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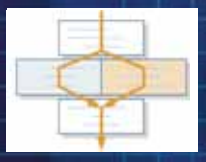
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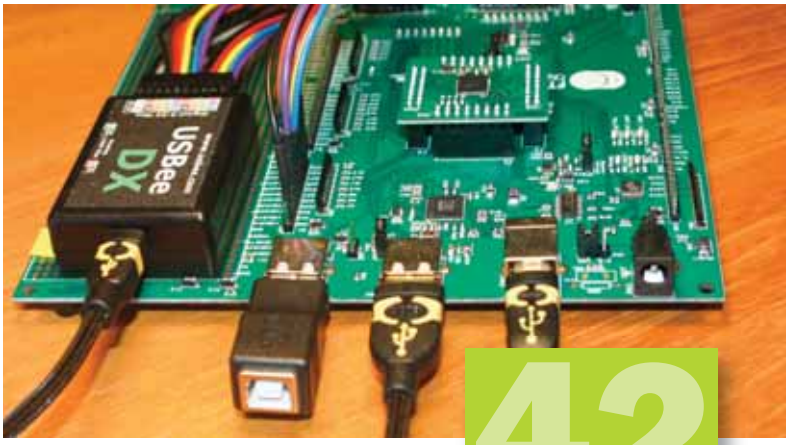
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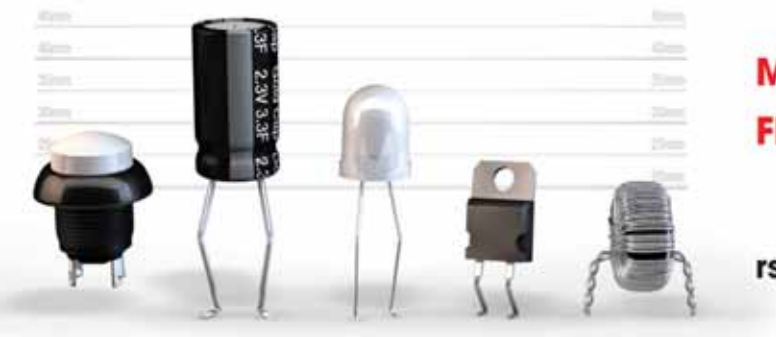
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THE TIME FOR 3D IS HERE AND NOW



The market for 3D in television and video games has made significant progress and is proving to be extremely profitable. 2010 has proved the year of 3D, as eight out of the top 20 highest revenue making films at the box office had a 3D version compared to only three films in 2009. According to a new report from PwC, "*3D Here and Now… a goose that lays a golden egg*" this trend will continue and by 2015 over 15% of all films will be produced in 3D.

"A year ago the industry was grappling with some fairly major issues. Twelve months on, a number of these have been resolved including, on the technical side, the definition of a 3D Blu-Ray standard and progress on HDMI1.4," said Phil Stokes, head of media and entertainment at PricewaterhouseCoopers (PwC).

"The growth of the 3D industry still has some challenges to overcome. While 3D films generate considerable revenues for the cinema operators, the cost of converting from traditional prints to digital projection is still a major and, in some cases, prohibitively large expense. However, the clear mutual benefits for film studios and cinema operators are leading to innovative and practical cost-sharing partnerships to support a wide-scale digital roll-out."

The market for 3D televisions is less developed than that of the film industry and the affordability of TV sets is a major factor impacting the growth of the sector. However, prices are beginning to fall and that, together with the availability of attractive 3D content, is helping to grow the market. But the wearing of 3D glasses to watch programmes is still a major issue. Major sporting events such as the Olympics and football World Cups also have an impact on the sales of TVs as viewers, unable to attend the events in person, willingly pay for the best quality experience at home.

Many market sources also feel that there is a natural fit between video games and 3D as the players demand immersive game play. But at the moment, 3D reduces both the resolution and the frame rate so there's a current reluctance, both from the industry and in apparent consumer demand, to increase the production of 3D video games.

The mass market potential of 3D entertainment still remains unclear. However, there is potential across all delivery channels:

> ***The first 3D auto-stereoscopic mobile phones are already available in Japan and will be introduced in Europe and the US shortly***

3D FILMS

PwC anticipate that by 2015, 15% of new films will have a 3D version. The major Hollywood studios are predicting that 25% of their films will have a 3D version but the smaller studios will struggle. The production of 3D films in Europe, China, India and Japan will also increase. There is also expected to be 100% adoption of digital distribution among the multiplex and large urban theatres in the medium term.

3D TELEVISION

The current offerings of 3D TV will continue to increase as prices for TV sets continue to fall and it is expected TV promotional campaigns around major sporting events such as the London 2012 Olympics to be in 3D.

3D VIDEO GAMES

Some consoles can already be upgraded and used to play 3D games. But the real increase in the availability of 3D games will be seen when the next-generation of consoles is available.

3D PC

3D Internet content will develop but its adoption is expected to remain limited to the early-adopter segment. There are 3D-ready laptops already available but the price premium they command limits their market attractiveness.

3D MOBILE PHONES

There are still problems with the interoperability among the different standards, i.e. a 3D picture captured on one model cannot be displayed on a 3D model from a different manufacturer. But the first 3D auto-stereoscopic mobile phones are already available in Japan and will be introduced in Europe and the US shortly. The introduction of 3D portable phone game consoles (such as Nintendo 3DS), scheduled for release in February 2011, will boost 3D mobile penetration.

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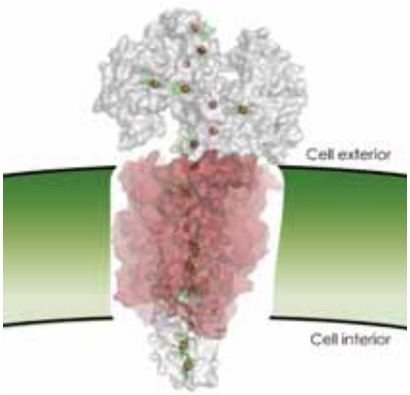
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Microbes Might Generate Our Future Electricity

Scientists at the University of East Anglia (UEA) in the UK, claim they have found the exact molecular structure of the proteins that enable bacterial cells to transfer electrical charge, paving the way to bacteria generating electricity.



The newly solved structure of an iron containing protein found on the bacterial cell surface helps to explain how a chain of iron atoms bound by proteins form a 'wire' that allows electricity from the inside of the cell to reach the surface

"This is an exciting advance in our understanding of how some bacterial species move electrons from the inside to the outside of a cell. Identifying the precise molecular structure of the key proteins involved in this process is a crucial step towards tapping into microbes as a viable future source of electricity," said Dr Tom Clarke of UEA's School of Biological Sciences.

The discovery means scientists can now start developing ways to 'tether' bacteria directly to electrodes – creating efficient microbial fuel cells or 'bio-batteries'. The advance could also hasten the development of microbe-based agents that can clean up oil or uranium pollution, and fuel cells powered by human or animal waste.

Funded by the Biotechnology and Biological Sciences Research Council (BBSRC) and the US Department of Energy, the project is led by Dr Clarke, Prof David Richardson and Prof Julea Butt of UEA, in collaboration with colleagues at the Pacific Northwest National Laboratory in the US.

In the research, the scientists used a technique called x-ray crystallography to reveal the molecular structure of the proteins attached to the surface of a Shewanella oneidensis cell through which electrons are transferred.



Protein crystals used to solve the structure of an iron-containing protein found on the cell surface of bacteria

Nanotechnology cannot be mass-produced with the top-down approach, says scientist

A leading nanotechnology scientist claims that there is a limit to how small nanotechnology materials can be mass produced, raising questions over a billion dollar industry.

Professor Mike Kelly from the Centre for Advanced Photonics and Electronics at the University of Cambridge, states that structures 3nm in diameter or less cannot be mass produced using the top-down approach, typically adopted by the semiconductor industry.

This raises questions over the billions of dollars that are injected into nanotechnology each year in the hope that lab developments can make the transition to a manufactured product on the market.

Nanotechnology is built on the ability to control and manipulate matter at the atomic and molecular level, and promises far reaching applications. As such it needs to be of low-cost, high-volume manufacturability, and yet reliable and of highly reproducible properties within a pre-specified limit, which Kelly states cannot happen below the 3nm limit when trying to make arrays.

The top-down approach to manufacturing, which Kelly states is limited, uses external tools to cut and shape large materials to contain many smaller features. Its alternative, the bottom-up approach, involves piecing together small units, usually molecules, to construct whole materials, however, this process is deemed too unpredictable for defect-free mass production of arrays.

Kelly used statistical evaluation of vertical nanopillars that have been suggested for uses in sensors and displays as an example to demonstrate his theory. He states that the proof comes in two stages. The first is due to the fact that when materials are mass produced on such a small scale there will be a lot of variation in the size of different components, which results in varied properties of the material where it cannot no longer function to full capacity within an array.

"If I am wrong – and a counterexample to my theorem is provided – many scientists would be more secure in their continued working, and that is good for science," said Professor Kelly. "If more work is devoted to the hard problem of understanding just what can be manufactured and how, then that too is good for science and for technology."

NEWS IN BRIEF

STMicroelectronics and McGill University in Montreal, Canada, have created an undergraduate course that teaches the integration of multiple state-of-the-art sensors into embedded computer systems. It is based around ST's iNEMO platform that integrates ST's accelerometers, gyroscopes, magnetometers and various sensors, to provide 3-axis sensing of linear, angular and magnetic motion, complemented with temperature and barometer/altitude readings.

"We believe this new course provides an ideal foundation for modern system design, which increasingly requires the ability to combine computer system and software design, as well as the signal processing needed to integrate multiple sensor data," said Professor Zeljko Zilic of McGill University.

The Wireless Power Consortium ("WPC") announced that Chinese automobile makers Geely, Chery, Changan and Dongfeng exhibited cars featuring its universal wireless charging standard Qi at the April 2011 Shanghai Auto Show. This is the first time that embedded Qi wireless chargers have been exhibited at a major auto show in concept vehicles, marking a key milestone for the universal wireless charging technology.

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element14 marks second anniversary with launch of the world's first interactive design automation hub – the element14 knode



Premier Farnell plc (LSE:pfl), has announced the launch of the element14 knode, a revolutionary online design platform that is exclusively focused on the needs of electronic design engineers. Launched at the Design Automation Conference in San Diego to coincide with element14's second anniversary the element14 knode provides one interface to a world of engineering design solutions. It supports the complete design flow from concept to final production and is unique in enabling engineers to research, design, develop and prototype manufacture in a single, intelligent environment. Products get to market more quickly, and by automating the configuration of product design flow solutions, valuable engineering resource can be increasingly focused on application design and IP creation

"The element14 community has become the first dedicated community in electronic design engineers to connect with industry experts, collaborate with peers and learn about the latest technologies," said Dianne Kibbey, Global Head of Community, element14. "We were the first to offer FREE CAD software, the first to launch a low cost development board –XL_STAR and also the first to offer FREE Online Training. Now we've taken innovation to a new level and given our customers access to the world's first revolutionary online design platform, the element14 knode. We will continue to innovate and revolutionise the web 3.0 space in the future to assist our customers at the forefront of world class design."

THE ELEMENT14 KNODE – AN OVERVIEW

SEARCH LIKE NEVER BEFORE

An engineering-focused alternative to standard search engines, the knode search function helps engineers find relevant design information and the latest technology quicker than ever before. Designers can use the element14 knode to quickly research, evaluate and purchase solutions, software and services. The availability of reliable technical information and solutions can save the designer hundreds of hours typically spent in searching and validating information. Further, the innovative search engine returns all relevant and related contents for the search performed – in one click. The search bar allows users to enter keywords by supplier, architecture or part number, while Search results can also be refined using categories and tag filters such as core architecture and silicon manufacturers.

EXPERT LEARNING CENTRE

The element14 knode Learning Centre provides a library of rich content to help a user research various technologies, platforms and associated core components. This includes "How To" videos, application notes, technical documentation and much more. Forums host discussions in areas ranging from product/technology and applications to design recommendations, and technical support and designers can post questions to subject matter experts from element14's enhanced technical support team and from suppliers across a number of industries and design environments.

DEVELOPMENT PLATFORMS AND KITS

A wide variety of development platforms and kits are available including:

- Pre-built boards to test the latest technology and protocols
- Hardware solutions to accelerate the design process
- Search for instant prototypes for embedded systems
- New technology and industry exclusives such as the Freescale™ XL Starboard

Operating Systems and Stacks

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CAD TOOLS

Through the knode, PCB design tools are available that enable designers to develop PCBs within a highly productive, scalable and easy-to-use environment. Solutions cover the spectrum of PCB development, from schematic entry to manufacturing. PCB Tools include the award winning CadSoft EAGLE. This powerful and easy to use PCB software offers high-end functionality in a schematic editor, layout editor, and autorouter.

PCB SERVICES

The element14 knode delivers high quality, low risk solutions for PCB fabrication and assembly in partnership with industry leaders. element14's partners not only provide rapid turn-around manufacturing using advanced technology and the application of state-of-the art design for manufacture (DFM) and test software, but they also deliver fabrication services at globally-competitive, affordable prices.

TEST EQUIPMENT

The element14 knode offers leading hardware analysis solutions for embedded systems or prototypes including oscilloscopes, multi-meters, signal generators and more..●

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The element14 knode is a full life-cycle electronics design flow solution that helps engineers design faster, better, cheaper. It provides a single interface to a world of design solutions where technology decisions made by the engineer create explicit dependencies and inter-relationships with other system level components. It helps engineers quickly research, identify and buy the solutions they need.

To see the element14 knode in action visit:
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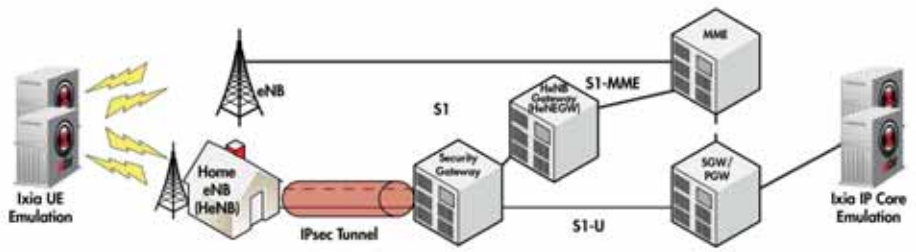
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Femtocells deliver promise of Cost- Efficient Mobile Connectivity

BY **JOE ZETO**, SENIOR MANAGER OF MARKET DEVELOPMENT, IXIA

Case 1: End-to-end femtocell testing



Femtocells are low-power wireless access points for connecting standard mobile devices to a mobile operator's network. They work using residential DSL or cable broadband connections and have the potential to change the mobile broadband industry's approach to cell design and deployment. Femtocells operate in licensed spectrum and offer many potential benefits to both consumers and operators, including increased upload/download performance, better coverage (5 bars) and traffic offload from congested macro cells.

Humble Beginnings

Femtocells originally began life designed as humble, low-cost consumer products. Their usefulness was quickly recognised and now they are an established technology, with several Tier 1 operators deploying small cells (femto, pico, micro) to address a variety of business models and a wide range of communications infrastructure applications. For example, they provide metropolitan "hot-zone" coverage, service enterprise in-building access needs and can help service providers deliver access to rural communities. Not only do they increase existing network capacity, they are becoming a fundamental enabler for operators deploying emerging network infrastructure technologies like LTE.

"Femtocells are already revolutionising 3G networks, improving coverage, handling the increased data traffic generated by smartphones and offering consumers more personalised services," said Paul Neil, LTE product manager at Picochip. "We believe that small cells will be even more important in LTE networks." At 2011 CES Picochip demonstrated a femtocell on a USB 3.0 dongle.

> *Mobile operators have to play it safe. Any aspect of a successful customer service roll-out must include testing*

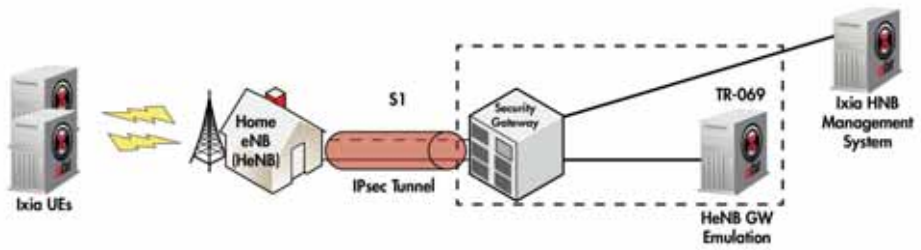
ABI Research forecasts that the total femtocell market will exceed 45 million globally within five years. This increase of the technology's acceptance will be fuelled by the availability of femtocell services as deployments migrate from the simple nods of early adopters to the mass market. Broadcom's acquisition of Percello confirms the transformation from early-stage, early-adopter technology to a solution whose time is now. Additionally, several Tier 1 European mobile operators including Vodafone in the UK, Qatar, Spain and Greece as well as Telefónica in Spain are actively pursuing femtocell deployments. Smaller operators including Moldtelecom, Cellcom and Mosaic are either deploying or committing to femtocell deployments, pressing home the business case for smaller mobile operators as well. In the Asia Pacific sector, Japan NTT DOCOMO, Softbank and KDDI have launched femtocell services.

Major players like Vodafone and T-Mobile have announced upcoming B2B offerings, illustrating the significant applicability of the technology to the enterprise market. In the US, Sprint is giving away free femtocells to subscribers who have experienced network connectivity or coverage issues, rather than risk losing business. Further evidence of growth lies in the total number of deployment commitments. According to Informa Telecoms & Media's 2010 Femtocell Market Status Report compiled for the Femto Forum, as of December 2010 there were 18 commercial services and a total of 30 deployment commitments by year's end. Deployments have almost tripled in the last 12 months.

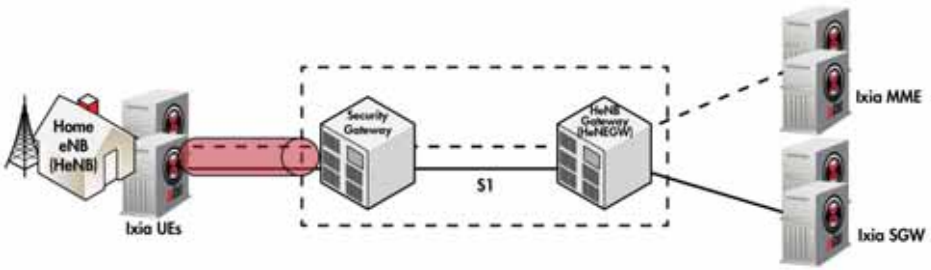
Role of the Femtocell

In practice, a femtocell is roughly the size of a home gateway or smaller and connects to the user's broadband line. Mobile operators sell femtocells to their

Case 2: HeNB isolation



Case 3: HeNB Gateway isolation



residential or enterprise customers and they can be integrated as part of a DSL router. The femtocell connects to the operator's mobile network and provides extra coverage in a residential range of around 30 to 50 meters. It is transparent to the customer, or plug and play, and there is no specific installation or technical knowledge needed.

Usually, the customer will designate which mobile phone numbers are allowed to connect to the femtocell. When the designated phones enter the femtocell coverage, they automatically switch from the macrocell, which is outdoors, to the femtocell. Communications will now route through the femtocell. When the customer leaves the femtocell range, his or her phone-call transfers seamlessly back to the macrocell network. Since femtocells need specific hardware, existing WiFi or DSL routers cannot be upgraded.



According the Yankee Group, 65% of carriers plan to build at least some of their LTE coverage using femtocells "from the bottom up" starting late 2012

Informa expects the femtocell market to reach nearly 49 million Femtocell Access Points (FAP) by 2014 with 114 million mobile users accessing mobile networks through them

Small cell, or femtocell, deployments have great market promise. However, like most emerging technologies gaining wide acceptance, femtocells must overcome a number of important challenges before products and services are fully viable. Major challenges include scalability, security, mobility, ease of deployment and interoperability. Full validation of these areas prevents product and service delays that might ultimately impact small cell market growth. The continual demand for more and more data over wireless networks is fuelling HSPA+ and LTE technology roll-outs. With this growth comes an increase in femtocell use in order to provide access in places that are not suited for traditional wireless deployments and to offload congested macro cells. Assessing all network aspects and femtocell devices both individually and as part of an end-to-end system gives equipment manufacturers and operators the ability to test all deployment challenges.

Testing criteria has been made somewhat clearer now that major standards bodies have published formal femtocells specifications for most of the popular technologies, like WCDMA, CDMA2000, LTE and WiMAX. The standards architecture is comprised of three major elements:

- The femtocell access point, which has similar functionality to macro cell basestations. The femtocell must have greater autonomy than macro cells for simplistic deployment. To achieve this they must be self-configuring. Femtocells are connected using broadband IP, such as DSL or cable modems, to the network provider's core switching centre.
- The femtocell gateway, which functions as both a security gateway and a signalling gateway that simultaneously terminates encrypted IP data connections and aggregates as well as validates signalling traffic. This gateway authenticates each femtocell and interfaces with the mobile network core switches using standard protocols.
- The management and operational system, which allows software updates and diagnostic checks to be administered. This system usually utilises the TR-069 management protocol published by the Broadband Forum.

The CDMA2000 standard released in March 2010 adopted the SIP protocol to set up a connection between the femtocell and a Femtocell Convergence

THE VOICE OF THE INDUSTRY

FOUNDED IN 2007, THE FEMTO FORUM PROVIDES AN INDEPENDENT AND IMPARTIAL VOICE FOR ALL STAKEHOLDERS IN THE FEMTOCELL SECTOR, INCLUDING VENDORS AND OPERATORS. Its strategic goal is global recognition of femto technologies as the de facto solution for mobile coverage in the home. The organisation's main areas of activity are in the areas of standardisation, regulation and interoperability as well as marketing and promotion. It also seeks to drive worldwide take-up of such technologies.

The Femto Forum is developing a policy framework that drives the standardisation by building and maintaining a dialogue with other relevant industry and official standards bodies to further femtocell technologies, and promoting standards-based solutions across the industry. It also nurtures an eco-system that delivers the most commercial, technically efficient solutions. The Femto Forum includes 72 vendors and 58 mobile operators that represent 1.71 billion mobile subscribers worldwide across multiple wireless technologies accounting for 33% of total mobile subscribers worldwide.

Server (FCS). SIP is not required or used by the mobile device itself and voice calls are routed through the FCS, which emulates a Mobile Switching Centre (MSC).

Thorough Testing is Required

All nodes in the femtocell ecosystem, including user equipment, home eNodeBs (HeNBs), HeNB gateways (HeNB GW) and HeNB management systems must be thoroughly tested individually as well as collectively to ensure interoperability that delivers the highest quality of service possible.

The end-to-end use case represents the ultimate system level or total testing picture that operators will be most interested in completing to totally validate their femtocell system. It is end-to-end in the sense that all the real components are present: the access point, the gateway, the actual evolved packet core, the mobility management entity and the serving (S-GW) and packet data network (P-GW) gateways.

In Case 1, testing equipment is used to emulate the devices on both edges of the network. The left side of the diagram shows it emulating the User Equipment (UE) over the RF connected to the femto access cell which is the Home eNode B. UEs consist of smartphones, smart tablets, dongles and other devices that create the traffic. The testing equipment emulates different types of commonly generated traffic from typical user behaviour and service requests like http requests (web browsing), video downloads (YouTube), music file sharing and email. The exact percentage of each type of traffic used in a test case is up to the test designer to model, depending on their specific network requirements.

On the right of the diagram, the equipment mirrors the Internet. It emulates the numerous types of servers that are found in a data centre, such as different web, music and video servers. The Mobility Management Entity (MME) node manages control plane signalling, while the S-GW and P-GW handle user traffic. The HeNB gateway is the new component that femtocell introduces. In this scenario operators will want to measure Quality of Service factors and test throughput, latency and latency variation as well as Quality of Experience measurements like video and voice quality scoring.

The next two use cases are of particular interest to vendors. Some vendors specialise in producing access points and other manufacturers are focused on gateway production. The following two use cases are customised for each specialism. The tests enable vendors to fully validate their products without the need to expend massive resources on setting up a full evolved packet core (EPC).

The femtocell market represents a significant investment in what looks to become a huge installed base of an emerging technology with much market promise

The Home eNodeB isolation test (Case 2 image) allows access point manufacturers to isolate and test the individual performance of their access points or devices.

The testing equipment behaves as the Gateway as well as the EPC.

HeNB Gateway isolation test (Case 3 image) tests the Home eNodeB Gateway. The equipment behaves as multiple access points and hundreds of thousands of UEs. Tests for scalability must be fully validated on multiple dimensions, including raw throughput, connections per second and transaction per second with security enabled.

Of critical importance in this test scenario is that vulnerability to security attacks must be assessed over IPSec and the performance of IPSec encrypted services and functionality of ciphering technologies must also be evaluated. As an example of scalability, at Mobile World Congress Ixia demonstrated the ability of an LTE security gateway product to handle 10Gbs of IPSec encrypted traffic on a single chassis blade. Additionally, operators need to validate mobility between femtocells and macro cells, and both positive and negative handover conditions must be fully vetted to ensure a positive user experience.

Ensuring Interoperability

To be economically viable residential femtocells must have Self-Organising Network (SON) capability to avoid site-specific radio planning and optimisation. The functionality and operation of the HeNB and HeNB management system to the TR-069 standard is critical. Operators have to offer consumers a variety of access points to select from. Each access point is required to be fully compatible with the operator's HeNB Gateway. It is imperative that operators seeking to deploy femtocells into their mobile network use test solutions that provide end-to-end system-level validation to speed deployment and ensure a successful roll-out of carrier-class quality.

From an interoperability standpoint, the key interface to be tested is between the femtocell access points and the femtocell gateway, regardless of technology. Testing these elements prior to deploying on the network is critical, because while theoretically standardisation enables a wider choice of femtocell products to be used with any gateway, device design differentiation may occur. ●

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450mm Takes a Step to REALISATION

MALCOLM PENN IS CEO AND CHAIRMAN OF MARKET ANALYST FIRM FUTURE HORIZONS, BASED IN THE UK

For several years now, 450mm wafer processing has been under discussion but apart from work on setting the standards and some prototype equipment, little has actually emerged. Indeed much discussion focused on whether the industry could actually afford to make this transition, how much it would cost and who would pay for it. It is, however, now certain that the future development of 450mm wafer processing will happen, thanks to an initiative driven by Intel and TSMC, which will most likely be joined in the not too distant future by Samsung and possibly three others. This will inevitably be an inflection point for the industry, with enormous ramifications for the complete semiconductor ecosystem. Even the most die-hard sceptics from the industry are now coming round to accepting 450mm will actually happen.

> *Even the most die-hard sceptics from the industry are now coming round to accepting 450mm will actually happen*

It was not always this way; quite the opposite, in fact, with a Mexican standoff between the chip industry giants saying: "We want it but we are not going to fund it"; and the semiconductor equipment industry stating: "Not only do we not want it, no way are we going to bankroll it!" With both sides seemingly bunkered down, 450mm looked set to become a research laboratory novelty.

Although standards for the wafer itself and its handling were being prepared, there was a continuing argument that the expense of developing and rolling out the technology could possibly exceed the benefits to be gained from manufacturing at this larger wafer size. Some equipment makers were even still arguing that they had not fully recovered the development cost for the past wafer scale up from 200 to 300mm.

Such transitions are also a huge drain on the infrastructure and there was thus also resistance from the smaller, less leading-edge chip firms and research labs that the inevitable redirection of resources would damage the industry in other ways. For example it has been argued that it would divert attention and resources from the more efficient manufacturing processes being developed at the 300mm node, as well as impacting on the 'More than Moore' approach many companies were adopting as an alternative to slogging down the 'More Moore' curve.

The climate changed dramatically during the first quarter of 2011, following Intel and TSMC's near simultaneous announcements that they intend to roll out 450mm wafer technology in their latest fab plants as soon as it was practically possible, closely followed by 'hints' from Samsung that it would be 'right up there too'. Of course, these are the three dominant semiconductor companies in the world, controlling well over half of the annual CapEx spend and the ones who can most easily afford the costs of the transition, and comments have been made that this is simply an attempt by these firms to cement their dominance of the crucial microprocessor, logic and memory industries.

This may of course be true but it is by no means a certainty; history has shown that leadership positions in the semiconductor industry can often be a transitory and one mistake can consign a company to steady decline. It will take a decade to determine whether this transition – and its execution – was the correct choice for them but, in the meantime, the rest of the industry will have to respond in the best way it can.

As with previous wafer size changes, the transition to 450mm wafer processing cannot be done overnight but this time it does seem that it will be an orchestrated way, well co-ordinated across the full industry food-chain, from the advanced research centres in IMEC and Albany to the potential end users keen to keep up their 29% per year transistor learning curve decline.

Interestingly, Europe's IMEC and ASML hold many of the key patents to this new wafer size technology. Ironically it seems that Europe's indigenous semiconductor firms – besotted with their fab-lite strategies – will be the last to embrace the new technology, if at all.

There are still some dissenting opinions as to whether the semiconductor process node roadmap and the transition to 450mm wafers are independent topics or if the two will need to become intrinsically linked. This is complicated by the fact that the technology roadmap, from today's 32/28nm advanced production node to the 11/10nm structures we can expect to see in early production around 2015 around the time of the transition, are littered with process dislocations, both in the structure of the transistors and the means to pattern and build them. Intel's 22nm FinFET announcement is just the first foot on this stool.

One lesson that can be learnt from the 300mm conversion was that the two issues were initially isolated, meaning that the conversion node became a moving target, starting off at 250nm, ultimately ending up

as 90nm, causing a raft of false starts, overlapping and redundant equipment development costs. It was this 'wasted' R&D spend that bruised the equipment industry so badly, hence their understandable reluctance to embrace 450mm transition. The fact that industry is unwilling to repeat this mistake adds weight to the argument that the node and 450mm are joined at the hip.

It does, therefore, seem likely that industry has learnt from this experience and now has a clear strategy to prove the new equipment platform first on a (relatively) mature and well understood node before moving to then prove the leading edge design on a now established and understood platform. This means that for a period of time, 300mm will appear to be more node-advanced than its 450mm sibling, but it would be wrong to interpret this as an opportunity for extended or parallel 450/300mm node development; it is not. It is merely the reflection of a carefully thought out transition process; once node comparability has been established, 450mm will flip and all future advanced processing will be on a 450mm platform only.

> *History has shown that leadership positions in the semiconductor industry can often be a transitory and one mistake can consign a company to steady decline*

From an equipment industry perspective, once the flip has occurred, all pressure (and CapEx spend) will be on ways to improve first generation 450mm equipment productivity plus new 450mm demand will start to come for the likely fast followers, such as Toshiba and some of the other large memory manufacturers (if Samsung goes 450mm, it has no choice), GlobalFoundries (likewise but by now competing against TSMC, Samsung and Intel all at 450mm) and probably IBM – what chance has a 300mm-only, node-less future, Common Platform Alliance against three hugely competitive 450mm foundry giants?

Customer pressure, limited R&D resources and dwindling long-term demand will drive the main-stream equipment industry into a 'follow the 450mm dollars' strategy. Those firms on a 450mm platform will then enjoy a huge cost and technology advantage forcing legacy 300mm capacity into ever more boutique and specialist low-volume product areas or other less demanding applications, for example to cost reduce 200mm-based products. The downstream squeeze on the chip industry will be enormous.

Mudding the water however is the advanced litho roadmap, given the fact that the most likely node flip-point will be 11nm for the leading edge memory and MPU suppliers. The more conservative and longer design-ramp lead times of the foundries means that their flip will likely be one node behind in technology, at the 14nm node, albeit at a coincident point in time, meaning whereas the foundries do not need EUV lithography for this node, for the rest, by 11nm, EUV will be a must. The triple and quad-patterning immersion lithography does not bare thinking about! ●

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In the ideal world every wireless module is a perfect example of logical design, every data sheet is a work of literary genius and every user has long experience of implementing radio systems of every variety. Unfortunately, we do not inhabit that world. In reality the data sheet is the product of imperfect human minds (and as such will be riddled with omissions, errors and misunderstandings); the module will have unexpected behaviours, undocumented features and hard-to-understand operating requirements; and the user may never have used a radio data link in their life.

> *A surprising number of experiments and applications do succeed – through a mixture of skill, luck and dogged perseverance*

That said, a surprising number of experiments and applications do succeed – through a mixture of skill, luck and dogged perseverance. The purpose of this article, however, is to deal with those that don't.

During the course of any implementation exercise there may come a point where no amount of testing, data sheet scrutinizing or experimentation is going to get the module's functioning. Assuming that surrender isn't an option, this is the point at which you compose an email or pick up the phone and start talking to the supplier's technical support department, which is where things can start to go very wrong indeed.

Technical Support staff are there to help you. They will be experienced in using the products you are asking for help with and – hopefully– will be able to offer useful recommendations, fixes and advice. Unfortunately, they are only human too and, unless a few basic rules are followed, the whole exercise can easily degenerate into a clumsy, acrimonious mess – and your radio still won't be working at the end.

The most useful piece of advice is probably "be realistic". Your module supplier wants repeat business as much as you want a working radio link, so ultimately you and the technical support engineer have the same aim – a working module, but both sides of the problem are working with similar restrictions: the suppliers know their modules inside-out, but rarely understand the customer's application, while the customer has no idea what is "inside the radio box" but is totally familiar with their particular area of activities.

Neither can see the whole picture at the start, but by the end of a (hopefully successful) support process, perhaps both can see a little more.

THE MOST USEFUL PIECE OF ADVICE WOULD BE TO:

Make a good contact

When looking for technical support from your module supplier, make sure that you are put in touch with someone who knows at least as much as you do and is actually prepared to help (this should become obvious in the first interchanges and discussions). If you find you have been passed off to the lab junior, firmly request to speak to someone "more senior". Once you have a friendly rapport, stick to them like glue. Try to get direct-email/direct-phone numbers (it usually takes a frustrating number of steps between an initial call to the company's generic contact number and actually speaking to someone who knows which end of a soldering iron gets hot. You don't want to go through this rigmarole every time you call). Make sure that you get to deal with the same person throughout the process.

Supply information

Although the problem almost certainly is "my radio isn't working", there is absolutely no point in emailing such a comment to technical support on its own. They aren't magicians and they cannot see what you are seeing. What is needed is a complete (or as complete as possible) description of how the misbehaving module is being used. At the very least, a circuit diagram and a description of the signals being applied. Quite often this

will be enough for a diagnosis to be made. If possible, take photographs of the module in its target application and of the connections to it. (A recent problem I was faced with was solved with a single photograph: From the connection wiring it could be seen that the customer had read the module's footprint diagram – assuming a "pin view" from below when the diagram was a view from above – and connected the device backwards).

Measure everything

Once the initial set-up has been described, the support engineer is going to have questions. Pre-empt some of them by making a set of measurements first. If possible measure the voltage on each of the module pins. If relevant, also observe the waveforms present (an analogue scope is probably the best tool for this). Measuring the supply current to the module is also very useful. Where periodic waveforms are being applied, it will also be necessary to sketch out a basic timing diagram for the module pin-waveforms.

Be patient

If the fault is less than obvious, the support engineer will need to ask you to conduct a series of further tests. Over a telephone link this can be a clumsy and frustrating process, so keep notes of what you're doing and insist on further explanations when instructions are ambiguous. Be aware that you may eventually reach a point at which no amount of further testing will find the problem. Then it is necessary to return the module and, probably, the target board it's on (there is no point sending back a module that has been wrecked in the de-soldering process) to the supplier, so they can examine the problem themselves.

> *Repeaters (or "nodes" acting as repeaters) will always re-send the packet identifier without changing the sender ID code or the burst identifier byte*

Be polite

It is very easy to become angry or frustrated when hardware isn't working, and when talking to technical support it is all too easy for this to turn personal. Remember that, while manufacturing defects and design flaws do occur, they are relatively uncommon and most problems dealt with by support engineers are down to customer errors or misunderstandings, or data sheet ambiguities. Ranting and raging, or threatening legal action, will not encourage the support engineer to do his best for you. (And insulting the design might not be the best policy either: in small niche-market RF companies the design engineer and the technical support operative you've talking with are sometimes the same person).

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THE KEY TO SUCCESSFULLY PARALLELIZING AN APPLICATION

MANAGING LOOPS AND DATA SYNCHRONIZATION IS THE KEY KEY TO SUCCESSFULLY PARALLELIZING AN APPLICATION, SAYS **BRYON MOYER**, VP OF MARKETING AT VECTOR FABRICS, WHO ALSO EXPLAINS HOW TO ACHIEVE THIS

Parallelization of a program is simple in concept but can be more complex in actual implementation. It also depends on the application.

Some applications lend themselves to parallelization more than others. Good examples are those that employ a high proportion of individual computational tasks. These can often be found in factory automation applications where a mechanical action is dependant on the recognition of an image. Likewise, CCTV applications can employ fairly complex algorithms to detect and differentiate movements of people and vehicles.

In practice, parallelization always involves loops in one way or another. While it is theoretically possible for an algorithm to involve multiple independent long chains of calculations that don't involve loops, it's highly unlikely in real life.

The loops involved may result from algorithmic requirements – for example, the traversing of matrices; they may come from the need to process more data than can be acquired from a single operation, such as reading and processing all of the data in a file; or they can result from a task processor that must repeatedly check whether there is data that needs to be worked, such as a packet processor looking for new packets that have arrived on the network.

It is the repetitive nature of loops that takes what appear to be small tasks and repeats them so many times that they accumulate to a large compute load. It is for this reason that loops are typically of interest when finding ways to parallelize a program to share the load over multiple processing units.

There are two fundamental ways to parallelize data: through fork/join configurations or through loop distribution. Theoretically, using fork/join to parallelize doesn't require a loop, but, in practice, it only makes sense when done inside of a loop so that the savings accrue over all of the loop's iterations.

Fork/Join

With fork/join parallelization, two (or more) tasks are spawned to run in parallel within one iteration of a loop. Such parallelization is most effective if the tasks are balanced in compute load (Figure 1). If not, then the faster tasks end up waiting for the longest task to complete (Figure 2).

For standard sequential C programs, it is simplest if there is no need to communicate data between the tasks. Unfortunately, this scenario is not common enough to handle most parallelization requirements.

Loop Distribution

When a single iteration of a loop involves a large amount of computing, it is common to split the loop into two (or more) tasks and assigning them to different processors. In the case of two tasks, the second half of the task cannot start until the first half has completed, but once the second half starts, the first half can start on its next iteration while the second task finishes the first iteration.

Effectively, the first task gets part of the work done and then hands it off to the second task. In the hardware world, this is known as "pipelining". However, in theory, if the second half were completely independent of the first half, not relying on any data generated in the first half, then it could start immediately, as in Figure 3, with no (or negligible) added latency.

Loop distribution requires attention to where the loop body is split. If data is produced before the split and consumed after the split, then that data must be communicated – or synchronized – between tasks after the loop is distributed. The second part of the loop can't start until all the necessary data is available, adding some latency. This is shown in Figure 4, with the "P" triangles indicating data production and the "C" triangles indicating data consumption.

Loops can be completely parallelized by a combination of unrolling and distribution.

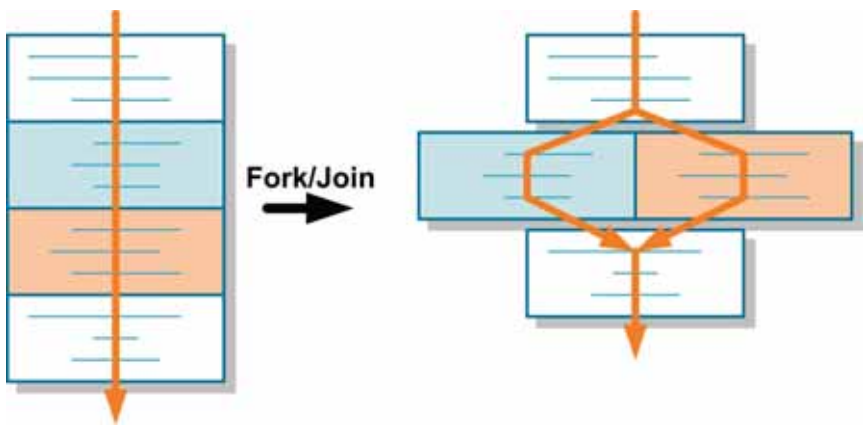


Figure 1: Balanced fork/join parallelization

Loop unrolling refers to taking the loop body and explicitly duplicating it within the loop, reducing the number of loop iterations accordingly. For example, if a loop has 16 iterations and you unroll four times, then the loop body now has four explicit copies of the original loop body, meaning the resulting loop only executes four times, as shown in Figure 5.

As an example of loop parallelization, two processors can split up the number of loop iterations by unrolling once and then distributing. In this way, the first processor takes the odd iterations and the second processor takes the even ones; this is illustrated in Figure 6.

If the loop is completely unrolled and there are as many processors as iterations, then all iterations can be executed in parallel.

Loop-Carry Dependencies

The degree of parallelization possible depends on how data needs to be communicated between iterations. This is the same synchronization issue as discussed for simple loop distribution, only applied to unrolled loops, where each copy of the loop body represents an iteration of the original loop.

Dependencies between one loop iteration and another are referred to as loop-carry dependencies. Loop-carry dependencies require synchronization if parallelizing across them.

Synchronization

Synchronization involves the communication of data from one task to another. There are a variety of ways to implement it – including dedicated hardware – so there is no one right or wrong way. Each carries a level of overhead that may be high or low, a consideration to be taken into account when making parallelization choices.

Depending on the program, synchronization might happen more or less frequently. Higher frequency indicates a higher level or "granularity" of parallelization; infrequent synchronization indicates "chunkier" parallelization.

For example, if a simple loop is distributed and a single value is calculated that must be synchronized, then synchronization will occur with each loop iteration for a small piece of data (Figure 7).

Nested loops provide a counter-example. If the loop being distributed contains two loops, one generating data and one consuming the generated data, and if the loop is split between those two inner loops, then one task will produce a number of data points; the other task will consume them.

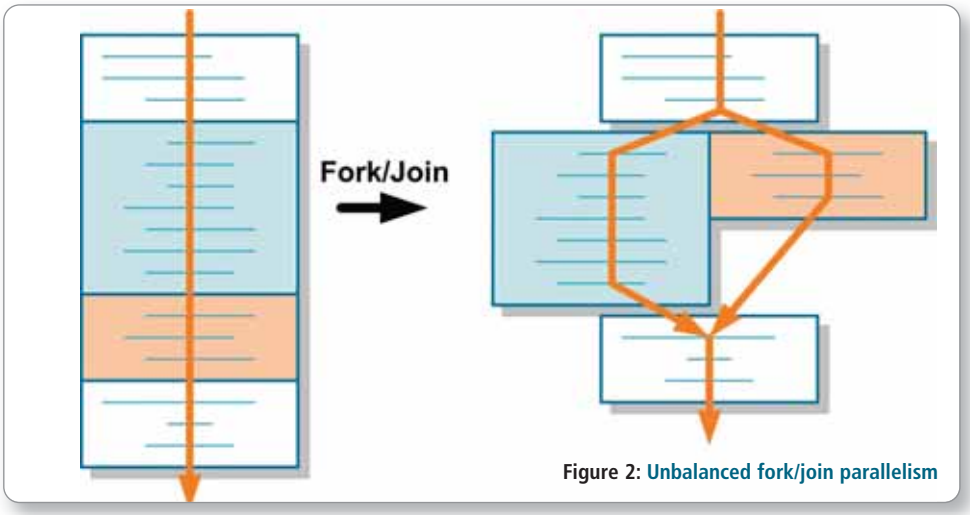


Figure 2: Unbalanced fork/join parallelism

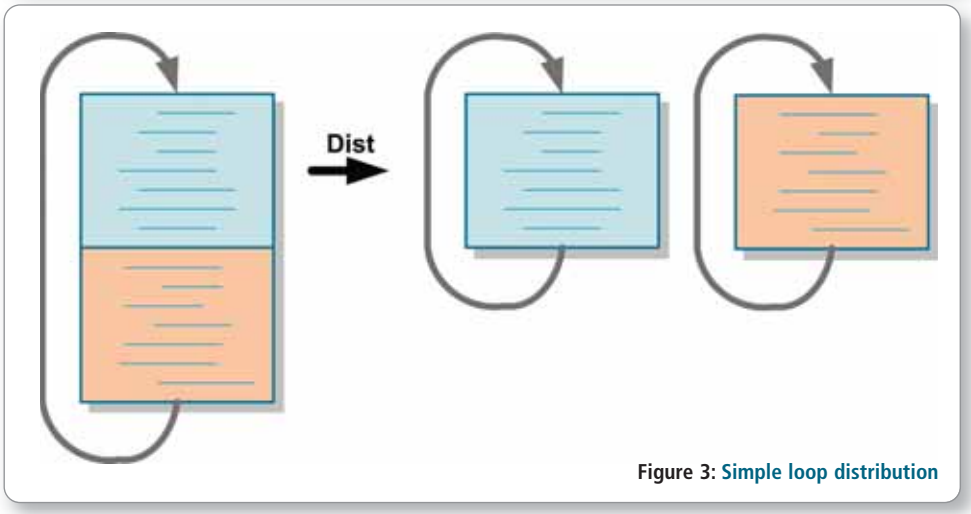


Figure 3: Simple loop distribution

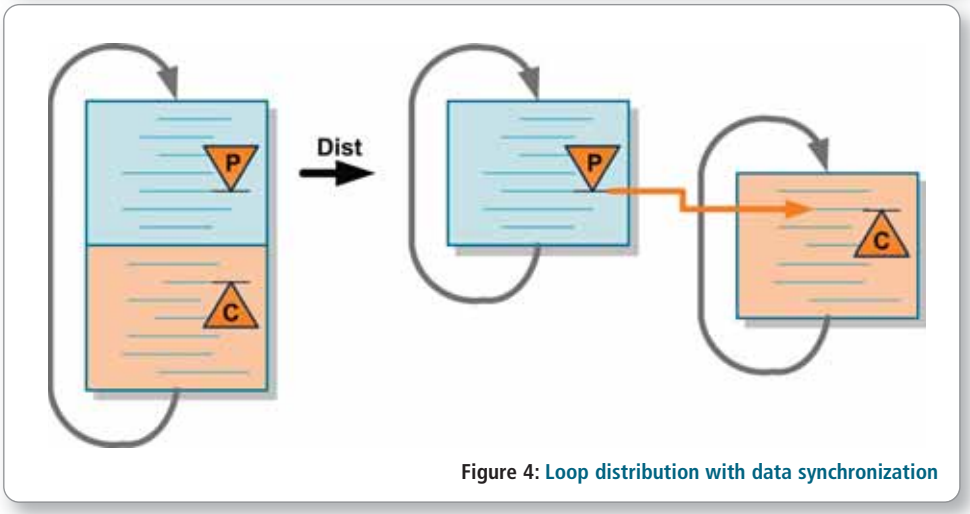


Figure 4: Loop distribution with data synchronization

Synchronization will not occur until the entire inner loop has finished generating data. So if the inner producing loop in the first task iterates 16 times and fills an array with 16 values, then synchronization will transfer those 16 values to the second task, whose inner loop will then iterate 16 times to read them (Figure 8).

To the extent that one task is waiting on another for data, the more data transferred at a time, the longer the waiting task has to sit around until the data is ready. So more things can be done in parallel more quickly if data is transferred smaller chunks at a time.

However, synchronization does involve some overhead. The overhead may be as small as a simple indicator that data is

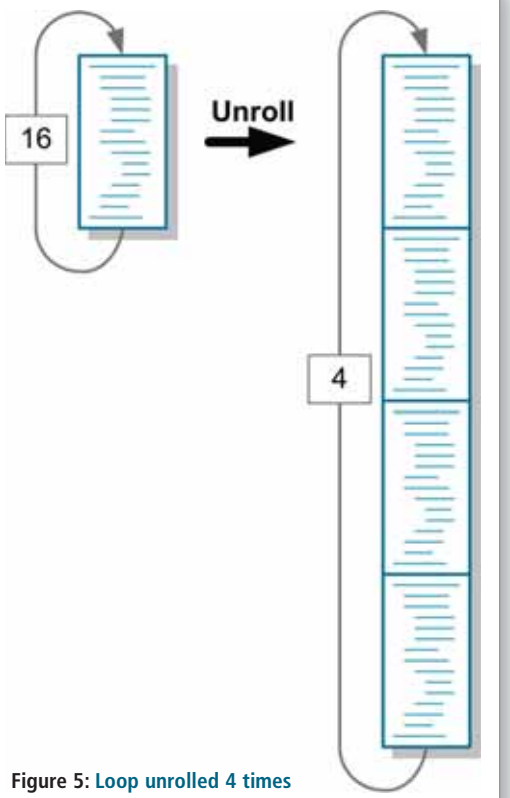


Figure 5: Loop unrolled 4 times

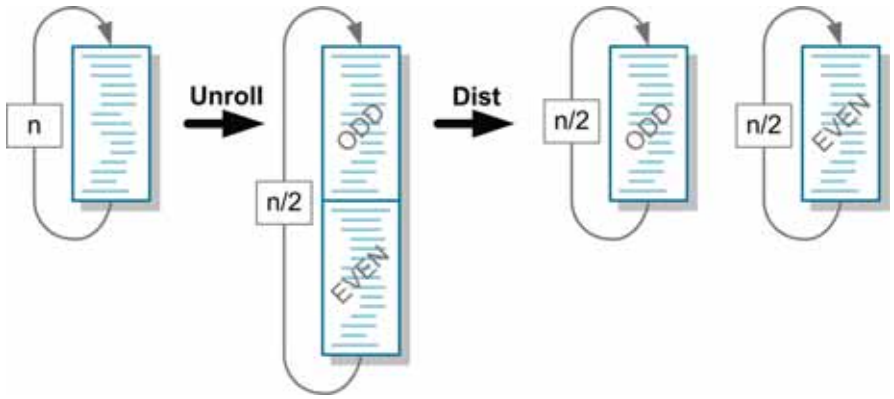


Figure 6: Loop parallelization by unrolling and distribution

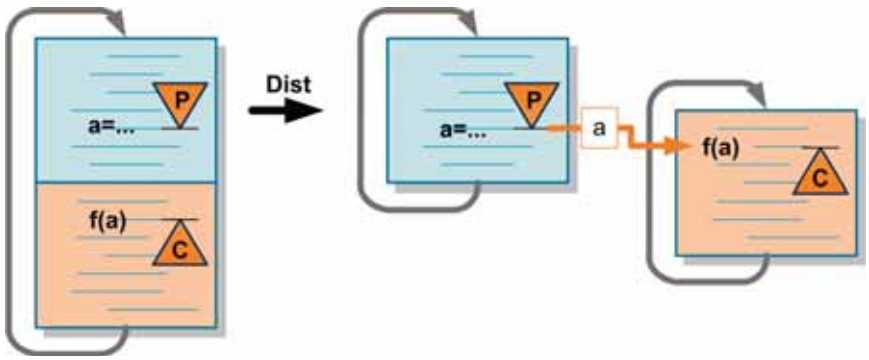


Figure 7: Synchronizing a single variable

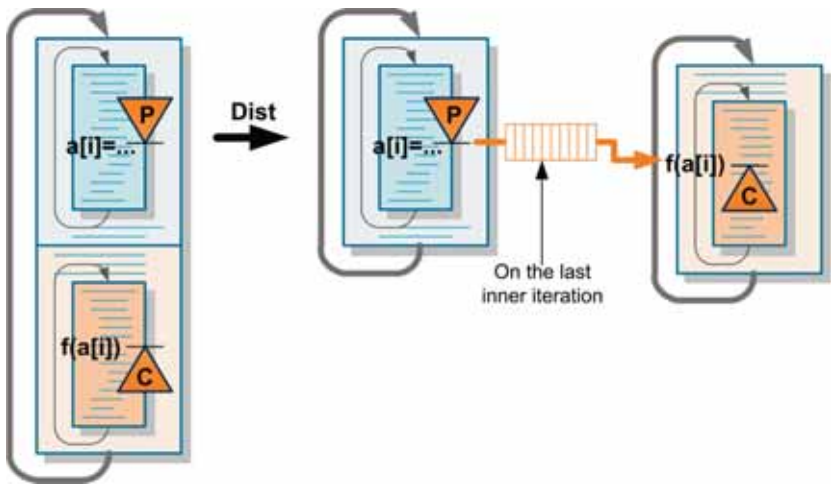


Figure 8: Synchronizing an array

available, or may involve locking and unlocking data structures and copying data. This overhead directly leads to the latency introduced by parallelization. Therefore, the more overhead there is for each synchronization, the more data you want to transfer in each synchronization. If you have zero to little overhead, then data can be synchronized more frequently with less penalty.

The dependency properties include the number of synchronizations ("syncs") and the amount of data per synchronization. Multiplied together, these give you the total data synchronized.

In general, given various parallelization choices, it's better to transfer less data than more. In a tie, there's a tradeoff between the latency introduced by doing fewer synchronizations with more data each time and the overhead introduced by doing more synchronizations with less data each time. When you explore the different ways you can partition your program.

FIND OUT

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"VIRTUAL REMOTE SENSING" IMPROVES LOAD REGULATION

"VIRTUAL REMOTE SENSING" IMPROVES LOAD REGULATION BY COMPENSATING FOR WIRING DROPS WITHOUT REMOTE SENSE LINES, SAYS **TOM HACK**, SENIOR DESIGN ENGINEER AT LINEAR TECHNOLOGY

Accurately regulating a voltage at a load can be difficult when there are significant voltage drops between the power supply and the load. Even if a regulator produces a perfectly regulated voltage at its own output, variations in load current affect the IR drop along the wiring, thus resulting in significant voltage fluctuations at the load end (Figure 1).

The conventional solution to improving regulation at the load side involves adding extra wires for remote sensing (Figure 2), but adding extra wires is not always desirable, or possible. A new control method, virtual remote sense (VRS) easily replaces and avoids the pitfalls of conventional solutions and, in some instances, solves the previously insoluble.

Load-End Regulation Before VRS

Virtual remote sense solves the problem of maintaining load regulation at the end of long wiring runs. VRS is easier to implement and generally performs better than conventional remote sensing techniques such as direct remote voltage sensing, voltage-drop compensation and load-end regulation.

The first conventional technique, direct remote sensing (Figure 2), produces excellent load-end regulation, but it requires two pairs of wires: one pair to provide the load current and a second pair to measure the voltage at the load for proper regulation. Remote sensing requires foresight – it must be designed into the system. Unless an extra pair of sense wires is ready and waiting, remote sensing is impossible to implement after the fact.

The second conventional technique, voltage drop compensation, doesn't require extra wires, but it does require careful estimation of the voltage drop of the load lines. The supply voltage is adjusted to make up for the estimated interconnection voltage drop. However, since the drop is only an estimated value and not measured, the accuracy of this method is questionable at best.

The third conventional technique involves placing a voltage regulator directly at the load. This provides both accuracy and simplified wiring, but the regulator consumes valuable space at the load end, reduces overall power system efficiency and power dissipation near the load increases. In industrial and automotive systems, it may be impossible to place a regulator in the harsh environment at the load end.

VRS avoids all of these limitations while producing impressive load regulation over a wide range of conditions.

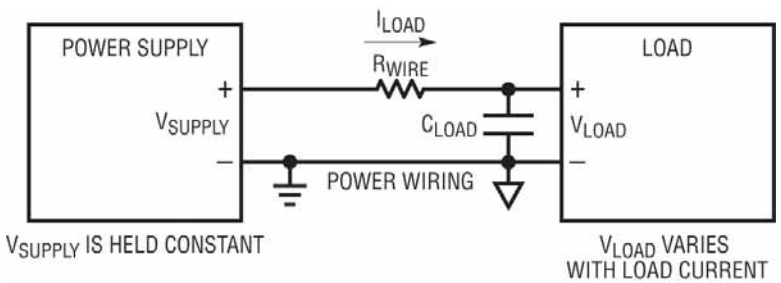


Figure 1: The simplest model for load regulation over resistive interconnections

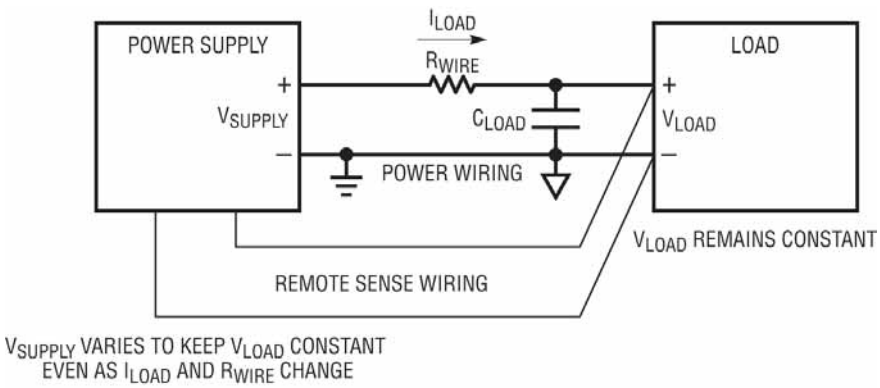


Figure 2: Remote sensing solves the problem of load regulation, but adds wires across the divide

What is VRS?

Figure 3 shows a simplified schematic of a virtual remote sense system consisting of a power supply or regulator driving a load over a resistive interconnection (consisting of wiring plus connectors). Without VRS, supply voltage (V_{SUPPLY}) and DC current (I_{LOAD}) are known, but there is no way to determine how much voltage is delivered to the load and how much voltage is lost in the wiring, so proper load voltage regulation can't be achieved.

The LT4180 VRS solves this problem by interrogating the line impedance and dynamically correcting for the voltage drops. It works by alternating the output

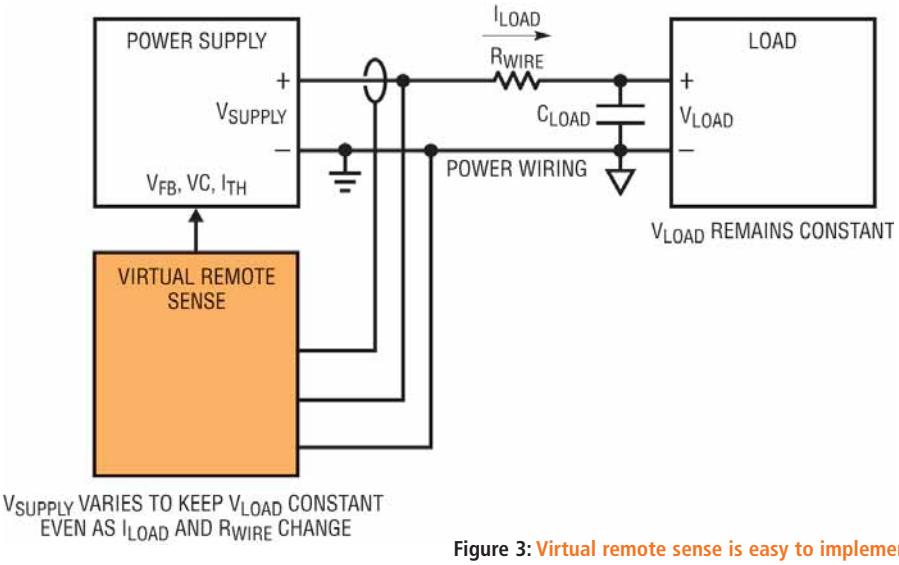


Figure 3: Virtual remote sense is easy to implement

current between 95% of the required output current and 105% of the required output current. In other words, the LT4180 forces the supply to provide a DC current plus a current square wave with peak-to-peak amplitude equal to 10% of the DC current. Decoupling capacitor C (which normally insures low impedance for load transients in non-VRS systems) takes on an additional role by filtering out voltage transients from the VRS square wave.

Because C is sized to produce an "AC short" at the square wave frequency, the interrogating voltage square wave produced at the power supply is equal to $V_{SUPPLY}(AC) = 0.1 \bullet I_{DC} \bullet R$, measured in V_{P-P}. The voltage square wave measured at the power supply has a peak-to-peak amplitude equal to one tenth the DC wiring drop. This is not an estimate – it is a direct measurement of the voltage drop across the wiring over all load currents. Minor signal processing creates a DC voltage from this AC signal, which is introduced into the supply's feedback loop to provide accurate load regulation.

How Well Does VRS Work?

Static load regulation for the LT4180 is shown in Figure 4. In this case, load current was increased from zero until it produced a 2.5V drop in the wiring. The voltage at the load dropped only 73mV at maximum current from what it would be at no current. Even with an in-the-wire voltage drop equivalent to 50% of the nominal load voltage, the voltage at the load stayed within 1.5% of the no load current value. Less dramatic wiring drops produced even better results.

Adding Flexibility

The LT4180 works with nearly any power supply or regulator: linear or switching, isolated or non-isolated. Power supplies can be synchronized to the LT4180 or not. To accommodate a variety of system and power supply requirements, VRS operating frequency can be adjusted over more than three decades. It also offers spread spectrum operation to provide partial immunity from single-tone interference. Its large input voltage range simplifies design.

Besides offering an alternative to conventional techniques, VRS opens up opportunities previously unavailable in battery charging, industrial and Ethernet, lighting, well logging and other applications.

To have an example, Figure 5 illustrates a poorly conceived power system for notebook computers, PDAs, cell phones or portable entertainment devices. An external power supply/battery charger is used to minimize the size of the portable electronic device. The charger only works properly when the device is off and not drawing current. As the battery approaches full capacity, battery charging current (I_{BAT}) is nearly zero. With I = 0, the battery charger voltage V_{SUPPLY} equals the battery float voltage and charge termination works properly.

But what happens if the system voltage regulator is drawing current? The battery voltage V_{BAT} can be less than the needed battery charger voltage, V_{SUPPLY}, thus slowing charging or even stopping it altogether. Interconnection resistance can't be lowered enough to solve this. The 1% Li-ion float voltage accuracy requirement translates into a 42mV float voltage error (for a one cell Li-ion battery). Because there are other float-voltage error sources, the wiring drop must be kept well below this.

The conventional solution uses a complex architecture like that shown in Figure 6, which incorporates the charger and a power path controller into the device. While this reduces wiring-related charging errors, it increases the size of the device and the power dissipation within the device because the charger and power path controller must be packed inside.

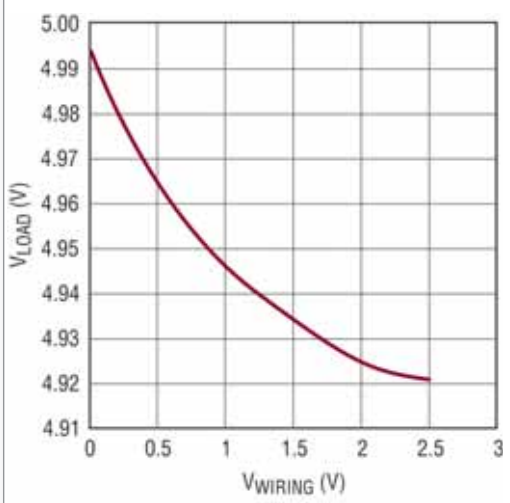


Figure 4: Static load regulation for the LT4180 is impressive over an extreme range of regulator-to-load wiring voltage drops

Figure 7 shows the no-compromise solution using VRS. Charger voltage is properly controlled at the device independently of load current (I), so an external battery charger supply can be used and a power path controller eliminated.

Easily Compensate Line Drops in Power over Ethernet Applications

Power over Ethernet and industrial applications also benefit from VRS. VRS

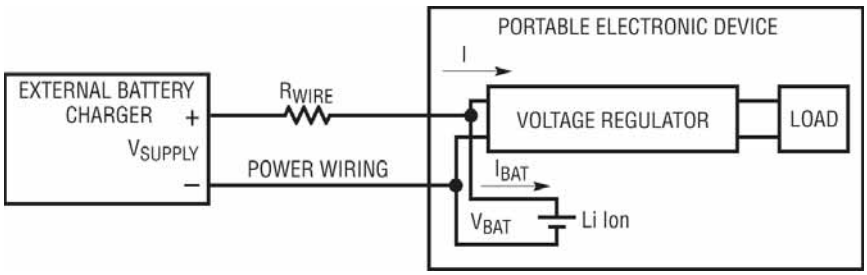


Figure 5: A (flawed) battery charging architecture aims to reduce the device size with an external battery charger

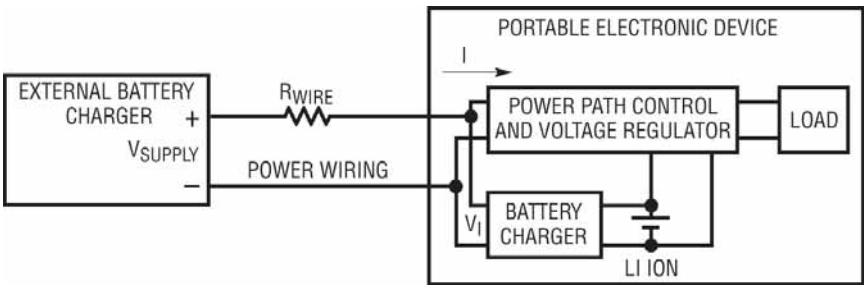


Figure 6: Typical battery charging architecture without VRS

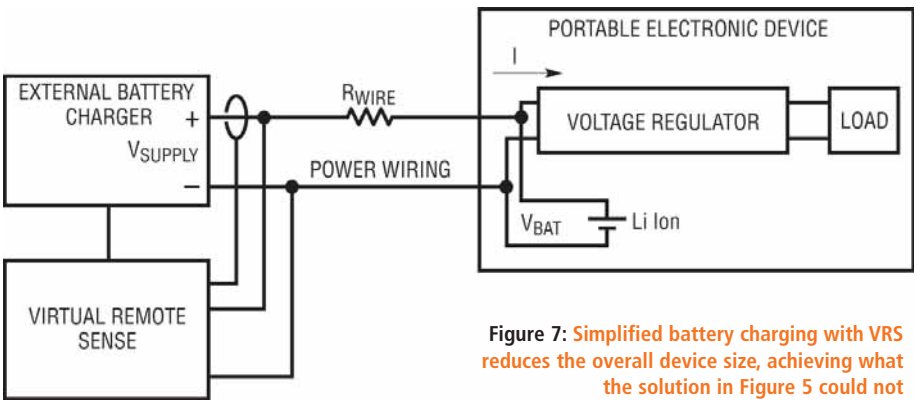


Figure 7: Simplified battery charging with VRS reduces the overall device size, achieving what the solution in Figure 5 could not

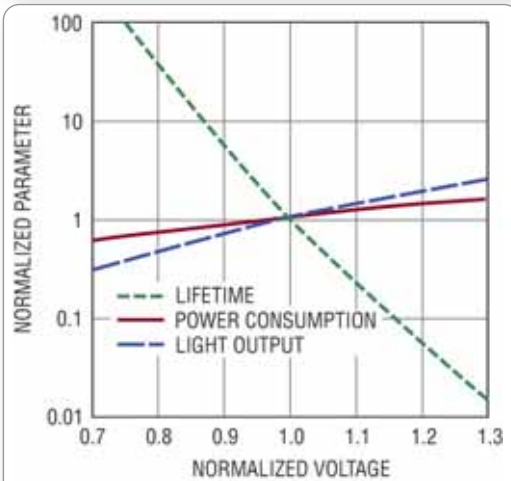


Figure 8: Lamp parameters vs normalized lamp voltage shows that better voltage regulation at the lamp improves output, saves energy and prolongs lamp life

allows low voltage devices (with high operating current) to operate over CAT5 and CAT6 cable – without the drops caused by long runs. Even 10V-to-20V line drops can be compensated, allowing either no regulator or a simple linear regulator at the far end.

VRS can also be used to simplify system retrofits to industrial applications. For example, a pair of power wires is available for new equipment, but regulation at the load-end is not up to the equipment spec. VRS can be easily dropped in to control the existing power supply or regulator. This is far easier and cheaper than adding another pair of wires for remote sensing, or adding load-end regulation.

Equally, in lighting applications: while incandescent lighting is on the decline, high intensity halogen lights continue to be popular. The operating voltage of halogens directly affects their light output, efficiency, lifetime and colour temperature as shown in Figure 8 and as follows:

- Light output is approximately proportional to $V^{3.4}$
- Power consumption is approximately proportional to $V^{1.6}$
- Lifetime is approximately inversely proportional to V^{16}
- Colour temperature is approximately proportional to $V^{0.42}$

Normally these devices run at 12V, but at relatively high current, so line drops can also be high, with the load-end discrepancy easily reaching one or more volts. A 12V halogen operated at 11V produces 25% less light than when operated at the correct voltage, while only saving 13% power. For a fixed light level, 25% more bulbs need to be used if the voltage is allowed to droop to 11V. Running halogens at the correct voltage offers more precise lighting control, colour temperature and better efficiency.

A VRS system can be used to maintain correct bulb intensity. A capacitor is placed in the vicinity of the bulbs, and the voltage is controlled at that point. For medium and large lighting systems, the energy efficiency can easily pay for the more complex DC power supply when compared to a standard transformer. Also, light colour temperature is well controlled and bulb lifetimes are very consistent.

A SEPIC-based automotive halogen headlight power supply (Figure 9) improves bulb reliability while also insuring optimum illumination. The design maintains 12V at headlight voltage over a 9V to 15V input voltage range. It works well up to 1Ω interconnection resistance. Using VRS allows the SEPIC converter to be placed far from the load – say in the passenger compartment, away from extreme under-the-hood environments, thus improving reliability.

Residential and commercial track-style lighting also benefit. The cost of properly regulating lamp voltage is quickly paid back in the form of lower power consumption and higher efficiency. Two to three kilowatt-hours may be saved in a day on a 250W string while maintaining the same amount of light. Colour temperature (while not as dependent on voltage as other lamp parameters) also benefits. VRS allows remote voltage regulation of a single lamp, or provides first-order regulation of several lamps distributed over a single power rail.

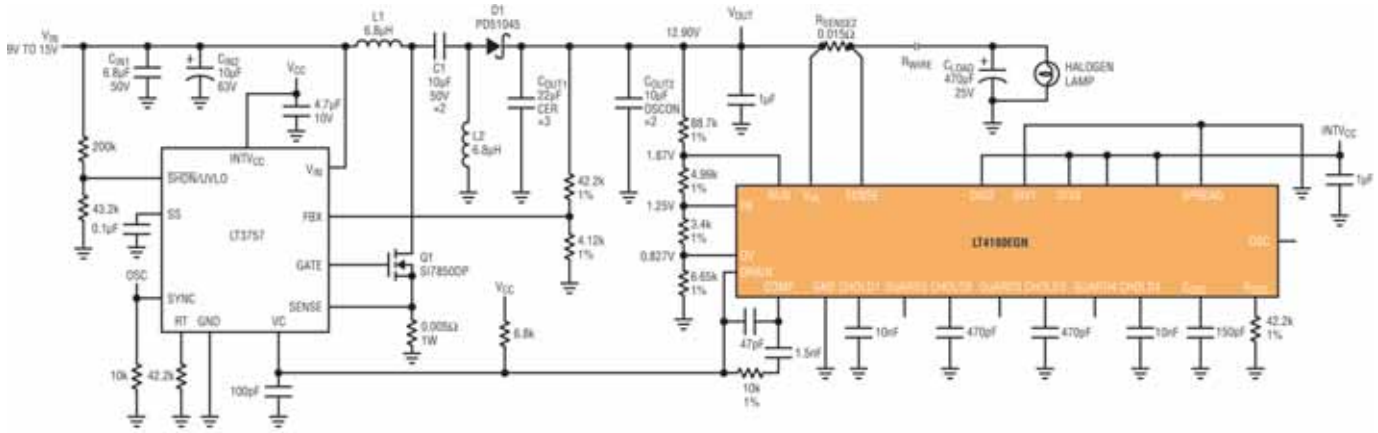


Figure 9: A halogen automotive headlamp power supply

For Very Long Line Lengths

VRS can be used in oil and gas well logging applications where instrumentation is often connected by cables from thousands, to tens of thousands, feet long.

The LT4180 includes all components needed for a linear power supply (except for the pass transistor). Undervoltage lockout, overvoltage lockout and soft-correct are also available, so a full featured linear VRS power supply can be built with few components (Figure 10). The linear supply in Figure 10 provides 12V at 500mA with an 18V input. Pass transistor Q1 is driven via R3, R7 and Q2 via the DRAIN pin. Q2 serves to keep DRAIN pin voltage below the absolute maximum rating. C5, R8, and C6 provide compensation. R2, R4, R5, and R6 set output voltage and lockout thresholds. R1 is the current sense resistor. C7 to C10 are hold capacitors used by the VRS, while C11 and R9 set the square wave frequency. Typical load-step response is shown in Figures 11 and 12 with 4Ω wiring resistance and 100µF and 1100µF load-end capacitances. VRS transient response is well controlled with widely varying C_{LOAD}.

Figure 13 shows how the LT4180 interfaces to a Vicor power module, providing virtual remote sensing for a 3.3V/2.5A or 5V, 2.5A load through 0.5Ω wiring resistance. Output voltage is adjusted by changing R3's value. Nominal input voltage is 48V. VRS is produced via the module's trim pin. This design works with 0.5Ω wiring resistance and 1000µF decoupling capacitance.

A fully isolated flyback converter capable of supplying 3.3V at 3A from an 18V to 72V input is shown in Figure 14. It is designed to correct for 0.5Ω to 2Ω of wiring resistance. Recommended load-decoupling capacitance is 1000µF. Isolation is achieved through T1 and opto-isolator U3. While not shown in this design, it is also possible to provide an opto-isolated OSC signal from the LT4180 to a power supply for synchronization.

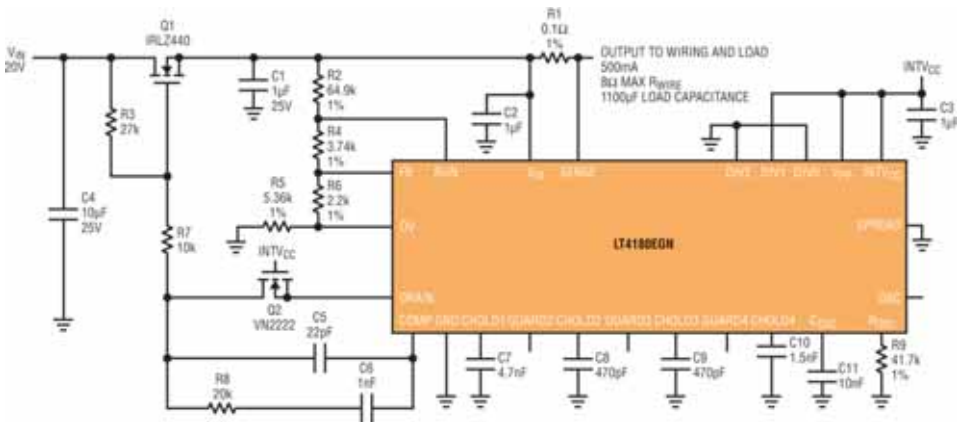


Figure 10: A full featured VRS linear supply using the LT4180

Figure 15 shows a buck regulator capable of supplying 12V at 2A to a load over 1Ω to 3Ω wiring resistance. 470µF load decoupling capacitance is recommended. Input voltage range is 20V to 36V.

Enabling the Use of Virtual Remote Sensing

While conventional 2-wire remote sensing gives proper voltage at the load, there are many drawbacks. The sense wires are an additional cost in the system as well as consuming connector space for the system. Reliability issues can occur if the sense wires are disconnected or broken. On the other hand, a virtual remote sense system gives excellent regulation at the

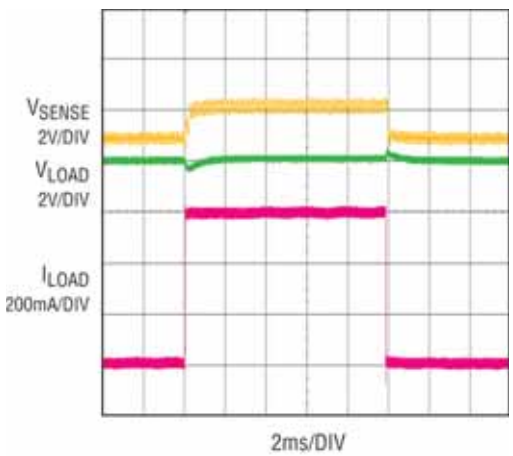


Figure 11: Load step response of the linear supply shown in Figure 10 with 100µF decoupling capacitance

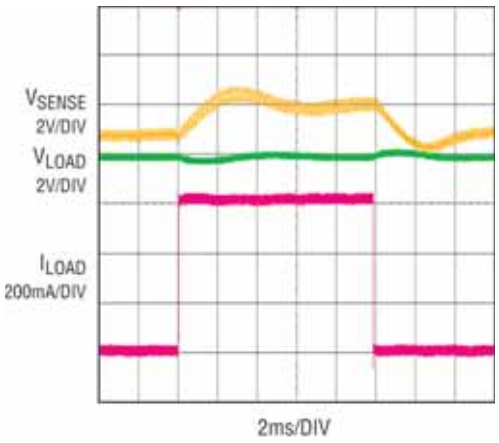


Figure 12: Load step response of the linear supply shown in Figure 10 with 1100µF decoupling capacitance

load and none of the drawbacks of wired remote sense. Unlike other compensation schemes such as negative resistance, virtual remote sensing provides continuous control of the output even if the line-drop resistance changes. Virtual remote sense corrects wire drops and connector drops.

The additional noise on the power supply lines from the virtual remote sense circuitry is easily removed by a capacitor at the load, which is always included in remote sense systems anyway. The LTC4180 can provide remote sense correction for IC regulators as well as preconfigured purchased offline supplies. The cost of adding a VRS IC in a power supply system is usually much less than laying wires for remote sensing.

The LT4180 gives power supply designers a valuable new tool, enabling use of virtual remote sensing for accurate load voltage regulation over highly resistive interconnections. Virtual remote sensing provides alternatives previously unavailable for simplifying or improving designs. The LT4180 VRS works with virtually any power supply or regulator: switching or linear, isolated or non-isolated, synchronized or unsynchronized. It contains a VRS regulation circuit and a variety of features such as undervoltage and overvoltage lockout and opto-isolator drivers. ●

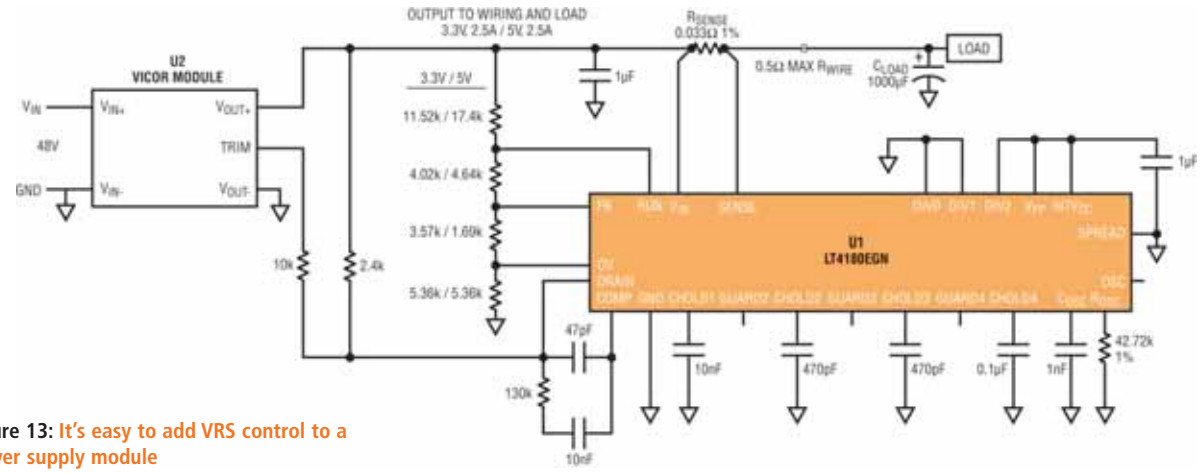


Figure 13: It's easy to add VRS control to a power supply module

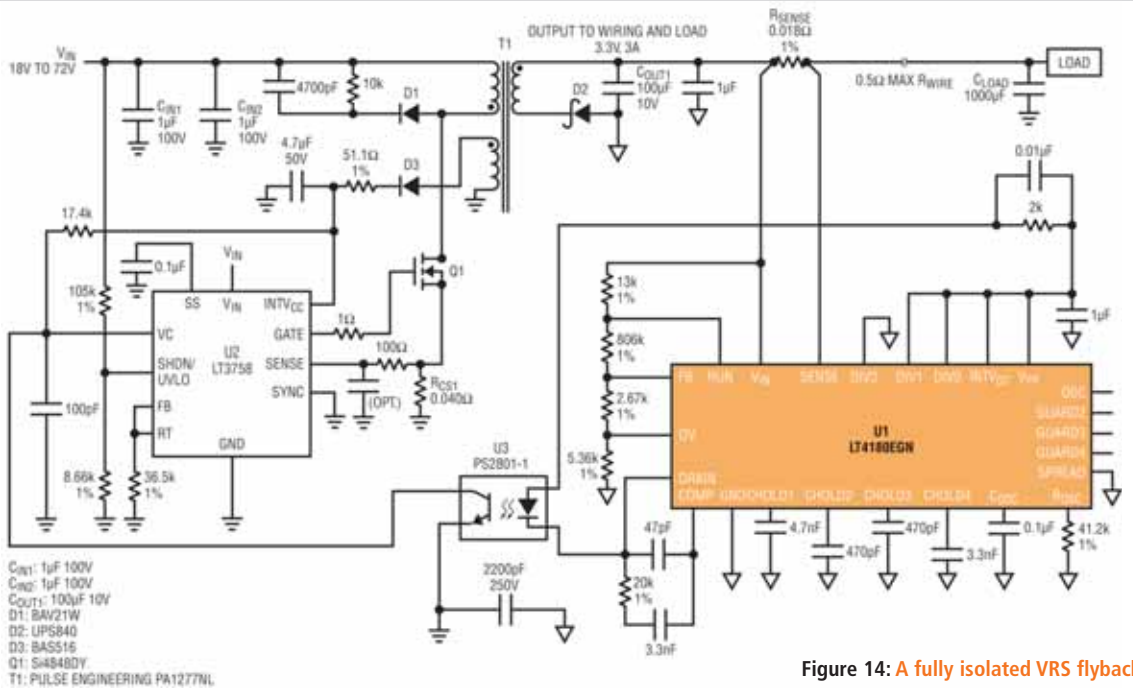


Figure 14: A fully isolated VRS flyback converter

Ready, set, change!

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SECONDARY PROTECTION DEVICE HELPS PREVENT DAMAGE BY THERMAL RUNAWAY IN POWER ELECTRONIC SYSTEMS

MATT WILLIAMS, GLOBAL APPLICATIONS ENGINEERING MANAGER AT TE CIRCUIT PROTECTION, LOOKS AT THE USE OF THERMAL PROTECTION DEVICES FOR IMPROVING RELIABILITY AND SAFETY IN INDUSTRIAL AND CONSUMER EQUIPMENT

The continued growth of power electronics in our homes, offices and vehicles is fueling a trend toward new materials and more efficient power components. High-power, high-temperature applications place greater demands on power electronic systems, resulting in the potential for serious thermal issues when components fail due to long-term exposure to harsh environments. As a result, most industrial and consumer equipment now incorporate thermal protection devices to improve reliability and safety.

When designing for thermal management, the heat generated by resistive and inductive loads, power capacitors, current drivers, switches, relays and MOSFETs present engineers with significant challenges. These heat-generating components are found in applications such as switch mode power supplies (SMPSs), high-voltage power supplies and switching applications for train traction motors and hybrid vehicles.

Improving power component performance, using design techniques that spread heat more evenly, and incorporating new heat sink materials are some of the solutions that have been utilized to enhance thermal management. Nevertheless, many designers currently rely on secondary protection to help prevent damage caused by thermal runaway events that may occur as a result of component failures or corrosion-induced heating.

There are a number of innovative technologies that have been designed to assist in protecting the application and end-user from catastrophic thermal events by interrupting electrical current flow when a power component is heated to its specific rated trip temperature. The most common approach is to use a thermal fuse, Thermal Cut Off (TCO) or a thermal switch. These devices offer the designer wide and specific temperature activation characteristics in both AC and DC applications. Available in bolt-in types, clip-on, pig-tail and lead-type styles, these shapes can present complexities in both design and manufacturing processes, and require careful handling procedures in order to guarantee that the protection device is not damaged during assembly.

Because more and more printed circuit boards (PCBs) utilize only surface mount device (SMD) components, using a through-hole device can translate to special mounting procedures and higher cost. Additionally, standard devices may not provide the ruggedness and reliability needed for industrial applications, whereas components that are qualified for the automotive and industrial environments are fully tested to meet stringent shock and vibration

Figure 1: PowerFET failure in resistive mode can lead to unsafe overtemperature conditions

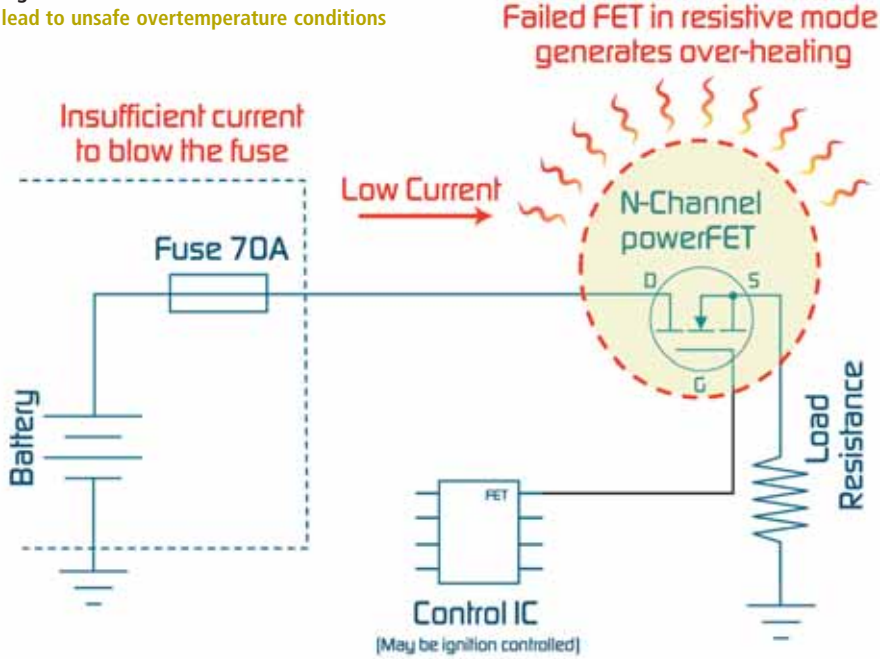
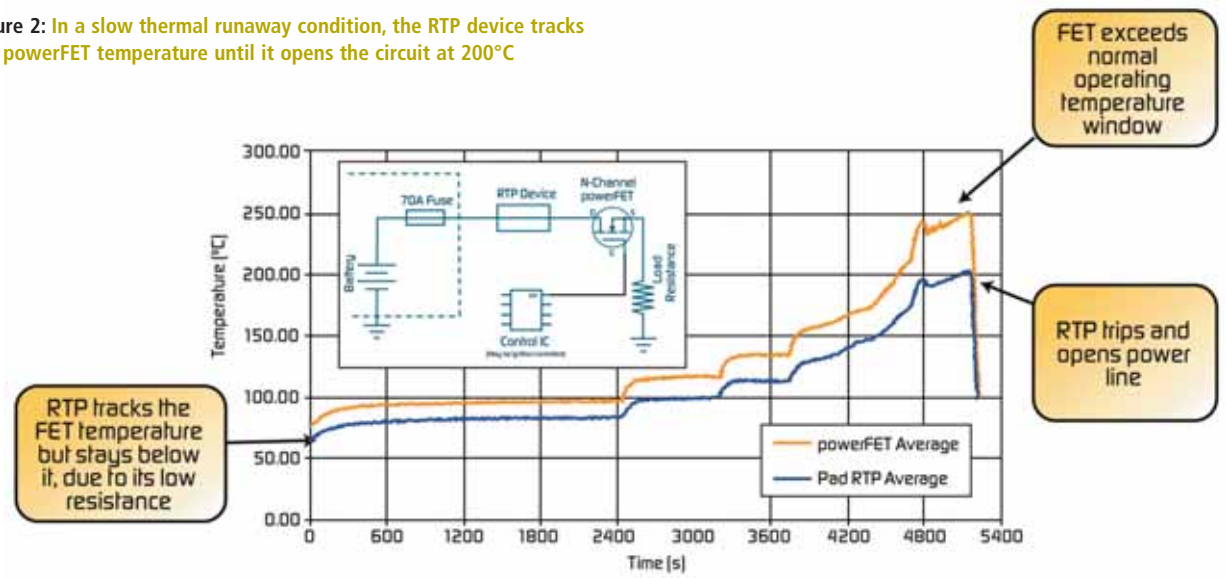


Figure 2: In a slow thermal runaway condition, the RTP device tracks the powerFET temperature until it opens the circuit at 200°C



specifications and to provide the proper DC ratings.

A new surface-mount component, the Reflowable Thermal Protection (RTP) device helps prevent thermal damage caused by failed power electronics. The device helps protect against damage caused by resistive shorts which may produce undesirably high temperatures through I2R heating, as well as hard-short overcurrent conditions. The device can be installed using standard lead (Pb)-free reflow processes and can be used to replace redundant powerFETs, relays and heavy heat sinks typically used in automotive and industrial designs.

Secondary Protection for powerFETS

Although powerFETs are increasingly robust, they are prone to failures which can occur very quickly if their ratings are exceeded. If the maximum operating voltage of a powerFET is exceeded, it goes into avalanche breakdown. If the energy contained in the transient overvoltage is above the rated avalanche energy level, the device will fail, causing a destructive thermal event that may result in smoking, flame or desoldering.

Automotive and industrial powerFETs have been shown to be more prone to fatigue and failure than devices that are installed in less demanding applications. When comparing powerFET failure rates over time, devices used in harsh environments exhibit greater parts-per-million failure rates. After five years in the field the difference can be more than a factor of ten.

Although a powerFET may pass initial testing, it has been demonstrated that,

Figure 3: Three-phase brushless DC motor configuration

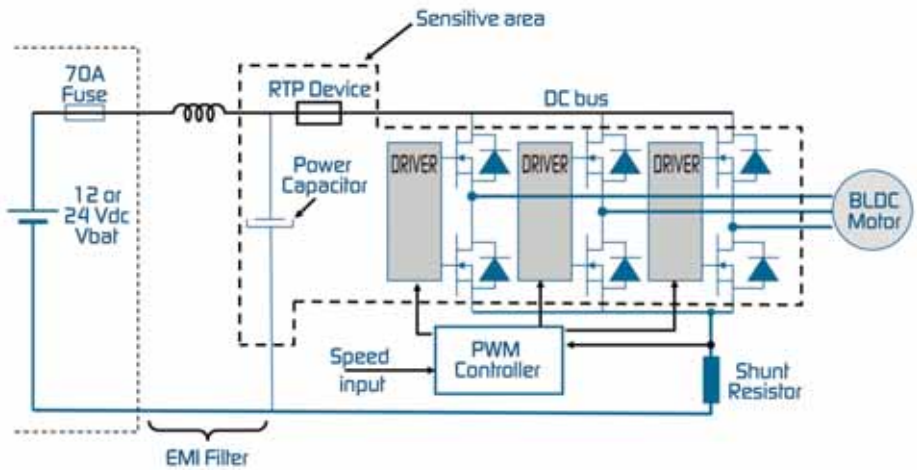
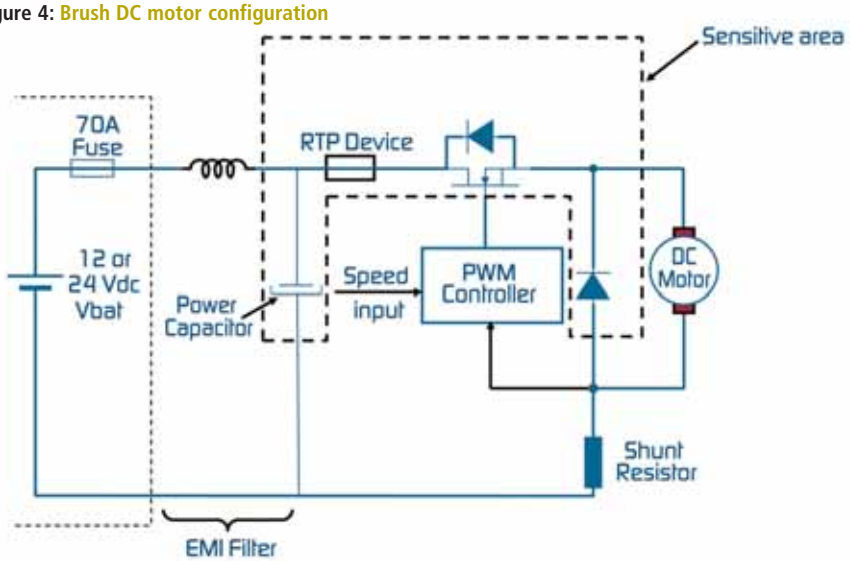


Figure 4: Brush DC motor configuration



given certain conditions, random weak points in the device can result in field failure. Even in situations where the powerFET is functioning within specified operating conditions, random and unpredictable resistive shorts at varying resistance values have been reported.

The resistive mode failure is of particular concern, not only for the powerFET but for the PCB. As little as 10W may generate a localized hot spot of more than 180°C, well above the typical PCB's glass transition temperature of 135°C, which can lead to damage of the board's epoxy structure as well as a thermal event.

Figure 1 describes a scenario where a failed powerFET may not generate a hard short overcurrent condition but rather a resistive short, therefore producing unsafe temperatures through I2R heating. In this case the resulting current may not be high enough to blow a standard fuse and stop thermal runaway on the PCB.

If a power component failure or a board defect generates unsafe overtemperature conditions a secondary protection device can be used to interrupt the current and help prevent a thermal runaway condition. As shown in Figure 2, when the RTP device is placed in series on the power line in close proximity to the FET, it tracks the FET temperature and opens the circuit before a slow thermal runaway condition can generate an undesirable thermal condition on the board.

Protecting Cooling Fan Modules

In most automotive cooling fan applications, powerFETs are used in the control modules to switch power to the fan motor on and off as needed. There are two typical motor configurations used in CFM applications: brush and brushless. Figures 3 and 4 illustrate the two configurations and the associated electronics, and define the sensitive area where power component failures could generate unsafe thermal runaway conditions.

In these applications, the RTP device helps prevent thermal runaway from generating a destructive thermal event. The device is placed in the sensitive area of the application and will open the circuit as soon as it sees a temperature above its opening temperature.

Although this article focuses on powerFETs, the RTP device also helps protect against thermal-runaway damage caused by capacitors, ICs, resistors and other power components that may crack or fail, or from the effects of any type of corrosion-induced heating.

To allow it to open at 200°C in the field, the RTP device utilizes a one-time electronic arming procedure to become thermally sensitive. Before arming, it can withstand three Pb-free solder reflow steps without opening. Timing of electronic arming is user-determined, and can be implemented to occur automatically at system power up or during system testing.

The RTP device's 200°C open temperature helps prevent false activations and improves system reliability, since it is a value above the normal operating window of most normally functioning electronics but below the melting point of typical Pb-free solders. As a result, the device will not open if surrounding components are operating in their target temperature range, but it will open before a component de-solders and creates the potential risk of additional short circuits.

Preventing Damage

The RTP device helps meet the reliability requirements of automotive power electronics systems such as cooling fan applications, as well as ABS, power steering, PTC heaters, etc. The surface mount device can be quickly and easily installed using industry-standard pick-and-place and Pb-free reflow equipment, and can withstand multiple reflow passes with peak temperatures exceeding well over 200°C and yet, in the field, will open if it detects a temperature above 200°C.

The device's thermal sensitivity is beneficial since, in some cases, failed power components may not generate a dead short circuit overcurrent condition, but instead may create a resistive short that cannot be opened by a traditional fuse. This type of event may actually reduce load current, but can still result in unsafe thermal runaway conditions. The RTP device helps prevent damage caused by both dead short circuit and resistive short circuit conditions. ●



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OUT WITH THE OLD, IN WITH THE NEW

KEN APPEL, MANAGER FOR REGULATED MARKETS AT VERITEQ, COMPARES COMPLIANCE, RISK AND COST OF OWNERSHIP FOR WIRED, WIRELESS AND STANDALONE MONITORING SYSTEMS USED IN HIGH-TECH MATERIALS AND PRODUCTS MANUFACTURE

Whether applications are mission critical that can affect public safety or involve high-investment operations, the need to be compliant with high manufacturing standards is clear. The method of data recording, reporting and archiving vary widely. However, the need to maintain good management and control to ensure accuracy, confidentiality and integrity of data is common in each case, especially when meeting requirements such as ISO 17025.

The cost vs benefit analyses for continuous monitoring modalities (wired or wireless networks and standalone monitoring instruments) are such that the economic costs of failure in the totality of monitoring systems are greater than ever before. All monitoring methods – whether wired, wireless or standalone instrumentation – need to be scrutinized for systemic weaknesses that allow human error to compromise product quality, system failure probabilities and overall costs of ownership.

This article discusses six approaches to monitoring critical environments for high tech products and materials manufacture such as clean rooms used in the semiconductor industry and with certain nanomaterials, paint booths used for high-precision coatings for aerospace components and similar materials and products where close monitoring of temperature and humidity is key to quality assurance. Quality, facility, IT and metrology managers employ different methods for maintaining the quality of products and information. This article will evaluate different monitoring methods and present the risks and costs of ownership for each.

Risks	Chart Recorders	Standalone Data Loggers	Wired—UPS only	Wired—PoE	Wireless WiFi	Wireless Mesh
Power outage risk impacts to data loss	Moderate (3-yr battery) to High (AC only)	Moderate—3-yr battery and data storage capacity	Low—dependent on device battery maintenance	Low—dependent on device battery maintenance	Low to Moderate—dependent on device and radio battery maintenance	Low to Moderate—dependent on device and radio battery maintenance
Human error risk—Adhering to maintenance schedules	Highest—charts, pens, batteries need frequent attention	High—data downloading before overload capacity and battery life	Lowest	Lowest	Low (if AC-powered)—Higher (dependent on battery replacement frequency)	Moderate—unpredictable drains on battery life require more frequent attention
Data security risks	High—paper chart data can be manipulated	Low	Low	Low	Moderate—access to data possible from outside facility	Low—proprietary networks prevent easy access
Risk of gaps in data records due to network downtime	Not Applicable	Not Applicable	Low—with redundant data capability, otherwise high risk	Low—with redundant data capability, otherwise high risk	Low—with redundant data capability, otherwise high risk	Low—with redundant data capability, otherwise high risk
Risks of IT training gaps and breakdown in IT staff turnovers	Not Applicable	Not Applicable	Low—Ethernet protocols widely understood	Low—Ethernet protocols widely understood	Low—WiFi protocols widely understood	Moderate—proprietary networks requiring additional training
Combined sources of human error posing risks to quality	High—frequent staff hours required to stock supplies, change paper & pens; check readings; retrieve records	Moderate—adherence to data download schedules required and to check for excursions and/or change batteries	Low—requires adherence to schedule of changing device batteries	Lowest—system least dependent on battery maintenance	Low—requires adherence to schedule of changing device batteries	Low to Moderate—requires adherence to schedule of changing device batteries and IT training on proprietary protocols

Figure 1: Risk factors

Modalities for Monitoring Critical Environments

There are many competing monitoring technologies and brands of systems purporting to provide for continuous environmental monitoring critical to many products' quality assurance programs. For purposes of this article we will examine six modalities for temperature and humidity monitoring: (1) wired systems with UPS power backups; (2) wired systems with UPS power backups and use of PoE (Power over Ethernet); (3) wireless WiFi; (4) wireless mesh; (5) non-networked/standalone data loggers; and, (6) chart recorders.

Briefly, chart recorders are the oldest technology – paper-based, powered either by AC or batteries. Standalone non-networked data loggers also use either AC or batteries and require manual

downloading of data at regular intervals. Wired networking technology has been around for decades. While this technology continues to evolve and remains the mainstay of most manufacturing operations where gap-free records of environmental conditions are key to controlling quality, wireless has fast become an interesting alternative.

Each method of communicating data has its advantages and disadvantages. However, the criteria for using one method over the other should be well understood. Figure 1 and 2 provide an overview of risk factors and cost-of-ownership differences between the continuous monitoring modalities. The chart in Figure 1 provides general guidelines only to risks to maintaining accurate records of clean room and other manufacturing environments requiring critical environmental controls. The chart in Figure 2 provides general guidelines only for some of the more salient factors affecting costs of ownership related to the six monitoring options. Varying plant sizes and scale of operations affect the impacts of various cost factors.

Cost of Ownership	Chart Recorders	Standalone Data Loggers	Wired—UPS only	Wired—PoE	Wireless WiFi	Wireless Mesh
Inventory costs required for operation	High—paper, pens, batteries	Moderate to Lowest with 3 to 10-year battery systems	Moderate to Lowest with 3 to 10-year battery systems	Moderate to Lowest with 3 to 10-year battery systems	Moderate to Lowest with 3 to 10-year battery systems	Highly variable depending on need to change batteries
Labor required for operation	Highest—daily or weekly maintenance	High—frequent data downloads	Low	Low	Low	Variable—dependent on need to change batteries
Costs for adding AC power or network cabling	Low	Low to Moderate	Low to Moderate	Low to Moderate	Lowest	Lowest
Labor costs for audit compliance	High—deviation reporting and manual retrieval & compilation of records	Moderate to High—deviation reporting and labor to show complete records	Lowest (with redundant data capability) to High (without redundant capability)	Lowest (with redundant data capability) to High (without redundant capability)	Lowest (with redundant data capability) to High (without redundant capability)	Lowest (with redundant data capability) to High (without redundant capability)
Energy and/or battery costs	Low to Moderate—dependent on battery type	Low to Moderate—dependent on battery type	Low to Moderate—dependent on battery type	Lowest—no local battery or AC, power required for PoE devices	Low to Moderate—dependent on battery type	Low to Moderate—dependent on battery type
Potential costs from human error	Highest—requires frequent human intervention	High—requires frequent human intervention	Low with redundant data, remote alarming & infrequent battery changes; High without these capabilities	Low with redundant data, remote alarming & infrequent battery changes; High without these capabilities	Low with redundant data, remote alarming & infrequent battery changes; High without these capabilities	Low with redundant data, remote alarming & infrequent battery changes; High without these capabilities

Figure 2: Costs of ownership factors

Paper-Based Chart Recorders

In the last decade, nearly every leading aerospace, semiconductor, nanotech or other high tech company that had relied on paper chart recorders has either replaced them with one network-based system or another or is in the thinking stages to do so. Chart recorders can still be found in the marketplace that cost as little as a few hundred dollars.

Most quality managers consider this obsolete technology due to both the considerable costs of maintaining chart recorder-based monitoring systems, and the obvious risks of handling paper-based records and limited or no alarm notification. It does not go unnoticed that chart recorders rely on humans for daily or weekly checks to replace paper, check pens and write deviation reports. In any event, costly staff hours must be devoted to tracking which charts need to be changed when, and which batteries need to be changed, in what intervals. AC-power based chart recorders without batteries offer no ability for continuous data records in the event of power outages.

The possibilities for human error are multifold. While customer audits will not reject chart recorder based monitoring systems, auditors will find confidence knowing manually-intensive processes have been replaced by more automation with the purpose of tightening up quality systems and make better use of quality resources.

Standalone Data Loggers

Unlike paper chart recorders, standalone data loggers are not as likely to break. They do however incur considerable labour costs for manually downloading data, especially in large plants where hundreds of data loggers are required to ensure environmental standards in clean rooms and other processing and storage areas. Operational costs for complying with customer requests for information and the interference on normal operations that quality audits can involve can be considerable.

As with chart recorders, the capability to access accurate and complete records throughout the record retention period is likely to be cumbersome and an interruption in normal production schedules if it takes too long to locate records or they are incomplete.

There are also multiple human-error sources with standalone data logger based systems. First, staff may neglect to download data before the storage capacity of the instrument is exceeded. Secondly, battery-powered standalone data logger systems also require ongoing monitoring of batteries, which also creates an opening for lost data, even when so-called battery alerts are in place, because someone has not been there to see it. Third, AC-powered data loggers without batteries may not provide gap-free records in the event of power outages.

If one thinks of technology investments as ways to automate routine tasks to eliminate the costs of labour and potential error any time there is human intervention, standalone data loggers do not generally pass muster. The reliance on human labour to download data, investigate deviations because they were not seen in time and maintain these files opens the door to auditor objections and the staggering costs that ensue with production delays. With the exception of monitoring the contents of a few chambers, standalone recorders put

undue risk on companies over other monitoring methods that automate more procedures and reduce reliance on human systems.

Wired Networks – With and Without PoE Capabilities

The semiconductor, aerospace and other industries requiring tightly-controlled manufacturing environments have long relied on a wired infrastructure using Ethernet standards for making the connection to transmit and receive data. A hard-wired network allows communications to proceed securely and continuously with few possibilities to intercept or interrupt the flow of data.

Uninterruptable Power Supplies (UPS) ensure that servers are always available for data exchange. However, a potential problem with data continuity of monitoring controlled environments arises with a power outage to the facility. The UPS maintains network uptime but devices connected to the network may be without power, which could mean loss of critical data. Until recently, traditional wired networks lacked a cost-effective alternative to maintain data flow with these critical devices.

Power over Ethernet (PoE), originally implemented for voice over Internet (VoIP) technology, allows electrical power and data to travel on the same Ethernet cable. Since 2003, companies have been integrating data and power standards on the manufacturing floor with PoE (IEEE 802.af) capable devices (see Advantages of PoE for Data Flow below). With PoE, security, maintenance and access can all be managed within an existing IT framework because staff is trained on setting up and maintaining communications networks based on worldwide standards.

ADVANTAGES OF POE FOR DATA FLOW

THE ADVANTAGES TO DEPLOYING A POE NETWORK ARE MANY:

(1) Saves the cost of running additional AC power, which usually requires a licensed electrician, aided by the low cost of network switches with built-in PoE power capability;
(2) Provides greater flexibility to locate devices around the plant because they can be installed wherever a LAN cable can be run;
(3) Increases data communication protection from power outage because the server's UPS provides backup to PoE connected devices;
(4) Uses less energy and managed from a central location; and most importantly:
(5) Protects critical data through the outage period.

Wireless Networks – WiFi and Mesh

For many high-tech products and materials plants, and especially those in older facilities where there are difficulties in running Ethernet cabling, wireless communications can be a convenient and cost-effective method of connectivity. Ease of installation, reduction in cabling cost, measurements in inaccessible areas are among the major factors driving the adoption of wireless networking.

Unlike the wired 802.3 international standard, several wireless communications protocols have emerged including the popular wireless version of Ethernet, commonly referred to as WiFi (802.11b and more recently 802.11g). Other network methodologies used for monitoring include a mesh structure based on the Zigbee (802.15.4) protocol.

WiFi is often the wireless system of choice because it uses the same IT infrastructure already in place in an organization. Wireless mesh (Zigbee) is a network architecture that uses access points or nodes to communicate with one another as well as with the host. It is designed to detect a degraded signal at one access point and reroute it to another nearby access point.

Nodes have a low power requirement, which has the expectation of less drain on battery life but, at the same time, low power inherently means less signal strength than WiFi. The low power requirement of Zigbee networks also means that there needs to be a sufficient number of nodes to maintain continuous data flow.

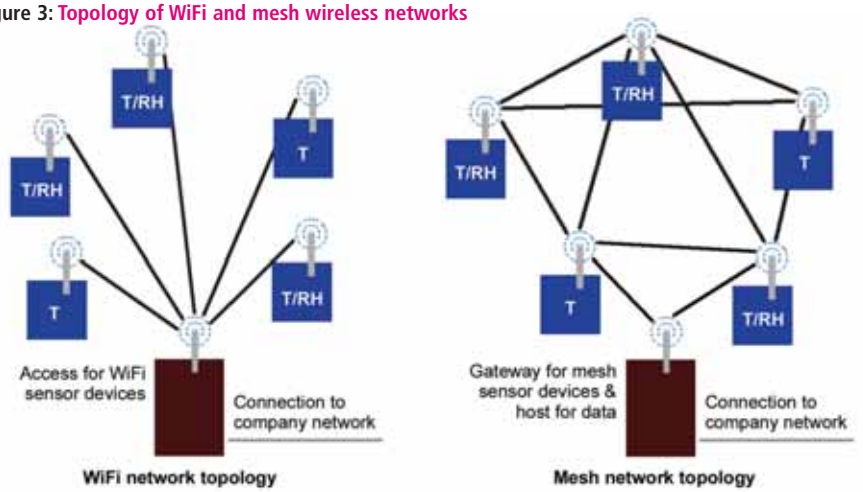
Whether WiFi or wireless mesh, the greatest downside is the possibilities for network interruptions such as those that occur when lift trucks move throughout a plant or when inventory is re-arranged, equipment is moved out of range or other potential obstacles to transmission and in turn the ability to ensure gap-free records. Fixed obstacles that could block the signal can be overcome using a sufficient number of wireless access devices. Intrusions from a fork lift or storage equipment, such as water-based gel packs or office modifications, may not be so well anticipated.

WiFi devices connect directly to the company network and uses WiFi access points to transmit data to a central host (server). Mesh devices connect to a gateway that can either host the data or forward to a central server.

The range for a wireless device is largely dependent on radio strength, which is also tied to the battery power. Installations using wireless monitoring technology have to accommodate signal range and barriers, which become important factors when continuous data is required. It can mean, for example, that more wireless devices are needed (and greater upfront cost) to ensure network transmission integrity in all situations.

With wireless mesh networks, signals are diverted to maintain data flow but this increases the load on other nodes picking up the signal, having implications for reduced battery life in unpredictable

Figure 3: Topology of WiFi and mesh wireless networks



ways. These type systems need a vigilant source for detecting and alerting for low battery issues well before data is lost.

With wireless systems, signals carrying critical data can also degrade from interfering sources such as other devices communicating in the same 2.4GHz band (WiFi & Zigbee), and in today's manufacturing plants this especially includes security cameras and Bluetooth devices. Wireless mesh is a proprietary network that needs to be integrated with the different standards of the existing infrastructure – involving IT hours, which potentially impact costs of ownership.

The batteries used in wireless devices are specified with 'up to' so many months or years of life. The 'up to' condition is often stated for ideal or labouratory conditions. This is because there are no typical operating conditions where power consumption can be calculated. Devices draw down battery power with each transmission, which includes the frequency of measurement updates established by the user, events such as alarms or communication problems brought on by many circumstances including a blocked access device.

Battery drain is even less predictable in a mesh infrastructure. For example, when the signal between a temperature device and node is blocked another nearby node picks up the signal for transmission. It now adds the new transmissions to those from other measurement devices it was already communicating with. The extent to which a wireless network requires battery replacements re-introduces human error potentials into what are assumed to be relatively error-proof automated systems.

Most connectivity methods have low risk of losing data when the time between real-time updates for data and alarms is long. For example, the initial requirements of a monitoring system may not have needed frequent data updates, but at some point someone may want to know if a chamber door was left open or other behavior that led up to a temperature or humidity excursion. In these instances, a faster sample rate would be needed, requiring more transmissions and thus making more demands on the battery. Reduced battery life is well and good if SOPs can anticipate the need, staff has the time for required maintenance without fail, and the expense of more frequent service (labour hours, replacements) are not burdensome.

Some devices provide low battery indicators and alarms. However, the question is: What happens to data if batteries are not replaced in time? Moreover, it is highly probable that data will be lost in systems that use the same batteries to power both the wireless radio and data memory electronics. Battery life, therefore, is not a minor specification but in fact has great impact on the ability to ensure compliant gap-free records and minimizing impacts of human error on quality assurance systems.

> Operational costs for complying with customer requests for information and the interference on normal operations that quality audits can involve can be considerable

Data Redundancy

Whether deploying a system of standalone devices, or a wired or wireless network for monitoring critical environments, the need to have a continuous record of data and events are the same. There will be times when the facility experiences network and power interruptions, among other unexpected disruptions. Assuming the need for a continuous record of quality, the monitoring system should be capable of filling in a database when temperature, relative humidity, pressure and other data cannot be communicated in real-time. This is nearly impossible and impractical with standalone monitoring instruments, making them obsolete technology.

In networked systems, recording data independently at the point of measurement is one key factor in protecting data. A system capable of identifying the time period of a communication interruption and bringing in data and events to fill the gap is essential to ensuring complete and accessible records. This assumes measurement devices have calibrated time-base clocks (specified with an accuracy over a temperature range) to ensure correct time/data recording.

> Battery drain is even less predictable in a mesh infrastructure

The capability to backfill data after power or network interruptions ensures a continuous record of data and events. Completeness of records also assumes there is an audit trail to capture all system events. Documented evidence of data and events during an outage will reduce quality management's involvement in having to review excursions and investigate deviations. Gap-free records save time during and after an audit, reduce unnecessary staff involvement and limit disruptions to ongoing production and shipments.

Data Security

There are two aspects of security: protecting data from unauthorized access and preventing alteration to data. Secure data begins at the measurement device and ends at a designated collection point, usually a network server. Secure access refers to specific levels of permission given to authorized users and other protocols for ensuring authenticity.

Devices communicate using protocols or common rules for data format and can be either open (public) or proprietary. An open protocol means just that – anyone who knows the rules can potentially access the files. A secure monitoring system ensures that the measurement device has a secure protocol in addition to other authentication and confidentiality features. This is a major factor in how and why communicating over wire is inherently more secure. In wired systems devices are only accessible within the building. A wired network can potentially be compromised only by someone who has already gained access to the facility.

On the other hand, wireless communications is inherently less secure and requires additional measures to maintain protections. Wireless devices are also manufactured with security features built in but may not be upgradable to the changing standards or security requirements of an organization. A capital investment made now may need replacement in two years time. Non-standard proprietary wireless networks require IT training and increased risk due to IT staff turnovers.

Quantify Risk and Cost

Whether you use standalone monitoring instruments or wired or wireless connectivity for your temperature and humidity measurement devices, it is

important to understand the limitations of each methodology. For the most part, the significant labour costs involved in standalone monitoring devices, combined with the multiple ways in which such systems insert human error potential, make them less than desirable compared to more automated network-based monitoring technology.

Wireless communication has the advantages of being flexible to install and providing for monitoring of environments that either have limited access to running cable or where refrigerators, freezers or other monitored storage units are moved on a frequent basis. Wired networks have the advantage of speed, security and data redundancy.

Generally speaking, if your goal is to reduce the risk of data loss to zero or nearly so, then wired systems are the best course. The lower upfront cost of wireless can disappear quickly if you have to write deviation reports from missing data, experience product loss or audit missteps. The good news is that connectivity technologies can be mixed – wired and wireless, solving the physical installation challenges that many facilities pose.

Of course network connectivity methods alone do not maintain product quality. They have to be used in conjunction with the capabilities of the facility's monitoring system, with specific attention to automating records – data, events, audit trail – that present a continuous gap-free history.

The details of how humans interact with systems, whether driving lift trucks, replacing batteries, downloading data, etc, are important factors in determining if a particular continuous monitoring technology truly minimizes risks introduced by the inevitability of human error. You have to weigh the costs of potential problems versus how much your organization is willing to invest to protect your operations. ●

MANAGING RISK

RISK REALLY COMES DOWN TO CONSEQUENCES OR THE IMPLICATIONS OF SYSTEM FAILURE. ANALYSIS OF RISK IS BOTH QUALITATIVE AND QUANTITATIVE. IDEALLY, YOU SHOULD BE ABLE TO ANSWER THE FOLLOWING QUESTIONS:

- **Can you afford to handle the expense of downtime? This can be in the form of missing data, equipment failure or human error.**
- **For an unplanned production stoppage, how long will it impact other research, production or shipments?**
- **What is the financial impact of losing product or materials?**
- **Can you define downtime cost either by time, lost production, blemish to reputation or other stakeholder pain?**
- **Can you identify single points of failure and ways to reduce them?**
- **Does it cost more to recover from equipment failure, product loss, internal and external reviews and other unplanned interruptions than it would to invest in continuous operation?**





THE ELECTRONICS BEHIND LIGHTING – PART 3

HAKKI CAVDAR FROM THE KARADENIZ TECHNICAL UNIVERSITY IN TURKEY PREPARES THIS FIVE-PART SERIES ON LIGHTING ELECTRONICS – THE FUNDAMENTALS, THE TOPOLOGIES AND THE TYPES OF BALLAST CIRCUITS USED. THIS THIRD PART DISCUSSES THE FUNDAMENTALS OF THE FLUORESCENT LAMPS ELECTRONICS BALLAST AND DESIGN

Fluorescent lamps cover a big portion of the lighting industry, especially indoor, home and office lighting.

The flourescent lamps are more economical while larger fluorescent lamps have been mostly used in commercial or institutional buildings. The compact fluorescent lamp is now available in the same popular sizes as incandescent bulbs and is used as an energy-saving alternative in homes.

Fluorescent lamps are negative differential resistance devices, so as more current flows through them, the electrical resistance of the fluorescent lamp drops, allowing even more current to flow. Connected directly to a constant-voltage power supply, a fluorescent lamp would rapidly self-destruct due to the uncontrolled current flow. To prevent this, fluorescent lamps must use an auxiliary device – a ballast – to regulate the current flow.

The terminal voltage across an operating lamp varies, depending on the arc current, tube diameter, temperature and fill gas. A fixed part of the voltage drop is due to the electrodes. A general lighting service T12 48 inch (1200mm) lamp operates at 430mA, with 100V drop. High output lamps operate at 800mA, and some types operate up to 1500mA. The power level varies from 10 Watts per foot (33 Watts per meter) to 25 Watts per foot (82 Watts per meter) of tube length for T12 lamps.

Fluorescent lamp tubes are typically straight and range in length from about 100mm (3.9in) for miniature lamps, to 2.43m (8ft) for high-output lamps. Some lamps have the tube bent into a circle, used for table lamps or other places where a more compact light source is desired. Larger U-shaped lamps are used to provide the same amount of light in a more compact area and are used for special architectural purposes. Compact fluorescent lamps have several small-diameter tubes joined in a bundle of two, four, or six, or a small diameter tube coiled into a spiral, to provide a high amount of light output in little volume.

The simplest ballast for alternating current use is an inductor placed in series, consisting of a winding on a laminated magnetic core. The inductance of this winding limits the flow of AC current. This type is still used, for example in 120V-operated desk lamps. Ballasts are rated for the size of lamp and power frequency. Where the mains voltage is insufficient to start long fluorescent lamps, the ballast is often a step-up autotransformer with substantial leakage inductance (so as to limit the current flow). Either form of inductive ballast may also include a capacitor for power factor correction through the tube.

Electronic Ballast for Fluorescent Lamps

The energy efficiency of fluorescent lamps can be further increased by 20-30% by operating at a high frequency (f > 25kHz), compared to the 50-60Hz magnetic ballasts.

Fluorescent lamps exhibit a negative resistance characteristic. This requires that an inductive ballast be used in series for stable operations. The ballast may be magnetic or electronics type. Electronic ballast offer many advantages

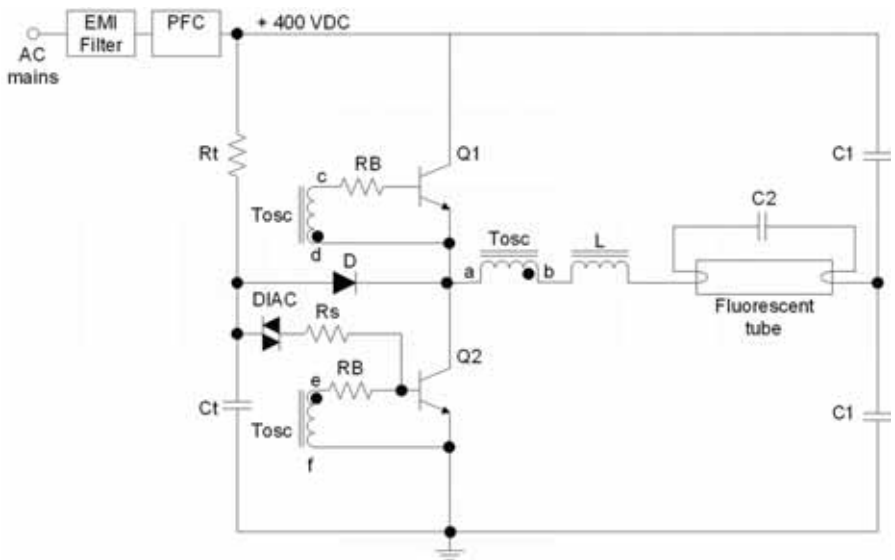


Figure 1: Fluorescent ballast using half bridge topology

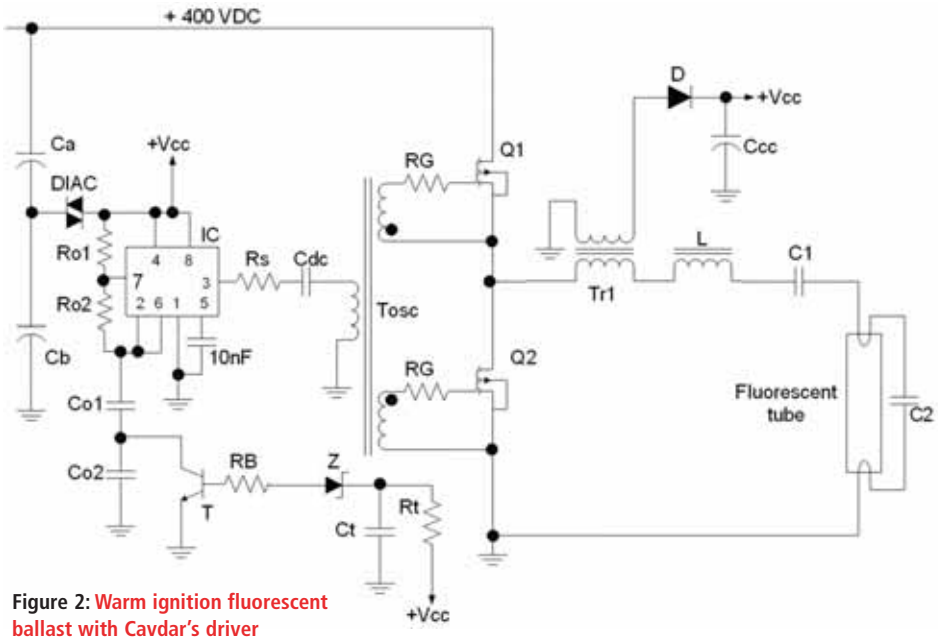


Figure 2: Warm ignition fluorescent ballast with Cavdar's driver

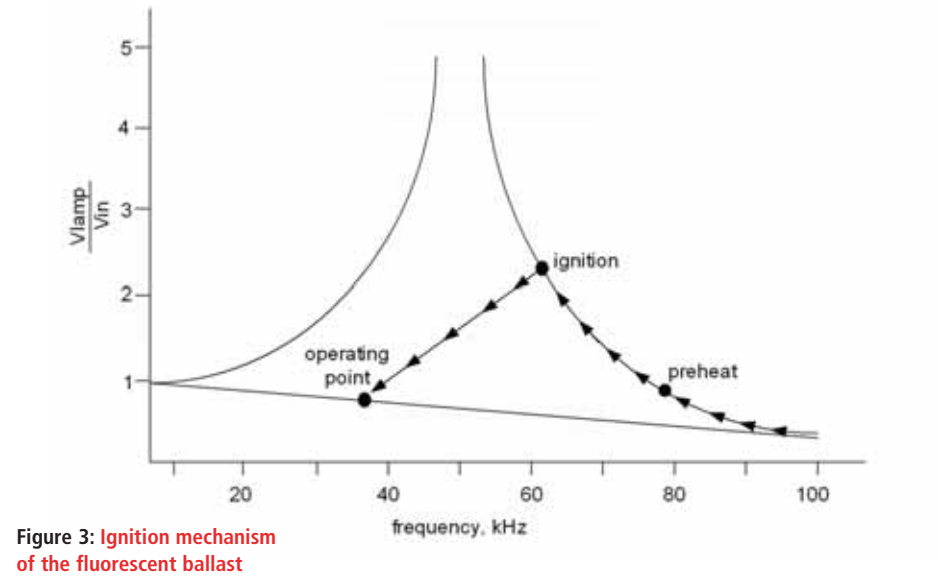


Figure 3: Ignition mechanism of the fluorescent ballast

including high efficiency, long lamp life, no flickering effect, noise-free operation, ignition quality and so on.

The main idea on the fluorescent electronic ballast is to create a power oscillator at the frequencies in the range above 25kHz for steady-state operation. Additionally, electronics fluorescent ballast must have the ignition system. The ignition is an important part of the fluorescent lamp setup; during ignition the lamp needs a much higher voltage range in relation to the normal operational voltage. The first generation of the electronic fluorescent lamps was developed by M. Bairanzade (Bairanzade, M., "Electronic Lamp Ballast Design", ON Semiconductor Application Note – AN1543-D, September 2000). The principal circuit diagram of the first generation electronics ballast is given in Figure 1; the ballast uses the half bridge topology. It is called a self-oscillating technique and it is a well-known method.

The circuit is given with the main elements and some protection elements. Q1 and Q2 operate as the switching elements of the half bridge inverter. A transformer, Tosc, is used in order to drive these switches.

Tosc includes three coils, one is primary on the power stage with a-b, and the others are secondary coils on the signaling side, with coils b-c and e-f. The magnetic coupling of the Tosc transformer is important; c-d and e-f secondary coils have an adverse magnetic coupling in relation to each other. The C1 capacitors have the same value.

The Q1 and Q2 bridge switches are in the OFF mode at the beginning. The circuit needs a triggering pulse in order to work as a power oscillator. The triggering pulse is obtained via the Rt, Ct, Diac, Rs and D elements. The Diac is generally selected as 33V. When main power switch is ON, the mains power is applied to the ballast, the Ct capacitor starts to charge via Rt. When the voltage across Ct reaches 33V, the Diac switches ON and this 33V across the Ct is the 'base' for the Q2 transistor. So, Q2 is ON and the power stage starts to work. Half cycle Q1 and the other half cycle Q2 are switched ON by Tosc.

Fluorescent lamps need the ignition before steady-state operations. At the instant of the ignition, the voltage value across the lamp should be several times of the nominal steady-state voltage. Firstly, the lamp has infinitive resistance before ignition. Therefore, the equivalent circuit of power stage is 400VDC, C1, C2, L, primary coil of Tosc transformer, and collector-emitter junction of Q1 or Q2 transistors. This serial resonance frequency is mainly determined by L inductance, C1 and C2 capacitors.

After ignition, the lamp has a finite resistance (Rlamp), smaller than the capacitive reactance of C2. So, the equivalent circuit is 400VDC, C1, Rlamp, L and collector-emitter junction of Q1 or Q2 transistors.

The resonance frequencies at the point of ignition and at the steady state can be calculated as follows:

$$f_{ignition} = 1/2\pi\sqrt{L(C_1C_2)/(C_1+C_2)} \quad f_{steady-state} = 1/2\pi\sqrt{LC_1}$$

As it is shown in the equations, the ignition frequency is bigger than the frequency of the steady state. Therefore, the lamp has higher voltage at point of ignition with respect to the voltage in steady state.

This topology has advantages and disadvantages. Firstly, it is an economical and simple design. This topology needs to use transistors as switching elements to produce the low driving voltage by Tosc. Transistors have higher switching resistance compared to power Mosfets when used as switching elements. So, the switching losses are high here.

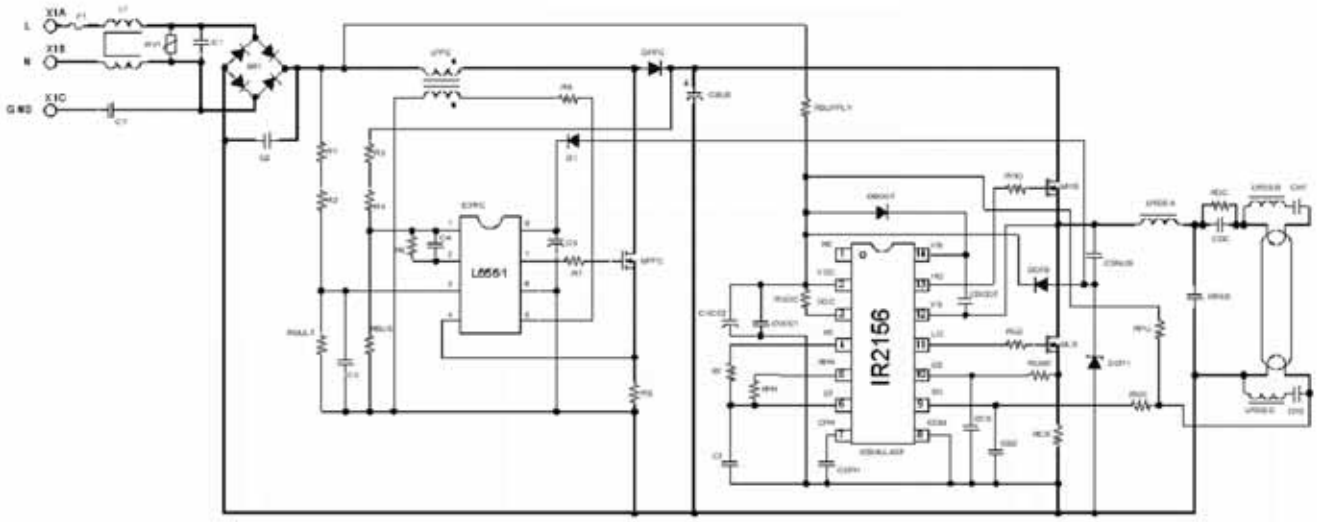


Figure 4: 32W fluorescent ballast with IR2156

This ballast operates in two modes: ignition and steady-state, not including the preheating mode before ignition. This may decrease the lamp life. For volume productions, this type of fluorescent ballast could be problem due to Tosc. In order to keep the operating frequency constant, Tosc should be designed carefully.

As mentioned earlier, power Mosfets and squarewave oscillators can be used to drive switches. Figure 2 shows the alternative solution for an electronics ballast for fluorescent lamps. In this design, transistors are replaced with power Mosfets in order to reduce switching losses and a LM555 is used to generate a square wave. The square wave is applied to the primary coil of the Tosc transformer via a DC filter capacitor Cdc. The only issue here is to provide the DC supply of LM555 at the starting point.

The power supply for the 555 at the starting point is provided from the 400VDC supply via the Ca and Cb capacitors. Here, Ca = 9Cb with the range of microfarads, so, Cb has approximately 40V. The Diac is selected as 33V and it delivers the voltage across Cb to the IC and oscillation starts. The required Vcc for the IC is obtained at the power stage by the Tr1 transformer. Ro1, Ro2, Co1 and Co2 are the elements of LM555 that determine the oscillation frequency.

Normally, Ro1, Ro2 and Co1 are enough for the oscillator but here Co2 is added to change the oscillation frequency. At the starting time, the total capacitance is equal to the parallel equivalent of Co1 and Co2, and the oscillation frequency is about 100kHz.

At the steady-state operation the oscillation frequency is only determined by Ro1, Ro2 and Co1. Q1, Q2 are the switches on the half bridge inverter. L, C1 and C2 are the serial resonance elements as explained above. This technique is called Cavdar's driver for fluorescent ballast with warm ignition.

Figure 3 shows the frequency sweep for a fluorescent ballast with warm ignition. The power oscillation begins at around 100kHz and stops around 30-40kHz. Ignition is realised at 60kHz in around one second due to the high voltage across the fluorescent tube. These frequencies are determined given the fluorescent tube voltage, wattage, C1, C2, L and power Mosfets parameters. ●

If you've missed Part 1 and Part 2 of this article, you can order their digital issue copies on line at **www.electronicsworld.co.uk**

MODERN DAY ICs

THERE ARE MANY MODERN ICS ABOUT FOR FLUORESCENT BALLASTS. INTERNATIONAL RECTIFIER (IR) ESPECIALLY HAS BEEN PRODUCING VERY USEFUL, COMPACT AND DIFFERENT ICS. ON THE OTHER HAND, IR HAS DEVELOPED A SOFTWARE CALLED 'IR BALLAST DESIGNER V4' (AVAILABLE AT: HTTP://WWW.IRF.COM/INDEXNSW.HTML). DIFFERENT TYPES OF FLUORESCENT BALLASTS CAN BE DESIGNED USING THIS SOFTWARE.

The software has five windows at its menu. These windows are:

- Input voltage ranges: 80-140 VAC, 90-140 VAC, 90-265 VAC, 185-265VAC and 24 VDC.
- Lamp power rate: 5, 7, 9, 10, 11, 13, 15, 18, 20, 25, 26, 32, 42, 55, 70 and 96 W.
- ICs: IR21571, IR2156, IR21592, IR2166, IR2520D, IR2161
- Configuration: single lamp/current-mode heating, single lamp/voltage-mode heating, dual lamp series/current-mode heating, dual lamp series/voltage-mode heating, dual lamp parallel/current-mode heating, dual lamp parallel/voltage-mode heating,
- Design: At this stage, ballast is designed and circuit diagram, bill of materials, magnetic component specifications are given as output files.

As an example, 32W fluorescent lamp ballast circuit is designed using the software with the following parameters: single lamp/voltage-mode heating,
90-265VAC input range, IR2156. Figure 4 shows the circuit diagram. L = 3.2mH, C = 3.3nF. Ignition frequency is 60kHz, preheating starts from 105kHz, operating frequency is about 30kHz for this design. L6661 is the PFC driver IC and it uses the step-up converter topology. The detailed information may be found on the IR web page.

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BUILDING A 'SMART DEVICE' USING THE FTDI VINCULUM-II – PART 1

JOHN HYDE FROM FUTURE TECHNOLOGY DEVICES INTERNATIONAL (FTDI) WILL IMPLEMENT A SERIES OF USB PROJECTS OVER SEVERAL ISSUES OF *ELECTRONICS WORLD*

This article looks into the USB capabilities of the Vinculum-II Dual Host/Slave controller (in this article we refer to a USB Slave rather than a USB Device). Here we will build a subsystem – as shown in Figure 1 – that fits between the PC and the keyboard/mouse and can record and playback keystrokes and mouse movements. This comprehensive example uses both Vinculum-II USB ports, one as a host and one as a device or slave, and will be implemented in stages so that VOS programming techniques can be demonstrated on the way.

You will discover that developing a USB host application or a USB device application follows exactly the same process as the GPIO and UART applications in the previous article (Electronics World, July); there will be more software to write since we have more data to handle but the staged implementation will make this easy to follow.

Figure 1 shows a mouse connected downstream of the keyboard; my keyboard has an integrated hub, many do, but if yours doesn't then we will add an external hub later in the project (when we add the mouse). I decided to start this project with the USB Host driver and the physical keyboard since this makes the example easier to explain.

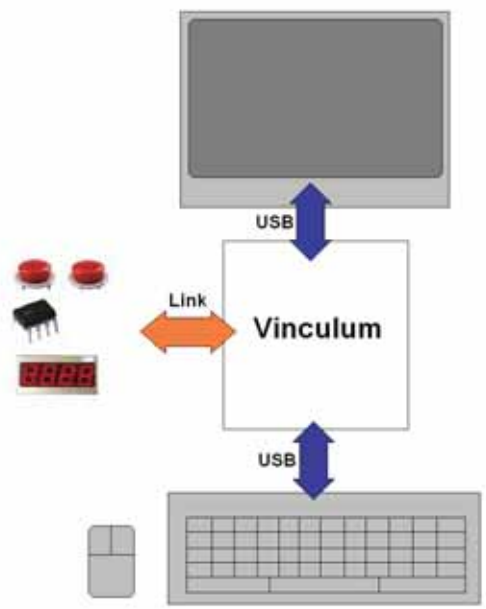


Figure 1: Creating a smart device

Main loop of DisplayReports:

```
while (1) {
// Wait for a Report to arrive
        i_vos_wait_semaphore(ThreadID, &DisplayReport);
// This thread now owns KeyboardMessage
// Display Report on V2EvalTerm
        ReportPtr = KeyboardMessage.ReportBuffer;
        Modifier = *ReportPtr;
        ReportPtr += 2;
        for (i=2; i<8; i++, ReportPtr++)
                if (*ReportPtr)
HidUsageToASCII(Modifier,*ReportPtr);
// Return ownership of KeyboardMessage
                i_vos_signal_semaphore(ThreadID,
KeyboardMessage.ResponseSemaphore);
                }
        }
```

Main loop of GetReports:

```
while (1) {
// Wait for a report to arrive from keyboard
        Status =
i_vos_dev_read(ThreadID,hDevice[Host],(BYTE*)&xfer,
                sizeof(usbhost_xfer_t), NULL);
        if (!Status) return dprint("Error (%d) ", &Status);
// Send the Report off to be processed
        i_vos_signal_semaphore(ThreadID,
Message>SignalSemaphore);
// Need ownership of Message to continue
        i_vos_wait_semaphore(ThreadID, &Returned);
        }
```

Figure 2: Threads are data consumers or data producers

Stage 1: Host Operation

Once started, the host driver will enumerate the device tree connected to a host port. The driver includes a HUB class driver and it will correctly walk down all connected hubs and identify devices. It builds a table of device interfaces; remember that a single USB device may contain more than one interface – this is called a composite device and is quite common. The host driver also sums all of the alternate interfaces so the resulting count can be surprisingly large. Most of the work of the new FindKeyboard thread is done in the WaitForKeyboard function in host.c.

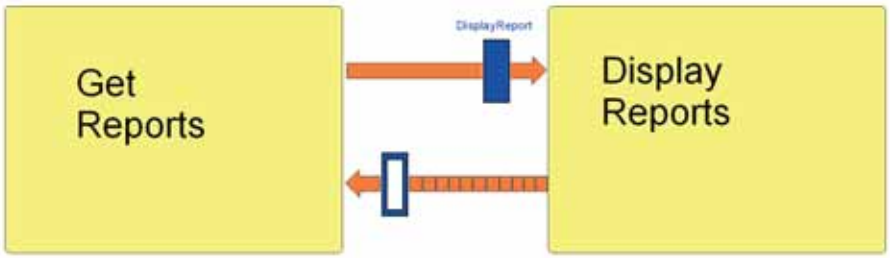


Figure 3: Message flow diagram of Stage 2

After waiting for enumeration to complete, we ask VOS how many device interfaces it found – we then query each interface to discover if it is a HID keyboard supporting the Boot Protocol. VOS does all the work for us and there is no real need to look at the descriptors. I decided, however, that it would be educational to display the descriptors of each attached device interface, so I wrote a DisplayDescriptors function that you can view in DisplayDescriptors.c. This allows you to plug random USB devices into the host2 interface and view its descriptors in the V2EvalTerm Window.

Returning now to our FindKeyboard thread in main you note that it doesn't do anything useful after proclaiming that a keyboard was found – this will be the topic for the next stage.

Stage 2: Serial-to-USB

The DisplayReport thread translates the fixed format keyboard report into ASCII and displays keystrokes in the V2EvalTerm window. The main loop of this thread, shown in Figure 2, is a typical "data-consumer" thread; it waits at the DisplayReport semaphore, receives ownership of the ReportBuffer, translates and displays the information and then returns the message to the sending thread. This allows GetReports to fill in the next report.

The work to fill the report is handled in GetReports that is called from the FindKeyboard thread. I moved the code to host.c due to its size (I like to keep main.c small and we have a lot more to add incrementing our way through the stages of this example). After some initialization the GetReports main loop, also shown in Figure 2 is a typical "data-producer" thread. It sets up a ReportReceived semaphore which VOS will signal once a report arrives from the keyboard then signals the availability of this report using the DisplayReport semaphore. Figure 3 shows a message flow diagram of Stage 2 – there are some key concepts that I must cover before we get too deep into this example.

Message Passing

I use the term 'message' to encapsulate a user-defined block of data. Think of it as a piece of paper with useful data written on it. Ownership of this message is important – if a thread owns a message then it may read and write data within it. On startup the GetReports thread owns the KeyboardMessage message and it will write useful data, such as a report from the keyboard, into this message. When the message is complete it "sends" it to the DisplayReports thread – I do this by writing to the DisplayReport semaphore and, using my definition, this means that the DisplayReports thread now owns KeyboardMessage so it can read and write within it. GetReports is not permitted to change KeyboardMessage after it has passed it to DisplayReports.

Once DisplayReports has finished with the message, it sends it back to GetReports so that it can write the next report on it. Again think of a message, or piece of note paper, passing between the two threads as the mechanism to exchange data. I implement this using two semaphores and a shared MessageType data structure. No data actually moves, in fact, I keep data copying to a minimum for good system performance, but this concept of message passing makes it easier to understand the flow of data amongst the threads.

Once a keyboard is found the FindKeyboard thread will spend all of its time in the GetReports procedure, in fact, the last few lines of the GetReport procedure. So I felt it reasonable to call this the GetReports thread in Figure 3.



Figure 4: USB device development uses a USB gender changer

Now attach a keyboard and type on it. The keystrokes that you enter will be displayed in the V2EvalTerm window. We have a serial-to-USB keyboard; interesting but probably not worth making into a product. Most people want a USB-to-Serial adaptor rather than a Serial-to-USB adaptor. This Stage 2 example has shown that it is straight forward to attach a human device interface (HID) to the Vinculum-II – we shall see in the later articles that connecting other device classes are also easy.

Stage 3: Device Operation

The Vinculum-II supports two USB channels and either can be a host controller or a device. Let's now look at creating a HID using the other USB port. Note that you must disconnect jumper JP5 (see V2Eval:Section 5.13) and we will need to attach the USB gender changer as shown in Figure 4. I should mention that FTDI has a ready-built driver that makes the Vinculum-II operate like a FT232 device – this works with the same PC drivers as a real FT232R so bulk data transfers are already done.

The EnumerateSlave thread waits for Setup packets to be sent from the PC then handles them. Most of the slave code is in Slave.c and you should view that now. All USB devices use descriptors to define their identity and the descriptors in slave.c define a HID keyboard with boot protocol. Initialize.c contains additional code to initialize the slave driver and to get handles for the slave's control and data endpoints.

Now build, download and run the Stage 3 project. I would recommend a USB bus spy, such as the Ellisys Tracker shown in Figure 4 when working at this low level of USB. The bus spy is connected in series with the V2Eval boards connection to the "target" PC and it is controlled by a different "development" PC as shown in Figure 5.

The Stage 3 program will enumerate our device/slave and the target PC will proclaim that another keyboard has been added. Using a bus spy and its required PC is not essential for this example but it will save you debug time when developing your own descriptors.

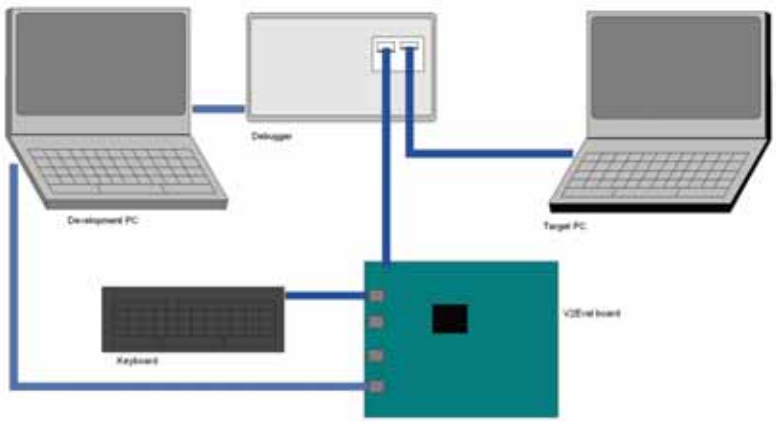


Figure 5: I recommend a bus spy for detailed USB work

Stage 4: Auto-Typer

For this stage I have added two threads, CreateKeystrokes and SendReports that share a KeyboardMessage and a SendKeyboardReport semaphore.

CreateKeystrokes is the producer thread that generates keydown and keyup reports exactly like a real keyboard does; it sends these to SendReports, a consumer thread, which sends them to the target PC.

Stage 5: Host+Slave Operation

We shall now combine Stages 2 and 4 to create Stage 5. I used the FindKeyboard thread from Stage 2 which now sends its reports using KeyboardMessage to the SendReports thread from Stage 4. The code within each of these threads is unchanged. I am combining two previously written threads to create new functionality. This is possible since each thread is self-contained and exchanges data using my standardized message passing mechanism.

Build, download and run the Stage 5 example code. You can type on the keyboard attached to the V2Eval board host2 port and the slave1 port will appear to the target PC as a real keyboard.

We have used Vinculum-II's USB host driver to enumerate real devices connected to USB port 2. We identified a keyboard and wrote a thread which collects keystroke reports. We created a message containing information about a keystroke report and sent this to another thread that used Vinculum-II's USB slave driver to send keystrokes to a target PC connected to USB port 1. We also have a debug console attached to Vinculum-II's UART driver which displays progress messages in V2EvalTerm's window. We have built a short circuit! But we have access to all of the data involved in these exchanges.

In the next article we'll see what we can do with this data. ●



EXTENDING THE REACH OF FREE BOUNDARY-SCAN TOOLS

JTAG Technologies has announced the latest extension to its popular JTAGLive family of boundary-scan powered design and repair debug tools for PCBs. JTAGLive Buzz-plus is an extension to the acclaimed free-of-charge Buzz tool that was launched in 2009.

While Buzz allows the user to sample activity on boundary-scan pins and test continuity of nets across a circuit board – and is free to all users – Buzz-plus extends the capability with a unique 'seek and discover' mode; that effectively learns the network of nodes for a specified net connection.

The JTAGLive family capitalizes on the boundary-scan resources found on today's high-end circuit boards. There is no need for a netlist since the tool uses just BSDL models of the compliant parts (usually freely available from IC vendors) to give the user access to all of the I/O pins for driving and sensing. The user can define up to two boundary-scan chains.

www.jtaglive.com/Products/Buzz





New PSGE40-65 Series Desktop Power Supplies Meet Level V CEC Requirements

The NEW PSGE40-65 Series of 40 to 65W desktop power supplies meet CEC Level V requirements for energy saving with no load standby power consumption of < 0.3mA. These compact desktop power supplies feature universal AC input of 90-264 VAC and DC output voltages of 12V, 15V, 16V, 18V & 24V. Output power ratings are 40, 60 & 65 Watts. Efficiency is > 87% minimum.

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www.powersolve.co.uk

LOWER PRICES ON ARCOL CARBON COMPOSITION RESISTORS AT RAPID ELECTRONICS

Rapid Electronics has reduced its prices on two popular ranges of high energy dissipation carbon composition resistors from Arcol.

One of the most popular types of circuit resistor, the RCC series is one of Arcol's best selling lines. Totalling over 140 individual lines, the 0.25W and 0.50W RCC series of axial lead resistors are available in a wide range of values, from 2.2Ω to 910kΩ. These solid carbon composition resistors have been designed for very high pulse capability and energy dissipation, and provide good stability and high reliability. They have 5% tolerance, low inductance and capacitance levels and a peak pulse voltage of 6kV on the 025 series and 10kV on the 050 series. Operating temperatures range from -55°C to +125°C.



The RCC series' carbon comp design provides much better pulse endurance compared to film type resistors, making the components ideal for all kinds of prototyping and development work, circuit assembly and audio applications.

www.rapidonline.com

Green Hills Software Enhances its Automotive Platform

Green Hills Software has enhanced its Automotive Platform to include a powerful new processor trace probe update, MULTI compiler performance and footprint optimizations, along with native support for the highly reliable and secure Green Hills INTEGRITY real-time operating system targeting Freescale Semiconductor's Qorivva family of automotive microcontrollers.

Today's automotive electronic control units (ECUs) are powered by incredibly sophisticated microcontrollers with numerous specialized processing elements that must be carefully optimized together to achieve the aggressive performance and reliability design goals set in place by the automotive OEMs and their Tier 1 suppliers. Developers require a correspondingly powerful set of development tools with highly reliable target software solutions to address these challenges.



The Green Hills SuperTrace Probe v3 recently received an upgrade that expands its support for the broad range of Qorivva microcontrollers by delivering 4GB of trace memory collection capability to this processor family with an option to upgrade to up to 8GB of memory.

www.ghs.com

Microchip Launches 60 MIPS and PIC24 Controllers

Microchip has introduced 60 MIPS 16-bit dsPIC Digital Signal Controllers (DSCs) and PIC24 microcontrollers (MCUs). Based on the next-generation core, the 60 MIPS dsPIC33 and PIC24 'E' devices offer more memory and higher integration compared to dsPIC DSCs and PIC24 MCUs with the previous-generation core. This includes 536KB of Flash memory, 52KB RAM, greater I/O capability with 144-pin packages, a USB 2.0 OTG interface and expanded motor-control, graphics, audio and real-time embedded-control capabilities.



To support the first nine dsPIC33 and PIC24 'E' devices, Microchip has launched two USB Starter Kits and five Plug-In Modules (PIMs) which can be used with its Multimedia Expansion Board, motor-control development kits and Explorer 16 development platforms. Also available are 30 software libraries and application notes on topics such as speech and audio, encryption/decryption, communications and motor control.

Microchip's dsPIC33E DSCs and PIC24E MCUs are fully compatible with the existing broad portfolio of dsPIC33F DSCs, PIC24H/PIC24F MCUs, software libraries and tools.

www.microchip.com/get/BDKV

MICROLEASE OFFERS NEW HIGH-PERFORMANCE AGILENT MICROWAVE PNA NETWORK ANALYSERS

Microlease will offer the latest in high-performance Microwave PNA network analysers from Agilent Technologies.

The five new models were unveiled at the International Microwave Symposium earlier this month and have a range of up to 67GHz. The new PNA series is based on Agilent's PNA-X architecture.

The range is suitable for testing a wide range of passive and active devices such as filters, duplexers, amplifiers and frequency converters. As well as component characterisations, the PNA is ideal for millimetre-wave, signal integrity and materials measurements.

The Agilent High-Performance Agilent Microwave PNA Network Analysers are available to purchase directly through Microlease or with flexible financial options. Lease, Easy Rent (a Rent to Buy option) and Easy Buy (12 monthly payments at zero interest). Financial solutions from Microlease and Agilent allow businesses to benefit from the latest equipment while spreading costs and helping cashflow.



www.microlease.com

Higher Performance Required from Measuring Instruments

Hameg has extended its popular HMO series by eight instruments (2-, 4-channel, 70 to 200MHz) with a starting price of only £1,025 – even including serial bus analysis (during the year of introduction).

Already with the new 2-channel 70MHz instrument HMO722, the serial triggering and decoding of I2C, SPI and UART/RS-232 protocols can be performed via the analog channels. With 3-conductor buses the external trigger input is also used. All instruments are MSO-ready and after buying a logic probe HO3508 they will be upgraded with eight logic channels.



Standard features are a powerful mask test, extended mathematics (e.g. integration or digital filters), an integrated source of square wave signals, up to 4 bits wide random or counter patterns, I2C, SPI and UART signals with different data rates and a component tester. Unique is also the sensitivity of 1mV/div, together with the lowest noise and a whispering fan.

www.hameg.com

APACER ROLLS OUT NEW SSD FOR INDUSTRIAL MOBILE DEVICES

Apacer has introduced two industrial SSDs (solid state disks) targeting industrial tablet PCs and rugged mobile devices. The new offerings include the 2.5-inch SAFD 25M3 and the 1.8-inch SAFD 18S3, both of which are storage solutions boasting thin profile and high speed.

The two next-generation ultra-slim SATA modular SSDs deliver high read/write speed of up to 115/90MB/s in half the size of typical 2.5-inch and 1.8-inch ones. They offer noiseless, shock-resistant and power-saving features and a small form-factor format.

Apacer's next-generation SSDs, SAFD 25M3 and SAFD 18S3 feature a superbly reliable SLC (single-level cell) flash memory and a built-in 7+15pin SATA connector. With a maximum capacity of 16GB, they can operate normally in harsh temperature environments ranging from -40°C to +85°C. The JEDEC MO-297-compliant SAFD 18S3 offers enhanced robustness while eliminating the concern of vibration with its screw holes on both sides, which help secure the SSD on the motherboard.



www.apacer.com



Premier Farnell Stocks 32-bit MCU Development Platform in Arduino Form-Factor

Premier Farnell is first to stock Microchip Technology and Digilent's first chipKIT 32-bit microcontroller development platform.

Microchip Technology and Diligent recently launched the first 32-bit-microcontroller-based, open-source development platform that conforms to Arduino hardware and software. Designed and manufactured by Digilent, a Microchip Authorised Design Partner, the chipKIT platform is the first 32-bit solution in Arduino form-factor in the industry to enable hobbyists and academics to easily and inexpensively integrate electronics into their projects, even if they do not have an electronic-engineering background. The platform consists of two PIC32-based development boards – Uno32 and Max32.

The chipKIT hardware is compatible with existing 3.3V Arduino shields and applications, and can be developed using a modified version of the Arduino IDE and existing Arduino resources, such as code examples, libraries, references and tutorials. The platform provides an unprecedented level of features for the Arduino community and four times the performance of any existing Arduino solution at a low price.

www.premierfarnell.com



LECROY LABMASTER 9 ZI-A OSCILLOSCOPE NOW OFFERS 36GHZ BANDWIDTH ON 4 TO 10 CHANNELS

LeCroy has announced that its LabMaster 9 Zi-A Modular Oscilloscope System now provides higher bandwidth at the same channel density with the addition of a 36GHz Acquisition Module. The new 36GHz capability is 20% more than previously offered by LeCroy at this channel density.

The higher bandwidth is desired by customers performing optical coherent modulation analysis at data rates of 28+ GBaud (112+ Gb/s) or for 10 to 28Gb/s electrical non-return to zero (NRZ) serial data testing. The new Acquisition Module can be configured in a LabMaster 9 Zi-A system to provide up to 10 channels at 36GHz and 20 channels at 20GHz, with analysis memory up to 512Mpts/ch. It is also backwards-compatible with previously purchased LabMaster 9 Zi-A "Master" Acquisition Modules. In addition, customers needing even more bandwidth than 36GHz can purchase LabMaster 9 Zi-A Modular Oscilloscope Systems that provide up to five channels at 45GHz.

www.lecroy.com

Arrow Electronics to Distribute ST's SPEAr Embedded Processors



Arrow Electronics EMEA has been chosen by STMicroelectronics (ST) as a specialist distribution partner for ST's SPEAr embedded microprocessor family.

The ST SPEAr family of embedded microprocessors offers powerful processing cores with performance of up to 3000MIPS and can manage external memory resources (DDR2/3, Flash) and a wealth of peripherals, while remaining flexible enough to serve a broad range of applications.

Combining an ARM926EJ-S 333MHz processor core with a rich set of audio, communication and connectivity interfaces, including those for Ethernet and USB Device/Host, I2C, the SPEAr3x0 MPU family is optimised to meet the particular challenges posed by human-machine interface, communications and security applications. The SPEAr600 delivers enhanced performance as a result of dual ARM926EJ-S cores, powerful connectivity features like Gigabit Ethernet, and a programmable LCD interface.

The recently-introduced SPEAr13xx utilises a dual-core ARM Cortex-A9 600MHz to deliver an optimised combination of processing performance and power reduction for next-generation communication and audio/video appliances.

www.arroweurope.com

FIBRE ADAPTOR IMPROVES OPTICAL INPUT OF SPECTRUM ANALYSERS

A new adaptor for use with the Yokogawa AQ6370 Series of optical spectrum analysers (OSAs) is designed to enhance the sensitivity, dynamic range and level stability by reducing the divergence of light emitted from the input fibre and increasing the input signal to the OSA by 5dB.

Using the new fibre NA adaptor on a GI50/125 multi-mode fibre results in the fibre's numerical aperture (NA) value being divided by two. The reduction in divergence of the optical input increases the monochromator optical throughput, producing a 5dB (factor 3) increase in signal strength, offering better dynamic range in passive component testing and better level stability in active device testing.

Covering the wavelength range from 350 to 2400nm and applicable to both single-mode and multimode fibres, the AQ6370 Series provides high wavelength accuracy of ±0.01nm, high wavelength resolution of 0.02nm, ultra-high dynamic range of 78dB (typical), wide level range of -90dBm and sweep speed of 0.2s/100nm.

www.tmi.yokogawa.com/ea



NEW HAL SOLAR PASSES ALL THE PV TESTS

Advanced new instrumentation has been developed for the fast and accurate safety compliance testing of photovoltaic (PV) modules during development and production. The HAL Solar from Seaward combines the performance of a multi-function production line safety tester.

Part of the extended range of specialist HAL electrical safety testing instrumentation, this highly versatile tester has been specially designed for the electrical testing of solar cells, panels and arrays in the production and lab environments to International Standards UL 61730, IEC 61730, IEC 61215 and IEC 61646.



The new tester incorporates DC Hipot (up to 6kV with dual display option uA or MΩ with arc detection) for Dielectic Withstand tests, insulation, ground/earth bond testing to 40A for larger PV modules and arrays with a fuse rating of 15A. It can also undertake wet leakage current test or insulation resistance test 1000V to 1GΩ.

It can be used to test other solar related components including connectors, junction boxers and inverters.

www.seaward.co.uk/clarehal-solar

Fully Integrated DMOS Motor Driver IC



The new A4950 from Allegro MicroSystems Europe is a fully integrated single full-bridge DMOS motor driver IC designed to drive DC brush motors with continuous output currents of up to 2.5A.

The new device incorporates two input terminals for controlling the speed and direction of a DC motor with externally applied PWM control signals. Internal synchronous rectification provides low power dissipation during PWM operation, while internal circuit protection features include over-current protection, motor lead short-to-ground or short-to-supply protection, thermal shutdown with hysteresis, under-voltage monitoring of load supply voltage and crossover current protection.

The internal PWM generator has an adjustable current limit which can be changed by the user using an external sense resistor. Integrated charge pump capacitors are also included to eliminate the need for external charge pump capacitors, reducing the pin count of the driver IC and minimising external component count and cost.

www.allegromicro.com

NEW 1.0MM PITCH INTERCONNECTS FROM HARWIN SAVE SPACE ON PCB

Harwin is introducing a brand new range of 1.0mm pitch interconnects. The new M40 series consists of surface mount pin headers and sockets, providing a new cost-effective solution for secure and highly reliable PCB-to-PCB connections. Benefiting from a low profile design and a dual beam contact system, the devices are aimed at design engineers seeking to reduce PCB sizes whilst not sacrificing connector reliability.

M40 series 1.0mm pitch interconnects are available in dual row format and feature gold-plated phosphor bronze contacts, surface mount solder tails and location pegs. Contact counts range from 2 x 3 up to a maximum of 2 x 25 positions. All components come packaged in tape and reel format for fully automatic pick and placement.



A typical application for the new pin headers and sockets are mezzanine PCB assemblies. The small contact spacing of 1.0mm makes these interconnects ideal for use in confined spaces.

www.harwin.co.uk

AVX's Land-Grid Array Capacitors Now Include 0805 2-Terminal Case Size

AVX Corporation has enhanced its land-grid array (LGA) capacitor product offering to include a low inductance 2-terminal 0805 package for advanced decoupling applications. Designated the LGC Series, the advanced capacitor is available with 100% tin and tin lead terminations to provide high-frequency performance similar to an 8-terminal interdigitated capacitor (IDC), making it ideal for design engineers in both commercial and military and aerospace applications.



The LGC Decoupling Capacitor Series provides capacitance values of 1.0uF at 6.3V and 2.2uF at 4V in an X5R dielectric formation across an operating temperature range of -55°C to +85°C.

The SnPb termination LGC Decoupling Capacitors are ideal for high speed decoupling of military and aerospace CPUs, GPUs, and server and networking applications.

Typical pricing for the SnPb termination LGC Decoupling Capacitor Series is in the $1.50 - $2.00 range with a lead time of about 12 weeks.

www.avx.com

Compact Energy-Harvesting and Power-Management IC from Maxim

Maxim Integrated Products has introduced MAX17710, an IC that integrates all of the power-management functions for ambient energy harvesting, as well as for charging and protecting micro-energy cells (MECs), a form of solid-state battery.

Operating at an ultra-low current level, the MAX17710 accepts energy from a variety of poorly regulated energy harvesting sources with output levels ranging from 1µW to 100mW. Examples include light (captured by photovoltaic cells), vibration (captured by a piezoelectric element), heat (captured by a thermoelectric generator), and RF such as near-field communications (NFC).

The MAX17710 integrates a programmable input boost regulator and needs no expensive external components to charge a MEC with energy sources as low as 0.8V. It protects the MEC by using a linear shunt-series regulator. An ultra-low-quiescent current, adjustable low-dropout linear regulator (LDO) with selectable voltages of 3.3V, 2.3V, or 1.8V allows the MAX17710 to adapt to a variety of loads.



www.maxim-ic.com

KONTRON AM4120 MODULE FIRST WITH FREESCALE QORIQ P2020 PROCESSOR

Kontron introduced its new universal single-width AdvancedMC processor module AM4120. This board is the first member of a new Kontron AdvancedMC product family with the Freescale QorIQ processors. The new AdvancedMC family is targeted to cost-sensitive applications as well as powerful data plane and control plane applications. The universal Kontron AM4120 offers cost sensitive AdvancedTCA and MicroTCA system designs long-term availability, support of various fabrics and an extraordinary performance-per-watt ratio.



The Kontron AdvancedMC processor module AM4120 is equipped with the Freescale QorIQ P2020 Dual Core processor with up to 1.2GHz and based on the Power Architecture e500. Application reliability is ensured with features such as the redundant universal bootloader U-Boot and persistent memory for cycle data storage. Furthermore, a dedicated Module Management Controller (MMC), which supports basic IPMI commands, is used for board management, enabling operators to monitor the status of the AdvancedMC module in the system, simplifying system management and improving availability.

www.kontron.com

Precision Mixed-Signal MCU for Portable Sensing Applications



ON Semiconductor now offers Q32M210, the first in a new family of mixed-signal microcontrollers for precision measurement and monitoring. Designed for use in portable sensing applications and built with the ARM Cortex-M3 processor, the highly-integrated Q32M210 provides a unique combination of high precision performance and predictable operation with exceptional power efficiency.

Q32M210 is specifically designed for portable sensing applications that demand high precision. The device features dual 16-bit ADCs, a highly accurate voltage reference, triple 10-bit DACs and 32-bit core. The ultra-low-noise ADCs offer true 16-bit performance unlike typical converters where non-linearity and noise can reduce the number of effective bits.

Operating at less than 400 microamperes/Megahertz (µA/MHz), Q32M210 is extremely power efficient, helping to extend the battery life of end products. The ultra-low-power sensor interface, flexible clocking architecture, multiple operating modes (active, standby and sleep) and intelligent power-supply monitoring feature make Q32M210 the most power efficient microcontroller in its class..

www.onsemi.com

CONDUCTIVE ELASTOMERS FOR RFI/EMI SHIELDING



Kemtron manufactures a range of conductive Elastomers as gaskets and gasket strip for emi shielding of electronic devices. The base Elastomer is silicone for normal environments and Fluorosilicone for fuel and oil resistance, both offer a wide temperature range of -40degC to +160degC and up to +200degC for some grades. The conductive fillers available are silver plated aluminium, silver plated copper, pure nickel and nickel coated graphite, with others available to special order.

The manufacture of a conductive Elastomer is a balance of conductive particle loading and distribution throughout the silicone base; the distribution must be sufficient to ensure that the particles are in contact with each other for good conductive path through the Elastomer, but without too great a loading to cause the silicone to lose its elastomeric properties. In general the conductive Elastomer will have a shore A hardness of between 60 and 75 depending on grade and still maintain good tensile strength.

www.kemtron.co.uk











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New CPX400DP bus interfaced PowerFlex dual PSU

The new TTi CPX400DP was developed from the best-selling CPX400A. As well as a comprehensive set of remote control interfaces it also offers some important new manual control features.

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HOME OF THE FUTURE ONE STEP CLOSER

Intelligent homes which can manage energy usage, monitor security and support independent living for the elderly and disadvantaged are closer to becoming a reality.

Researchers at De Montfort University Leicester (DMU) have been developing an international framework that will enable products and applications from different suppliers to work together in the same house. Their work has now been adopted by CENELEC, a European standards organisation, as a new standard.

One of the key challenges facing future technology is interoperability: ensuring products and appliances do not interfere with each other's operation and that they are able to communicate with each other in a consistent way. For example, a security system could work with another supplier's web application to enable remote monitoring. Interoperability standards enable such services to work seamlessly together.

During the project, researchers developed an international standard to allow manufacturers to create new products and applications that work in harmony with each other, regardless of which company made them.

MAURIZIO DI PAOLO EMILIO, Telecommunications Engineer, INFN – Laboratori Nazionali del Gran Sasso, Italy: Smart homes have been viewed with increasing interest by both home owners and the research community in the past few years. One reason for this development is that the use of modern automation technology in the home or building promises considerable savings of energy, therefore, simultaneously reducing the operational costs of the building over its lifetime. Energy efficient homes have low voltage using appliances and modern insulation that will not break down over time. These homes are well thought out and planned. They use only materials that will stand up against the test of time; that will not crack and wear down, like wood and plaster in older homes do.
While newer homes offer the latest in technology, many people have a difficult time adjusting to this new efficiency.

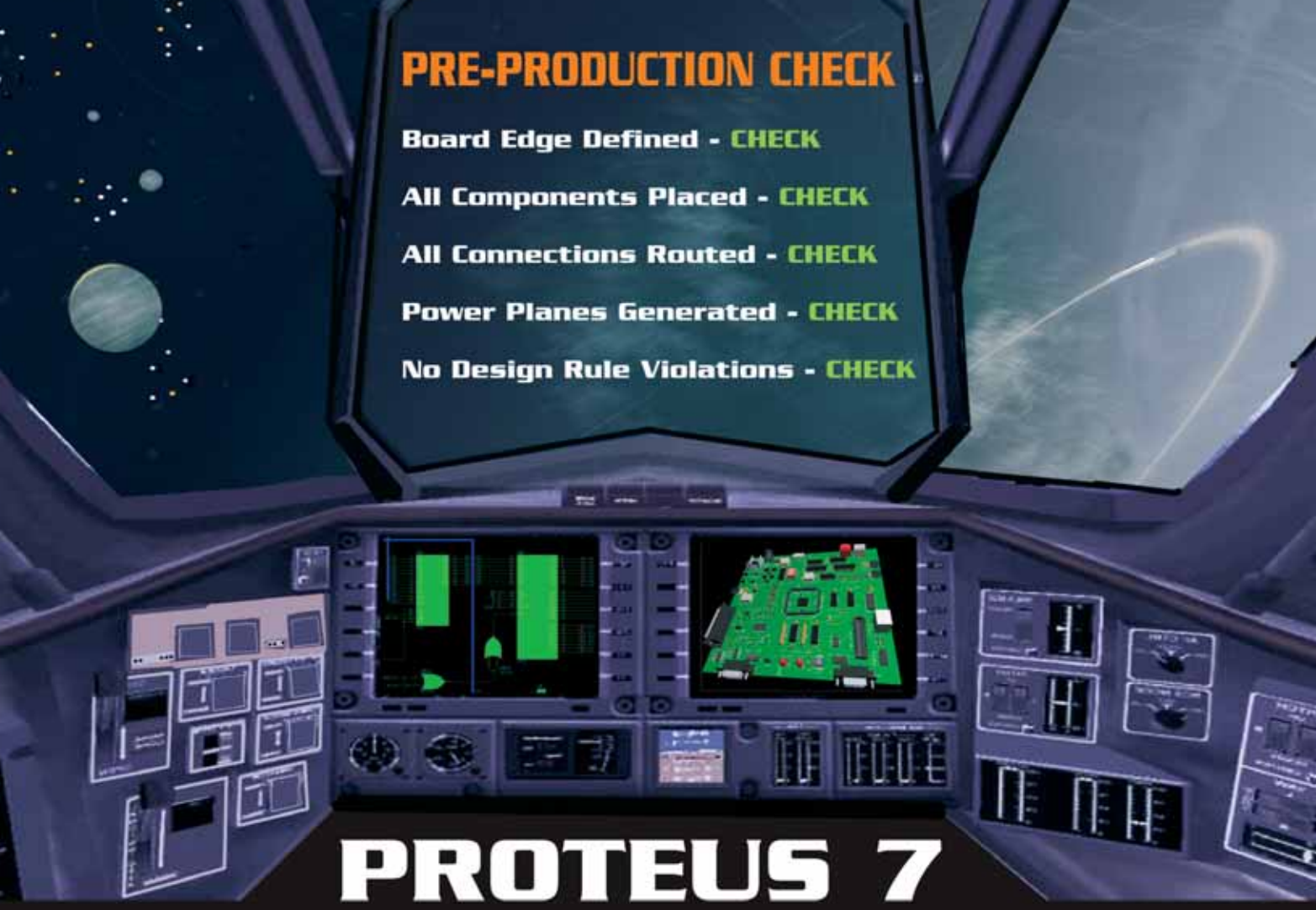
BURKHARD VOGEL, Managing Director, Germany: The goal of making things at home interoperable is highly desired. In addition, producing the corresponding standards is a must. However, to make these things operable for the elderly, I strongly recommend the participation of the elderly in the development process too.
But, due to the many web and mobile phone shortcomings concerning security, I would like to warn strongly of any web and mobile phone-based applications and standardizations. Therefore, remote monitoring of home security systems and/or of such systems that might damage parts of the home – or the home as a whole – after an unfriendly web or phone attack should not become a part of the project work. To overcome these threats we need other approaches that should not be part of the described efforts.

HAFIDH MECHERGUI, Associate Professor in Electrical Engineering and Instrumentation, University of Tunisia: The idea of exploiting modern technology in the smart home is encouraging but needs to be standardized. This project can be a reality if an international coordination of communication means exists.
The smart house's uses of telecommunications, computing, video monitoring etc means developing control and management systems and radio frequency chips to communicate remotely, necessary to achieve such a scenario.

> To make these things operable for the elderly, I strongly recommend the participation of the elderly in the development process too

PROFESSOR DR DOGAN IBRAHIM, Near East University in Nicosia, Cyprus: Interoperability is currently one of the fundamental problems in most technological products we use at home. Most products at home come from different manufacturers and, usually, they are not compatible with each other. Perhaps the most common example is the large variety of incompatible mobile phone chargers most of us have at home.
The international standard IFRS is a major development as it will allow different manufacturers to develop products that can work together, regardless of the manufacturer. This is very important as it will bring the concept of intelligent homes one step closer to reality, and we shall see greater variety of home automation products at lower costs – all working in harmony.

BARRY MCKEOWN, RF and Microwave Engineer in the Defence Industry, and Director of Datod Ltd, UK:
Interoperability is a serious issue which is much misunderstood. It was one of the CEOs of HP who stated that "marketing is too important to be left to marketing". He overruled marketing and permitted the HPIB to become an IEEE open standard. Unless and until CEOs give this issue their attention then this group can only gather information and raise awareness. Indeed, this matter usually raises in the public mind the power connector issue for mobile phones and the proprietary interface connectors of other consumer products, whereby marketing do not want a competitor's product being able to connect with theirs.
If they really wanted to understand the vested interests at play here they would case study this issue with military products.



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