements of the system and the application it is used in. We will classify the RFID system tags according to its power supply system.

Host Computer

The host computer is at the end of the RFID system. There we can see the collected data of the application and do calculations on this information or adding it to a database. The reader is typically connected to the host computer in many ways, depending on the manufacturing company. The connection between computer and reader can be via RS232 or Ethernet.

RFID System Classification

RFID system classification can be done according to the system features. For example, we can classify the RFID system according to its functionality, whether it is a read or a read/ write system. Alternatively, we can also classify the system according to its operating frequency.

In this case, we will take one of the most important features, which is the type of power supply to the transponder, and based on this we can classify the system into one of three types: active; semi-passive and passive.

Active System

In this type of RFID system, the tag is active, which means it has its own power, used to transmit data. An active tag has

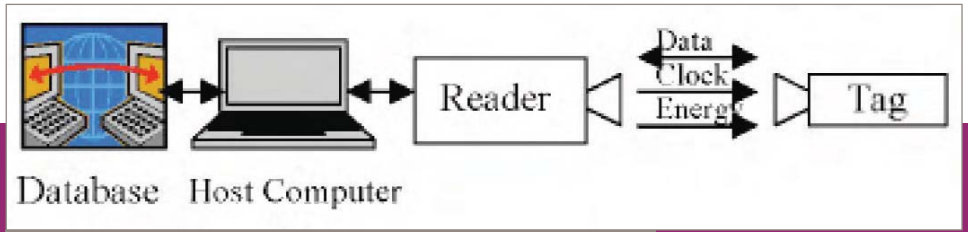


Figure 1: *A block diagram of an RFID system*

Mustafa Alani, **Widad Ismail** and **JS Mandeep** from the Electrical and Electronic Department at the University Sains Malaysia discuss an active type of RFID system, its operating frequency and the standards that it works with, in addition to its advantages and disadvantages

the ability to interface with many types of sensors too. The term Active RFID incorporates many technologies including Real Time Locating Systems, Ubiquitous Sensor Networks and Active RFID with Zigbee, RuBee, Ultra Wide Band and WiFi.

The active tag is not cheap due to its hardware. However, it does offer greater flexibility and it can be integrated in many systems, serving different applications, see **Figure 4**.

The active tag also has a higher communications range, of up to several kilometers. Active tags can be read while the target is moving at up to 100 miles an hour (e.g. in automatic toll-road payment systems) and the readers are capable of reading up to a thousand tags per second. Active tags can also be equipped with built-in sensors, for example to monitor temperature. In addition, they are typically accompanied by a much larger memory capacity and, due to their higher processing capabilities, are also more secure.

One of most important things in this system is the power supply, usually this is a DC power supply. The RS 232 interfaces with the tag, used for programming the control section with the suitable software to control the RF end and any other components in the tag – which can be a sensor or even a power amplifier, used to increase the range of communication between the tag and the reader. The entire additional components and operating frequency of the system should be done according to regulations and standards to solve the compatibility problem.

Semi-Passive and Passive Systems

The semi-passive system requires the tag to use battery power for the electronic chip, but still uses harvested power for communication. Semi-passive tags are far more reliable and have greater read ranges than purely passive tags, but they also have shorter lives (due to their reliance on battery power), are more fragile and are significantly more expensive.

Passive systems do not have an on-board power source, so a tag has to take power from the reader in order to run the electronic chip, but also issue a response to the reader. These tags can only operate in the presence of a reader.

Their communications range is limited by the need for the reader to generate very strong signals to power the tag, which therefore limits the reader-to-tag range. In addition, the small amount of energy that the tag is able to harvest, in order to power its response to the reader, means that the tag-to-reader range is also limited, typically to around four or five meters in UHF.

However, as passive tags do not require a continuous power source, they have a much longer lifecycle and, due to their minimal on-board circuitry, they are much cheaper to make. This means that passive RFID tags are more suitable for tagging individual product items for applications such as smartcards and in supermarket items.

Frequency

RFID is fundamentally based on wireless communication, making use of radio

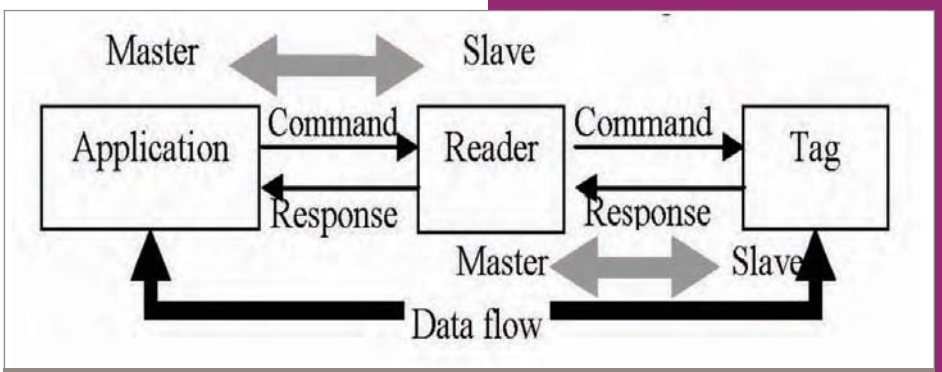


Figure 2: *Master-slave principle between the applications of software and reader, and reader and transponder*

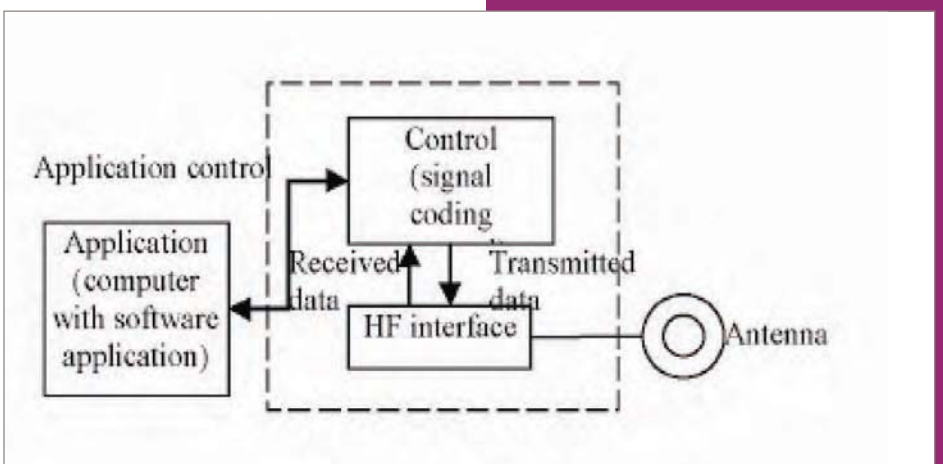


Figure 3: *Block diagram of a typical RFID reader*

Band	LF Low frequency	HF High frequency	UHF Ultra high frequency	Microwave
Frequency	30–300kHz	3–30MHz	300 MHz–3GHz	2–30 GHz
Typical RFID Frequencies	125–134 kHz	13.56 MHz	433 MHz or 865 – 956MHz 2.45 GHz	2.45 GHz
Approximate read range	less than 0.5 metre	Up to 1.5 metres	433 MHz = up to 100 metres 865-956 MHz = 0.5 to 5 metres	Up to 10m
Typical data transfer rate	less than 1 kilobit per second (kbit/s)	Approximately 25 kbit/s	433–956 = 30 kbit/s 2.45 =100 kbit/s	Up to 100 kbit/s
Characteristics	Short-range, low data transfer rate, penetrates water but not metal.	Higher ranges, reasonable data rate (similar to GSM phone), penetrates water but not metal.	Long ranges, high data transfer rate, concurrent read of <100 items, cannot penetrate water or metals	Long range, high data transfer rate, cannot penetrate water or metal
Typical use	Animal ID Car immobiliser	Smart Labels Contact-less travel cards Access & Security	Specialist animal tracking Logistics	Moving vehicle toll

Table 1: *RFID operating frequencies and associated characteristics*

waves, which form part of the electromagnetic spectrum (I. frequencies from 300kHz to 3GHz). It is not unlike two other wireless technologies, WiFi and Bluetooth. The three technologies are all designed for very different uses and, therefore, have different functionalities. However, there is a shared ground between the three, so now some hybrids are starting to appear.

RFID systems can utilize both WiFi and Bluetooth and need not be competitors.

RFID operates in the unlicensed spectrum space, sometimes referred to as ISM (Industrial, Scientific and Medical) band, but the exact frequencies that constitute the ISM band may vary depending on the regulations in different countries.

The differences between passive and active tag type RFID system are shown in **Table 2**.

RFID for Comms

RFID covers a very wide world of contactless communication. In addition, it has many applications, which increase daily. This article describes the characteristics of an RFID system and types, so it may help you to decide the type of RFID system you need, depending on your application. For example, an active RFID system is best suited where business processes are dynamic or unconstrained; movement of tagged assets is variable; where sophisticated security is necessary or sensing and/or data storage capabilities are required.

It could easily be said that the rapid increase in RFID technologies will evolve into new fields of applications. In addition, the increase in RFID technologies will require an increase in software engineers too.■

	Active RFID	Passive RFID
Tag Power Source	Internal to tag	Energy transferred from the reader via RF
Tag Battery	Yes	No
Availability of Tag Power	Continuous	Only within field of reader
Required Signal Strength from Reader to Tag	Low	High (must power the tag)
Available Signal Strength from Tag to Reader	High	Low

Table 2: *Technical differences between active and passive RFID technologies*

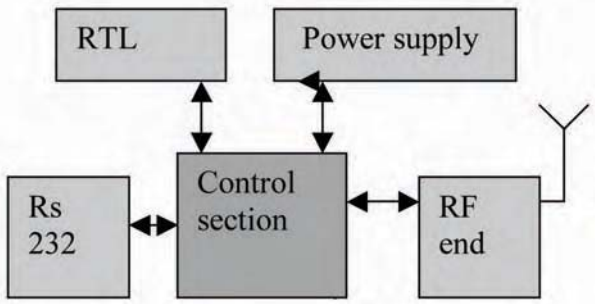


Figure 4: *Block diagram of an active tag RFID system*

Errett Kroeter, Director of Channel Marketing at Lantronix, discusses the remote access security challenges for embedded systems

SECURITY considerations are always a major issue when deploying a remote access solution, and the difficulties are compounded when solutions must include support for embedded systems.

Successful implementations must provide effective authentication and access control, and care must also be taken to ensure that data is secured during transport over the network. Additional considerations arise when target devices are hosted as guests on remote networks administered by others. In such cases particular care must be taken to ensure that your systems do not open the hosting network to outside threats.

Effective network security is not based upon any one technology or component; it is most successful when it is built up using a layered approach, with multiple defenses contributing to the overall solution.

In this article we review some of the common technologies used by security professionals when developing secure remote access solutions, along with some of the challenges faced when implementing such deployments in the real world. We will also examine one commercial offering that addresses these challenges in an innovative and cost-effect way. With care, it is possible to provide effective, secure network access to remote access deployments, enabling new service models and increasing customer capabilities.

Network-Based Access Controls

Network-Based access controls are used to ensure that only authorized hosts are allowed to establish connections to your networked devices. Such access control usually takes the form of a Layer 2 or Layer 3 firewall that screens out inappropriate connections before they can reach your equipment.

Firewalls may work at Layer 2 (also referred to as the Data Link layer in the OSI Seven Layer Networking Model) or Layer 3 (the Network layer).

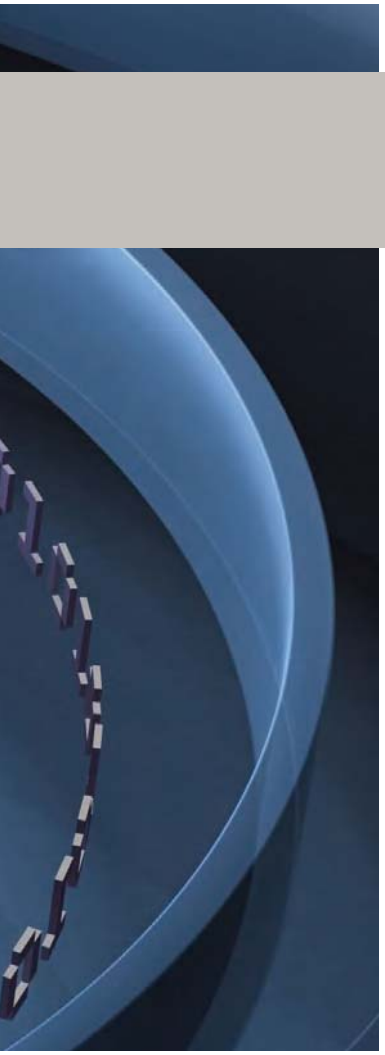
Layer 2 solutions are sometimes described as "stealth firewalls" – they do not appear as a router hop to the network layer, instead they provide a filtering capability on top of a transparent bridging connection between two network end points.

A Layer 2 firewall may have Access Control Lists that allow the operator to control connections to or from specific devices or to prevent traffic for specific network protocols. For example, you may configure such a system to block IP-based traffic to a specific host while permitting Novell Netware IPX-based traffic.

Layer 3 firewalls, also known as port-based firewalls, operate at the TCP layer. When setting up a Layer 3 firewall, the administrator configures Access Control Lists that enable or block connections based upon specified source and destination IP addresses and ports. Some so-called "Layer 3/Layer 4" firewalls function by examining the contents of Layer 3 packets for additional information to help make their decisions.

The success of firewall technology in addressing external network threats did not come without a price; universal deployment of firewalls has greatly aggravated the difficulty of providing remote access to network devices.

Although effective and usually offering good performance, firewalls are complex to set up and administer and require network administrative privileges on the protected network. When setting up a Layer 3 firewall it is common practice



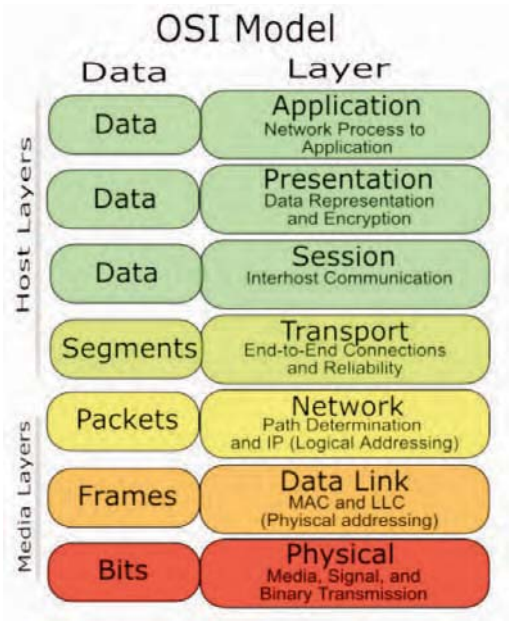


Figure 1: *The OSI seven layer networking model*

Network Security Challenges for REMOTE ACCESS

to enable connections to a device only on those ports that you know will be used. This will often lead to problems when a new service is enabled and the required port is being blocked.

Enabling Remote Access with VPNs

The networking industry's initial response to the growing remote access challenge was the Virtual Private Network (VPN). As its name implies, a VPN replaces dedicated leased lines, cellular links or other costly physical connections with a secure mechanism over which traffic from a remote device can be tunneled to the target network using an existing network connection.

As with firewalls, installing and operating your own VPN requires network administrator privileges. Both IPSec and SSL VPNs are "IT-oriented" solutions, used by network administrators to control access into their networks and, thus, installing such a device at each remote location is usually not an option for enabling remote access to devices on other people's networks.

Another issue for SSL VPN solutions is the challenge of maintaining large numbers of user-level security credentials for each support technician when accessing equipment at a large number of locations.

A final significant issue for VPNs when used to grant guest access is that once a VPN connection is established, the remote host essentially becomes another node on the remote network. This can be a problem when the goal is to grant limited access privileges to specific hosts. One solution is to group guest devices onto their own LAN, but this is often not possible when your equipment is being hosted on networks outside your own administrative control. Because of this, once connected, a single infected guest PC is potentially capable of attacking every device on a remote LAN.

The ManageLinx VIP Access Solution

The ManageLinx management platform is an M2M remote management solution capable of providing easy yet secure remote Internet access to virtually any piece of IP-enabled equipment – even when such equipment is located behind remote firewalls or a VPN. Readily adaptable to a wide range of management tasks, it is especially well suited for accessing and managing embedded systems located on remote customer networks and other situations where support staff do not have administrator privileges on the remote network.

The patent-pending ManageLinx VIP Access component provides transparent Layer 3 network access to any piece of remote equipment without specialized client software or network reconfiguration. Because it is able to work with any TCP/IP-enabled application running on any host or operating system, ManageLinx VIP Access is particularly useful for embedded systems deployments where dedicated VPN clients or specialized networking configuration changes are not an option.

ManageLinx is extremely easy to deploy. Its USB Flash drive based configuration module allows completely automated configuration of network settings, security credentials and other essential parameters, eliminating the need for skilled staff or special equipment during installation. ManageLinx works over conventional Internet connections with as little as one open port to the WAN and requires no reconfiguration of the target network's firewall settings. Because it can use existing Internet connections, ManageLinx VIP Access eliminates the need for

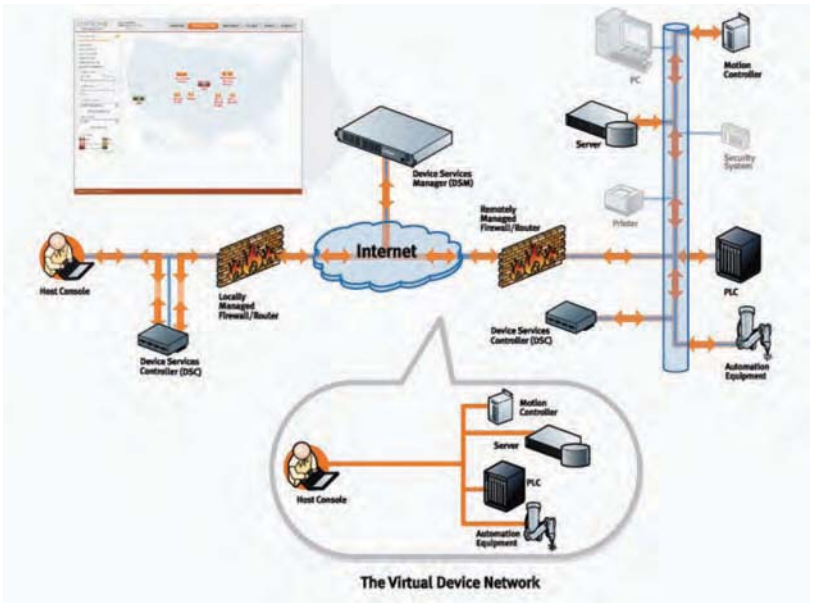


Figure 2: *ManageLinx VIP Access – theory of operation*

dedicated analogue phone lines or cellular coverage, along with the associated recurring charges.

Security Considerations

Because the ManageLinx VIP Access operates at the network layer, and communication between VIP address and the endpoint device is fully automated, it is easy to integrate embedded devices into the system. Because there are no dedicated clients or specialized software needed to access the system, implementing network access is very straightforward. Embedded systems programmers utilize traditional TCP/IP programming mechanisms – simply open a connection to the VIP address and the system will automatically establish and manage the connection to the remote device.

A Secure Tool

The ManageLinx VIP Access system is a secure, easy-to-use and cost-effective tool for providing remote access to devices behind firewalls. It is particularly well suited for use with embedded systems or in deployment scenarios where the operator does not have administrator privileges on remote systems.

Particular care has been taken to ensure the system addresses known issues with Network Layer Access Control and traditional VPN solutions. It uses state of the art encryption technology to provide an effective key management infrastructure and enhanced Network Layer Access Control. Because it requires no dedicate clients and has greatly simplified ease of deployment, it is particularly effective in providing remote access capability for either embedded systems or for any system where skilled network expertise is not available for deployment or maintenance. ■

Associate Professor **Dr Murat Uzam** from Nigde University in Turkey presents a series of articles on a project that focuses on a microcontroller-based PLC. This is the seventh article in the series describing the counter macros CTU_8 (Up Counter) and CTD_8 (Down Counter)

PLC with PIC16F648A Micro

COUNTERS can be used in a wide range of applications. In this article, three counter functions, namely up counter down counter and up/down counter, are described.

The definition of 8-bit variables to be used for the counter macros and their allocation in BANK 0 of RAM data memory are both shown in **Figure 1a** and **b** respectively. Here, it is important to note that as we restrict ourselves to use the BANK0, where there is not enough registers left, we cannot define different sets of 8-bit variables to be used in counting process for each counter type. Rather, we define eight of 8-bit variables and share them for each counter type. As a result, in total, we can define 8 different counters at most, irrespective of the counter type. The status bits of all counters are defined as shown in **Figure 2a**.

All of the 8-bit variables defined for a counter must be cleared at the beginning of the PLC operation for a proper operation. For this purpose the macro "init_cnts" is defined as shown in **Figure 2b**. This macro must be run after the macro "initialize" explained in Part 2 of the series. The file "cnt_mcr_def.inc" (all files considered in this article including "tmr_mcr_def.inc" can be downloaded from http://host.nigde.edu.tr/muzam/) contains the entire counter macros defined for UZAM_PLC.

Let us now consider the counter macros. In the following, first of all a general description will be given for the considered counter function and then its implementation in UZAM_PLC will be provided.

Up Counter (CTU)

The up counter (CTU) can be used to signal when a count has reached a maximum value. The symbol of the up counter (CTU) is shown in **Figure 3**, while its truth table is given in **Table 1**.

The up counter counts the number of "rising edges" (↑) detected at the input CU. PV defines the maximum value for the counter. Each time the counter is called with a new rising edge (↑) on CU, the count value CV is incremented by one. When the counter reaches the PV value, the counter output Q is set true (ON – 1) and the counting stops.

The reset input R can be used to set the output Q false (OFF – 0) and clear the count value CV to zero. The following section explains the implementation of eight of 8-bit up counters for UZAM_PLC.

(a)

```
;--------------- VARIABLE DEFINITIONS ---
      CBLOCK 0x6D
      CTU8_Q,CTD8_Q,CTUD8_Q
      endc
      CBLOCK 0x70
      CV_8
      endc
      CBLOCK 0x78
      CTU8_RED,CTD8_RED,CTUD8_RED,CTUD8_FLG
      endc
;----------------------------------------
```

(b)

6Dh	CTU8_Q
6Eh	CTD8_Q
6Fh	CTUD8_Q
70h	CV_8
71h	CV_8+1
72h	CV_8+2
73h	CV_8+3
74h	CV_8+4
75h	CV_8+5
76h	CV_8+6
77h	CV_8+7
78h	CTU8_RED
79h	CTD8_RED
7Ah	CTUD8_RED
7Bh	CTUD8_FLG
7Ch	
7Dh	
7Eh	
7Fh	

BANK 0

***Figure 1: (a)** The definition of 8-bit variables to be used for the counter macros **(b)** Their allocation in BANK 0 of RAM data memory*

Macro "CTU_8" (8-bit Up Counter)

The macro "CTU_8" defines 8 up-counters selected with the num = 0, 1...7. **Table 2** shows the macro "CTU_8" and its symbol.

CU (count up input), Q (output signal = counter status bit) and R (reset input) are all defined as Boolean variables. The PV (preset value) is an integer constant (here, for an 8-bit resolution, it is chosen as any number in the range 1-255) and is used to define a maximum count value for the counter. The counter outputs are represented by the counter status bits: CTU8_Q,num (num = 0, 1...7), namely CTU8_Q0, CTU8_Q1...CTU8_Q7, as shown in Figure 2a.

We use a Boolean variable, namely CTU8_RED,num (num = 0, 1...7) as a rising edge detector for identifying the rising edges of the CU. An 8-bit integer variable CV_8+num (num = 0, 1...7) is used to count the rising edges of the CU.

controller – Part 7

(a)

```
;- defining Up Counter outputs -
#define CTU8_Q0 CTU8_Q,0
#define CTU8_Q1 CTU8_Q,1
#define CTU8_Q2 CTU8_Q,2
#define CTU8_Q3 CTU8_Q,3
#define CTU8_Q4 CTU8_Q,4
#define CTU8_Q5 CTU8_Q,5
#define CTU8_Q6 CTU8_Q,6
#define CTU8_Q7 CTU8_Q,7

;- defining Down Counter outputs -
#define CTD8_Q0 CTD8_Q,0
#define CTD8_Q1 CTD8_Q,1
#define CTD8_Q2 CTD8_Q,2
#define CTD8_Q3 CTD8_Q,3
#define CTD8_Q4 CTD8_Q,4
#define CTD8_Q5 CTD8_Q,5
#define CTD8_Q6 CTD8_Q,6
#define CTD8_Q7 CTD8_Q,7

;- defining Up/Down Counter outputs -
#define CTUD8_Q0 CTUD8_Q,0
#define CTUD8_Q1 CTUD8_Q,1
#define CTUD8_Q2 CTUD8_Q,2
#define CTUD8_Q3 CTUD8_Q,3
#define CTUD8_Q4 CTUD8_Q,4
#define CTUD8_Q5 CTUD8_Q,5
#define CTUD8_Q6 CTUD8_Q,6
#define CTUD8_Q7 CTUD8_Q,7
```

(b)

```
;------------------ macro: init_cnts ---
init_cnts   macro
      clrf CTU8_Q       ;Clear CTU8_Q
      clrf CTD8_Q       ;Clear CTD8_Q
      clrf CTUD8_Q      ;Clear CTUD8_Q
      clrf CV_8         ;Clear CV_8
      clrf CV_8+1       ;Clear CV_8+1
      clrf CV_8+2       ;Clear CV_8+2
      clrf CV_8+3       ;Clear CV_8+3
      clrf CV_8+4       ;Clear CV_8+4
      clrf CV_8+5       ;Clear CV_8+5
      clrf CV_8+6       ;Clear CV_8+6
      clrf CV_8+7       ;Clear CV_8+7
      clrf CTU8_RED     ;Clear CTU8_RED
      clrf CTD8_RED     ;Clear CTD8_RED
      clrf CTUD8_RED    ;Clear CTUD8_RED
      clrf CTUD8_FLG    ;Clear CTUD8_FLG
      endm
;---------------------------------------
```

***Figure 2: (a)** The definition of status bits of counter macros*
***(b)** The initialization of all variables of counter macros defined as a macro "init_cnts"*

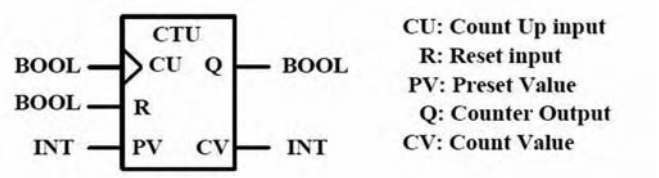


***Figure 3:** The up counter (CTU)*

CU	R	Operation
×	1	1. set the output Q false (OFF – 0) 2. clear the count value CV to zero
0	0	NOP (No Operation is done)
1	0	NOP
↓	0	NOP
↑	0	If CV < PV, then increment CV (i.e. CV = CV + 1) If CV = PV, then hold CV and set the output Q true (ON – 1)

× : don't care

***Table 1:** The truth table of the up-counter (CTU)*

Let us now briefly consider how the macro "CTU_8" works. If the input signal R is true (ON – 1), then the output signal CTU8_Q,num (num = 0, 1…7) is forced to be false (OFF – 0) and the counter CV_8+num (num = 0, 1…7) is loaded with "00h". If the input signal R is false (OFF – 0), then with each "rising edge" of the CU, the related counter "CV_8+num" is incremented by one. In this case, when the count value of "CV_8+num" is equal to the PV, then state-change from 0 to 1 is issued for the output signal (counter status bit) CTU8_Q,num (num = 0, 1…7) and the counting stops.

Down Counter (CTD)

The down counter (CTD) can be used to signal when a count has reached zero on counting down from a preset value. The symbol of the down counter (CTD) is shown in **Figure 4**, while its truth table is given in **Table 3**.

The down counter counts down the number of "rising edges" (↑) detected at the input CD. PV defines starting value for the counter. Each time the counter is called with a new rising edge (↑) on CD, the count value CV is decremented by one. When the counter reaches zero, the counter output Q is set true (ON – 1) and the counting stops.

The load input LD can be used to clear the output Q to false (OFF – 0) and load the count value CV with the preset value PV. The following section explains the implementation of eight of 8-bit down counters for UZAM_PLC.

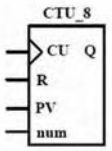
Macro "CTD_8" (8-bit Down Counter)

The macro "CTD_8" defines 8 down

Macro

```
;--------- macro: CTU_8 -------------------------
CTU_8  macro   num,cu_reg,cu_bit,rs_reg,rs_bit,PV
       local   L1,L2
       btfss   rs_reg,rs_bit
       goto    L2
       movlw   00h
       movwf   CV_8+num
       bcf     CTU8_Q,num
       goto    L1
L2     btfsc   CTU8_Q,num
       goto    L1
       btfss   cu_reg,cu_bit
       bsf     CTU8_RED,num
       btfss   cu_reg,cu_bit
       goto    L1
       btfss   CTU8_RED,num
       goto    L1
       bcf     CTU8_RED,num
       incf    CV_8+num,f
       movfw   CV_8+num
       xorlw   PV
       skpnz
       bsf     CTU8_Q,num
L1
       endm
;-----------------------------------------------
```

Symbol



num = 0, 1, …, 7

CU (cu_reg,cu_bit) = 0, 1

R (rs_reg,rs_bit) = 0, 1

PV (8 bit constant) = 1, 2, …, 255

Q = CTU8_Q,num (num = 0, 1, …, 7)

Table 2: *The macro "CTU_8" and its symbol*

forced to be false (OFF – 0) and the counter CV_8+num (num = 0, 1…7) is loaded with PV. If the input signal LD is false (OFF – 0) then with each "rising edge" of the CD, the related counter "CV_8+num" is decremented by one. In this case, when the count value of "CV_8+num" is equal to zero, then state-change from 0 to 1 is issued for the output signal (counter status bit) CTU8_Q,num (num = 0, 1…7) and the counting stops. ■

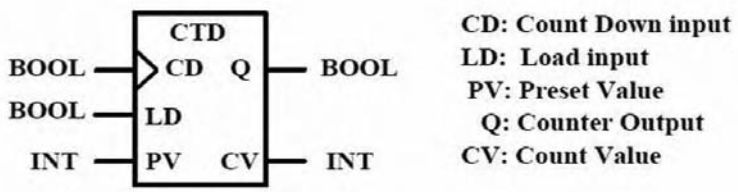


Figure 4: *The down counter (CTD)*

counters selected with the num = 0, 1…7. **Table 4** shows the macro "CTD_8" and its symbol. CD (count down input), Q (output signal = counter status bit) and LD (load input) are all defined as Boolean variables. The PV (preset value) is an integer constant (here, for an 8-bit resolution, any number in the range 1-255 is selected) and is used to define a starting value for the counter. The counter outputs are represented by the counter status bits: CTD8_Q,num (num = 0, 1…7), namely CTD8_Q0, CTD8_Q1…CTD8_Q7, as shown in Figure 2a. We use a Boolean variable, or CTD8_RED,num (num = 0, 1…7) as a rising edge detector for identifying the rising edges of the CD. An 8-bit integer variable CV_8+num (num = 0, 1…7) is used to count the rising edges of the CD.

Let us now briefly consider how the macro "CTD_8" works. If the input signal LD is true (ON – 1), then the output signal CTU8_Q,num (num = 0, 1…7) is

CD	LD	Operation
×	1	1. clear the output Q to false (OFF – 0) 2. load the count value CV with the preset value PV
0	0	NOP (No Operation is done)
1	0	NOP
↓	0	NOP
↑	0	If CV > 0, then decrement CV (i.e. CV = CV - 1) If CV = 0, then hold CV and set the output Q true (ON – 1)

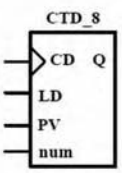
× : don't care

Table 3: *The truth table of the down counter (CTD)*

Macro

```
;--------- macro: CTD_8 -------------------------
CTD_8  macro   num,cd_reg,cd_bit,ld_reg,ld_bit,PV
       local   L1,L2
       btfss   ld_reg,ld_bit
       goto    L2
       movlw   PV
       movwf   CV_8+num
       bcf     CTD8_Q,num
       goto    L1
L2     btfsc   CTD8_Q,num
       goto    L1
       btfss   cd_reg,cd_bit
       bsf     CTD8_RED,num
       btfss   cd_reg,cd_bit
       goto    L1
       btfss   CTD8_RED,num
       goto    L1
       bcf     CTD8_RED,num
       decf    CV_8+num,f
       movfw   CV_8+num
       xorlw   0
       skpnz
       bsf     CTD8_Q,num
L1
       endm
;-----------------------------------------------
```

Symbol



num = 0, 1, …, 7

CD (cd_reg,cd_bit) = 0, 1

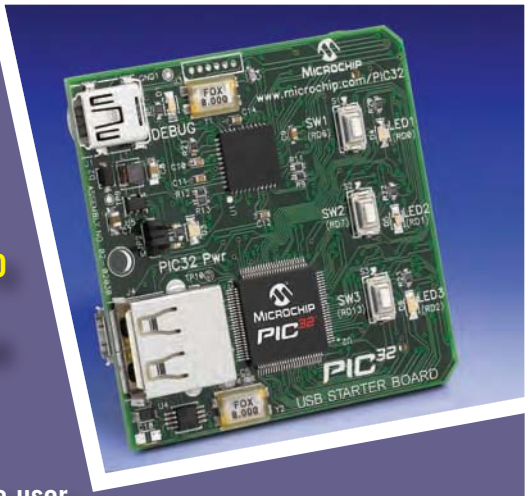
LD (ld_reg,ld_bit) = 0, 1

PV (8bit constant) = 1, 2, …, 255

Q = CTD8_Q,num (num = 0, 1, …, 7)

Table 4: *The macro "CTD8" and its symbol*

WIN A MICROCHIP PIC32 USB STARTER BOARD!!



ELECTRONICS WORLD IS OFFERING ITS READERS THE CHANCE TO WIN THE NEW PIC32 USB STARTER BOARD FROM MICROCHIP!! THE BOARD PROVIDES THE EASIEST AND LOWEST COST METHOD TO EXPERIENCE THE USB ON-THE-GO FAMILY OF PIC32 MICROCONTROLLERS.

The starter board comes pre-loaded with demonstration software for the user to explore the new features of the PIC32MX. It is also expandable through a modular expansion interface, which allows the user to extend its functionality. The PIC32 USB Starter Board also supplies on-board circuitry for full debug and programming capabilities. Users can develop USB embedded host, device, dual-role, or On-The-Go applications by combining this board with Microchip's free USB software (USB host, device and OTG stacks, and class driver source code) and documentation (application notes, data sheets and a family reference manual).

The USB Starter Board has the same form factor and expansion connector as the PIC32 Starter Kit (#DM320001). New in MPLAB 8.10 is support for the 32-bit edition of Microsoft Windows Vista; Windows XP and Windows 2000 are also supported.

For the chance to win a PIC32 USB Starter Board, log onto www.microchip-comp.com/ew-pic32usb and enter your details into the online entry form.

Special DATA Acquisition Board

Maurizio Di Paolo Emilio presents a series of articles focusing on a data acquisition (DAQ) board project for the management of environmental sensors and a high-speed data acquisition system. This article, the fourth in the series, covers the buses that can be used with this board

THE DAQ board is composed of various slots for upgrades. It works on a VME bus but also by the means of USB, GSM, wireless and Ethernet connections. In the last issue of Electronics World I outlined the key points of the GSM, wireless and USB technologies; now I will describe the VME bus, as well as others that are used in data communication.

The VME bus (Versa Module Europa) is a flexible, open-ended, bus system based on the Eurocard standard. It was introduced by Motorola, Phillips, Thompson and Mostek in 1981.

It was intended to be a flexible environment supporting a variety of computing intensive tasks and is now a very popular protocol in the computer industry. It is defined by the IEEE 1014-1987 standard. The system is modular and follows the Eurocard standard.

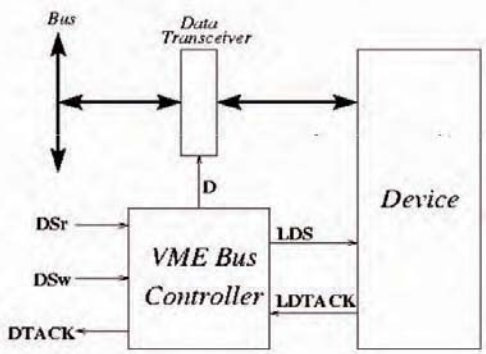


Figure 1: *VME controller*

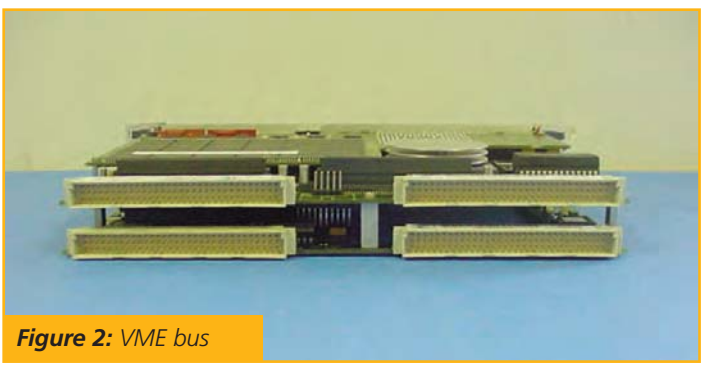


Figure 2: *VME bus*

VME card cages contain 21 slots, the first of which must be used as a crate manager.

The principal use of this board is to manage the data acquisition system on the VME bus. This means that the board can be used in a VME bus (crate, see **Figures 1**, **2** and **3**), to manage the data acquisition.

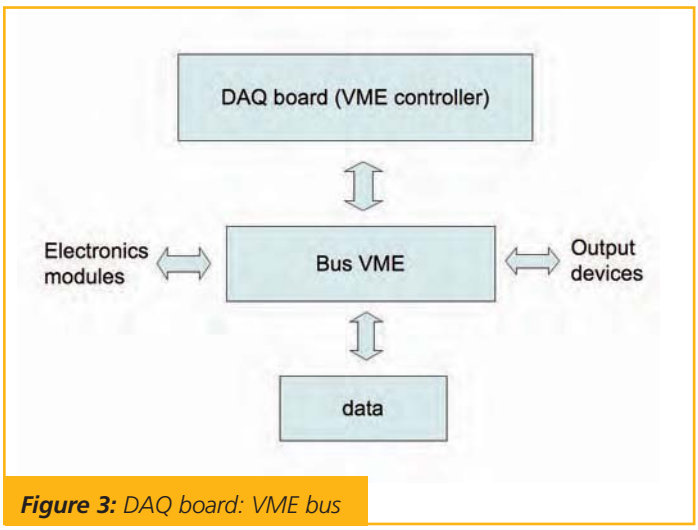


Figure 3: *DAQ board: VME bus*

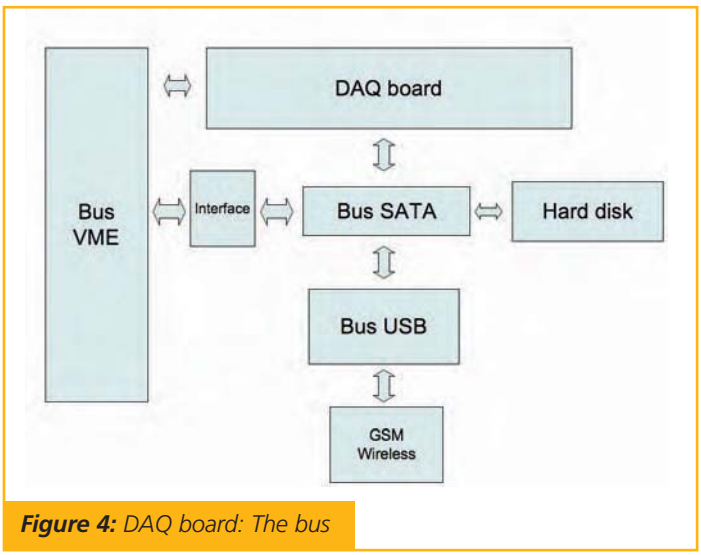


Figure 4: *DAQ board: The bus*

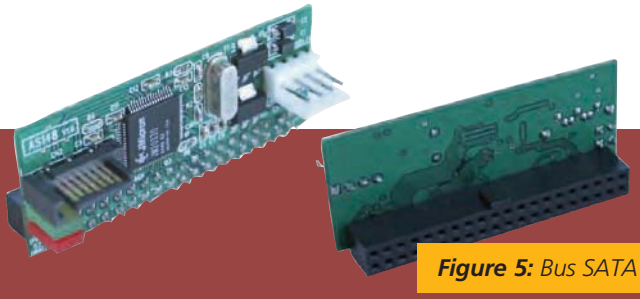


Figure 5: *Bus SATA*

PART 4

Other Buses

Among the other buses used with the DAQ board are USB and SATA/ATA.

The Universal Serial Bus (USB) connects more than just computers and peripherals; it can connect a whole host of PC applications.

The main features of this bus are:

- It is economic and expandible, with automatic configuration;
- It allows data transfer speeds of Mbps;
- It allows connectivity of up to 127 devices.

The Serial ATA (SATA) computer bus is a storage-interface for connecting host bus adapters to mass storage devices. Conceptually, SATA is a "wire replacement" for the older AT Attachment standard (ATA). The Serial ATA host adapter and devices communicate via a high-speed serial cable (see **Figure 4** and **5**).

Serial ATA is the proactive evolution of the ATA interface from a parallel bus to a serial bus architecture. This architecture overcomes the electrical constraints that are increasing the difficulty of continued speed enhancements for the classic parallel ATA bus. Serial ATA will be introduced at 150Mbyte/s, with a roadmap already planned to 600Mbyte/s, supporting up to 10 years of storage evolution based on historical trends. Though Serial ATA will not be able to directly interface with legacy Ultra ATA hardware, it is fully compliant with the ATA protocol and hence it is software compatibile.

An Address bus is a computer bus (a series of lines connecting two or more devices) that is used to specify a physical address. When a processor or DMA-enabled device needs to read or write to a memory location, it specifies that memory location on the address bus (the value to be read or written is sent on the data bus). The width of the address bus determines the amount of memory a system can address. For example, a system with a 32-bit address bus can address 232 (4, 294, 967, 296) bytes, or 4GBytes, of memory.

Early processors used a wire for each bit of the address width. For example, a 16-bit address bus had 16 physical wires making up the bus (**Figure 6**).

DAQ Board Bus Outline

A possibile outline of the bus of the DAQ board is shown in **Figure 7**. Data, address and control buses connect the processor, memory and I/O controller.

The control bus is a bi-directional bus (two-way). Its purpose is to transmit command, timing and specific status information between system components.

Typical control lines include:

- Memory Write: causes data on the data bus to be written into the addressed location.
- Memory Read: causes data from the addressed location to be placed on the data bus.
- I/O Write: causes data on the data bus to be output to the addressed I/O port.
- I/O Read: causes data from the addressed I/O port to be placed on the data bus.
- Bus Request: indicates that a component needs to gain control of the system bus.
- Interrupt Request: indicates that an interrupt is pending.
- Clock: used to synchronise operations.
- Reset: initialises all components. ■

The series continues in the next issue of Electronics World magazine. If you missed your last copy you can order your digital version of that issue on line at www.electronicsworld.co.uk

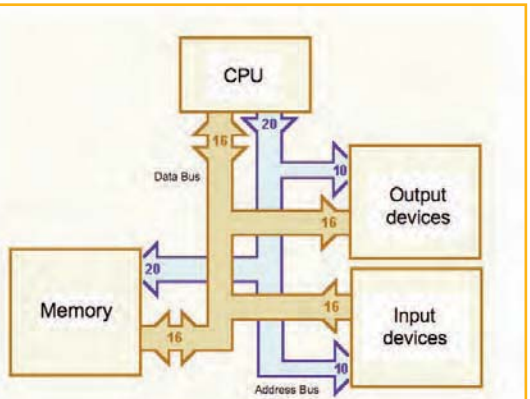


Figure 6: *Data and Address bus*

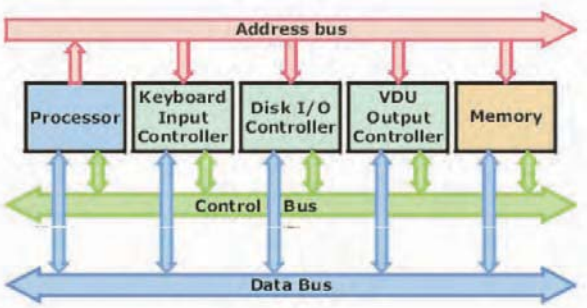


Figure 7: *The buses*

Good VIBRATIONS

Pierre Mars, vice president of applications engineering for Sydney, Australia-based CAP-XX, goes into the technical detail of selecting an energy harvester that can convert vibration into energy, as well as choosing the supporting supercapacitor that can store this energy and allow it to be used to deliver power bursts for transmitting data

THIS ARTICLE describes a machinery condition monitoring system developed by GE Energy for a field trial in the challenging industrial environment at the Nyhamna gas plant in Norway. We will concentrate on the power supply, which is inexhaustible by way of harvesting vibration energy from machines being monitored. This power supply uses a microgenerator to convert vibrational energy into useable electrical energy, and then stores that energy in a supercapacitor so that enough is available for the higher power bursts to measure and transmit condition monitoring data to a base station.

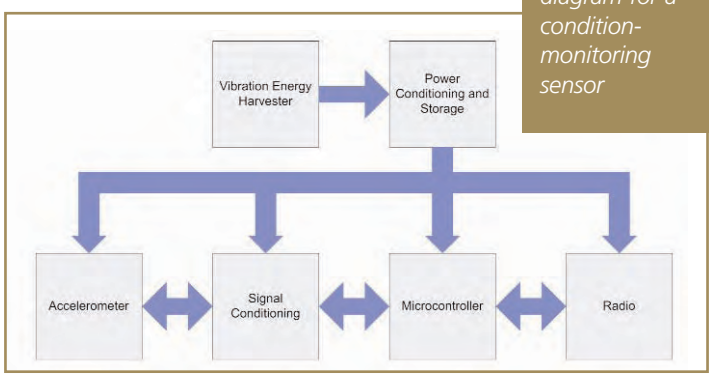


Figure 1: *Block diagram for a condition-monitoring sensor*

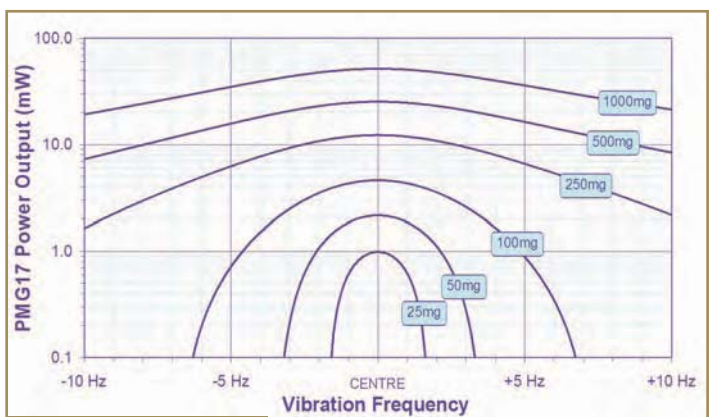


Figure 2: *The power output spectra for the PMG17 microgenerator*

Condition Monitoring

Plants and refineries monitor both machines and processes to ensure optimum safety, up-time and efficiency. Here, we will concentrate on the machinery side.

Machinery condition monitoring involves measuring the vibrational spectrum of rotating machinery such as pumps, motors and turbines to determine their health. The frequency of vibration is determined by rotational speed and shaft/bearing construction. The amplitude of vibration indicates machine health. For instance, smooth-running machines have low amplitude vibration, while defects in bearing surfaces, unbalanced or misaligned shafts increase the amplitude of vibration. As the problems become more severe, the amplitude increases. Therefore, frequent monitoring of vibration frequency and amplitude reveals problems as they occur to help engineers predict when it is most economical to take equipment offline for maintenance.

Plants will instrument and wire key pieces of machinery – such as turbines, critical high-capacity pumps and motors – when installed. However, it is not cost-effective to do this for the "balance of plant", including the less critical pumps, motors and compressors that abound in oil refineries, gas plants and mineral processing plants. If one of these less critical pieces of machinery fails unexpectedly, the plant may incur significant costs in lost production and emergency maintenance.

Typically, maintenance engineers monitor "balance of plant" by walking around with a vibration transducer and laptop to periodically inspect equipment, the frequency of which is determined by how critical the equipment is.

It would be far more convenient if a low-cost system consisting of a vibration sensor, microcontroller and radio transmitter was fitted to the balance of plant, which could periodically report the vibration spectra to a maintenance base station. The question then becomes how to power these remote sensors.

Energy Harvesting Provides Perpetual Power Supply

Batteries could power the remote sensors. However, batteries may survive only two to five years in such harsh environments, so in plants with hundreds or thousands of battery-powered wireless sensor nodes, the cost of monitoring, replacing and recycling them is significant.

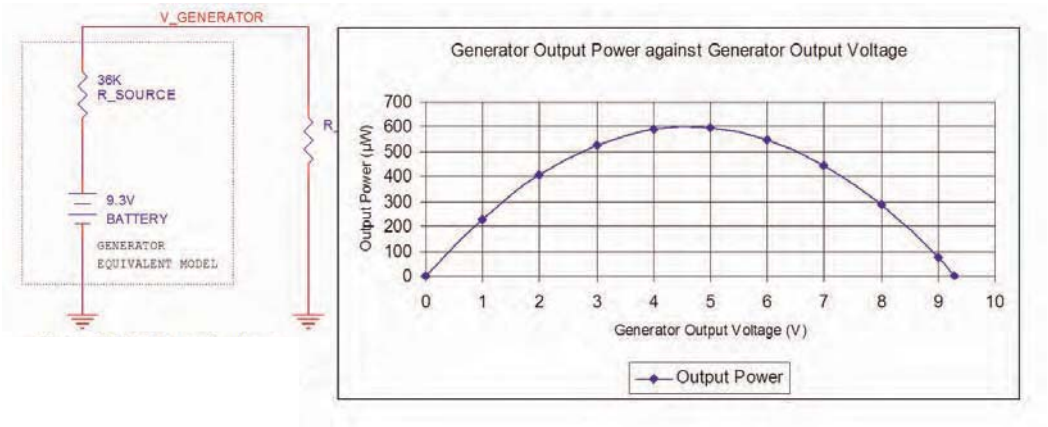


Figure 3: *The equivalent circuit of the microgenerator as a high impedance voltage source and the output power as a function of output voltage*

Given we are monitoring rotating machinery, there is guaranteed to be vibrational energy available. Hence, the most natural and attractive solution is to capture this vibrational energy to power the remote condition-monitoring sensors, thereby providing a free, perpetual power supply.

The critical components to this power supply are:

- A PMG17 microgenerator from UK-based Perpetuum, which can harvest even very low levels of vibrational energy from a smooth-running piece of equipment, and
- A supercapacitor from Australia-based CAP-XX which can store this energy and release it in short, high-power bursts to read and transmit the condition monitoring data.

Figure 1 shows the block diagram for a condition-monitoring sensor, where the PMG17 is the block labelled Vibration Energy Harvester and the power supply circuit, which includes the supercapacitor is the block labelled Power Conditioning and Storage.

Vibration Energy Harvester

The PMG17 microgenerator from Perpetuum is the vibration energy harvester used in this unit. An inductive energy harvester with an optimized magnetic circuit coupled to a magnetic resonator designed for AC motors, it harvests the commonly-found "twice the line frequency vibration" so the unit is tuned to 100Hz for a 50Hz AC supply or to 120Hz for a 60Hz AC supply. The PMG17 will produce a minimum power output of 0.5mW with as little as 25mg RMS vibration within a 2Hz bandwidth.

Interpreting **Figure 2**, if a unit is tuned to 120Hz to harvest energy from a 60Hz AC motor, then the output power is:

- 1mW if there is 25mg of vibration at 120Hz;
- 0.6mW if there is 25mg of vibration at 119Hz;
- 1mW if there is 50mg of vibration at 122Hz, etc.

The microgenerator is a high impedance voltage source. **Figure 3** shows the equivalent circuit and the output power as a function of output voltage. It also shows that the power conditioning and storage block should control the current drawn from the microgenerator to maintain its output voltage at approximately 5V to maximize the power transferred from it. This current level will be ~ 120 microamps to achieve the 600µW shown in Figure 3.

Power Conditioning and Storage

A dual-cell CAP-XX supercapacitor, consisting of a pair of HW109 cells, forms the heart of the Power Conditioning and Storage block. It was chosen for the following desirable attributes in this application:

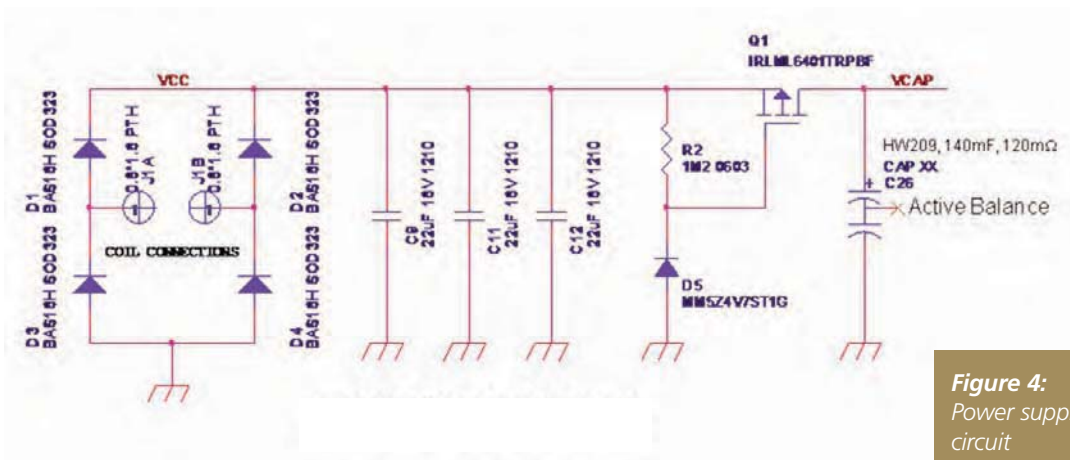


Figure 4: *Power supply circuit*

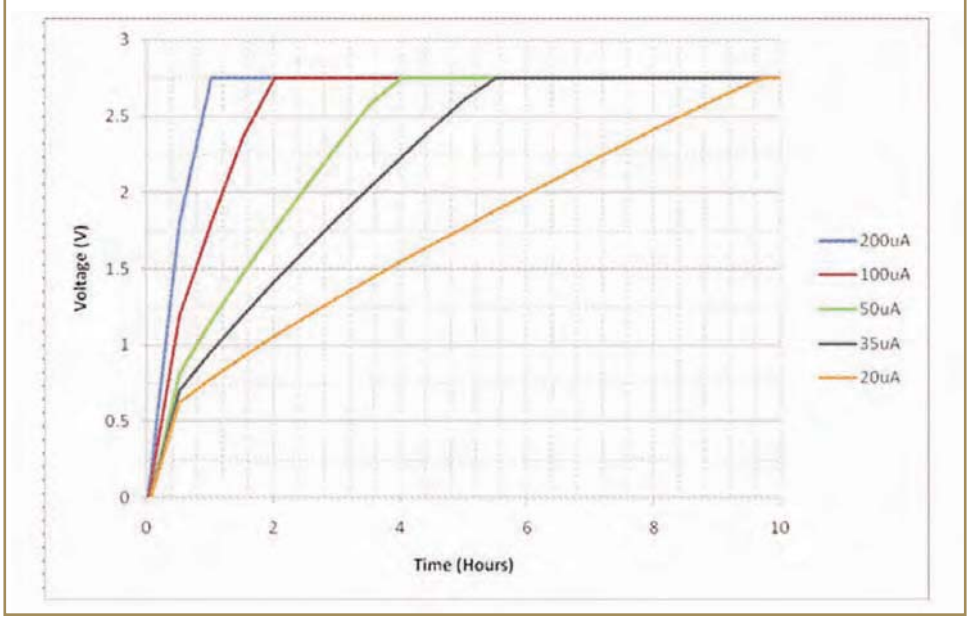
- Small and thin, two cells, each 28.5mm x 17.0mm x 1.1mm;
- High energy storage, 140mF at 5.5V = 2.1J;
- High power delivery, only 120mOhms ESR, so max power transfer = 63W;
- Industrial temperature range from -40°C to +85°C;
- Can be charged with low current down to 50 microamps;
- Very low leakage current, down to ~ 3 microamps with an active balance circuit.

Figure 4 shows the power supply circuit. The PMG17 produces AC which is full wave rectified by the diode bridge D1-D4. To maximize efficiency, the diodes should have low forward voltage and low reverse leakage current. The diodes selected were BAS16 from ON Semiconductor which have good characteristics over the industrial temperature range of -40°C to +85°C.

From Figure 3, the PMG17 operating voltage should remain in the range of 4V-6V. There is approximately a 1V drop across the diode bridge, so VCAP will be in the 3V-5V range. VCAP must be > 3.2V to supply a buck converter with a 3.0V output that drives the data-gathering and transmission circuits.

D5 has a reverse voltage of 2V at reverse leakage current of 3 microamps.

Figure 5: *Supercapacitor charging at low values of constant current*

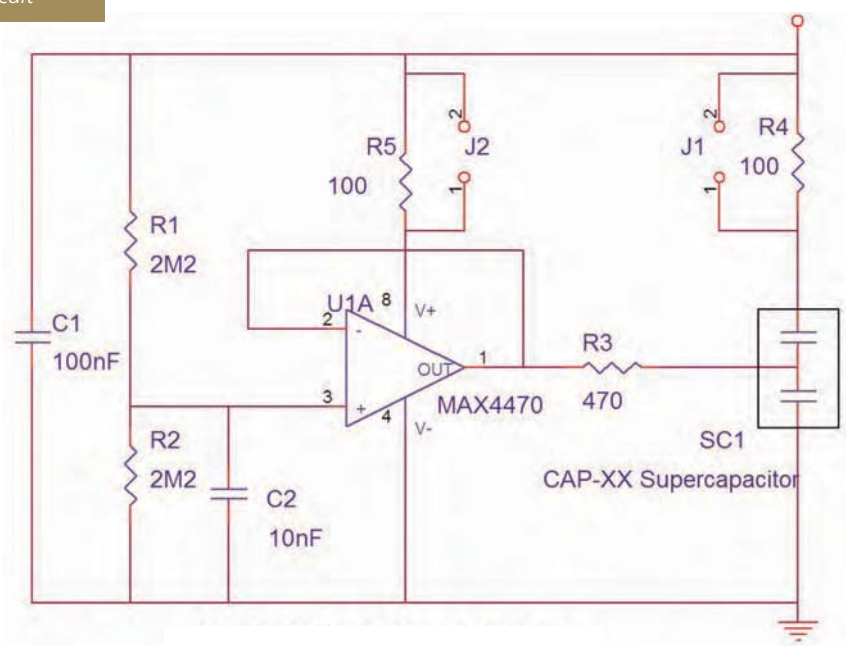


Stage	Voltage (V)	Current (A)	Time (s)	Energy (J)
Sensor & bias circuit	18V	2mA	1.2s	43.2mJ
Analogue	18V	1mA	1.2s	21.6mJ
Microcontroller (sleep)	3V	30uA	1.0s	90uJ
Microcontroller (active)	3V	8mA	0.5s	12mJ
Radio	3V	20mA	0.1s	6.0mJ
Total				**82.89mJ**

Table 1: *Energy budget to determine supercapacitor size*

R2 and D5 ensure that Q1 does not turn on until VCC approaches 5V. As Q1 turns on, VCC drops as charge current flows to the supercapacitor, turning Q1 off again. The PMG17 then charges C9, C11 and C12 until VCC is sufficient so that reverse current flows through D5 and the voltage across R2 reaches VGS of Q1 to turn it on again.

Figure 6: *Balancing circuit*



With a few tens of microamps, the combined capacitance of C9, C11, C12 = 66 microF can be charged to 5V in less than 30 seconds. In this manner, R2, D5 and Q1 regulate VCC to ~ 5V, ensuring maximum power transfer from the PMG17 microgenerator to the supercapacitor. At 120 microamps it will take ~ 1½ hrs to charge the supercapacitor to 4V where it can support a data-gathering and transmit cycle.

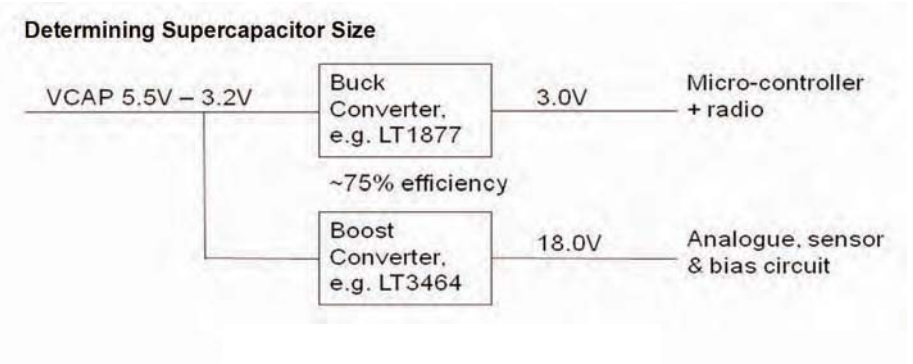
A supercapacitor needs a minimum charge current to charge effectively. For very low currents, a discharged supercapacitor does not follow I(t) = CdV(t)/dt. This is because supercapacitor electrodes are porous carbon with ions migrating inside the pores as the supercapacitor takes charge, so some of the current is "diffusion" current, which increases the state of charge of the supercapacitor but does not increase its terminal voltage. At the

same time, any impurities will result in electro-chemical reactions, which will consume some of the charge, so not all the charge current will increase supercapacitor voltage. This behaviour is illustrated in **Figure 5**, which shows supercapacitor charging at low values of constant current. Figure 5 shows that charge current should be ≥ 50µA to charge in reasonable time.

The two supercapacitor cells need to be balanced so that neither goes over voltage. The balancing circuit connects to the node labelled Active Balance in Figure 4. The balancing circuit current + supercapacitor leakage current must be << PMG17 output current ≈ 100uA to 200uA. A high-impedance, low-power operational amplifier, as shown in the balancing circuit of **Figure 6**, will only draw approximately 3uA, including the supercapacitor leakage current.

The chosen operational amplifier needs to be rail-to-rail. It only draws < 1uA supply current and can source or sink up to 11mA to bring cells quickly into balance. Once the supercapacitor is charged, the op-amp only supplies or sinks the difference in leakage current between the two supercapacitor cells in series in order to maintain voltage balance.

Figure 7: *The load supported by the supercapacitor*



Determining Supercapacitor Size

Figure 7 shows the load supported by the supercapacitor and **Table 1** details the energy required. With DC:DC converters that are 75% efficient, the supercapacitor must deliver 83/0.75 = 111mJ. The supercapacitor energy delivered

= ½ x C x (V^2initial – V^2final)

therefore, C required = 2 x Energy/(V^2initial – V^2final)

= 2 x 111/(52-3.22) = 15mF + 20% tolerance = 18mF

Allow for loss of capacitance due to supercapacitor ageing, so start with double the capacitance, hence the initial C ≥ 36mF.

Select the smallest CAP-XX part that operates over the industrial temperature range, which is the HW209 with C = 140mF and ESR at room temperature range = 120mOhms. ESR at -40°C is approximately 3 x room temperature ESR. Check the suitability of the HW209: peak current = (28mA x 3V/3.2V + 3mA x 18V/3.2V)/0.75 = 58mA, so voltage drop due to ESR at -40°C = 0.36Ohms x 58mA = 21mV << voltage drop from capacitance discharge due to supplying load energy.

Figure 8: *PMG17 Vibration Energy Harvester and Power Conditioning PCB; CAP-XX Supercapacitor with 25c coin comparing size comparison*

Successful Field Trial

Shell conducted a twelve-month condition-monitoring field trial of this energy-harvesting system in the harsh environment of its Nyhamna gas plant in Norway, which is now operational. The sensors monitored the condition of six rotating motors (rotating equipment is the main culprit in production shutdowns), reporting temperature and overall vibration every five minutes. The trial was a complete success – no failures occurred with the PMG17 or power-conditioning circuitry.

According to the "*Successful trial of wireless monitoring at Nyhamna gas plant*" article (**http://www.cap-xx.com/news/Norwegian_Technology.pdf**) in the January 2008 special edition of Shell EPE Technology Learning Publication, "The system means that much greater numbers of monitoring points – many in hazardous areas – can be regularly monitored and so help the plant maintenance engineers identify potential system breakdowns in advance."

In the same article, Sicco Dwars, Shell Global Solutions R&D Engineer said: "A self-generating power supply is important because batteries have a limited life, particularly when they are required to work outdoors, with temperatures spanning from tropical to arctic conditions."

Figure 8 shows the PMG17 Energy Harvester and Power Conditioning Circuit with the CAP-XX supercapacitor. This combination has proven to be an ideal solution to power remote sensors where vibration energy from machinery rotating at AC line frequencies is available. ■

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DESCRIPTION OF A NEW PHASE DETECTOR OF MICROWAVE SIGNALS

IN THE MAY 1988 issue of *Electronics* and *Wireless World* I learned about the Silvertooth discovery and about the Sagnac phenomenon, exploited by technology but not explained by modern physics. After some years (1994), a Belgacom technician – Roland Dewitte – discovered a regular phase-change of a radio wave travelling in a coaxial cable; change with sideral cadence (this means that time has been computed by the stars rather than by the sun, and it's about 4 minutes longer).

Modern physics ignored both discoveries. Only some physicists elaborated certain aspects of these discoveries mathematically. However, there were no experiments made.

So, it dawned on me that I should try and verify both theories. I know classical physics and I have had plenty of experimental experience with radio waves. Hence, I decided to investigate microwave signals enclosed in a guide. The waveguide is a perfect Faraday screen that isolated the source of signals (or in this case the phase's variations) from the actual 'chaos' "in the air", so that physical phenomena inside the guide will depend only on the space characteristics, as any external influence could give wrong readings.

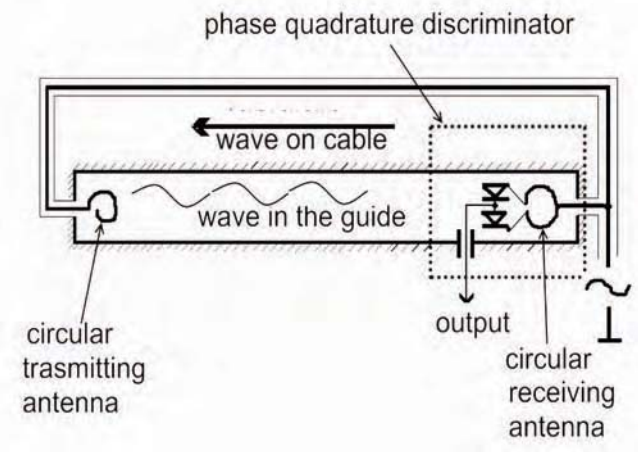


Figure 1: *Electrical set for measuring phase*

Electrical Solution

The phase discriminator was the main problem. I calculated that it must detect a few millidegrees – clearly – in the microwave range. I solved this problem by designing it in a distributed constants form, and placing the discriminator inside a guide (see **Figure 1**).

The second problem came from the external cable (of a rigid microwave type but not completely immune to interference). So I eliminated the external cable using reflection inside a second guide, driving RF from a single connector (**Figure 2**).

Finally I opted for the simpler mechanical form, exploiting reflections inside the waveguide (**Figure 3**):

Either way, the reference signal must be 90° out of phase for a null output; it means that the two diodes detect an opposite reflected signal equally added to the reference signal delayed 90°, so the result is zero (**Figure 4**).

The output, supposing the three vectors are equal, is the Sine of the angle x. The subtractive system instead used for light, in which the light is subtracted from another light, is the composition of two vectors (**Figure 5**).

The ratio between the two systems can be easily calculated as:
Sin x/(1 - cos x) and as shown in **Table 1**.

The results, for very small angles, are enormously different. Perhaps for this reason the diversity of light in different directions was imperceptible, and yet it is stated that the light always travels at the same speed. As the experiment demonstrates, this can't be true.

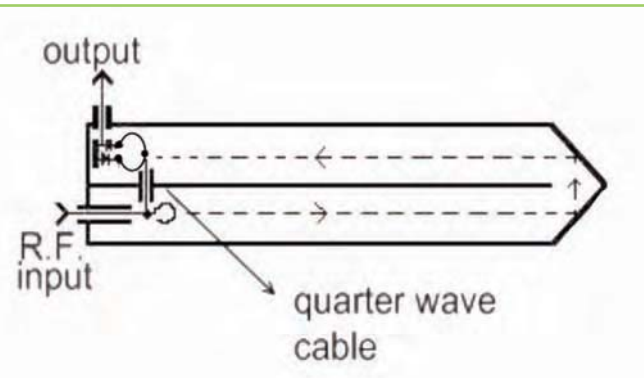


Figure 2: *As in Figure 1, but without the cable*

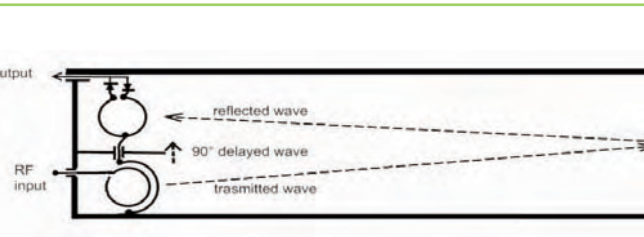


Figure 3: *A simpler option*

Angle x	Result in subtractive system	Result in quadrature system	gain
0,1°	$1{,}52 \cdot 10^{-6}$	$1{,}74 \cdot 10^{-3}$	**1.160 times**
0,01°	$0{,}0152 \cdot 10^{-6}$	$0{,}174 \cdot 10^{-3}$	**11.447 times**
0,001°	$0.000152 \cdot 10^{-6}$	$0{,}0174 \cdot 10^{-3}$	**118.000 times**
0,0001°	$1{,}52 \cdot 10^{-12}$	$1{,}74 \cdot 10^{-6}$	**1.144.736 times**
0,00001°	$1{,}52 \cdot 10^{-16}$	$0{,}174 \cdot 10^{-6}$	**11.447.360 times**

Table 1: *Table of comparison*

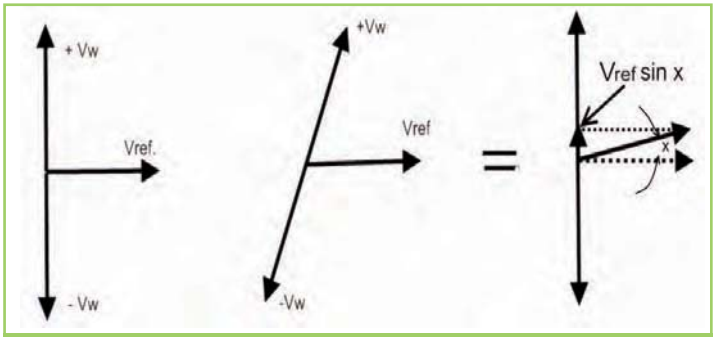


Figure 4: *Phasor pattern of voltages in a quadrature detector*

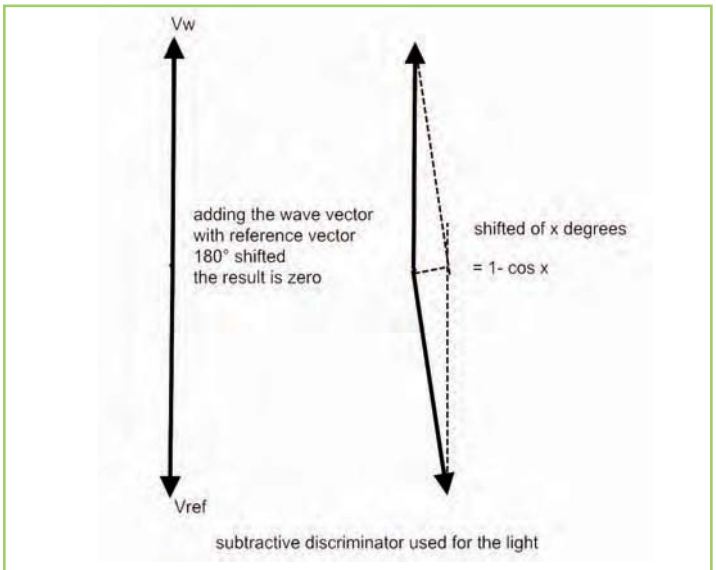


Figure 5: *Pattern of a subtractive system*

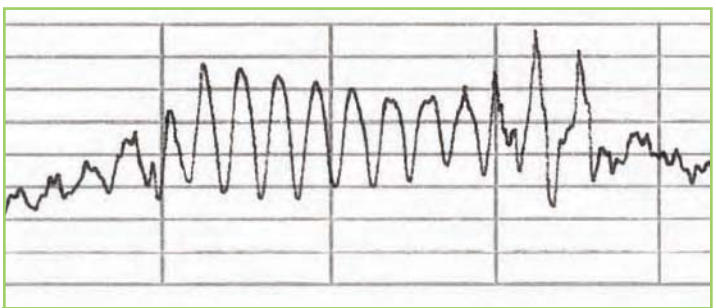


Figure 6: *Record of the phase variations, created by the pendular oscillation of the set*

Mechanical Realization

The guide was accurately thermo-stabilized and thermally insulated. Any magnetic field influence on the generator was accurately eliminated a priori, so that the terrestrial magnetic field didn't affect the experiment.

A synthesized oscillator, a Gigatronix 7200, used for generating microwave signals, was rigidly joined and connected to the guide, which was fed by a short rigid cable. The whole set was suspended by a wire to the ceiling of my house for easy change of direction.

Definition of Phase

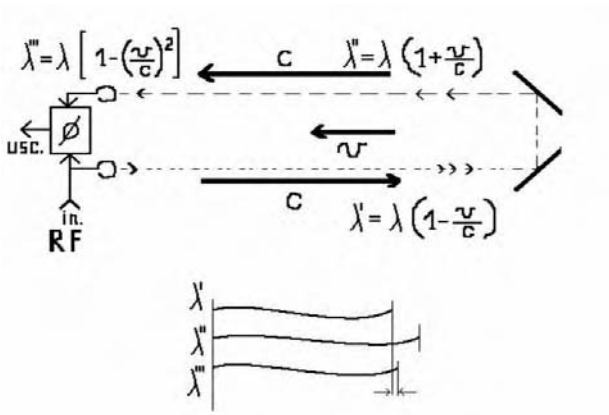
The phase could be expressed in degrees or radians. For simplicity, I prefer to express it as a difference in kHz, necessary to raise or lower the wavelength (remembering that wavelength is affected in space by the Doppler effect and gravity, and the frequency is, obviously, fixed by the oscillator).

At the beginning it is necessary to null the output. This is done easily by tuning the frequency of the generator until the reference phase is in quadrature (90°, or $\pi/2$, or $\lambda/4$). The second step is to measure the variation, to double-check the set. To do this, you can change the frequency of a known step, say 100kHz, and registering the output – this will be the 'phase marker'.

The ratio of frequency step to frequency is the percentage of the length of a cycle in space, expressed directly in kHz rather than as a fraction of wavelength, or degrees, or radians. This frequency variation for the change of phase eliminated any mechanical tuning. Besides any electronic tuning, it is perfectly readable and of high precision (down to a single Hertz).

For instance, if you operate with 10GHz, a step of 100kHz means 1/100,000 of a cycle, or 3.6 millidegrees.

To know the speed in absolute space, and considering that the light travels in one direction then the opposite, you must extract the square root of the ratio, as seen below:



A wave λ travelling against the wind with speed v is shortened by a factor of v/c (hence becoming λ'); when reflected it is the longer λ'', so the result is that second order λ''' as above (Maxwell's inkling of the Doppler effect in electromagnetic waves).

Gravity acts as a variation of the refraction index n, which is c/w , were c is the light speed and w is the new speed in gravity. Fizeau calculated that light changes the speed c in a moving medium with speed v, with refraction index n, so the new speed w is:

$w = c/n - v/n^2$

Hence, gravity acts as a refractive medium, which is 'travelling' with Earth in space; which then means that the Fizeau effect could be taking place around Earth too, 'slowing down' the ether. It is only a hypothesis to try and explain the following surprising phenomena. Fizeau measured in a glass tube full of moving water the interference between light travelling forward with the same lightwave reflected back by a mirror. He demostrated that the Doppler effect in light exists, confirming again the wave character of light. In classical physics, light and a microwave signal are the same phenomenon.

Results

The very first result was a complete surprise: the set perceived the mechanical oscillation! The phase changed immediately. **Figure 6** is the record of the phase variations provoked by the pendular oscillation of the set.

The maximum peak-to-peak was about 1kHz over 10GHz. It means that light varied its speed at the same percentage of 1/10,000,000 of 300,000, or 30meters/s!

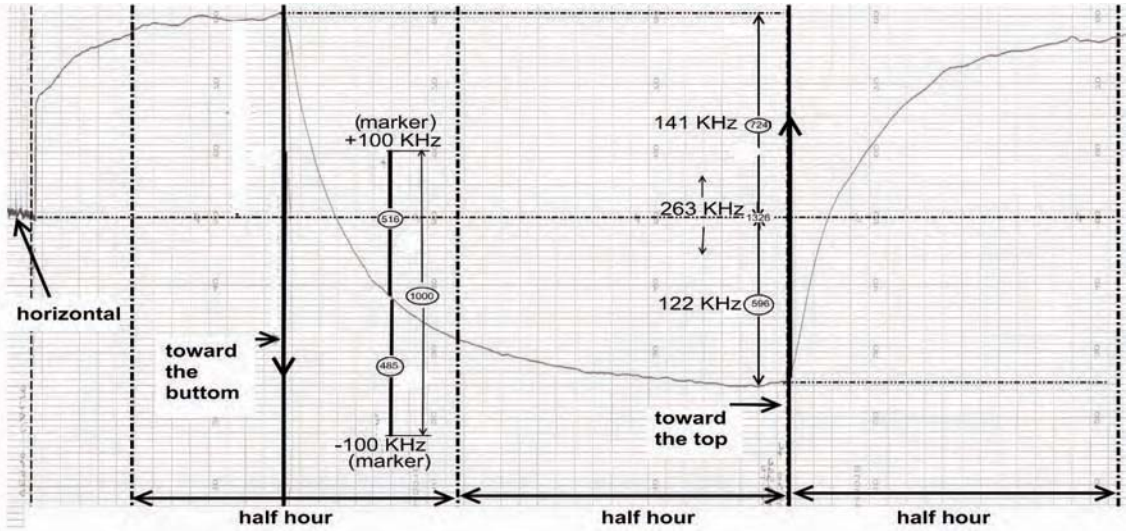
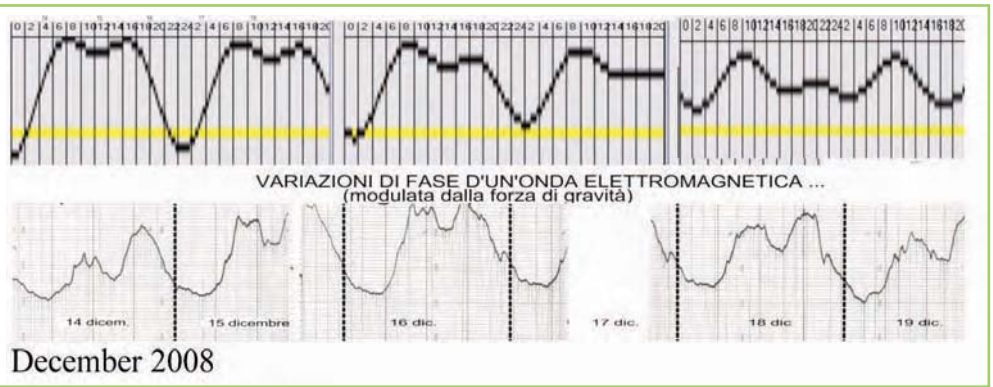


Figure 7: *Slow change of phase when inclining the guide from planar to down or up*



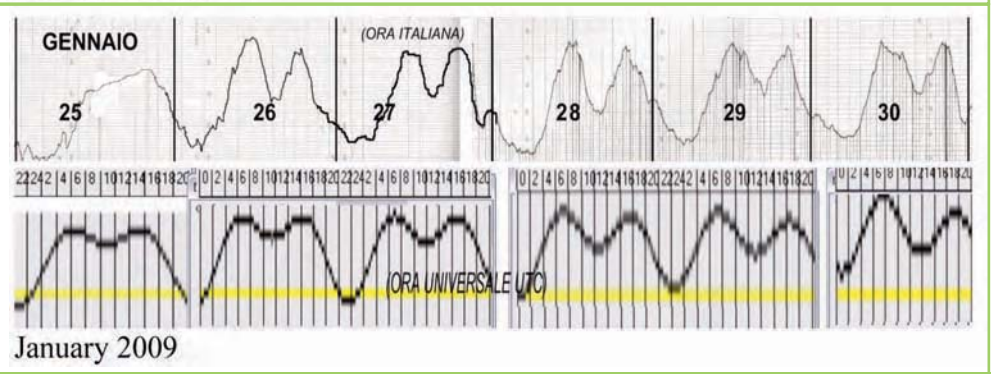


Figure 8: *Records from different months*

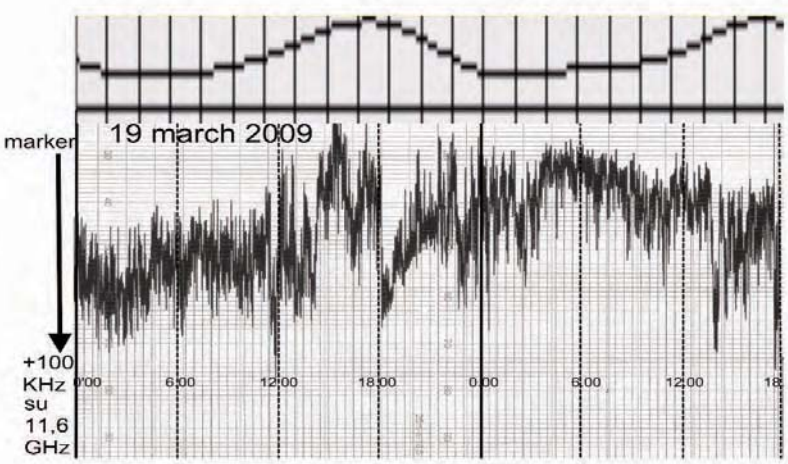


Figure 9: *Over: Universal time of tide Down: Italian time of phase shift during two days. Peaks could be due to gravitational waves, mixed with the Doppler component*

Inclining the set by 90°, and the phase shift registered was about 100kHz, which means that the light varied 3km/s – but slowly, as shown in **Figure 7**.

The set perceives the inclination quite immediately, but the variation takes about an hour to stabilize, which I found strange and inexplicable.

I left the set still for several days, nevertheless the phase changed each day with certain regularity; always different, but with the same peaks, at very regular intervals. For two periods I discovered a similarity with the gravitational tides.

From that strange regularity I deduced that the set is sensible to gravitational waves. The detector detects gravity and electromagnetic waves together, briefly. So I deduced the existence of an 'ether' responsible not only for the propagation of the electromagnetic waves, but also for the propagation of gravitational waves too.

But this radio tide is quite different, because it is mixed with the Doppler effect, depending on the direction of the waveguide and its construction. Again, the Doppler effect is delayed!

The guide, which is 30 centimeters long, was transmitting horizontally toward west (**Figure 9**):

The Doppler existence is deduced from the three dimensional pattern. Three orthogonal guides gave three different patterns. Supposing that the Doppler effect was really detected, based on three vectors I figured out the direction and velocity of Earth in the space.

Fabio Mosca
Italy

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TIP 1: VERIFY PORT POWER BEFORE USE

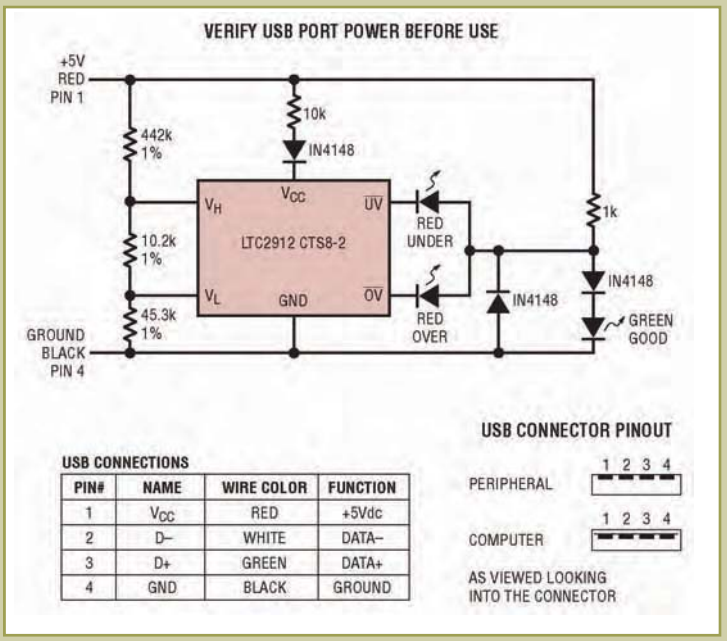
By Mitchell Lee, Senior Applications Engineer, Linear Technology

SHORT of a sacrificial thumb drive, I needed a quick and easy means of verifying the supply voltage on USB ports before plugging in valuable peripherals and data. This was especially critical when using cart-borne "lab" machines that are routinely exposed to experimental and unproven circuit breadboards. The solution presented itself in the form of a supply monitor capable of detecting under- and overvoltage conditions on a power supply.

The circuit shown in **Figure 1** illuminates a green (good) LED if the USB supply is within ±5% of 5V and lights a red "under" or "over" LED if the voltage exceeds that range. If one or more LEDs are dimly lit, it means the supply exhibits excessive ripple.

The circuit is fully protected against gross overvoltages and reverse voltage. A severed extender cable provided the means for plugging into USB ports.

For detailed information on USB operation and pinouts, see **http://pinouts.ru**



USB CONNECTIONS

PIN#	NAME	WIRE COLOR	FUNCTION
1	V_{CC}	RED	+5Vdc
2	D–	WHITE	DATA–
3	D+	GREEN	DATA+
4	GND	BLACK	GROUND

Figure 1: *The circuit used to verify the supply voltage on USB ports before use*

KONTRON LAUNCHES IP NETWORK SERVER WITH XEON PROCESSOR 5500

Kontron has unveiled its IP Network Server NSN2U, further extending its commitment to IP networking customers by providing the latest in state-of-the-art rack mount servers.

The new Kontron NSN2U is a 2U rack mount server for IP network applications, supporting the latest Intel micro architecture within the Intel Xeon Processor 5500 Series, with an Integrated Memory Controller, Intel QuickPath Technology, Intel Turbo Boost Technology, Next-Generation Intel Virtualization Technology and Intel Hyper-Threading Technology. The innovative chassis design combines extensive network port density, huge processor performance and additional advanced features in a densely and compact 2U package, ideally suited for network data applications with intense I/O and compute performance requirements.

With support of the new Intel Xeon Processor 5500 Series the Kontron NSN2U rack mount server for IP network applications combines greater performance and power efficiency to provide improved performance-per-watt over previous-generation rack mount servers.

Furthermore Kontron's latest IP Network Server introduces new benefits by providing support for the latest technologies and industry standards including PCI-E Gen2, Power Management Bus (PMBus), DDR3 memory, enhanced remote management capabilities via IPMI and directed I/O virtualization technology.

www.kontron.com

INTERFACE DEVELOPMENT SUITE SUPPORTS THE CREATION OF DISPLAY-BASED DESIGNS

Anders Electronics and Tilcon Software have launched the UMR Interface Development Suite (IDS) that enables rapid creation and deployment of embedded graphical user interfaces (GUIs). Using IDS, designers can deliver enhanced, display-based user experiences while streamlining product development, reducing project risk and speeding time-to-market.

The UMR Interface Development Suite (IDS) has been optimised for Anders's UMR 5 Series, allowing the company to provide complete 'end-to-end' solutions to enhance the ultimate user experience.

Featuring an advanced GUI/HMI builder and a device-optimised embedded runtime engine, the UMR IDS is a powerful development tool that reduces by 80% the UI coding requirements. The integrated functionality includes dynamic screens, photo-realistic transitions and effects and customizable 'widgets' such as gauges, charts and meters which can be employed to rapidly build key elements of the interface. The ability to directly import, export and merge Photoshop files allows graphical designs to be easily integrated to the user interface.

The pre-integrated GUI runtime platform embedded into the UMR 5 Series allows designers to take the GUI developed using the IDS and deploys it seamlessly onto the target UMR hardware.

www.anders-electronics.com

MICROCHIP EXPANDS SERIAL EEPROM PRODUCT LINE

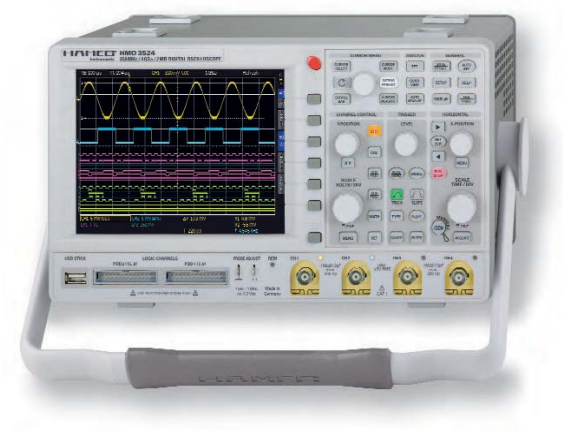
Microchip has announced several new I2C serial EEPROM devices in small packages. The company has unveiled a series of 4, 64 and 128kbit serial EEPROMs in an innovative Waver-Level Chip Scale Package (WLCSP). Additionally, the company introduced the industry's first 1kbit and 2kbit I2C serial EEPROMs in a 5-pin SC-70 package, and the industry's first 32kbit and 64kbit serial EEPROMs in a 5-pin SOT-23 package. The small, innovative devices complement industry trends toward smaller and more sophisticated designs, and are ideal for a wide range of portable and consumer-electronic applications.

Smaller form-factors have forced engineers to consider smaller packages to meet the needs of their applications. With Microchip's tiny new serial EEPROMs, designers can replace larger packages with these smaller, less expensive packages without sacrificing performance. One of the newest and most innovative packages on the market, Microchip's die-sized WLCSP has an extremely low profile, making it appropriate for not only space but height constrained applications.

The low pin-count of the ultra-small 2mm x 2mm SC-70 and 3mm x 3mm SOT-23 packages requires fewer I/O connectors, which helps to minimise overall design size and cost.

www.microchipdirect.com

NEW, 350MHZ 2- AND 4-CHANNEL TFT DSO/MSO FROM HAMEG



Hameg Instruments has introduced its new 350MHz 2- and 4-channel TFT DSOs with 4GSa/s and 2MB memory per channel. By connecting an optional active logic probe, each can be upgraded to a 16-channel MSO.

Signals can be captured in the Real Time Sampling mode with 4GSa/s and in the Random Sampling mode with an apparent rate of 50GSa/s. The great memory depth allows 'zooming' a signal up to 100,000 : 1. The FFT and Automeasure functions, as well as the six-digit counter and the comprehensive trigger modes, fulfill the highest requirements.

The 6.5" TFT display shows 12 divisions in X direction. Virtual Screen allows you to extend a typical eight division display to 10 divisions, and a full-screen display of the 16 logic channels is possible.

A TFT monitor or projector can be connected to the DVI output. There are three USB ports available for mass storage, printer and remote control purposes (IEEE-488 or Ethernet/USB are options).

www.hameg.com

HARTING MICROTCA CONNECTOR PASSES 'RUGGED' TEST

The Harting MicroTCA connector has successfully passed the latest tests established by the PICMG Group for the 'Rugged MicroTCA' PICMG specification.

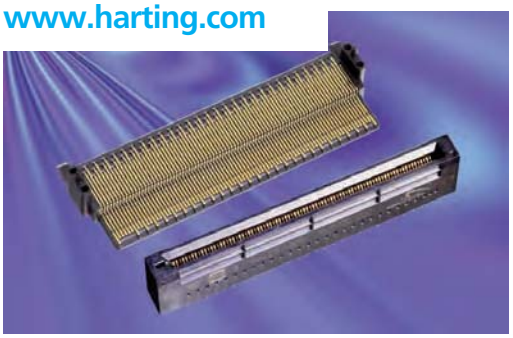
The Harting con:card+ connector for MicroTCA backplanes and the plug connector for AdvancedMC modules passed the vibration sine and shock test of the MTCA.1 'Rugged Air Cooled' specification without contact interruptions.

The contact test according to the MTCA.3 'Hardened Conduction Cooled' specification and the related 40g shock test in accordance with MIL-STD-810 were passed by the con:card+ connector successfully.

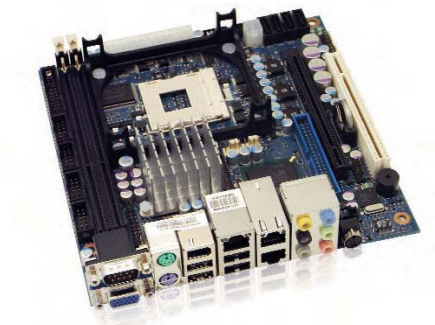
The design of the Harting MicroTCA con:card+ connector featuring the patented Guidespring contact is a key factor contributing to these results and is playing a major part in supporting the further development of the 'Rugged MicroTCA' specification.

Harting connectors and network components are used in mechanical engineering and plant manufacturing, in automation systems, energy generation and distribution, and in electronic and telecommunication markets. Industrial connectors are also vital in construction machinery, rail vehicles and shipbuilding. Harting offers Ethernet network components and cable systems for both indoor and outdoor networking applications involving power and data.

www.harting.com



THREE NEW EMBEDDED MOTHERBOARDS WITH 45NM INTEL CORE2 DUO PERFORMANCE

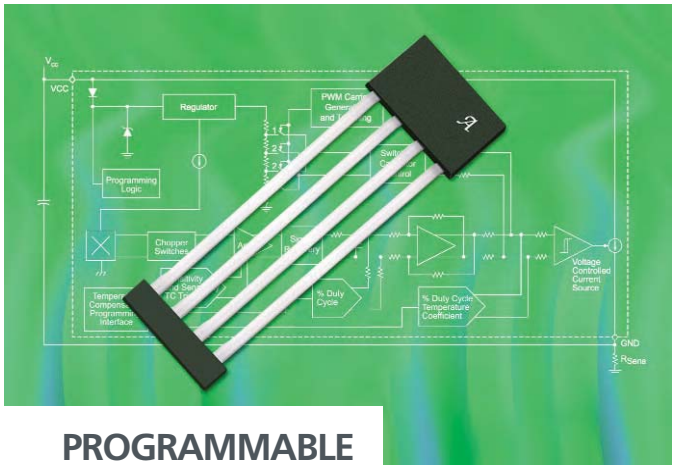


Kontron is presenting three new embedded motherboards with 45nm Intel Core2 Quad and Intel Core2 Duo processors in the form-factors of Mini-ITX, Flex-ATX and ATX. The Kontron KTGM45 motherboards outperform conventional motherboards that were developed for the consumer market thanks to long-term availability, highest design quality and a lavish selection of interfaces.

Based on the Mobile Intel GM45 chipset, the Mini-ITX, Flex-ATX and ATX Kontron KTGM45 embedded motherboards offer an ideal performance-per-watt ratio and up-to-date interface technology, like PCI Express x16, without neglecting the needs of embedded designers. They still carry, for example, four serial interfaces alongside the 12 USB 2.0 interfaces. The embedded motherboards also offer more PCB layers than conventional motherboards, in order to achieve excellent signal qualities and optimize electromagnetic compatibility. Furthermore, the new Kontron KTGM45 embedded motherboards premiere a new quality feature: Solid capacitors. Compared to boards with conventional electrolyte capacitors they feature an extended lifetime and little to no wear-out even at the highest temperatures.

Graphic intensive applications profit from the integrated DirectX10 graphics with Shader Model 4.0 for VGA and SDVO with DVI and HDMI via the PCI Express x16 slot.

www.kontron.com



PROGRAMMABLE HALL SENSOR FEATURES DIAGNOSTICS

The new A1354 from Allegro MicroSystems Europe is a high-precision, programmable two-wire Hall-effect linear sensor that provides a pulse width modulated (PWM) output with a duty cycle proportional to an applied magnetic field.

This is the first linear Hall-effect sensor from Allegro to include a voltage regulator, which allows the device to be powered directly from a battery with a forward supply voltage in the range from 4.5V to 18V.

The A1354 converts an analogue signal from its internal Hall sensor element to a digitally encoded PWM output signal. The coupled noise immunity of the digitally encoded PWM output is far superior to the noise immunity of an analogue output signal.

This new device is targeted at position sensing applications in the automotive and industrial sectors, particularly where diagnostic capabilities are required, where there is a limitation on the number of wires to and from a control unit, or where noise immunity over long wires is required.

The A1354 incorporates a monolithic BiCMOS circuit integrating a Hall element, precision temperature-compensating circuitry to reduce the intrinsic sensitivity and offset drift of the Hall element, a small-signal high-gain amplifier, proprietary dynamic offset cancellation circuits, and PWM conversion circuitry.

www.allegromicro.com

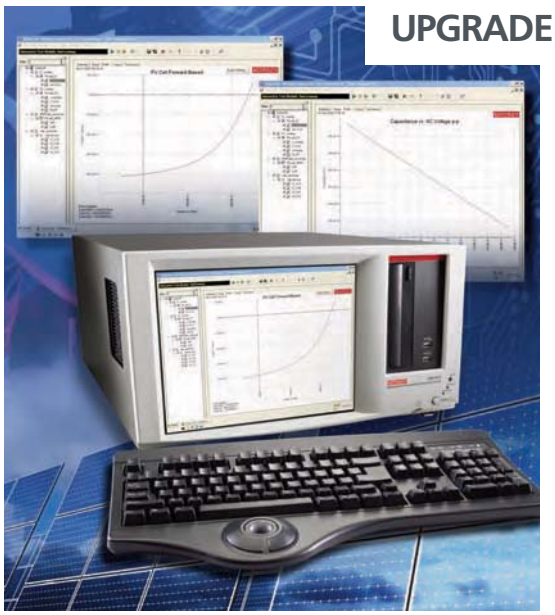
HALIDE-FREE, LEAD-FREE, WATER SOLUBLE, SOLDER PASTE

Alpha-Cookson Electronics Assembly Materials has launched Alpha WS-820 halide-free, lead-free, water-soluble solder paste. This new product offers outstanding printability with excellent print volume and print repeatability down to 12mil (0.3mm) features. It also has an excellent reflow process window with straight ramp and short soak or long soak profiles in air.

The WS-820 is the latest generation water soluble, lead-free paste in Alpha's long tradition of manufacturing high performance solder pastes. It is designed to provide excellent print performance at both low and high relative humidity (20% to 65%), and it offers IPC 7095 Class III resistance to voiding. WS-820 is also very easy to clean with warm de-ionized water, leaving virtually no ionic contamination behind.

Available in SAC305 and SAC405 alloys and in Type 3 and 4 powder, Alpha WS-820 delivers excellent wetting characteristics on all common surface finishes, including Entek HT OSP. As many electrics assemblers explore the conversion to lead-free water-soluble surface mount applications, WS-820 will allow a wide variety of them to make the transition without sacrificing printability and first pass yields.

www.alpha.cooksonelectronics.com



UPGRADED SOLAR CELL TESTING MODEL

Keithley Instruments has introduced a variety of hardware, firmware and software enhancements to its award-winning Model 4200-SCS Semiconductor Characterization System. The Keithley Test Environment Interactive (KTEI) V7.2 upgrade includes nine new solar cell test libraries, an expanded frequency range for the system's Capacitance-Voltage (C-V) measurement capability, and support for the company's new nine-slot Model 4200-SCS instrument chassis.

The new test libraries included in KTEI V7.2 expand the Model 4200-SCS's capabilities for solar cell I-V, C-V, and resistivity testing applications, which are increasingly important, given the growing interest in and governmental support for alternative energy technologies. The software upgrade also supports Drive-Level Capacitance Profiling (DLCP), a new solar cell testing technique that was difficult to perform accurately using earlier test solutions. DLCP provides defect density information on thin film solar cells. Existing Model 4200-CVU Capacitance-Voltage Unit cards, which were introduced in November 2007, can be readily modified to support this testing technique.

The Model 4200-CVU's frequency range has been expanded to 1kHz-10MHz from 10kHz-10Mz to support DLCP testing. This extended frequency range also expands the system's applications, providing support for testing flat panel LCDs and organic semiconductors such as organic light-emitting diodes (OLEDs).

www.keithley.com

NEW 0.3MM TEST AND BURN-IN SOCKETS FOR DEVICES UP TO 6.5MM SQUARED

Aries Electronics, an international manufacturer of standard, programmed and custom interconnection products, now offers its high frequency Center Probe and CSP/MicroBGA test and burn-in sockets in sizes up to 6.5mm squared with pitches down to 0.3mm. The reduced socket pitch meets the growing need to test smaller components while increasing reliability.

The cost-effective sockets feature replaceable interposer sets and require minimal handler tooling for use in an increased number of CSP, MicroBGA, DSP, LGA, SRAM, DRAM and Flash devices. In addition, with an operating temperature from -55°C (-67°F) up to 150°C (302°F), the new sockets are ideal for devices that require exceptional thermal management qualities in a compact package.

The sockets' solderless pressure mount compression spring probes, accurately located by two moulded plastic alignment pins and mounted with two stainless steel screws, enable easy mounting to and removal from the printed circuit board (PCB) for RF sockets and the burn-in-board (BIB) for test and burn-in sockets.

The signal path of the sockets is only 0.077" (1.96mm). Sockets with a 0.30mm to 0.35mm pitch feature only 15g of contact force per contact and a test PCB diameter ("P") of 0.009" (0.23mm).

www.arieselec.com

2.5V XPRESSO VCXOS NOW AVAILABLE IN LVPECL VERSIONS

Fox Electronics, a global supplier of frequency control solutions, has expanded its XpressO oscillator series to include a 2.5V LVPECL VCXO version with an industry standard 7mm x 5mm package size and a frequency range from 0.75MHz through to 1GHz.

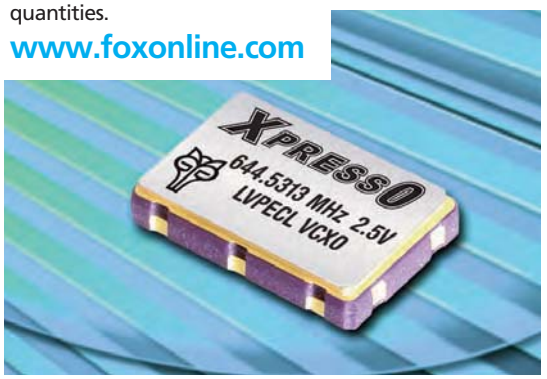
The new FVXO-PC72 oscillators are ideal for use in any application requiring an oscillator, including SONET, Ethernet, storage area network, broadband access, microprocessors, DSPs, FPGAs, industrial controllers, test and measurement equipment and Fiber Channel applications.

The cost-effective Fox XpressO oscillator series is a breakthrough in configurable frequency control solutions. These oscillators and VCXOs utilize a family of proprietary application specific integrated circuits (ASICs), designed and developed by Fox, with a key focus on noise reduction technologies, as well as significantly lower levels of jitter.

The FVXO-PC72 oscillators employ a third order Delta Sigma Modulator (DSM) to reduce noise to levels comparable to traditional bulk quartz and SAW oscillators. The state-of-the-art technology utilized in these oscillators enables the optimum selection of the output type, input voltages and temperature performance features.

The LVPECL VCXO versions are guaranteed to be shipped within 24 hours for samples and within 10 days maximum for production quantities.

www.foxonline.com



ENERGY-EFFICIENT CHOKES FOR PHOTOVOLTAIC PLANTS

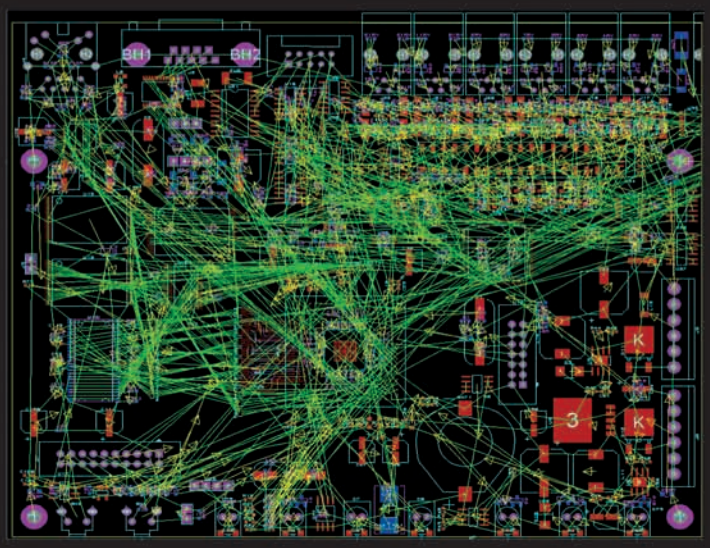
SMP Sintermetalle Prometheus (SMP) offers chokes for power inverters in photovoltaic plants. These inductive components feature low losses, very low stray fields and a highly compact design, and offer energy efficiency advantages for power inverters that are based on these chokes. SMP uses core materials made of powder composites that are purpose-designed for every individual application.

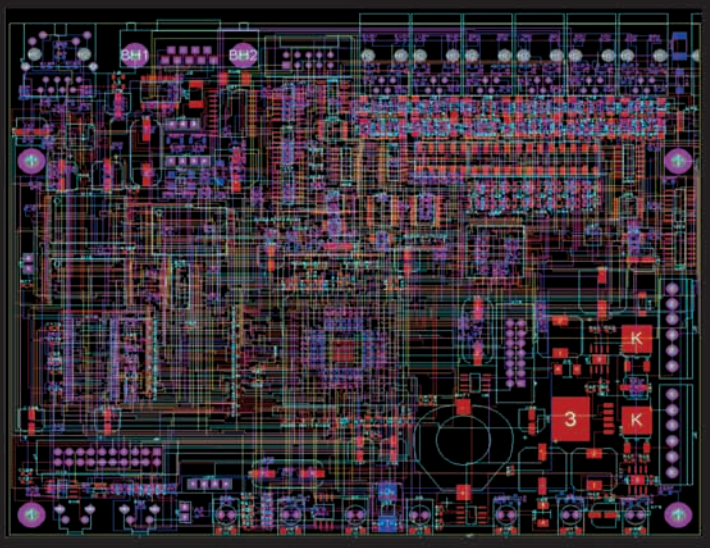
Power inverters in photovoltaic plants convert the direct current originating from the solar cells into alternating current. It is desirable that a plant yields a maximum of energy at low cost from the Sun's radiation on the connected photovoltaic modules. The direct current from the modules must be converted into a sinusoidal waveform and be converted into the values required by the grid. So-called filters consisting of capacitors and filter chokes ensure that the current being fed into the grid exhibits a sinusoidal waveform.

The materials used have low magnetostriction and exceptionally low eddy current and hysteresis losses; the inverters in which they are used are highly efficient, so that a larger proportion of the generated power can be fed back into the grid. This is because the cost-effectiveness of a photovoltaic plant is directly related to the inverter's efficiency.

www.smp.de

Our new autorouter will turn this... into this...





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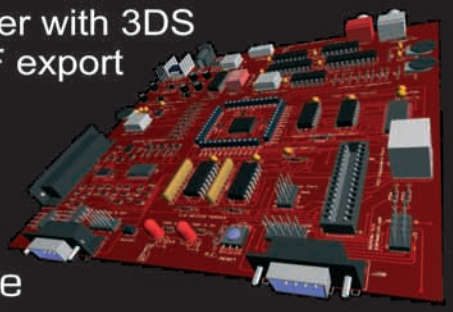

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Increased Focus on Power Supplies and DC/DC Converters

Arrow Electronics has expanded its power technology portfolio by signing a distribution agreement with Recom, a leading global supplier of DC/DC and AC/DC converters. Arrow will sell and support Recom's complete power converter product range throughout Europe.

The new agreement is in line with Arrow's strategy to provide the widest possible range of power supply and converter technologies to designers across Europe. For Recom, the agreement will expand the penetration of its product ranges into European markets and ensure that customers have access to products and support at a local level.

Available in single, dual, and triple rail outputs and a wide variety of input and output voltage configurations, power ratings, and isolation voltages, Recom converters are used in most industries requiring low- to medium-power voltage conversion in the 0.25W to 60W range. The company also offers the largest range of safety agency-approved converters from any manufacturer.

www.arrowne.com

Harwin in an Exclusive European Trio-Tek Catalogue Sales Agreement with Farnell

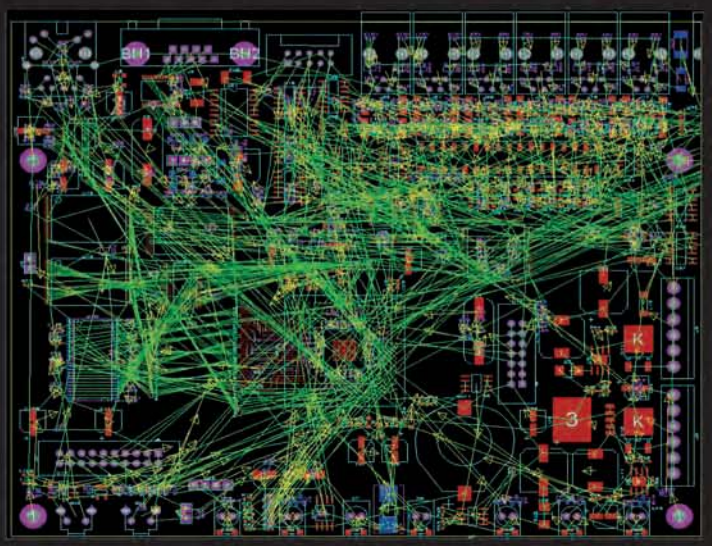
High-reliability interconnect company Harwin has appointed Farnell as exclusive European catalogue distributor for its innovative Datamate Trio-Tek range of crimp contact connectors. Harwin's Datamate Trio-Tek open-barrel crimp contact offers significant advantages over conventional Datamate contacts whilst providing the same high reliability, as it enables assembly time to be shortened significantly and therefore reduces processing costs. The new crimp design features a triangular form that simplifies the insertion of contacts into the housing, enabling customers to fully automate crimping in medium and high volume applications.

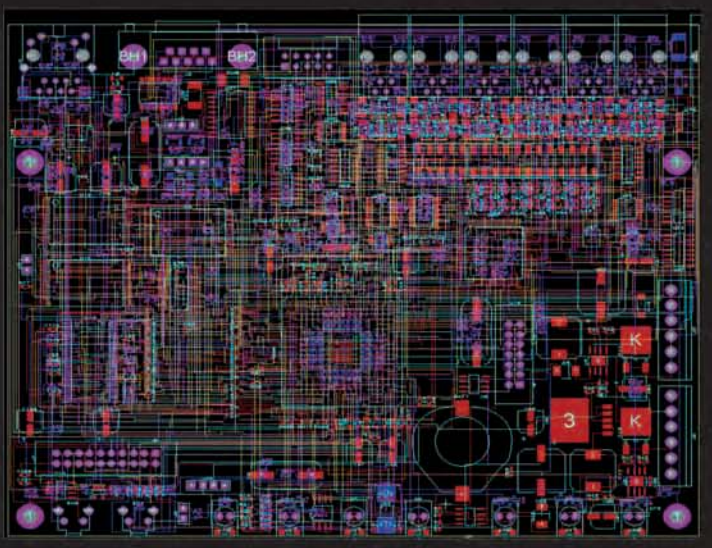
Harwin's Datamate Product Manager Graham Cunningham commented: "Farnell is one of Europe's leading distributors and justifiably known for offering customers an extensive range of the best products and latest technology from leading manufacturers. We have a strong relationship with them and believe their reputation for first-class customer service and the strength of their catalogue media will provide an excellent partner for Trio-Tek. We are delighted to have appointed them as our catalogue distributors for this important initial phase of Trio-Tek sales in Europe."

Farnell's Justin Willoughby said: "We have a long and fruitful relationship with Harwin and always welcome the opportunity to offer their latest products to our customers. Harwin's expertise as a global leader in the design and manufacture of electronic interconnect solutions means their products are always leading edge and provide elegant solutions for electronics engineers across a great number of applications and markets."

www.farnell.co.uk
www.harwin.co.uk

Our new autorouter will turn this... into this...





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