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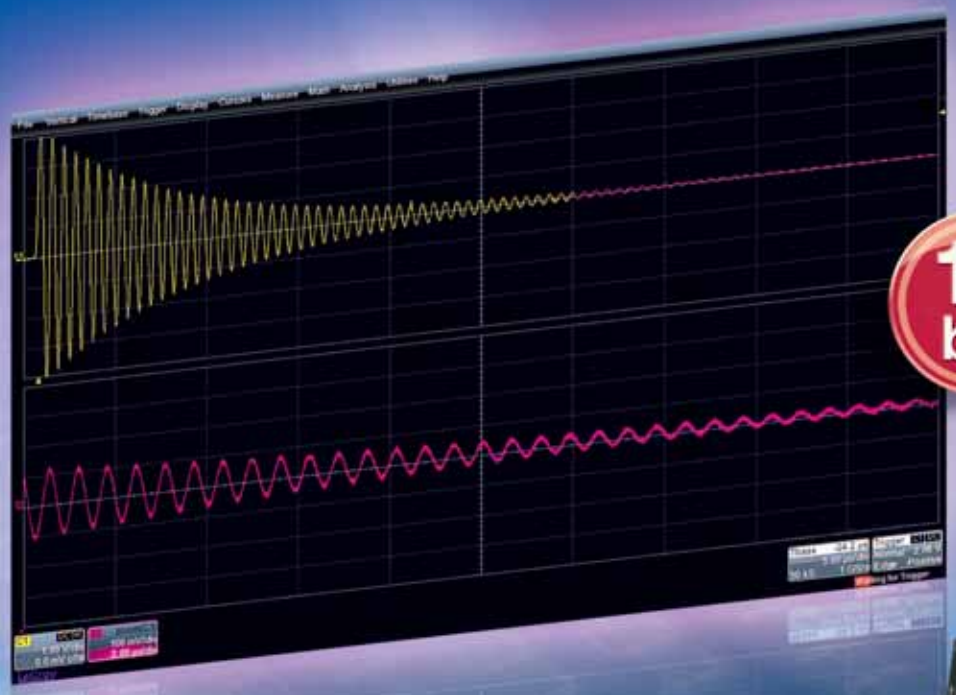

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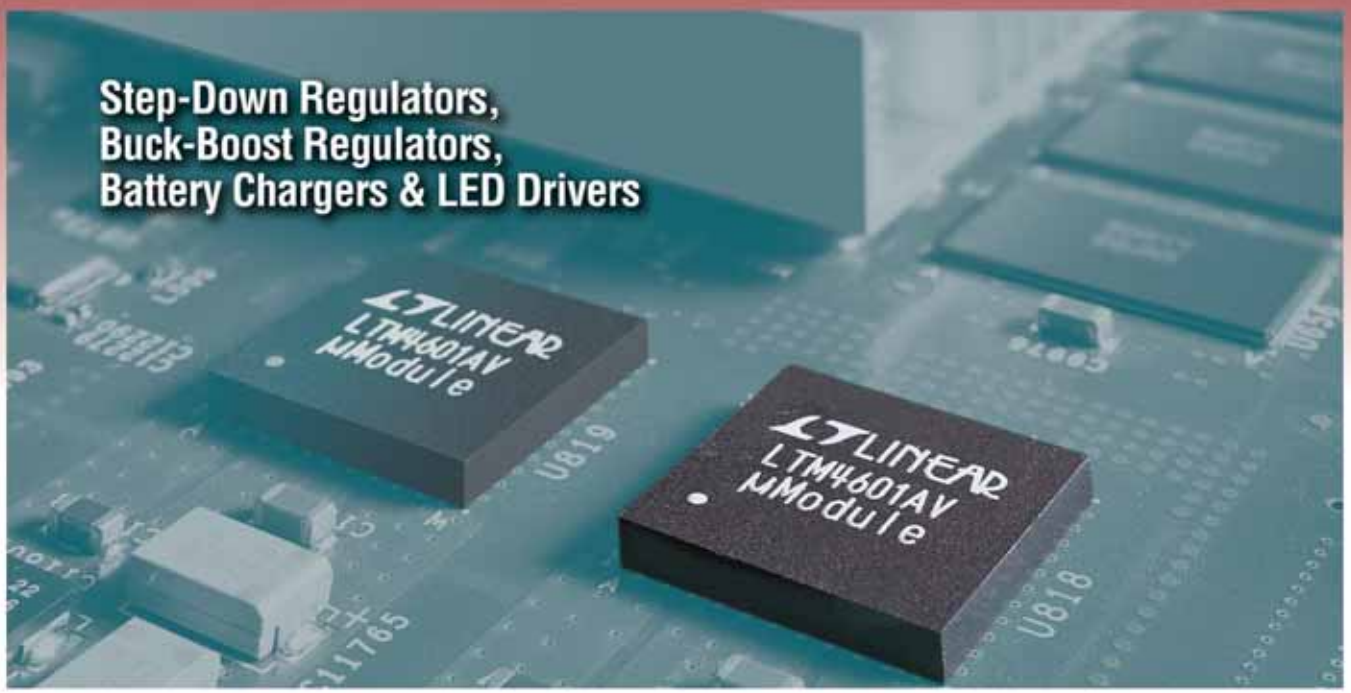
µModule Power Products



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CONSUMERISATION OF ELECTRONICS THROWS FRESH CHALLENGES TO THE SEMICONDUCTOR INDUSTRY

With the industry moving towards a consumer-driven product lifecycle, semiconductor companies are being expected to churn out products faster

The fast-growing consumer electronics market and the shift towards devices targeted at the consumer rather than the enterprise user has resulted in consumer demand for electronic products commanding close to 60% of semiconductor sales today. Industry experts only expect this trend to continue.

The consumerisation of electronics will demand a number of changes to the way the semiconductor industry operates. To keep pace, semiconductor companies will increasingly need to build product differentiation, ease time-to-market and time-to-revenue pressures, lower costs and manage the unpredictability of the consumer-driven product cycle.

The rhythm of the end customer in a consumerised era is fundamentally different to the enterprise customer. The consumer is not willing to wait for a product if it doesn't offer substantial differentiation when they can choose instead between readily available clones.

Today's consumers demand feature-rich electronic devices, both in terms of individual functionality and cross-product integration, connectivity and convergence with new technologies such as LTE 4G. To meet this demand, semiconductor companies need to provide a full working system, with more software content encapsulated within the silicon.

In addition, consumer-driven product cycles demand more localised products/variants. To arrive at these, semiconductor companies need in-depth knowledge of local markets. This is resulting in a move towards 'derivative products' and re-engineering of existing product lines for emerging market requirements of cost and functionality, particularly in domains like mobile devices and consumer electronics.

With semiconductor companies needing to release multiple customised solutions in market to achieve product differentiation, but without incurring substantial costs, one model that is increasingly being adopted is to use a design service provider to handle all derivative products. This outsourced relationship allows the semiconductor company's R&D team to focus on developing key product differentiators.

Semiconductor companies are getting more closely involved in the conceptualisation and design of the end product of their OEM customers, and are expected to visualise multiple variants spanning at least two generations of products. This is being attempted by developing platforms to give the product manufacturer a time-to-market edge. However, greater feature integration at subsequent stages makes it challenging to meet faster time to market needs.

How can the semiconductor industry address this challenge? Leveraging the silicon design ecosystem effectively can help semiconductor companies meet time-to-market and time-to-revenue needs. The well-established ecosystem of IPs, design service partners, strong electronic design automation (EDA) and process/manufacturing networks can be invaluable in helping semiconductor companies achieve a faster time-to-market.

Reusable blocks – IP and tools – can help semiconductor companies lower production costs while managing margin pressures. However, assembling and reusing the blocks isn't always hassle-free due to the tweaks required for some reusable blocks. Selection and verification of the optimal reusable block and integration of the block in the design is also a common challenge. Involving partners with expertise in integrating disparate blocks, instead of developing everything from scratch, can go a long way to helping semiconductor companies overcome these challenges and lower costs. Semiconductor companies can also consider globalising the R&D workforce – through their individual centers or partners – to lower R&D cost levels.

Consumer-driven product cycles come with market risks of demand volatility. Semiconductor companies face phases of very strong demand, varied with phases of low demand, depending on the market requirement for electronic goods. This applies tremendous pressure to bring out more variants, with minimal cost, in shorter development cycle, when demand exists.

To better manage such risks, semiconductor companies are increasingly resorting to keeping their R&D spend variable, particularly for non-core parts of design development. They are engaging mature design services partners in a risk-sharing business model, which would mean shared financial goals and market risk, strong collaboration and deep involvement in strategic decision-making early on in the design cycle.

Looking ahead, the ecosystem is going to play an important role in the consumerised electronics world and increased collaboration with service providers will help semiconductor companies meet the dynamic needs of a consumer-driven product lifecycle.

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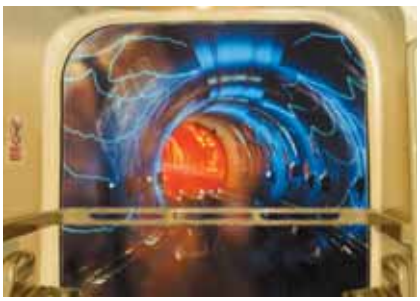
Shanghai Bund Sightseeing Tunnel Uses Élan Digital Signage



The technologically-enhanced sightseeing tunnel located along the famous Shanghai bund

Onelan's digital signage solutions have been used in a novel sightseeing tunnel in China. Onelan installed its 510 Net-Top-Box to drive two 47" screens at the Puxi entrance of the sightseeing tunnel located along the famous Shanghai bund, which connects the Puxi to the Oriental Pearl Radio and Television Tower in Pudong.

The tunnel's layout was enhanced by dynamic video and images, and easy drag-and-drop function using the FTP server allows digital photographs of visitors to be displayed almost instantaneously on the TV screens. The state of the art display system offers the ability to play high-definition MPEG videos and JPEGs; crystal clear sound system to broadcast audio content; easy picture file transfer via FTP to enable rapid display to screens; and attractive and dynamic content creation, among others.

The Net-Top-Box is a multimedia, multi-zoned solution capable of touch interactivity. With a browser-based user interface, the system is fully multi-lingual and capable of displaying both stored media and live media such as RSS feeds, webpages and broadcast TV or locally streamed video.

"Onelan's system has created endless marketing possibilities for the sightseeing tunnel and has increased our visitor revenue," said M. Yang, Bund Sightseeing Tunnel's Staff Supervisor.

GENT BY HONEYWELL LAUNCHES ITS FIRST HYBRID WIRELESS FIRE SYSTEM

Fire Industry expert, Gent by Honeywell, is launching its first ever wireless fire detection system, Plexus, incorporating a unique technology which offers the ultimate level of integration and user confidence.

Plexus brings the best of both worlds to fire system designers by allowing the flexibility of wired and wireless devices on site. The designer can now specify wireless devices when building constraints prohibit the use of cables and disruption to the buildings or the activity within them needs to be minimised. In areas of buildings where cables can be run without detriment to the building fabric, wired devices can still be used.

The innovative radio technology employed by Plexus was initially developed for the petrochemical industry and offers a reliable and resilient method of wireless communication. Whilst other radio fire systems need every detector to relay signals to a single transmitter, the Gent system ensures that every device on the radio loop can relay its own signal, as well as the signals from other devices nearby, to maintain the connection.

The new hybrid system works using an integrated wireless approach, incorporating up to 10 radio loop transceivers, each acting as a gateway between the wired and the wireless system. The wireless devices use the same addressing and labelling structure as the wired loop thus allowing seamless integration. Wireless parameters such as battery life, device type and device status are reported back to the main Vigilon panel to enable the full system to be managed from a single point.

The system supports call points, sounders, strobes and a comprehensive range of sensors that incorporate Gent's renowned multifunctional S-Quad technology.

Gent by Honeywell combines wired and wireless devices to create a high-tech fire detection system

NEWS IN BRIEF

Rhodia Aroma Performance and CEA-Liten have joined forces to offer a sustainable solution to the energy needs of the electro-mobility markets, addressing electric vehicles and portable electronic devices such as computers and mobile phones.

The partners are collaborating on the side of technical performance and safety of electrolyte batteries; in a Li-ion battery, LiTFSI is used for electrolyte – the conductor environment in which ions are moving and thus creating electric current.

"The safety, autonomy and cost of Li-ion battery systems are the top concern of the mobility market and a guarantee that must be provided to consumers," said Didier Marsaq, Director of CEA-Liten.

Cambridge Consultants has released a report discussing the foremost business opportunities in wireless technologies enabled by White Space frequencies and even predicting the development of the first White Space consumer devices in the next five years. The report entitled '*White Space radio: High Street Hit or Left In the Lab?*' states that the use of White Space radio is an inevitability, addressing a critical need for redressing methods of spectrum usage and opening up new possibilities for wireless devices in a 'always on' society.

Deemed the 'White Space economy', the report considers the new business opportunities for a range of industries but also the revenue generation from such opportunities.

Anvil Semiconductors, created by the University of Warwick, promises to revolutionise semiconductors by developing smaller, more efficient power converters using innovative Silicon Carbide (SiC) power semiconductor switches.

SiC devices are able to withstand higher voltages and currents and are ten times faster than traditional silicon devices. However, they are also currently ten times more expensive to produce, a factor which has prevented the material being widely adopted.

Anvil Semiconductors has received an investment of £25,000 from Midven's Early Advantage Fund, £125,000 investment from private investors group Minerva and an R&D grant from the Technology Strategy Board.

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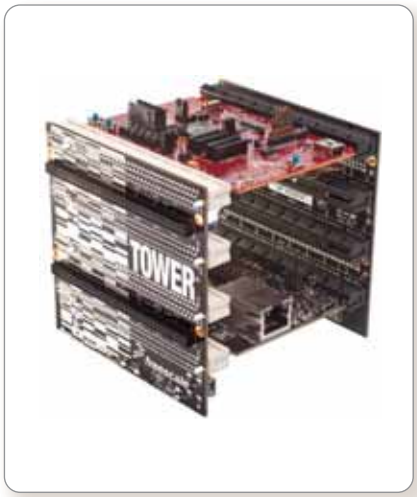
DRIVING GROWTH
through new products and eCommerce

As the world's leading high service distributor of electronics and maintenance products, RS Components serves 1.6 million customers worldwide. This figure is estimated at double the customer base of the company's nearest rivals, reaching twice as many engineering teams globally.

Ensuring the right product offering is key to RS's success. In practical terms, this means having the most comprehensive product range available to all customers on a global basis. To support this objective, over the past year RS has added 76,000 new products to its portfolio sourced from leading suppliers, growing the global range to over 550,000 products.

The global electronics market has on average grown at around twice the rate of global GDP during the past year. To capture this growth opportunity, RS adopted a strong customer-focused business strategy to offer the widest possible product range with the quickest delivery. Around 37,000 new electronics products were introduced during the year* from leading suppliers such as Analog Devices, Texas Instruments, Panasonic, and TE Connectivity. This investment has driven a 60% growth in RS's global semiconductor sales in 2011*, and a 30% growth* in the company's overall electronics business.

Quick to recognise that technology enables enhanced relationships with customers, RS embarked on a strategy to connect with electronics engineers by



creating an innovative online environment for sourcing information, tools and services, to provide a reliable support service at every stage of the design process. Since its introduction in July 2010, RS's DesignSpark has become the fastest growing online community for electronics engineers, with more than 80,000 members now registered. In addition, DesignSpark PCB, the free online design software tool and the key driver to the site, has recorded more than 100,000 downloads since its launch, while there have been more than 30,000 downloads of RS's free comprehensive library of certified 3D CAD models of electromechanical components. These tools have enabled RS to build a direct relationship with this important customer segment and drive additional sales through this channel.

RS operates an unparalleled global multi-channel service, with eCommerce at its heart, combining the Internet with the traditional catalogue; field sales, who understand customer needs; internal sales, who provide instant support for customers; cyber sales, via pro-active live chat; and eTech magazine, the

company's highly interactive publication which is available as an iPad app. eCommerce allows customers greater flexibility in the way they purchase their products, and greater convenience, helping them to find and buy the products they need. The new RS website, launched earlier this year, allows the customer's entire search and navigation journey on the RS website to be tracked, and Search Engine Marketing enables that research and demand to be converted into sales.

RS's new product introduction strategy is a vital component in the company's growth, with thousands of new lines being launched from a broad range of leading suppliers over the coming months. By the end of December 2011, a further 25,000 new products will have been added to RS's electronics portfolio.

Recent introductions include the 60 MIPS 16-bit dsPIC digital signal controller and PIC24 microcontrollers from Microchip, for high-end industrial and commercial applications such as servo motor control and solar inverters. Also available is Freescale Semiconductor's range of Kinetis boards, general-purpose development systems aimed at a range of embedded applications, based on the company's 32-bit ARM Cortex-M4 based microcontroller series. Another new addition to the RS portfolio is a range of power management devices from iWatt, targeting leading consumer mobile brands and is a perfect example of the innovative new technology RS is bringing to market.●

Tel: 08457 201201
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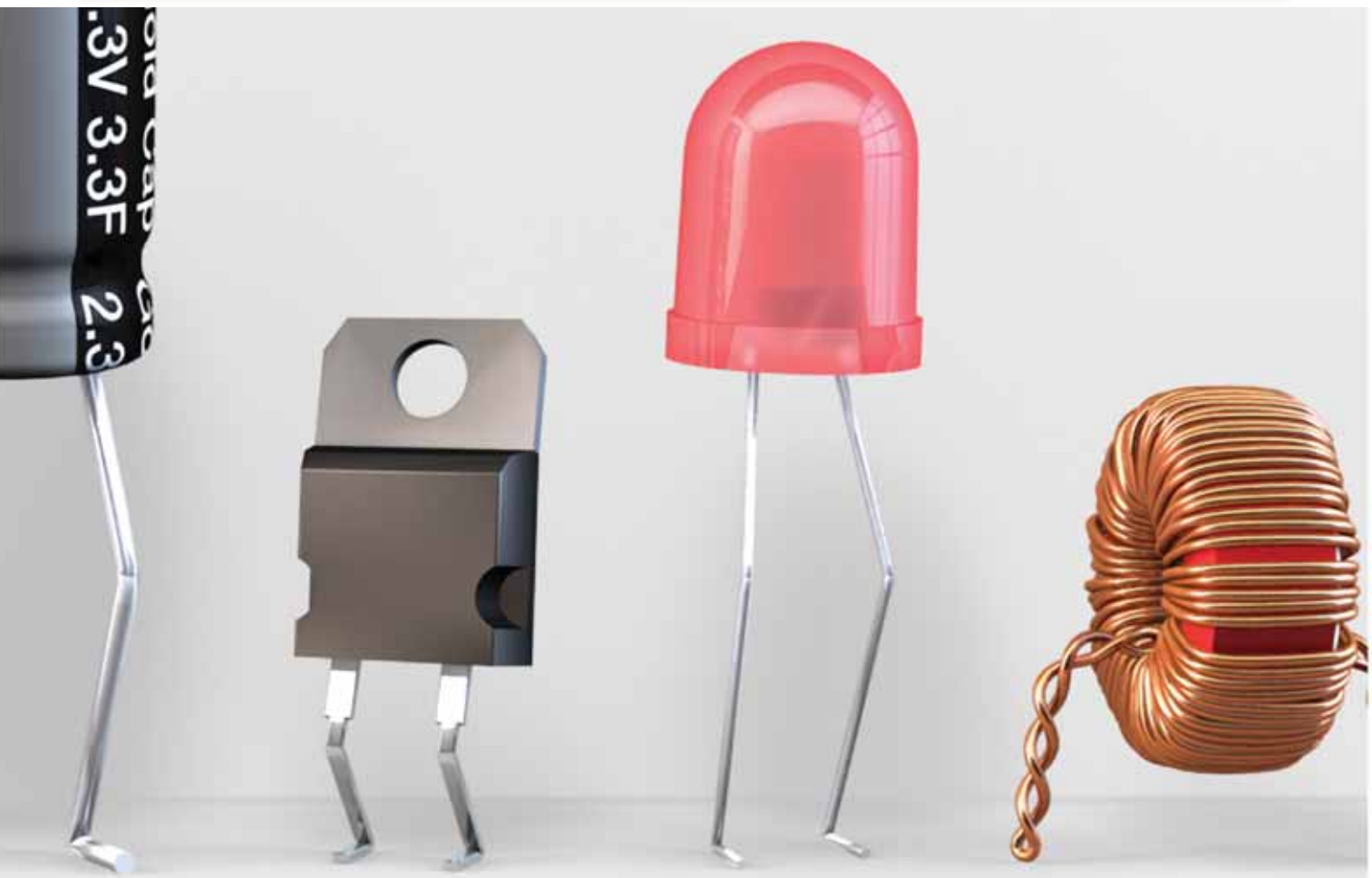
* Financial year 2011



Semiconductor Supply Chain DYNAMICS

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

The last decade heralded a dramatic transformation in supply chain dynamics, driven by the complexity challenge of staying on the 'More Moore' curve. On the demand side, the high cost of fabs persuaded almost all integrated device manufacturers (IDMs) to use foundries for their leading-edge wafer supply. The ever-increasing process complexity and its negative impact on manufacturing yields forced the adoption of sophisticated foundry-specific design-for-manufacturing (DFM) techniques, effectively committing new chip designs to a single foundry and process.

At the same time, the industry adopted a much more cautious lagging rather than leading demand approach to new capacity expansion, resulting in under-supply and shortages in leading-edge wafer fab capacity. To make matters worse, the traditional oxide-based planar transistor started to misbehave at the 130nm node, as manifested by low yields and higher than anticipated power dissipation, especially when the transistors were supposed to be off, with no increase in performance, heralding the introduction of new process techniques (e.g. high-k metal gates).

Even before these structural changes have been fully digested, supply chain dynamics have been further disrupted by the prospective transition to 450mm wafer processing, to extreme ultra violet (EUV) lithography, and from planar to vertical transistor design.

Since the start of the industry, adding more IC functionality while simultaneously decreasing power consumption and increasing switching speed – a technique fundamentally known as Moore's Law – has been achieved by simply making the transistor structure smaller. This worked virtually faultlessly down to the 130nm node when quite unexpectedly things did not work as planned. Power went up, speed did not improve and process yields collapsed. Simple scaling no longer worked and new IC design techniques were needed.

While every attempt was made to prolong the life of the classic planar transistor structure, out went the polysilicon/silicon dioxide gate; although this transition was far from plain sailing, in came high-k metal gates spanning 65nm-28nm nodes. Just as the high-k metal gate structure gained industry-wide consensus at 28nm, it too ran out of steam at the 22nm-16nm nodes, forcing the introduction of more complex vertical versus planar transistor design and making the IC design even more process-dependent (i.e. foundry-dependent). Dual foundry sourcing, already impractical for the majority of semiconductor firms, will only get worst as line widths continue to shrink.

With more firms adopting an outsourcing strategy at 65nm and below (often misleadingly termed fab-lite or asset-lite, but in reality actually meaning fabless), the source of supply for such leading-edge processes became increasingly tight. This was driven by the limited number of foundries and remaining IDM players that could afford $3bn fabs. There was also a deliberate change in wafer fab investment strategy, cutting back capital expenditure so capacity lagged rather than led demand to avoid the financially crippling side effects of over-capacity at the high-tech end of the market.

This changed in Q1 2008 when investment was cut back well before over-heating occurred and at a time when the "Main Street" economy was still in good shape; this cut-back occurred a good three quarters before the Lehman Brothers global economic crash.

While new fab investment bounced back in 2010, it failed to reach the level of investment seen in 2007, was 9% lower than the previous investment peak in 2000, and significantly slowed in Q4 2010, despite the fact that utilization was running at 96.6% and on allocation.

The writing is, thus, now clearly on the wall; leading-edge wafer fab capacity is not going to become a commodity item, supply will be limited and longer term supply commitments are the new name of the game. The era of ever-cheaper, freely available wafers is over, at least at the leading edge. Welcome to the new world of a slowdown in processed wafer price reduction and the need to commit to capacity versus wafer procurement to guarantee sufficient availability.

Just to add further competitive mud to the waters, 2011 saw the 450mm wafer transition gain traction. For several years now, 450mm wafer processing has been under discussion, but apart from work on setting standards, 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. Whereas the major chip players wanted it, the equipment industry was universally against it – stung by the huge costs they were forced to swallow with the 300mm transition.

As with previous wafer size changes: the transition to 450mm wafer processing cannot be done overnight. But this time it does seem as if it will be well co-ordinated across the full industry food chain, from the advanced research centres in IMEC and Albany to the

Dual foundry sourcing, already impractical for the majority of semiconductor firms, will only get worst as line widths continue to shrink

potential leading-edge semiconductor end users keen to keep up their 29% per year gate cost learning curve decline.

The transition from today's 32/28nm advanced production nodes to the 11/10nm structures expected to be in early production around 2015/2016 is littered with process dislocations, both in the structure of the transistors and the means to pattern and build them, with the structures and patterning techniques different for each node.

The 2015/2016 timeframe is also the approximate timescale for the first 450mm prototype facilities, which means that for the leading-edge memory and MPU supplier extreme ultraviolet (EUV) lithography is a must. The more conservative and longer design ramp lead times of foundries indicate that their flip will likely be one node behind in technology, albeit coincident in timing. Thus, whereas foundries do not need EUV lithography for their early 450mm production, for the rest, by 11nm EUV will be a must. The alternative option of triple- and quad-patterning immersion lithography is too slow and costly to bare thinking about.

Transistor design complexity, new device structures, increasingly tighter design rules and all of the other associated changes will mean that semiconductor firms will be forced to choose a lifetime foundry partner; 'divorce' and second sourcing will become too expensive for all but the very biggest firms to even contemplate.

Only a handful of chip firms will have early access to next-generation foundry technology, giving them at least a one-year advantage over their competitors. This means many of today's Tier 1 ex-IDMs will become foundry Tier 2 accounts – quite a humbling and significant competitive demotion.

The era of abundant leading-edge capacity is over; a deliberate over-investment strategy would be recklessly suicidal, even for an industry not best known for its rationality. Buying capacity up front will become the new industry norm, eventually to be enhanced by up-front contributions to future capacity investment costs and effectively co-owning portions of the capacity – a kind of IDM-lite model.

From an equipment industry perspective, financing new tool development will mirror the airline industry model, whereby customers make long-term up-front commitments with deposits and partial payments to ensure both

Only a handful of chip firms will have early access to next-generation foundry technology, giving them at least a one-year advantage over their competitors

delivery and their place in the queue.

The combined effect that these changes will have on the semiconductor supply chain will be both far-reaching and profound, and a very different industry will emerge by the end of the decade. No longer will the industry simply muddle through the various challenges. New business models will emerge built increasingly on co-operation and partnerships, with an ever-increasing need for all parties to share the technology risks and costs.

The past adversarial-driven supplier-customer relationship will no longer be appropriate; for the first time in the industry's history, across-the-board consolidation is unavoidable. The industry might even finally break its fixation with its inherent quarterly short-term fixation of making the quarterly number. ●

Top ten considerations when choosing memory

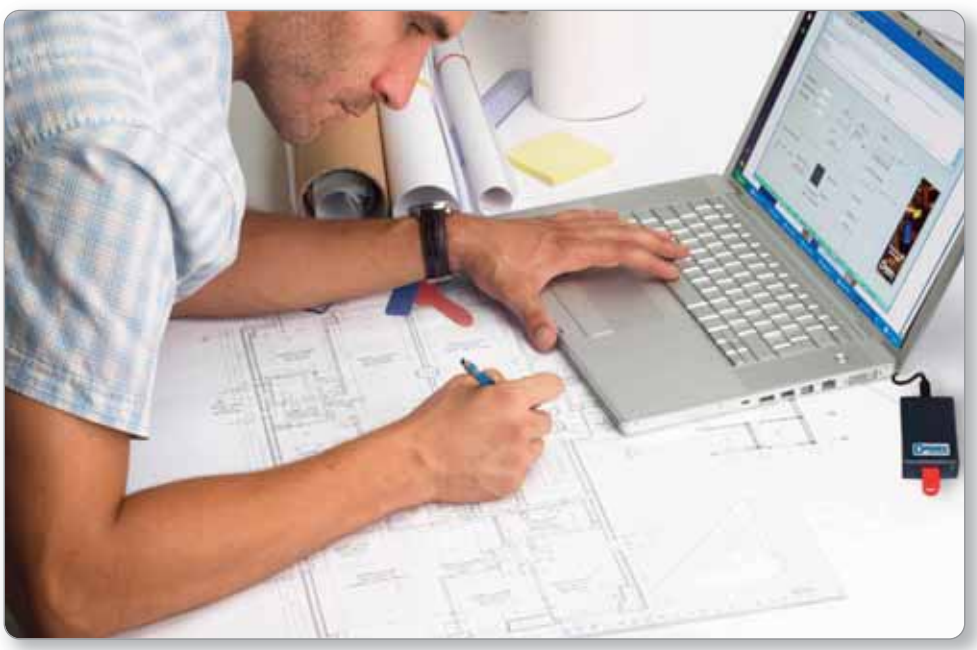
VICTORIA BARRETT, MARKETING AND PR DIRECTOR AT NEXUS GB, WRITES ABOUT WAYS IN WHICH DESIGN ENGINEERS CAN AVOID THE COSTLY MISTAKES THAT GO HAND IN HAND WITH INTEGRATING CONSUMER STYLE MEMORY PRODUCTS, SUCH AS USB, SD AND SDHC OR XD CAMERA CARDS

We should begin our discussion by establishing what the differences between consumer memory and industrial memory are. The former category includes USB sticks, SD cards and similar products as well as other portable memory devices that are really designed for use as IT peripherals. In contrast, industrial memory products are designed for use by OEMs and are portable, rugged and fit for purpose. However, many designers simply aren't aware that industrial memory is an option; they design in consumer memory because they think it is the only choice.

More to the point, these problems are all more likely to take effect the longer a product has been in circulation. As a result, the continued inappropriate use of consumer style memory products in industry could create a legacy of technical issues for forthcoming generations of design engineers to face.

It's bad enough if one of these factors affects your product when it's launched or within a couple of years of it being in production. However, it's much worse if it comes into play further down the line when you might find that a complete re-design is required. This could be due to a combination of obsolescence with another factor such as changes in memory standards, for instance. This is where rectifying the issue can become really expensive.

Figure 1: Nexus GB, the exclusive UK distributor of Datakey Electronics's range of rugged portable memory products, has produced a checklist of issues that OEMs should consider before integrating portable memory into a new design



Considering All Choices

It's not surprising that when an OEM product requires the use of a portable memory device, design engineers and product marketing staff often consider consumer memory solutions like USB flash drives and SD (Secure Digital) memory cards. After all, these devices have become an integral part of daily life. However, before integrating a consumer memory device into an embedded system, engineers must be aware of the potential pitfalls that these consumer focused products can have. Below are the top ten factors that OEMs must consider:

1. Look for memory that is guaranteed to work in the OEM device. While consumer memory may fit physically, it may not work in the device, for any one of countless technical reasons. As a result, the design engineer using consumer memory should pre-qualify those products on the market that do work. This eliminates perhaps the most compelling reason to use consumer memory – widespread availability.

2. Look for longevity in the product life cycle. Consumer memory becomes obsolete when the manufacturer ceases production. The right industrial memory product is guaranteed to offer substantially better longevity because

Figure 2: Nexus GB's RuggedDrive range of portable memory tokens are ideal for environments where a controller connector is required

industrial manufacturers understand that your product may need continual maintenance over a long period.

Let's say, for example, that you are working on a medical device application in a fluid removal instrument that is going to be available on the market in eighteen months' time. You need to build in a memory device to ensure that the machine is used for a limited amount of time, to meet the compliance requirements. After this period, the device needs to be withdrawn from use and re-sterilised.

'Sitting at your drawing board' you design in a USB stick, produced by a commercial manufacturer. In eighteen months' time, just as the machine is about to be mass-produced your colleague in purchasing contacts the USB manufacturer to place an order. He or she receives the unwelcome news that they need to place their final order now, because the USB stick is end-of-line and they have already stopped making them.

This undesirable situation can be avoided by choosing specialist industrial memory, which will be available throughout the lifecycle of your application. As a result, OEMs don't need to waste valuable engineering time re-qualifying new memory devices or re-designing their system due to obsolescence.

3. Always choose a controlled connector so that only approved products fit. If you design in USBs or camera cards, users can plug in untested, unqualified consumer memory. Malware becomes thus a real threat to your application and data loss may occur. Additionally, another issue to consider is that information theft cannot be prevented by consumer memory. This isn't the case with a specialist memory key or token, as it would only match the application it has been designed for.

4. Choose the right size and the right type of memory. If your application only requires 4MB of memory, there is no need to buy a device that provides 32GB.

Imagine for a moment that the cheap and nifty 64MB memory-stick you sourced isn't going to be available when you go to market. Instead, you will be offered the 6GB model, which will cost a small fortune but offer over ninety times the memory you need for your machine (and even at 64MB you were over specifying to future-proof the instrument). As with all design engineering projects, over specification can be expensive.

Designers also have to think about the kind of memory needed to meet the objective. Serial EEPROM is ideally suited for low to medium data-logging, parameter/configuration upload and data storage, as well as access control including CIK (Crypto Ignition Key) use. Serial Flash or SPI keys and tokens complement Microwire and SPI EEPROM devices. Such keys and tokens are page-writable and are ideally suited for high volume data logging and firmware updates.

5. Do your products operate in a harsh environment? If so, both the memory device and the mating receptacle may need to be immersion rated, produced for a specific temperature, shock rating or ESD (Electro Static Discharge) rating.

Memory tokens of a more rugged construction allow for use in environments where consumer memory products would not survive. They are completely encapsulated with a proprietary, high-durability, composite plastic material that has been used in

ABOUT NEXUS GB

ESTABLISHED IN 1986 NEXUS GB IS DATAKEY ELECTRONICS'S UK AND IRELAND EXCLUSIVE DISTRIBUTOR FOR PORTABLE, RUGGED KEYS AND TOKENS CONTAINING NON-VOLATILE MEMORY.

These reliable and re-programmable items provide data transport, security and access control solutions even in extreme environments where other methods, such as USB memory, would not survive. Furthermore, distinct from consumer-like memory solutions, they are a well established product that will not become obsolete as technology progresses. As a result, they are commonly used by design engineers working on long term projects, with more than three million units currently in UK service.

www.nexusgb.co.uk

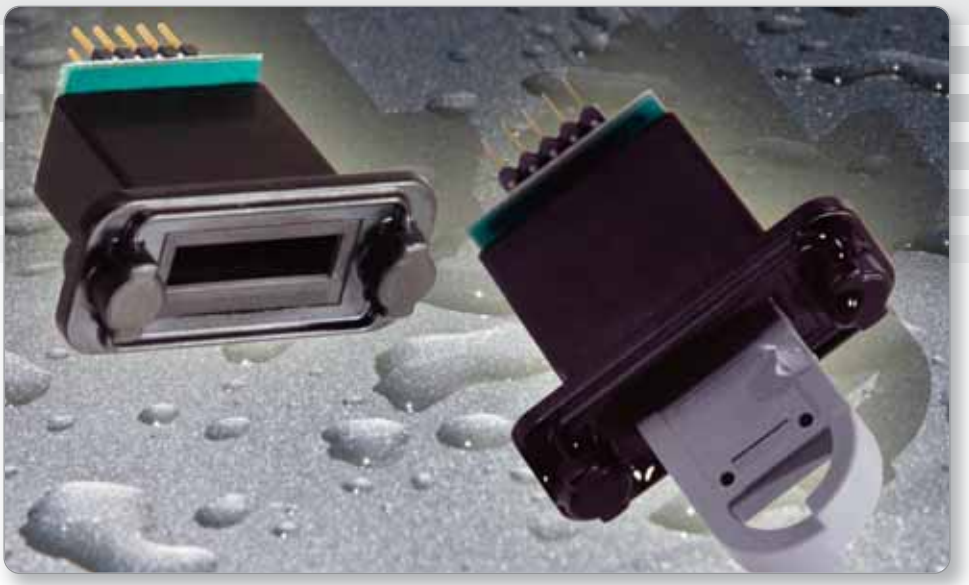


Figure 3: Nexus GB's range of IP67 immersion rated and EMI reduction receptacles are ideal for use in harsh environments

harsh industrial and military environments for decades. Using rugged tokens eliminates the downsides of SD and USB connectors, which are easily damaged and don't perform well in tough industrial environments.

Moreover, if your portable memory is meant for a cleanroom, medical or pharmaceutical environment, it's essential that it can survive sterilisation with no loss of data. The most common forms of sterilisation are wash down, autoclave and gamma sterilisation. When choosing memory on the basis that it can be sterilised along with the device, one should also check whether you can easily add anti-counterfeit and limit-use capabilities to disposable attachments that are sterilised in the same way.

Figure 4: A key from Nexus GB in use on a Klixkey application for beverage vendoring

6. Triple check the mated cycle life. If your product is used ten times a day, a typical USB connector will only last five months. This may be great for the spare parts business but it will leave your end users pretty unhappy. Always ensure that the usable life cycle of the product matches its predicted usage, otherwise costs could mount throughout the duration of your project.

7. Check the product support for industrial OEMS. Consumer memory manufacturers focus on consumer OEMs and industrial memory manufacturers on industrial work, so it's vital that you match your own organisation to the manufacturer correctly.

8. Use form-factor to discourage theft. USB drives and SD cards are targets for misuse and theft but a stock design from a specialist portable memory supplier isn't. If there is the possibility of product or data theft in your application, this should be a key consideration.

Even if the data on the device can't be used for any other purpose, you should bear in mind that USB sticks themselves have a habit of making their way back to the homes of the people who use them.

9. Use form-factor to improve data security. By design, most industrial products do not plug into standard PC ports, whilst USBs and memory cards are made for this purpose. It may well be beneficial to your security strategy if lost products can't be accessed without specialist equipment.

Some manufacturers, such as Datakey for example, offer a unique physical interface which prevents the use of unqualified consumer memory devices, as they don't physically fit.

10. Watch out for changing standards. USB and SD 'standards' can and do change. Indeed, history shows that these standards are driven by the consumer market and changes can adversely affect embedded OEMs who adopt the products. For instance SDHC cards use a different addressing method to SD cards, meaning embedded devices using SD can't also use its successor, even though they fit in the receptacle.

Serial EEPROM is ideally suited for low to medium data-logging, parameter/configuration upload and data storage, as well as access control

Easy Steps Forward

So, in conclusion, while the process of choosing a key, token or plug and a receptacle is simple, it's only the first step. The crux of the matter is dealing with security and longevity issues, as well as making sure that the device meets ruggedness standard required by the environment. So, my advice would be: conventional memory – forget it. If the device still needs to be on the market in twenty years time, or even five, you need to go down the specialised, OEM specific route. ●

Farnell and Eurocircuits collaborate to offer quick-turn PCB prototyping service for European customers

New service, which streamlines design cycles and accelerates time to market, now available through the Knode on element14

Adding to its depth of services for electronic design engineers, Farnell, a part of Premier Farnell plc (LSE:pfl), announced a collaboration with Eurocircuits to provide quick-turn bare board PCB prototyping services for its customers in Europe.

The PCB prototyping service will be available via the Knode on element14 allowing design engineers to quickly upload their design specifications for rapid turnaround of high-quality bare-boards. The service is also integrated with the CadSoft EAGLE PCB design tool – further increasing productivity and design flow integration.

Design engineers are always in need of a reliable, trusted PCB prototype supplier who not only has the technical expertise and dedicated equipment, but also the flexibility to handle time critical customer specifications and special design materials. As a specialist manufacturer of high-quality PCB prototypes, Eurocircuits is able to meet that demand while offering 48-hour turnaround at competitive prices.

"High quality, quick-turn PCB prototyping is a critical step in the electronics design flow and directly impacts the time-to-market and commercial success of a finished product," said David Shen, Group Senior Vice President and Global Head of Technical Marketing at element14. "The collaboration with Eurocircuits allows our customers to quickly and easily create reliable, high quality prototype PCB boards and is another example of our commitment to continually expand our services offering and enhance the value proposition."

"The cornerstone of Eurocircuits' success has been our straightforward business terms, quick turnaround and absolute focus on quality and design integrity," said Dirk Stans, Sales and Marketing Director at Eurocircuits. "We already serve more than 6000 customers in Europe, and the higher market penetration and visibility brought to us by Farnell and the Knode on element14 will increase our pooling efficiency and help drive a better deal for customers."

The Knode on element14 is an intelligent online search and knowledge tool that helps design engineers select and buy the right solution for their design right from the start. It helps to improve speed to market, quality of both the design and prototype and provides a knowledgebase that helps engineers learn and design new technologies.

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With over 500,000 products in stock from over 3000 suppliers, our product portfolio continues to expand, offering our customers the very latest technologies.

Farnell is part of the global Premier Farnell Group, which works across geographic and business boundaries. Sharing these facilities and best practice Farnell distribute a huge range of electronic components, electrical parts and wholesale electronics.

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ABOUT ELEMENT14

Launched in June 2009, element14 is the first, innovative information portal and eCommunity specifically built for electronic design engineers. It provides product data, design tools and technology information, whilst incorporating Web 2.0 functionality to facilitate communication, interaction, collaboration and information sharing between colleagues around the world. Users can consult experts, discover trends, post blogs, articles and comments in this world-wide forum.

Since its launch element14 has surpassed all of the targets set, has garnered overwhelmingly positive feedback from customers and suppliers alike, and is now attracting more than 24,000 visitors a week with new user profiles created each day.

element14 is an innovative offering from Premier Farnell plc (LSE:pfl), FTSE 250, a leader in multi-channel distribution and specialty services for electronic design engineers throughout Europe, the Americas and Asia Pacific. ●

For more information visit: www.element14.com.

RF Quiz

MYK DORMER IS SENIOR RF DESIGN ENGINEER AT RADIOMETRIX LTD **WWW.RADIOMETRIX.COM**

It is not reasonable or possible to expect every waking moment to be absorbed by "the job". Sometimes even engineers take a little relaxation and in such a vein I am presenting a "coffee time challenge" in the form of a quiz, concentrating on some of the history of the technologies we currently use and some of the more unusual trivia.

The format is simple: questions are in the first section, answers in the second. Each correct answer receives one point (so you can compare with like-minded colleagues).

While I cannot guarantee the usefulness of all (or any) of the information contained herein, I hope some of it proves to be entertaining.

QUESTIONS:

HISTORY

1. Which researcher was the first to observe and identify radio wave propagation?
2. Which nineteenth century scientist first postulated the existence electromagnetic waves and was responsible for the basic equations describing their behavior, still used today?
3. In 1900 the Marconi company filed a patent for what we would recognize as a frequency division multiplexed radio system. What was the number of this famous (and frequently contested) patent?
4. Under what trade name did the American researcher Lee De Forest market his early "soft vacuum" triode detector valves?
5. "Superhet" is a term frequently used to describe a radio receiver architecture using mixing to convert the wanted carrier to an intermediate frequency, but "superhet" is an abbreviation of a longer term. Give the full name.
6. John Logie Baird demonstrated one of the earliest practical television systems, but he did not actually invent the mechanical scanner on which it was based. Who did?
7. During the war years, Allied computer pioneers (such as Von Neuman and Turing) rose to fame. But who was the leading German researcher?
8. Which Austrian born actress filed a patent for a spread spectrum frequency hopping radio system? (Although it was not actually the first description of such an idea).
9. The "Yagi" antenna is a familiar sight, on rooftops across the world, but what was the nationality of its inventors?
10. In what year was the first practical bipolar transistor demonstrated (in this case a germanium point contact device)?

PRACTICE

11. What unusual characteristic is seen in conically wound inductors?
12. If a brass slug is introduced into an air-cored inductor, does the inductance value rise, or fall?
13. Which capacitor dielectric has the better temperature stability: NPO or X7R?
14. Mosfets are commonly used RF amplifier and mixer parts. What does the "O" stand for in the name?
15. The common (or grounded) base amplifer configuration is frequently seen in high frequency applications. Does it offer greater than unity current gain, voltage gain or both?
16. What is the re-inforcing material in the resin matrix of an FR4 circuit board?
17. The ROHS directive prohibits the use of six materials. Five are: lead, mercury, hexavalent chromium and the brominated phenyls PBB and PBDE. Name the sixth.
18. Which is the more stable frequency reference: a rubidium atomic clock or a hydrogen ion maser?
19. Which commonly used SI unit is a measurement of electric charge?
20. Name an element with a lower bulk resistivity than pure copper.

MISCELLENIOUS

21 The Cold War era Soviet "Setun" computers had one unique feature. Name it.

22 Everyone was familiar with VHS and Betamax. What was the third (even less successful VCR standard?

23 What is a "rope memory"?

24 Why are old RF power transistors dangerous if roughly handled?

25 It is a popular cliche to declare that some relatively modest piece of modern electronic equipment or other has "more processing power than the Apollo spacecraft". How much RAM did the Apollo Guidance Computer actually have?

Answers:

1. Dr Heinrich Hertz
2. James Clerk Maxwell
3. British patent number 7777
4. Audion
5. Supersonic heterodyne
6. Paul Nipkow
7. Konrad Zuse
8. Hedy Lamarr
9. Japanese
10. 1947
11. A very high self-resonant frequency
12. It falls
13. NPO
14. Oxide
15. Voltage gain only
16. Glass (or glass fibre)
17. Cadmium
18. The second one (hydrogen ion maser)
19. The Coulomb
20. Silver (mercury or niobium are also acceptable, but only if superconductivity or cryogenic temperature operation are mentioned)
21. It used ternary (or 3-level) logic circuits (instead of binary)
22. Video 2000
23. A form of ROM (read only memory) made from ferrite cores. Used by NASA
24. Many types used beryllium oxide insulators. Toxic if inhaled as dust
25. 2k (2048 x 16 bit words). An answer of 4K (4096 bytes is also correct)

PROCESSORS FOR EMBEDDED DIGITAL SIGNAL PROCESSING

PROFESSOR DR DOGAN IBRAHIM OF THE NEAR EAST UNIVERSITY IN CYPRUS DESCRIBES THE BASIC FEATURES OF DIGITAL SIGNAL PROCESSORS AND GIVES THE DESIGN OF A FIR TYPE LOW-PASS DIGITAL FILTER USING A DSP DEVELOPMENT KIT, PROGRAMMED IN C

Digital signal processing is the mathematical manipulation of digitally represented signals. DSP processors are microprocessors designed to perform efficient, high-speed, low-cost digital signal processing. DSP is nowadays used in many diverse signal processing applications such as digital filtering, convolution, spectrum analysis, speech processing, speaker recognition, image processing, image compression, automatic control and many more.

Digital signal processor systems are built from several elements:

- A digital microprocessor fast enough to carry out the mathematical operations;
- Fast memory to store the program and data samples;
- A/D and D/A converters to get real signals into and out of the microprocessor;
- The microprocessor program.

Most DSP operations are based on multiply-accumulate (MAC) cycles. For example, the FIR digital filter is mathematically expressed as

$$\sum h.x$$

where x is a vector of input data, and h is a vector of filter coefficients. The input samples are multiplied by the corresponding coefficients and the results are summed. Thus, the main operation here is a dot product, consisting of multiplication and addition. These operations are common to most digital signal processing applications.

In early days of digital signal processing, ordinary microprocessors the likes of 8085, Z80, 6801 and others were used in real DSP applications. Multiplication was performed in software by a series of shift and add operations, each of which consumed one or more clock cycles. The microprocessor clock-speed was low and the instructions were primitive, thus causing considerable delay in each processing loop. The maximum clock frequency was not higher than the audio frequencies and as such the processing capabilities were rather limited. Later, the speed of DSP processing has increased considerably by the development of fast hardware multiplier chips that could be interfaced to the general purpose microprocessors. The overall performance was still poor, and a typical implementation required several external chips, including memory, multiplier, A/D converter and D/A converter, resulting in high power consumption and design complexity.

The first commercially available DSP chip, the TMS32010, was introduced by Texas Instruments (TI) in 1992. This chip incorporated special architecture and multiplication hardware to yield faster performance. Since then there has been major advances in the development of DSP chips, and today several DSP processor vendors (Texas Instruments, Analog Devices, Motorola, Lucent Technologies etc) are offering high-performance DSP processors.

The processors for embedded digital signal processing can be classified into three groups:

- **DSP processors:** These are specialized microprocessors for signal processing applications. like Texas Instruments's TMS320C55xx series, or Analog Devices's ADSP-2106x series. These processors usually have multiple operations per instruction.

> To achieve the necessary reaction times for a real-time interface, it is necessary to decouple the high-level operating system using a dedicated peripheral block

- **DSP-enhanced processors (DSPEP):** These are efficient general-purpose microcontrollers with added DSP features. Among them are the Microchip dsPIC series, Analog Devices's Blackfin etc. These processors can have more than one operation per instruction.
- **General purpose processors (GPP):** These are fast general purpose microcontrollers that can be used in DSP applications, as well as in general microcontroller based applications. Examples include ARM, ARM7 etc.

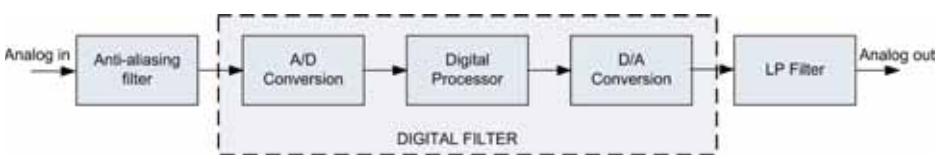

Figure 1: Digital filtering

Manufacturer	Family	Arithmetic	Data width	Clock Speed	Relative DSP Speed (BDTImark2000)	External Addressable Memory (Max)
Analog Devices	ADSP-21xx ADSP-2116x	Fixed-point Floating-point	16 32	75MHz 80MHz	230 410	32KB 4GB
Hitachi	SH2-DSP	Fixed-point	16	100MHz	280	64MB
Infineon	Carmel	Fixed-point	16	250MHz	1850	8MB
Lucent Technologies	DSP16xxx	Fixed-point	16	170MHz	810	64KB
Motorola	DSP563xx DSP568xx MCS8101	Fixed-point Fixed-point Fixed-point	24 16 16	150MHz 40MHz 300MHz	450 110 3430	16MB 64KB 4GB
Texas Instruments	TMS320C54xx TMS320C62xx TMS320C67xx	Fixed-point Fixed-point Floating-point	16 16 32	160MHz 300MHz 167MHz	500 1920 820	8MB 8MB 8MB

Table 1: Some commercially available DSP processors (source: Packet Guide to DSP Processors and Cores, Berkeley Design Tech Inc.)

These processors usually have one operation per instruction.

CHOOSING A DSP PROCESSOR

The choice of a DSP processor depends very much on the type of application and the tools available for development. For low-cost and low-speed applications the user can select a GPP. Most GPPs incorporate on-board memories, multiplier modules and A/D converters, making them suitable candidates for low-cost digital signal processing applications. For higher performance one can select a DSPEP processor. These processors have modified architectures supporting DSP operations (e.g. fast multiplier modules) in addition to usual microcontroller functions. For very high speed signal processing applications the only choice is to use a DSP processor.

Table 1 gives a list of some of the commercially available DSP processors. The points that are important in the choice of a DSP processor include:

Arithmetic format: Most DSPs use fixed-point arithmetic, where numbers are represented as integers or as fractions. Some DSPs use floating-point arithmetic, where numbers are represented by a mantissa and an exponent. Floating-point is more flexible and provides a wider dynamic range, resulting in easier programming, but having higher power consumption and costing more as a result of the chip complexity. Most embedded applications use fixed-point arithmetic as the priority is on low-cost and low-power consumption. The dynamic range of these processors is increased by using additional guard bits in the accumulator registers in order to avoid arithmetic overflow.

Data width: Most fixed-point DSPs use a 16-bit data width. Motorola's DSP563xx series uses a 24-bit data width. Floating-point DSPs usually use a 32-bit data width. A higher data width gives higher numeric precision, but the size of the data width has direct impact on the cost of the chip as a higher data width increases the chip complexity and size of external memory, resulting in an overall higher cost.

Speed: The execution speed of a DSP chip is very important as it is a measure of its suitability for a particular application. Traditionally, processor speeds are measured using the MIPS (millions of instructions per second) or MOPS (millions of operations per second). It is very important to realize that using MIPS or MOPS in DSP applications can give very misleading results. This is because some DSP processors can perform much more work in a given instruction than others. For example, some DSP processors can perform all the required MAC operations by a single instruction consisting of several operations, where some other processors can take several instructions to perform the same operations.

Another used performance index is the MACS (multiply-accumulates per second). This index is also misleading since DSP applications involve operations other than multiplication and addition and therefore MACS is not a reliable measure of the performance index.

One of the most commonly used DSP performance indices is the Berkeley Design Technology's benchmarking, known as the BDTImark2000, which is based on the calculation of the execution time, memory usage and energy consumption for each DSP chip tested. Typical DSP applications used in the benchmark are: FIR and IIR digital filter blocks, vector dot products, vector addition, vector maximum, FFT and so on.

DESIGN USING MATLAB

THE MATLAB FUNCTION FIR CAN BE USED TO OBTAIN THE COEFFICIENTS OF AN FIR FILTER EASILY. TO DESIGN AN FIR FILTER WITH ORDER 10, FS = 20KHZ AND FC = 2.5KHZ WE HAVE TO USE THE FOLLOWING MATLAB STATEMENT:

```
>> h = fir(10, 0.25)
```

where the second parameter is "fc / (fs / 2)", i.e. 2.5 / (20/2) = 0.25. The fir function uses the Hamming Window by default. The filter parameters displayed by the above statement are given below:

```
h[0] = -0.0039
h[1] = 0
h[2] = 0.0321
h[3] = 0.1167
h[4] = 0.2207
h[5] = 0.2687
h[6] = 0.2207
h[7] = 0.1167
h[8] = 0.0321
h[9] = 0
h[10] = -0.0039
```

The filter frequency and phase responses can be plotted using the MATLAB function:

```
>> freqz(h)
```

which displays the filter response shown in Figure 5. Notice that the response is plotted with normalized frequency where the cut-off frequency is at 0.25.

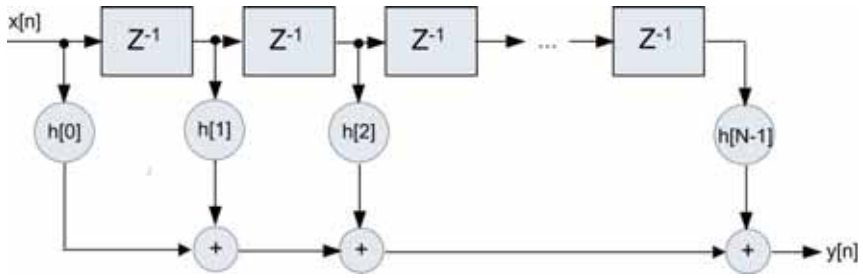

Figure 2: FIR filter direct realisation

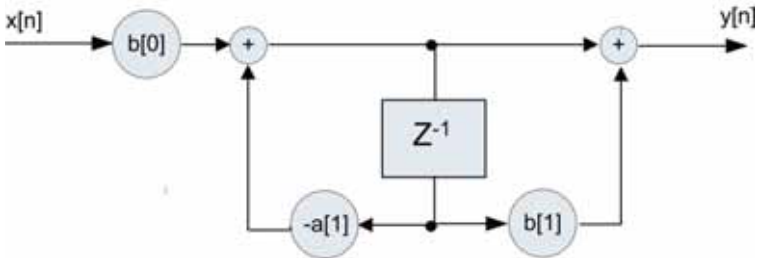

Figure 3: First order IIR section

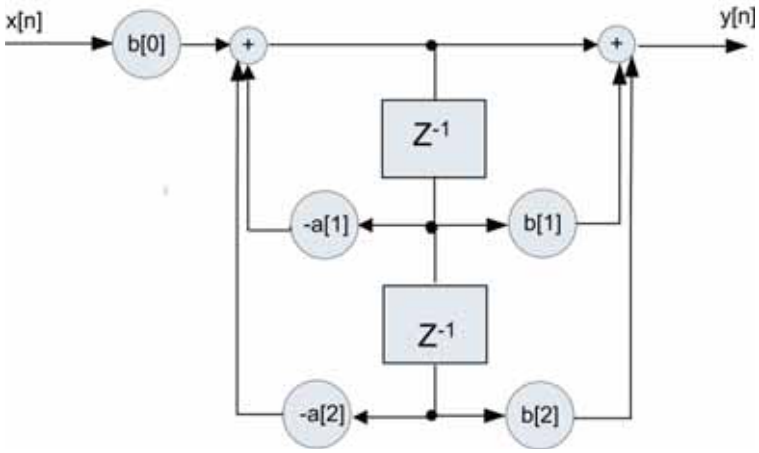

Figure 4: Second order IIR section

Development time: The ease of development is also important in DSP-based applications. Most DSP manufacturers offer DSP development kits together with suitable assemblers or high-level language compilers. Using such kits shorten the project development time considerably.

Memory: Fast memory is a requirement in all DSP applications. Most DSP chips are based on multiport memories which permit multiple memory accesses per instruction cycle. Harvard architecture and its derivatives are used in DSP chips with separate bus for the memory in order to increase the memory throughput. Some DSP chips use up to 11-stage pipeline with multi-cycle latencies, and several level cache memory systems. The size of the total memory is also important and is application dependent.

Power consumption: Many embedded DSP applications are portable and as such low power consumption is usually a fundamental requirement. Some DSP chips operate with reduced voltages to lower the power consumption. Most DSP chips feature idle or sleep modes that help to reduce the power consumption when the chip is not busy. In some DSP chips the unused peripherals can be turned off to lower the power consumption.

> A PRU clocked at 225MHz can execute 22.5 commands during this 100ns period

Cost and system complexity: The cost is also an important factor when choosing a DSP for an application. System complexity depends upon the number of external chips required and the total pin count used. For example, external A/D and D/A, or external memory requirements are key factors that affect overall cost of the system.

DIGITAL FILTERING

Figure 1 shows the block diagram of the digital filtering process. Digital filtering has specific characteristics that we need to pay special attention to. The analog input signal must satisfy certain requirements. Furthermore, on converting an output digital signal into analog form, it is necessary to perform additional signal processing in order to obtain the appropriate result.

If an input signal contains frequency components higher than half the sampling frequency (fs/2), it will cause distortion to the original spectrum. This is the reason why it is first necessary to perform filtering of the input signal using a low-pass filter to eliminate high-frequency components from input frequency spectrum. This filter is called anti-aliasing filter as it prevents aliasing. The signal is then converted into digital, the filtering action is carried out via the algorithm implemented on the digital processor, and the signal is converted back into analog form. In some DSP applications the A/D and D/A converters are incorporated on the DSP chip. But usually these converters are added externally to the DSP chip. Notice that the output signal is sometimes filtered to remove any high frequency components.

Types of Digital Filters

The two major types of digital filters are the finite impulse response (FIR) and the infinite impulse response (IIR). Both types have some advantages and disadvantages that should be carefully considered when designing a filter. Besides, it is necessary to take into account all fundamental characteristics of a signal to be filtered as these are very important when deciding which filter to use.

A filter has two important characteristics: the frequency response

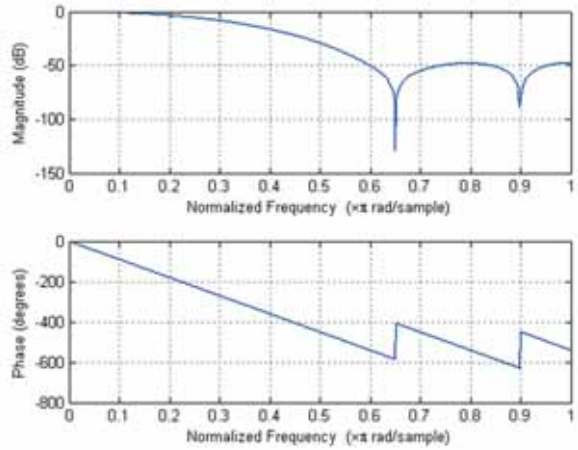

Figure 5: Frequency and phase responses of the filter

and the phase response. Most types of filters can be designed with excellent frequency response characteristics. The phase response on the other hand depends on the type of filter designed and it can either be linear or non-linear. Speech signal, for example, can be processed with non-linear phase characteristic as the phase characteristic of a speech signal is not of the essence and as such can be neglected, which results in the possibility to use much wider range of filter systems for its processing.

There are also signals for which a linear phase characteristic is required. A typical example is signals obtained from various sensors in industry. Here, it is important that a filter has linear phase characteristic to prevent loosing information. FIR filters have linear phase characteristics, but higher filter order is required, making the design complex. These filters are inherently stable. IIR filters on the other hand have non-linear phase characteristics, but a lower filter order is required, making them less complex, and the resulting filter has the potential to become unstable.

FIR Filters

FIR filters are digital filters with finite impulse response. They are also known as 'non-recursive digital filters' as they do not have feedback and the filter output depends only on the present and pass inputs. The output samples of the FIR filter are computed as:

$$y[n] = \sum_{k=0}^{N-1} h[k].x[n-k]$$

where x[k] are the filter input samples, h[k] are the filter coefficients and y[n] are the filter output samples. The FIR filter transfer function can be expressed as:

$$H(z) = \frac{Y(z)}{X(z)} = \sum_{n=0}^{N-1} h[n].z^{-n}$$

There are several types of FIR filter realizations. Here, we will only look at the direct realisation which is the most commonly used FIR filter realisation. Figure 2 shows a block diagram of the FIR realisation. As can be seen from the diagram the filtering action consists of delay lines, multiplications and summations.

In practical applications two circular buffers are used in the filter program to hold the input samples and the filter coefficients. The contents of these buffers are multiplied and added as in Equation 1 by manipulating the buffer pointers. The total sum is the filter output and is sent to the D/A converter.

FIR filters are normally designed with a suitable windowing function used to shape the response. There are many windowing functions, such as Rectangular, Triangular, Hann, Hamming, Bohman, Blackman and so on. The windowing theory is well established and readers are recommended to look at books on DSP for further information (e.g. Continuous Discrete Time Signals and Systems, by Mandal and Asif).

The filter coefficients can be calculated analytically from the filter impulse response. There are many freeware and commercially available computer programs that can be used to obtain these coefficients quickly and reliably. For example, ScopeFIR (www.iowegian.com),

DESIGN USING A DSP DEVELOPMENT KIT

IN THIS SECTION WE WILL BE DESIGNING AND IMPLEMENTING OUR FIR DIGITAL FILTER USING THE LOW-COST DSPICPRO4 DSP DEVELOPMENT BOARD (WWW.MIKROE.COM), PROGRAMMED USING THE MIKROC PRO DSPIC30/33 C LANGUAGE.

dsPICPRO4 is a low-cost DSP development board (see Figure 6) that can be used in low-cost, low-speed DSP applications, and especially in teaching the practical aspects of designing DSP systems. The board supports 64 and 80-pin dsPIC30F MCUs. The board includes all the hardware needed for developing a DSP project.

The brief specifications of this development board are:

- dsPIC30F6014A DSP microcontroller
- USB programmer with mikroICD debugger
- 67 LEDs and 67 push-button switches
- Real-time clock chip
- MMC/SD card slot
- RS232 and RS485 serial ports
- LCD, GLCD and touch-screen interface
- Ethernet controller chip
- CAN interface module
- 12-bit D/A converter (A/D converter is on the MCU)
- Voltage reference for A/D and D/A converters

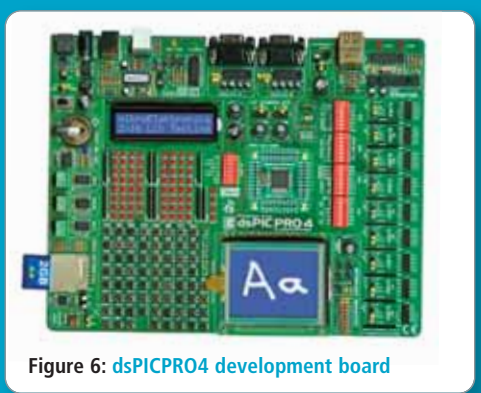

Figure 6: dsPICPRO4 development board

The filter software was developed using the mikroC PRO for dsPIC compiler. This is a C compiler developed specifically for DSP applications, using the dsPIC series of microcontrollers. The compiler supports a large number of built-in library functions for interfaces such as RS232/RS485, I2C, Ethernet, CAN, USB, SD card, LCD, GLCD, touch-screen and many more. In addition, the compiler has a filter design tool that can be used to generate the filter coefficients for FIR (or IIR) filters, and it also generates a template code that can be used as the basis for the actual filtering process.

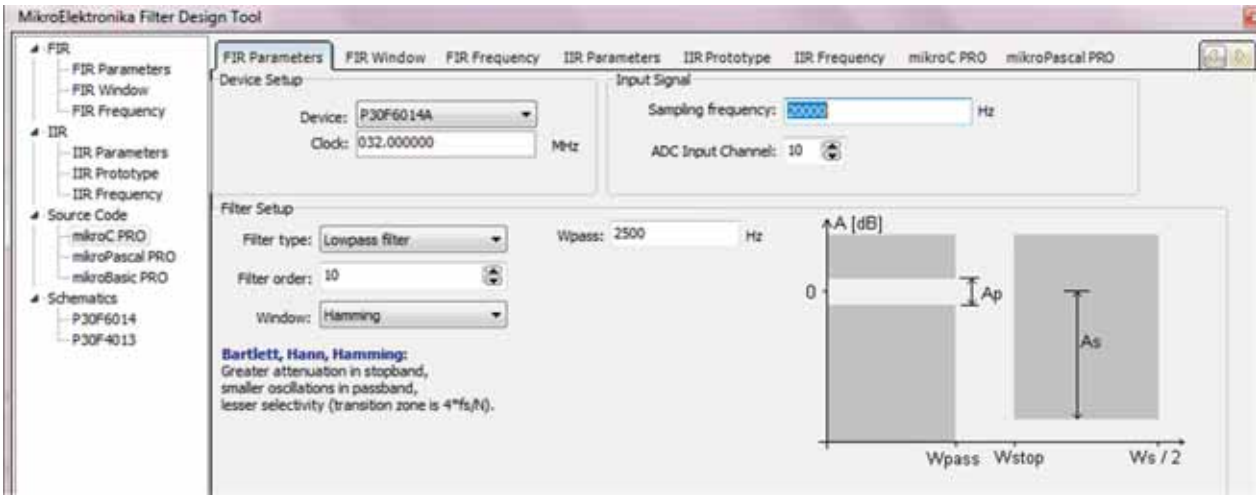

Figure 7: The filter design tool

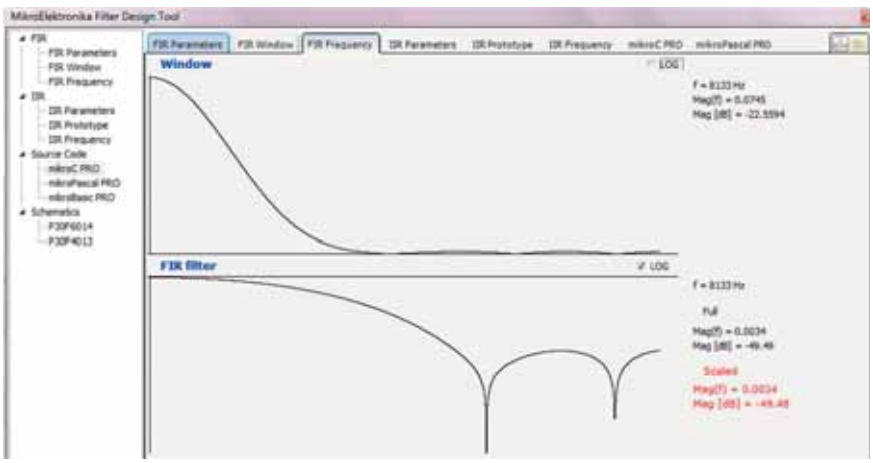

Figure 8: The frequency response of the filter to be designed

winFilter (www.winfilter.20m.com), Fiwiz (www.icsi.berkeley.edu/~storn/fiwiz.html), Tfilter (http://t-filter.appspot.com/fir/index.html) and many others.

IIR Filters

FIR filters are digital filters with infinite finite impulse response. They are also known as 'recursive digital filters' as they have feedback and the filter output depends not only on the present and pass inputs, but also on outputs. Some commonly used IIR digital filters are Butterworth, Chebyshev, Bessel and so on. The transfer function of an IIR filter can be expressed as:

$$H(z) = \frac{Y(z)}{X(z)} = \frac{\sum_{k=0}^{N} b[k].z^{-k}}{1 + \sum_{k=1}^{N} a[k].z^{-k}}$$

where N is the order of the filter, b[k] and a[k] are the filter coefficients. The filter output samples can be calculated from the expression:

$$y[n] = \sum_{k=0}^{N} b[k].x[n-k] - \sum_{k=1}^{N} a[k].y[n-k]$$

There are several IIR realizations. One of the commonly used one is the cascade realization shown in Figure 3 for the general first order and Figure 4 for the second order sections. Higher order filters are constructed by cascading these basic sections. The filter coefficients can be calculated by initially designing an analog filter and then converting it into discrete form using a bilinear transformation. Alternatively, there are many programs that can be used to obtain the coefficients a[k] and b[k].

EXAMPLE DIGITAL FILTERING

In this section we will be designing a low-pass FIR digital filter as an example. First, the filter will be designed and simulated using the MATLAB package. Then, the filter will be implemented in real-time on a DSP development kit.

The specifications of the filter to be designed are:

- Sampling frequency, fs = 20kHz
- Cut-off frequency, fc = 2.5kHz
- Filter order, N = 10
- Window used = Hamming ●

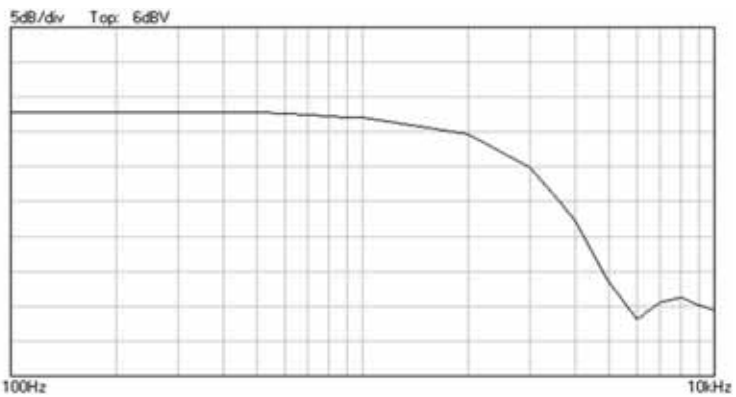

Figure 9: Frequency response of the designed filter in real-time

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WEAK OPTICAL SIGNAL DETECTION BY MODULATING THE LIGHT SOURCE

BOCHUN WU, **HONGZHI JIA** AND **XIAOQING WANG** FROM THE UNIVERSITY OF SCIENCE AND TECHNOLOGY IN SHANGHAI, CHINA, PROPOSE A NOVEL METHOD TO DETECT WEAK OPTICAL SIGNALS BY USING MODULATED LIGHT

Weak signal detection is an important field in signal processing. With the development of various applications of science and technology, there are greater needs to measure weak signals so the research in this field has also spread to other areas such as light, electricity, magnetism, sound, heat, materials and others.

The equipment used to detect weak signals has become indispensable in all fields of research. In this article, we improve the sensitivity of the polarimeter system by using modulated light signal.

In the early polarimeter systems, the power of the light source is held constant. The light from the light source passes through a polarizer – with the optically active substance, and an analyzer, to finally arrive at a photoelectric transducer. The photoelectric transducer turns the light signal to an electric signal. This electric signal is amplified and processed by a circuit, see Figure 1.

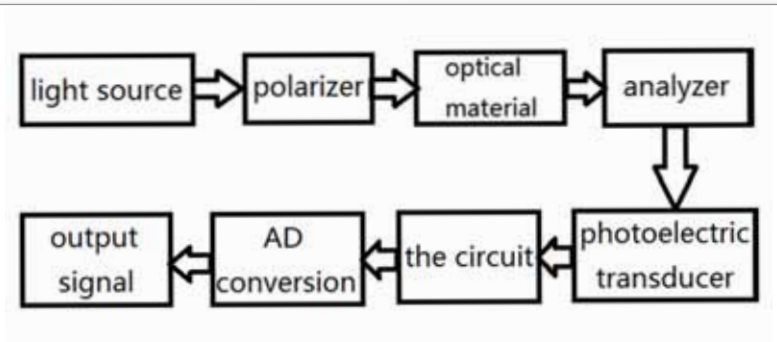


Figure 1: The polarimeter system

The measurement principle of the polarimeter is to look for the position of minimum light intensity by rotating the analyzer. We can get the different positions of the analyzer with different optically active materials.

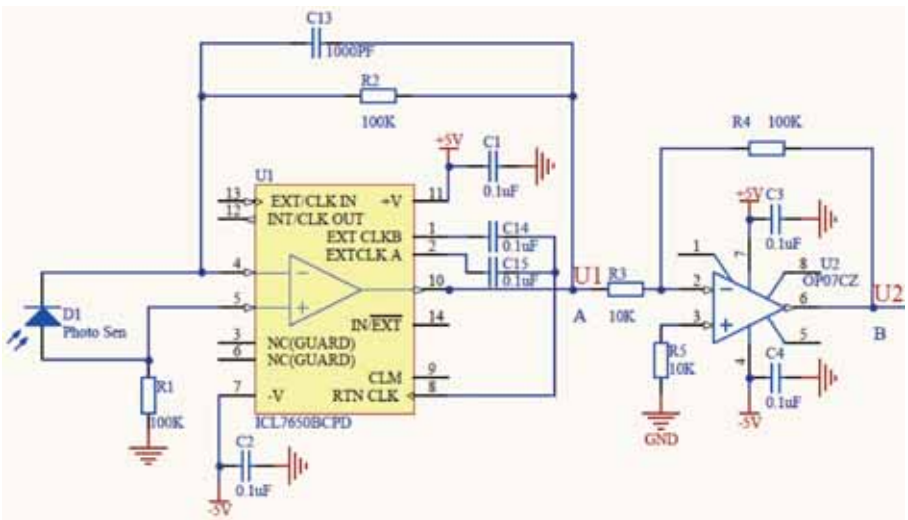
If this weak light can be detected accurately, then the position of the analyzer can be determined accurately. Usually, the signal is too small to be detected. For this article, the weak optical signal was detected by using a modulated laser source. This method plays a very important role in the development of a new type of polarimeter.

Principle of Operation

In our experiment, a laser diode with wavelength 635nm is employed as the light source, and the optical signal is detected by a photodiode. Figure 2 and Figure 3 show the circuits used to detect the weak optical signal.

Figure 2 comprises a preamplifier and a secondary amplifier. The IC component ICL7650 is used for the preamplifier because it has the high gain, low bias current and automatic chopper-stabilized modules. As a result of using the light-voltage mode, the photodiode has no reverse bias, and the circuit has high input impedance which is matching to the output impedance of the photodiode. The circuit has low noise, good linear relationship and it is suitable for measuring weak signals. If the input

Figure 2: The circuit of the preamplifier and the secondary amplifier



current generated by photodiode is I, then the voltage at point A is:

$$U1=I*(R1+R2) \quad (1)$$

In order to filter out the high frequency noise, we add a capacitance C13. We must choose the capacitance reasonably. If the capacitance is too big, the response time of the circuit would be affected. If the capacitance is too small, the circuit would reverse the high frequency noise. After repeated experiments, we choose the capacitance of 1000pF and get the best results of the experiment.

The voltage at point B is:

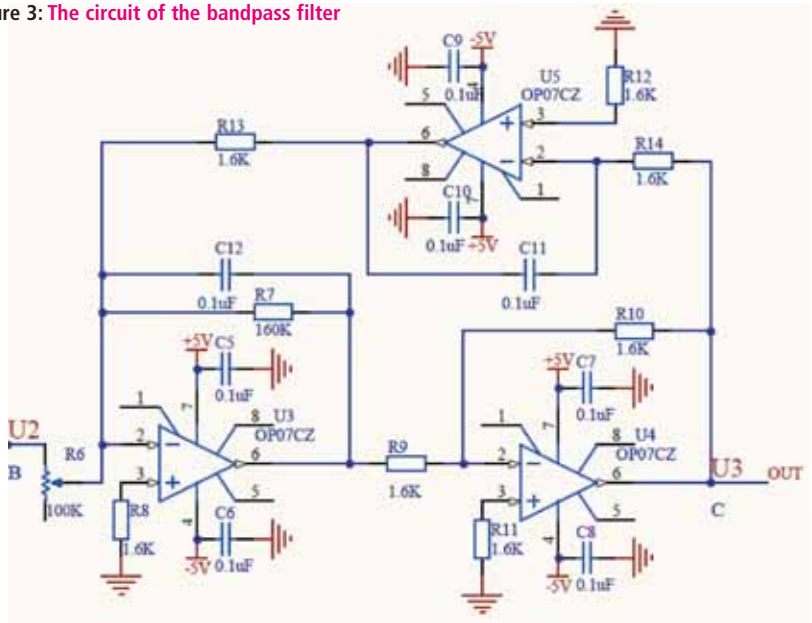
$$U2=R4/R3*U1 \quad (2)$$

When the input signal is an un-modulated light signal, we use the above-mentioned circuit to detect the output signal at point B. We should see a DC signal. Then, in order to detect the weak light signal, we use a square wave as the modulation signal to modulate the laser.

The frequency of square wave is 1kHz and its duty cycle is 50%. To filter out the noise, we add a bandpass filter after the above-mentioned circuit (see Figure 3). The whole circuit includes an inverter, an integrator and a low-pass filter. It has depth DC negative feedback and stable DC working point. The bandwidth of the filter is very small.

The experiment results show that this bandpass filter can decrease the noise effectively. Now, we detect the output signal at point C. The square wave will become the sine wave after the bandpass filter.

Figure 3: The circuit of the bandpass filter



The measurement principle of the polarimeter is to look for the position of minimum light intensity by rotating the analyzer

The voltage at point C is:

$$U3=\frac{U2*R7*R10/(R6*R9)}{1+R7*C12*P+(R7*R10/R9)/(R13*R14*C11*P)} \quad (3)$$

In Equation 3, P is called Rumsfeld operator. If we use jω instead of P and make imaginary part zero, we would find the center angular frequency of the bandpass filter:

$$\omega_0=\sqrt{R10/(R9*R13*R14*C11*C12)} \quad (4)$$

Here R7 = 160kΩ, R9 = R10 = R13 = R14 = 1.6kΩ, C11 = C12 = 0.1μF, then we can get the center angular frequency ω_o = 6250rad/s, $f_o = \omega_o/2\pi \approx$ 1kHz. The bandwidth of the filter BW = 1/ (R7C12) = 62.5Hz.

Experimental Results

Figure 4 and Figure 5 show the output signal at point B and point C when there is no light signal. They are the noises of the circuit. We can see that the filter increases the circuit noise when there is no input signal, but it will filter other frequency noises and improve the system's Signal to Noise Ratio (SNR).

When the power of input light signal P = 6nW, the Figure 6 shows the output signal at point B with un-modulated laser

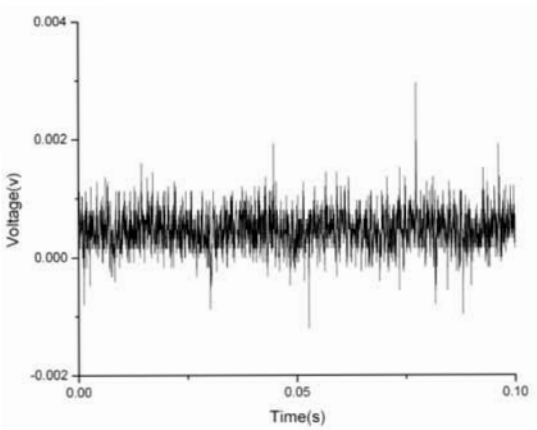


Figure 4: The output signal at point B without light signal

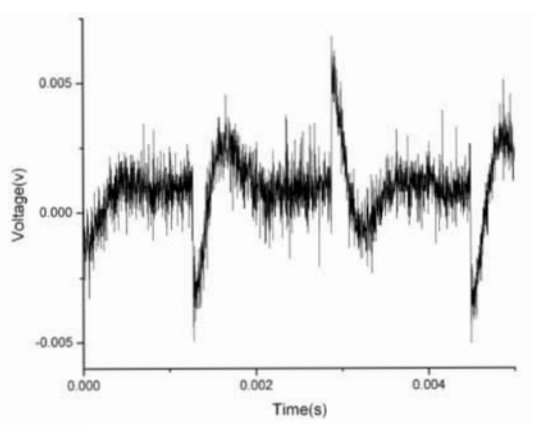


Figure 5: The output signal at point C without light signal

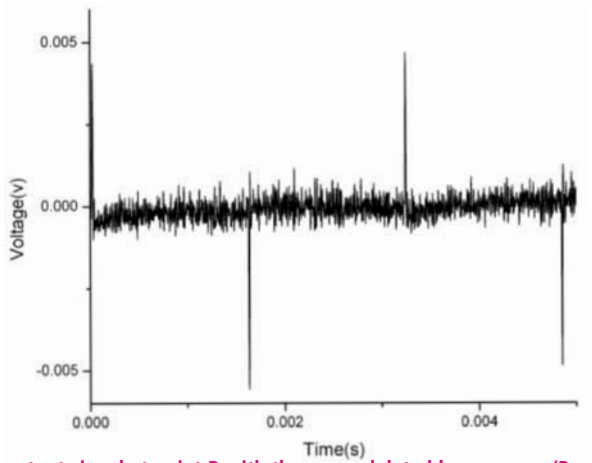


Figure 6: The output signal at point B with the un-modulated laser source (P = 6nW)

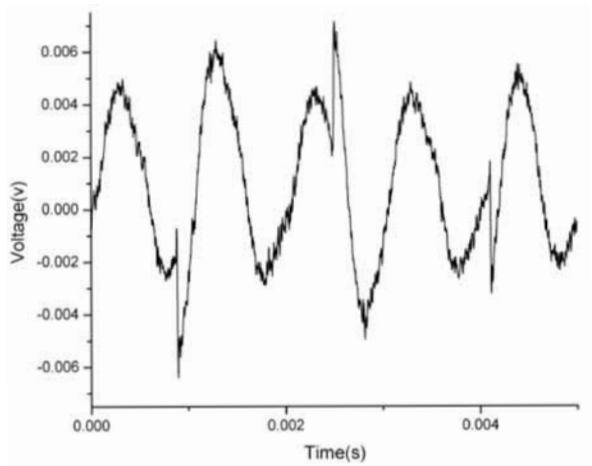


Figure 7: The output signal at point C with the modulated laser source (P = 6nW)

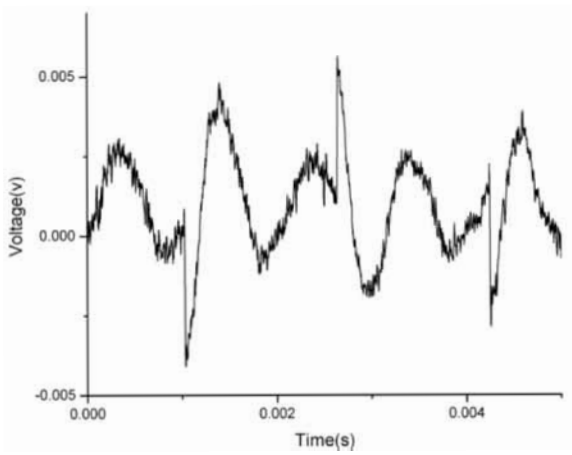


Figure 8: The output signal at point C with the modulation laser source (P = 2nW)

source. We can't distinguish the output signal from the noises. In this situation, we can't detect the output signal. Now, we can say that the effective signal has been submerged by the noises.

The impulse noise, which is amplifier's chopping noises, does not affect the results of the measurement. Figure 7 shows the output signal at C point with the modulation laser source. From Figure 7 we can see the output signal clearly and get the amplitude of the signal easily. We can smooth this curve and get the average of the amplitude in Figure 7. This means that this output signal can be detected easily.

Then we continue to reduce the light intensity. When the power of input light signal is 2nW, Figure 8 shows the output signal at point C with the modulation laser source. Obviously, this signal is smaller than that in Figure 7. But, besides the impulse noise we can still clearly distinguish a signal amplitude.

> *The weakest light intensity that can be detected is more than 6nW with un-modulated light source and the weakest light intensity that can be detected is as low as 2nW with modulated light source*

We can use the same method to detect the output signal like we do in Figure 7. So, we can still detect the output signal. This means that for almost the same circuit, the weakest light intensity that can be detected is more than 6nW with un-modulated light source and the weakest light intensity that can be detected is as low as 2nW with modulated light source.

Method for Detecting Weak Optical Signals

In this study, a method to detect the weak optical signal by modulating the light source has been presented. We can see that when the intensity of the light source P = 6nW with no modulation, the signal cannot be detected. When the laser source is modulated, the modulation signal can be distinguished.

This circuit can be used to detect the intensity of optical signal as low as 2nW in the laboratory. The experimental results provide a feasibility method for the signal's modulation used in weak optical signal detection, and we have used it in the development of a new polarimeter. ●

Electronics
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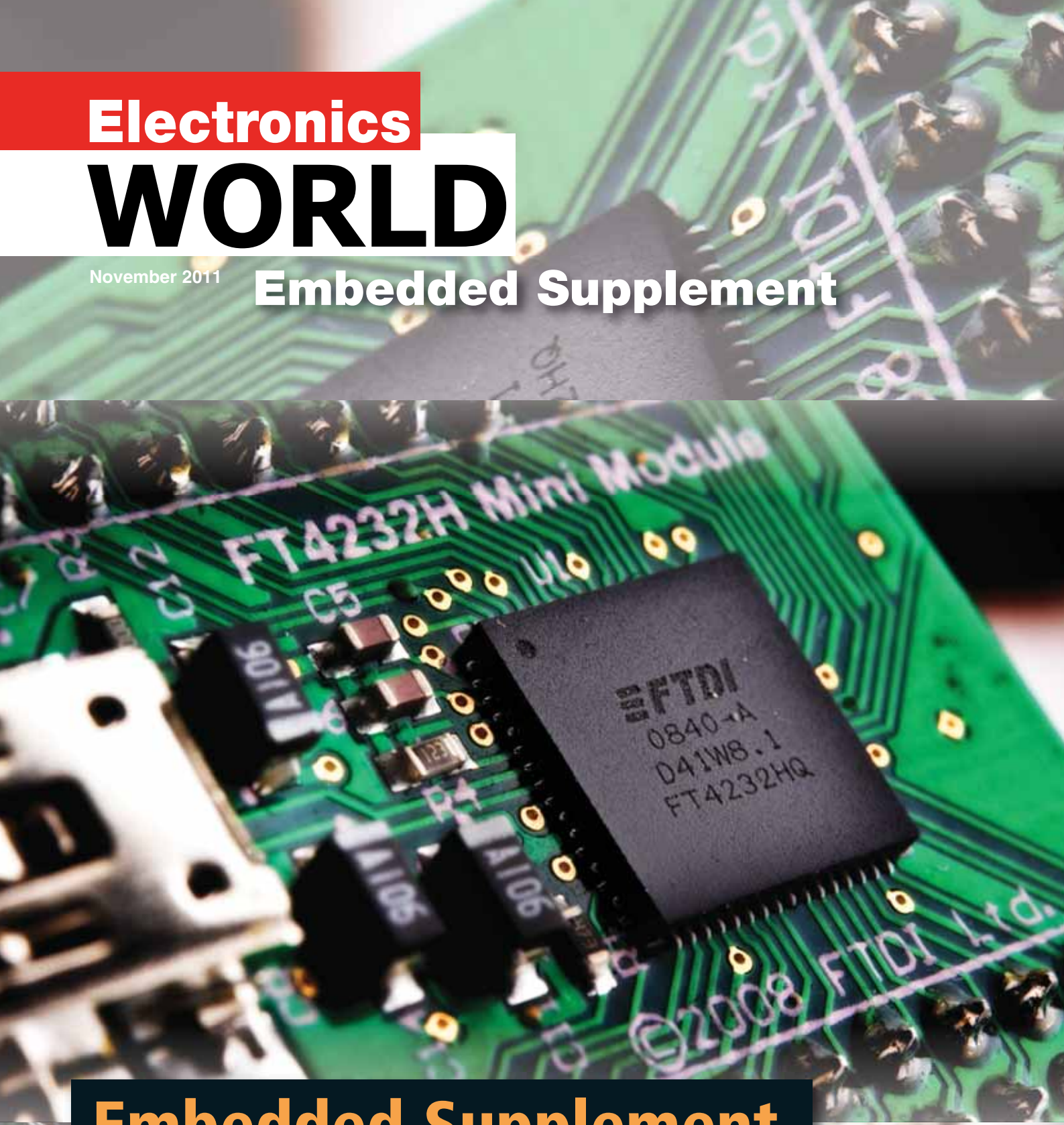
November 2011

Embedded Supplement



Embedded Supplement

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FTDI's Hi-Speed USB products allow you to rapidly produce a hardware design that will pass USB I/F certification – but that's only a small part of the story. Our Hi-Speed solutions are 100% complete , no firmware to write or download. Complete design guidelines allow you to rapidly create a PCB solution that will work, and continue to work with other USB certified products. When you've got a proven, tested design solution, USB certification is **SIMPLE.**

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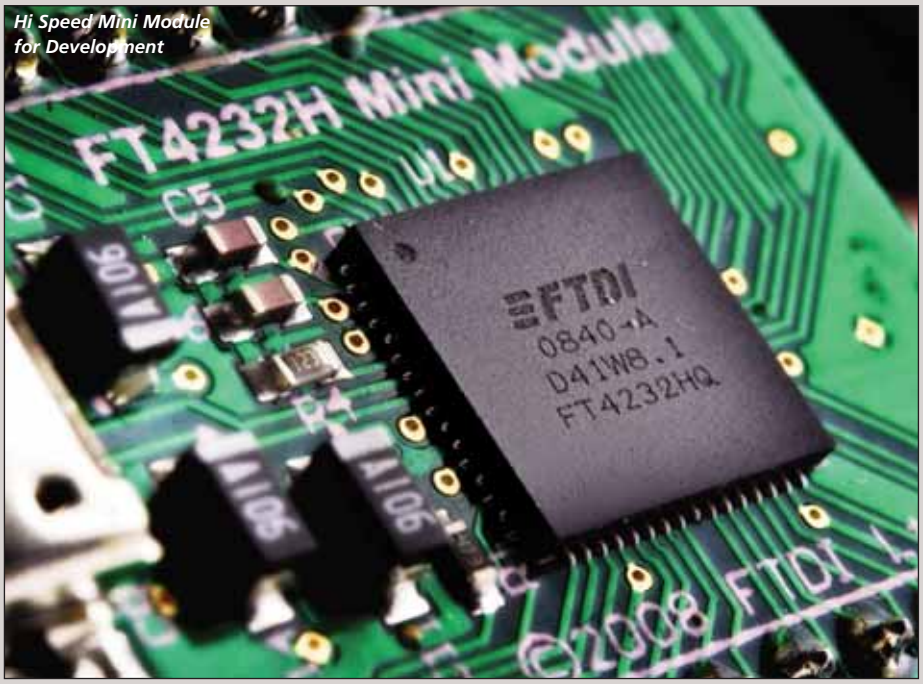

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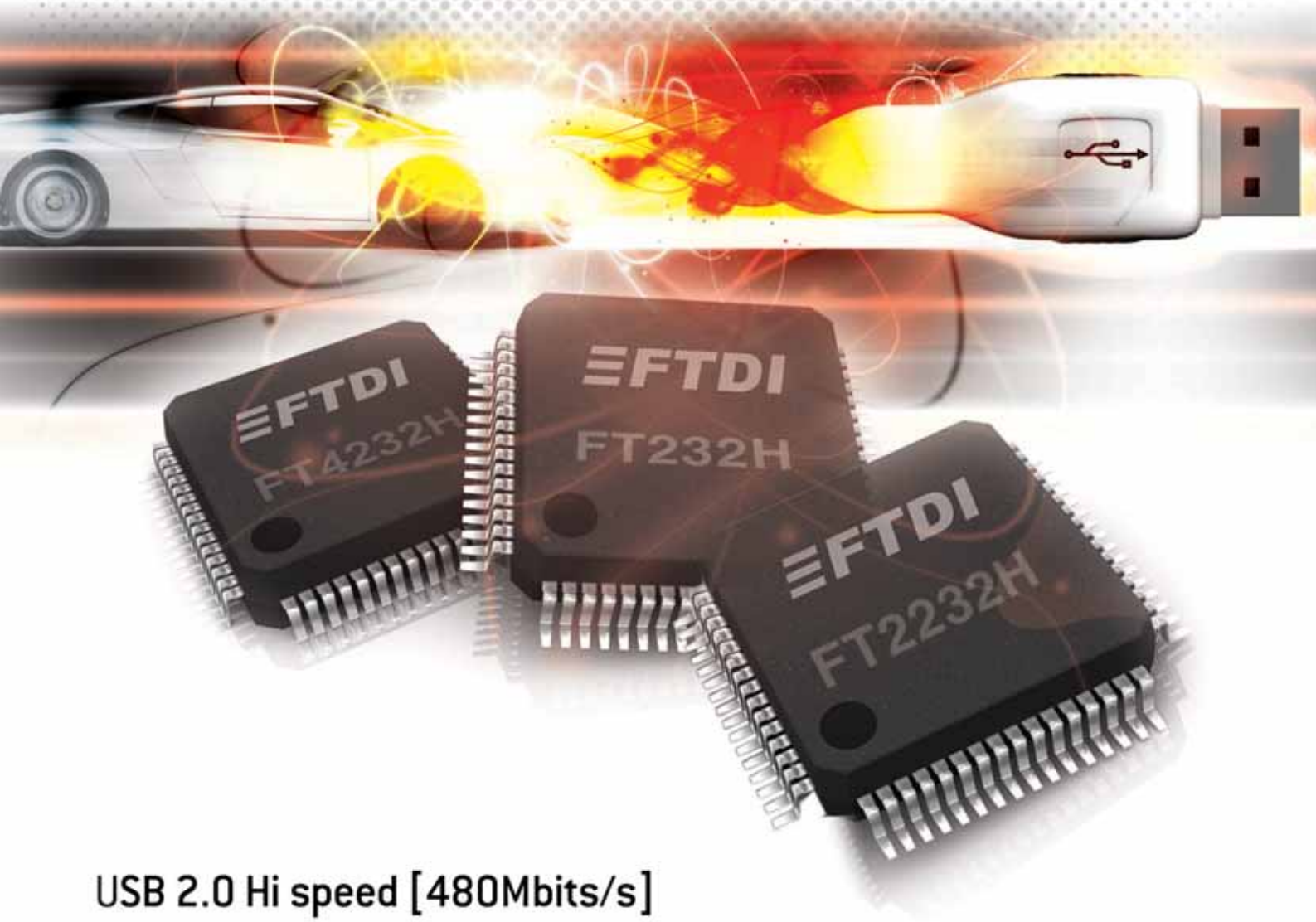

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Daniel Piper, Senior Marketing Manager at Kontron in Germany, discusses the popularity of the AMD Geode LX800 processor in modern designs, first launched twelve years ago

THE REVIVAL OF THE AMD GEODE LX PROCESSOR

The first Geode processors were launched as early as 1999 and the AMD Geode LX800 processor made its entry in 2005. And now, after the processor has already been available in the market for six years, leading embedded manufacturers are currently working on new designs – which goes to show how attractive this 500MHz processor and AMD's long-term availability support actually are.

Five-plus-two years is the 'rule of thumb' for a processor's availability in the x86 technology. After this period, the technology loses its momentum as far as new designs are concerned and last-time orders and last-time delivery management are the name of the game. At this point in time, sales figures have fallen significantly and all that remains is just the "long tail" demand, which can remain stable for a long period but more often than not only hovers around a one-figured percentage of the original demand. Maintaining the required resources for production and support often just no longer pay off.

UNIQUENESS

The AMD Geode LX processor family breaks free from this reference pattern. Today a stable demand still exists – especially for the Geode LX800 processor – and due to the order volumes it is still yielding a profit. What's the reason behind this?

The answer is simple. The most unique thing about this processor is the fact that there are no other comparable solutions left in the market. At this time there had been no other single x86 processor that is equipped with a graphics processing unit and that has an average power consumption of under 1.8W. And still today, it is a hard task to find a comparable solution. So for customers who need a very slimline x86 solution, if the 500MHz watt clocking is sufficient for the design, the processor is an attractive choice.

How come this particular chip has survived?

SLIM GUI APPLICATIONS

In terms of operating system support, right from the start the AMD Geode LX family provided a broad base for 32-bit operating systems with full Windows and Linux support. In addition it supports Flash, features full browser support and AC sound, so that it perfectly fits the bill for GUIs and thin clients and for slim visualization tasks. For such an application environment, there always was a broad market and this is the reason why the Geode LX800 variant was launched in 2006.

At that time high performance processors were already available. But with features like MMX and 3DNow!, the AMD Geode LX 800 @ 0.9W processor achieved the highest performance per watt in comparison to all the other 32-bit processors with x86 architecture that were available at the time – and at the same time offered higher memory bandwidth via a DDR interface and an improved I/O throughput with USB 2.0.

So right from the start, the LX 800 was geared to accommodating long-term applications when it succeeded the Geode GX. And even today's applications require the type of performance the LX family is offering. More than anything it is remarkable how low the power consumption actually is and on top of this, thanks to its high level of integration, how ideal it is for fanless SFF designs, as the processor integrates a graphics processor, a display controller and a video processor, plus a security block with AES besides the CPU and memory controller.

> **"The most unique thing about this processor is the fact that there are no other comparable solutions left in the market"**

Combined with the corresponding AMD Geode CS5536 chipset it offers a complete 2-chip solution with full x86 functionality. A further advantage particular to the Geode LX800 processor lies in its high temperature area which ranges from -40°C up to +85°C, making it an ideal solution for applications which have to run smoothly, even in critical environmental conditions. This also simplifies the design of fanless systems, as they usually require a maximum processor case temperature that should be at least 15°C higher than the environmental temperature of the system.

HIGH MARKET PENETRATION

Due to these characteristics the processor was used in embedded applications such as point-of-sales terminals, information appliances, kiosks and voting machines, which were all in high demand at the time of its launch. But the processor was found even in applications such as industrial control computers, panel PCs and thin clients. The fact that it supports legacy interfaces, such as COM or VGA, makes it suitable for many applications which already exist in the market, like car park ticketing machines for example.

Figure 1: AMD Geode LX800 meets Pico-ITX

> "During its lifetime, an up and running OEM application will hardly ever change its OS"

WHAT JUSTIFIES A REDESIGN?

What explains the logic behind the fact that embedded manufacturers such as Kontron not only are still selling the existing designs with this processor but even drafting new designs? The answer is: a number of good reasons. On the one hand, the existing designs reflect the status of the technology and the availability promises of the year in which they were launched. So previous designs did not provide today's important interfaces like SATA or a MicroSD slot, since they were not available.

This also applies to the operating system support. Not every component has the latest OS support like Windows Embedded Standard 7. During its running time, only the operating systems are supported which were available at the time of launch, or which were already announced. This is only logical, as why should operating systems support be extended. It only usually makes sense for new designs.

During its lifetime, an up and running OEM application will hardly ever change its OS. That would prove too costly and would, therefore, only be justifiable for a new product launch. New board level products, however, tackle the absence of this.

NEW FORM-FACTOR PICO-ITX

Kontron recently introduced a new single board computer in the Pico-ITX form-factor, featuring AMD's Geode LX800 processor. It exactly fits in with the trend towards Small Form Factor, cost-efficient, off-the-shelf solution, which minimizes development effort and guarantees fast time-to-market. Individual development tasks on such a small form-factor (10 x 7.2cm, respectively 72cm²) are no longer compulsory. And as for many applications, there is no longer a need for a large range of extension options; a single board design suffices, which accommodates all the interfaces in such a way that standard cables for USB, COM, VGA, Ethernet and others can be connected without a fuss. No embedded connectors are needed to connect these interfaces to the housing.

These are the reasons which have led Kontron to further extend its existing portfolio of Geode LX designs in this segment.

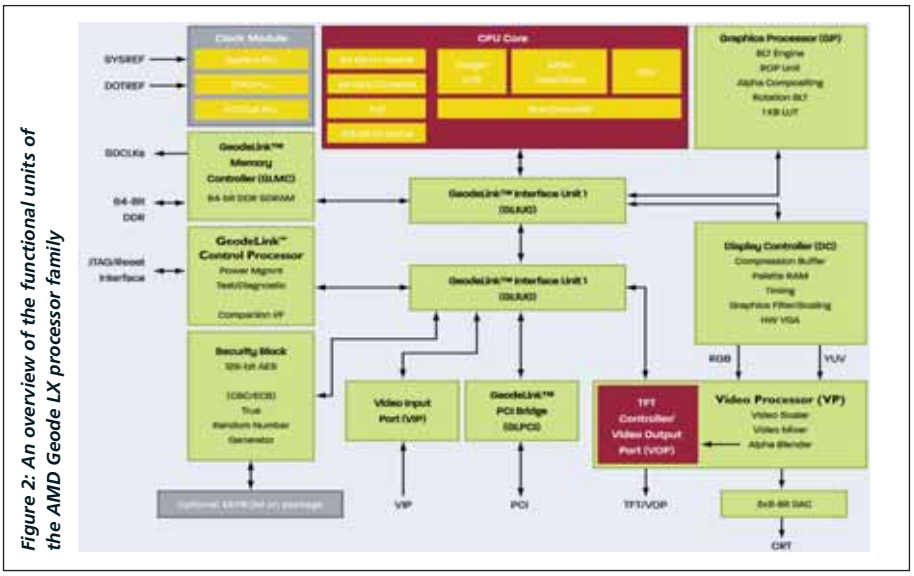

Figure 2: An overview of the functional units of the AMD Geode LX processor family

POWER CONSUMPTION OF AROUND 6 TO 7 WATTS

The new 2.5" Pico-ITX SBC Kontron KTLX800/pITX with AMD Geode LX800 processor combines highest cost and energy-efficiency with an industrial interface offering for automation and test and measurement sectors. Thanks to its price-optimized performance and the compact footprint the Kontron KTLX800/pITX also presents an ideal alternative to the RISC-based solutions. This provides advantages due to the extensive software base of the x86 ecosystem and the simplified application development which results from it, which means faster time-to-market and lower operational costs (TCO). Development is also simplified by Kontron's large range of software with various Board Support Packages and the Cross Platform Middleware Kontron Embedded Application Programming Interface (KEAPI). Kontron EAPI standardizes the hardware access and reduces the required development effort additionally achieving a much faster time-to-market.

With several years of long-term availability and an average of only 5 to 7 watt power consumption, the Kontron KTLX800/pITX is the ideal basis for a large range of extremely compactly designed and cost-sensitive industrial applications.

MEETING MANY NEEDS

To meet the interface needs, the 2.5" Pico-ITX SBC Kontron pITX-SP has an extensive range of interfaces which – apart from VGA and LVDS with Jili30 – include two serial interfaces, Fast Ethernet, SATA, 4x USB 2.0 and 16 GPIO, which helps realize application-specific I/Os.

To connect any type of display or panel there are 1x VGA (DSUB-15, up to 1600 x1200 UXGA) and 1x Jili30 (LVDS Single Channel, up to 1280 x1024 @ 85Hz) with backlight support. Data media can be connected via either 1x SATA II or in an extremely space-saving way via the socket for MicroSD cards. The 2.5" Pico-ITX SBC Kontron KTLX800/pITX supports Windows XP, Windows XP Embedded, Windows Embedded Standard 7 and Linux and has now become available. ●

Also Available for the PC/104

Since 2006 the AMD LX800 processor has been available at Kontron even for the PC/104. PC/104 is now experiencing increased demand. This is a result of the trend towards SFF designs. PC/104 excels for a reason which Pico-ITX currently cannot fulfil to the same extent – its immense range of I/O components.

On the other hand, Pico-ITX offers an extensive range of external interfaces that sit on-board. The two form-factors complement each other. The disadvantage of the sandwich design, which over the past few years has hindered the growth of PC/104, is becoming more and more insignificant. Both the production size of the chips and the TDP of SFF designs are constantly being lowered. This does away with design-in problems.

A new launch is available for PC/104, i.e. with AMD Embedded G-Series processors which with the new APU deliver convincing results.

Multi-functionality of industry PC technology is on the increase. And so is the need for service, says Norbert Hauser

MULTI-TALENTS NEED INDIVIDUAL SUPPORT

More and more functions are being integrated into industrial PC technology and this multi-functionality creates the urgent need for more individual hardware development and tailor-made software services, so that OEMs can concentrate on developing their own particular application. Embedded computing manufacturers like Kontron are consistently extending their range of OEM development services.

In hardly any other area of industrial technology has so much progress been made than in industrial PC technology. Real-time behavior is – thanks to the boost in performance - no longer an issue. Even the required determinism can be obtained for nearly every application. Thanks to multi-core hardware and virtualization or hypervisors control and visualization can be combined. The range of multi-function solutions is therefore becoming all the more complex. And more networked: Via Ethernet transfer rates of up to 1 Gigabit/s and more are standard. And Wireless LAN performance has increased to up to 450 Mbit/s. And with LTE mobile bandwidth remote services will become available which will enable applications that to date were not possible. This is where the right hardware and software design needs to be tailored, not only for operating OEM systems but for monitoring the hardware so as to supervise the availability of an application.

MORE INDIVIDUAL TAILORING

Furthermore, with the integration of FPGAs, like have now first become available in the Intel® Atom™ E6x5 processor series, solutions are possible, which for example with industrial Ethernet or field-buses or special I/Os and algorithms can be flexibly adapted to meet the required I/O and real-time requirements. An attractive solution, for example, for intelligent cameras is also the high level of integration of the AMD Embedded G Series, which combines the CPU and the GPU to a so-called APU (Accelerated Processing Unit). If you want to realize solutions based on these technologies, it often needs hardware customization and extensive software support. Indeed, GPGPU programming is very specific. As is the case with algorithms for imaging, they are offered by specialists or are carried out by the OEMs themselves. But the hardware supplier should be in a position to deal with the FPGA layout in terms of the standard interfaces which the OEM requires, otherwise the development costs for the OEM could explode dramatically. And if, for example, you imagine systems in critical environmental conditions which do not only have to be networked with flexible field-bus or industrial Ethernet interfaces, but also must have I/Os i. e. for hardware monitoring, external triggers etc. so OEMs have to pose themselves the important question of how the individual interfaces are fixed in the housing. A standard board does not suffice. Or perhaps it does?

STANDARD CUSTOMIZATION

Correct: A standard board can be designed to accommodate individual interfaces via a feature-connector. And this is even possible with motherboards: Kontron, for example, has carried this out with its new embedded motherboards Kontron KTQ67/Flex in the Flex-ATX form factor and the mini-ITX embedded motherboard Kontron KTQM67/mITX (see photos). This is ideal for applications with special I/O requirements. The implemented embedded feature connector supports up to 160 GPIOs with ADDA converter (analog-digital and digital-analog converter) and PWM (Pulse Width Modulation). With a simple additional customer-specific I/O board, the customer is free to decide how and where the interfaces are placed. Also the definition of the I/O is – thanks to the implemented Intel® 8085 microcontroller- flexibly configurable via software. The standard embedded motherboard itself does not have to be altered. The technology is field-tested. And the availability of the application is on the increase. Development costs are reduced to a minimum. The development and the production of specific I/O boards can be carried out by the customer or by Kontron for the customer. That is what is referred to as an application-ready solution. But what exactly does that mean?

APPLICATION-READY

The term application-ready applies to the delivery of an industry PC – whether on board- or on system-level – that the OEM can unpack, build into the system, install the application software and the system is then up and running. Of course, this – in 99 % of cases – cannot be achieved by employing standard components. This is reflected in the fact that over the past few years, in which embedded computer technology has been expanding and become a significant economic factor, a service network of integration providers has developed. The availability of such service providers is extremely important for many small OEMs, but for large OEMs the procedures and costs become too complex with this approach. They need one single contact person who takes on the whole system responsibility. Not just for one group of components, but for the whole application-ready system. This trend is comparable to one seen in the automotive industry. The industry has drastically reduced the number of suppliers and called for platform suppliers. The design effort has thus also been transferred to the suppliers. So it is important that such a supplier can come up with the right resources in order to be able to expertly fulfill the individual needs of each customer.

THE NEED FOR INDIVIDUALIZATION

For system integrators the term 'application-ready' applies to a finished system. For OEMs it has the same meaning – however in a completely different way. For OEMs namely, it is about the individual customization of the solution. Everything else could otherwise just be bought straight off the shelf (which of course is possible at embedded computing suppliers, as it is with Kontron). But the growing need for more individualization due to the increasing multi-functionality of systems reinforces the need for these individual services. That is a question of both software and hardware. Examples are: fanless designs, implementation of suitable storage media such as SSD or RAID, implementation of remote access or remote management and control, FPGA programming, porting software to new hardware platforms, isolation of interfaces, addressing safety and security aspects with encryption etc. – to name but a few aspects.

Norbert Hauser

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So which road to go down? COTS platforms or individualization? Hardware or software? The answer is: both. The world is neither black nor white. Only if as many facets as possible are carried out in a standardized fashion it is possible to work cost-efficiently. That not only applies to products but to services. This is why it is advantageous to have a broad base of experience with customers from many applications so as to be able to realize individual cases which require customization as professionally and cost-efficiently as possible. As well as a strong product portfolio, a strong engineering team is required, which is available not only locally but which can operate around the world for OEMs.

KONTRON COOPERATES WITH SOFTING FOR FPGA IP CORES

For FPGA-based Real-Time Ethernet solutions Kontron cooperates with Softing Industrial Automation GmbH. Softing IP cores and stacks, for example, for PROFINET, EtherCat, EtherNet/IP and MODBUS TCP can be implemented by Kontron application-ready in the FPGA-based I/O hubs of the new processor boards and Kontron can also take care of any necessary licensing. Customers therefore save valuable time when working on their individual FPGA configurations. Kontron's portfolio of application-ready FPGA platforms currently consists of the PCIe/104™ Singleboard Computer Kontron MICROSPACE® MSMST with Intel® Atom™ E600C series processor and Altera Arria II GX FPGA on a multi-chip module as well as the Kontron COM Express™ FPGA Starterkit with Altera Cyclone IV GX FPGA. Customer-specific designs are also on offer on board- (i. e. motherboards) and system-level (i. e. HMI/Panel PCs and Box PCs). Users profit from the high level of flexibility of the FPGA-based realization of I/Os via FPGAs, which enables upgrades and/or modifications, without having to change the board layout. This means that one and the same hardware platform can be applied in numerous different applications which drastically reduces development time and costs and significantly speeds up time-to-market. ●

Figure 1: Current Kontron FPGA platforms: The PCIe/104™ Singleboard Computer Kontron MICROSPACE® MSMST with Intel® Atom™ E600C series processor and Altera Arria II GX FPGA on a multi-chip module and the Kontron COM Express™ FPGA Starterkit with Altera Cyclone IV GX FPGA

Figure 2: The Kontron Embedded Motherboards KTQ67/FLEX and KTQM67/mITX have a feature-connector for up to 160 freely programmable GPIOs with ADDA converter and PWM

Figure 3: Kontron IPCs and Box PCs are available as COTS systems or as individually configured, certified solutions

Figure 4: Ex works, Kontron Panel PCs are available with different versions and certifications. They form the basis for customer-specific designs

Thomas Mauer, Embedded Processing Systems Engineer at Texas Instruments (TI), describes a method that integrates the real-time requirements of an interface back into the microprocessor, without needing an ASIC or FPGA

IMPLEMENTING INDUSTRIAL INTERFACES WITH A PROGRAMMABLE REAL-TIME CORE

The real-time requirements of microprocessor interfaces lie in the range of mere microseconds, if not nanoseconds. Conventional microprocessors are largely operated using a high-level operating system (HLOS), such as Embedded Linux or Windows Embedded CE. However, this makes it very difficult to achieve a deterministic reaction time of less than one millisecond in the user application or kernel driver, and significant effort is necessary.

To achieve the necessary reaction times for a real-time interface, it is necessary to decouple the HLOS using a dedicated peripheral block. The interface in question is typically made available by the manufacture in hardware on the microprocessor (UART, SPI and I2C are examples). If no appropriate interface is available on the microprocessor, the real-time requirement must be decoupled from the HLOS using an external application-specific integrated circuit (ASIC) or a field programmable gate array (FPGA) providing the corresponding functionality.

Above all, the industrial sector presents an enormous range of complex applications with real-time requirements. The developer can only provide the interface necessary to meet these requirements using an external ASIC or FPGA. This means using more space on the board and additional component costs.

> **"To achieve the necessary reaction times for a real-time interface, it is necessary to decouple the high-level operating system using a dedicated peripheral block"**

The Texas Instruments (TI) AM1808 ARM microprocessor offers an alternative solution. This article describes a method that integrates the real-time requirements of an interface back into the microprocessor, without needing an ASIC or FPGA.

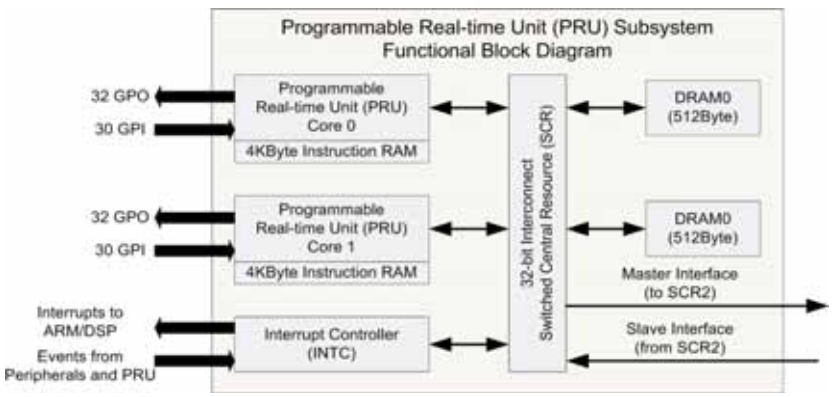

Figure 1: Programmable Real-time Unit (PRU) subsystem functional block

THE PROGRAMMABLE REAL-TIME CORE IN THE AM1808

The AM1808 is a low-power ARM9 microprocessor based on an ARM926EJ-S RISK core, and may be clocked at up to 456MHz. It includes a range of valuable on-chip peripherals, which may be usefully deployed in industrial applications: a 10/100Mb/s Ethernet MAC (EMAC) with Management Data Input/Output (MDIO), USB interfaces, I2C interfaces, multichannel audio serial port (McASP) with 16 serializers, multichannel buffered serial ports (McBSP), SPI interfaces, 64-bit timer, host port interface, UARTs, enhanced PWM module, enhanced capture module, GPIO, LCD controller, connection to external memory, and asynchronous external peripheral modules.

An important distinguishing feature included in the peripheral devices is the programmable real-time core (Programmable Real-time Unit, PRU). It can access all system resources independent of the ARM core. The PRU may be freely programmed by the developer and is ideal for real-time interface, Layer 2 protocol processing and proprietary manufacturer protocols. Particularly in the field of industrial applications, which are distinguished by a large number of different interface protocols, the implementation of the real-time interface in the PRU may result in savings on external hardware components.

Figure 1 shows the PRU Subsystem (PRUSS). The PRUSS contains two PRU cores consisting of independent 32-bit RISC processors with their own instruction and data memory. They are clocked at half the frequency of the ARM core. The zero-stage pipeline on the instruction memory allows the PRU to execute all commands in a single cycle. So, if the ARM core is clocked at 456MHz, each PRU will run at 228MHz, which corresponds to a command cycle time of only 4.4ns. Knowledge of the command cycle time makes it possible to calculate the execution time

of program algorithms in the PRU, and thus also to implement interfaces with real-time requirements.

REGISTER ADDRESSABLE INPUTS AND OUTPUTS

The PRUs feature 30 inputs and 32 outputs, which are addressed directly using registers. These inputs and outputs are tapped over the microprocessor pins after pin multiplexing for external signals has been configured in the AM1808. This allows each PRU to switch external signals within just a few nanoseconds and react to external signal changes with service routines. Application examples include reading in data after an external event, serial log generation with clock and data links and the connection of external modules.

INTERRUPT CONTROLLER AND SYSTEM EVENTS

Another component of the PRUSS is an interrupt controller (INTC) through which each PRU event (interrupt) can be received by on-chip peripherals and the ARM core. If an event is triggered by the on-chip peripheral, it will be registered in the INTC and evaluated in the program flow in the PRU. This means that even complex protocols interacting with the on-chip peripherals can be implemented in the PRU. The serializers included with the McASP/McBSP ports are an example of this: The PRU processes the Layer 2 protocol on the byte level and uses the serializer ports for physical input and output.

The bit-test command allows each PRU to check whether an event was triggered. Evaluating the event number in the PRU then makes it possible to call the proper service function. The service function then returns a receipt for the event in the INTC to allow reception of the next event.

Eight system events are additionally available in the INTC to trigger interrupts in the ARM core. These system events exist for effective inter-process communication (IPC) between the PRU and the ARM, avoiding unnecessary polling.

INTERNAL BUS ARCHITECTURE

Each PRU can also act as an independent bus master, just like the ARM core and the EDMA controller. This means it is capable of accessing all system resources mapped in memory, e.g. internal and external memory, UART, McASP, timer and all other peripherals available to the system. To guarantee data consistency, each peripheral block should only be used by one bus master. The Linux kernel allows for resource allocation to prevent such dual use. The IPC is an exception, as data exchange takes place over a shared memory range.

The internal bus architecture (Switched Central Resources, SCR) of the AM1808, which is used to connect all master and peripheral devices with one another, allows for the parallel execution of multiple bus transactions without the bus masters blocking one another. This means the PRU can access internal memory and the ARM core external memory without reducing memory throughput.

PROGRAMMING THE REAL-TIME UNIT

The PRU is programmed in assembly language. Over 40 assembler commands are available for this purpose. They cover arithmetic, logic, flow control, memory access, bit and packet manipulation, and pattern search functions using a number of registers. In the AM1808, each PRU has 4kB of instruction memory for up to 1024 assembly commands. The PRU program is loaded into instruction memory and started either by the ARM core, the EDMA controller or the second PRU.

The PRU can be stopped at any time and loaded with a new program. This makes it possible to cover multiple functions with the PRU, dynamically loading them depending on the current application requirements. The PRUSS provides

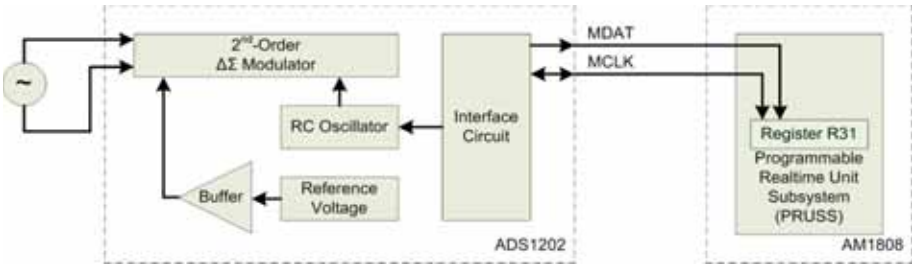

Figure 2: Block diagram showing implementation of data acquisition and a reduction filter in the programmable real-time unit sub system (PRUSS)

> **A PRU clocked at 225MHz can execute 22.5 commands during this 100ns period**

control registers to start and stop the PRU core. Another register provides information on the number of processed PRU command cycles.

PRU IMPLEMENTATION EXAMPLE

Implementation of data acquisition and a reduction filter in the PRUSS allows a low-cost delta-sigma modulator to be employed in the solution presented here.

A delta-sigma modulator returns the average value of a time range Δt. Oversampling in the modulator means several data values are required to generate a single output value. Many cases see the use of a SINC filter – an easy-to-implement and cascadable low-pass filter (see the application brief http://focus.ti.com/lit/an/sbaa094/sbaa094.pdf). The modulator is suitable for low-frequency data acquisition, e.g. temperature measurements, audio signal processing or current flow metering at motor PWMs and generators.

The ADS1202 delta-sigma modulator used in this example has a dynamic range of 80dB with an effective 12-bit resolution at 10kHz signal bandwidth, while oversampling takes place at 10MHz. It is operated with a 5V supply. Its differential inputs allow sampling at transducers/magamps and low-voltage signals.

The delta-sigma modulator is connected to the PRUSS using the data (MDAT) and clock (MCLK) lines to two input bits mapped in register R31. The bit-test command (QBBS – Quick Branch Bit Set, jump when bit is set) allows the PRU program to query the status of an input in a single clock cycle.

The delta-sigma modulator delivers a new sample bit every 100ns by oversampling the 10MHz input signal. The sample bit must be fetched and processed by the PRU within this period of time before the next sample bit from the delta-sigma modulator is ready. If this does not occur, sample bits will be lost and the measured value distorted.

A PRU clocked at 225MHz can execute 22.5 commands during this 100ns period. The implementation of data acquisition and filtering may not exceed this command budget.

The following functions are implemented in the PRU:

1. Wait for the next valid measured value to become available: Test the MCLK bit in register R31 for a transition from 0 to 1. This event triggers the following steps.
2. Process the MDAT bit sample from register R31 in the SINC filter integrator step.
3. Call the SINC filter differentiation step, depending on the selected reduction value (oversampling rate).
4. Save the measured value in local memory and, if necessary, signal event to the ARM for further measured value processing.
5. Test the measured value for outside the min/max limit.

The diagram lists the individual PRU tasks and compares the number of commands necessary between SINC2 and SINC3 filters. The assembler commands for the SINC3 filter implementation are also displayed in a simplified form.

The first four functions are carried out for every sample. This part uses six (for SINC2) or seven (SINC3) commands from a budget of 22.5 commands per bit sample. Depending on the selected oversampling rate, the program either waits for the next sample bit or calls the SINC filter differentiation step. The next measuring result only becomes ready for further processing after the SINC filter differentiation step. For this reason, the measured value min/max check and saving the sample to local memory only takes place after this step. In this example, it can be recognized that a SINC3 filter implementation with 21 commands uses almost the entire budget – to reduce the budget load, the min/max check can be postponed to the next sample bit cycle, which will only require seven cycles.

OUTLOOK

The programmable real-time core in the AM1808 makes it possible to implement customer-specific interfaces and protocols without any need for additional components. The real-time interfaces programmed by the PRUSS work independently from the ARM core. This allows the ARM core to run a HLOS such as Embedded Linux or Windows CE Embedded with access to the independent real-time interfaces in the PRUSS.

Other PRU applications include additional UARTs (SoftUART). The AM1808 already provides three UARTs as on-chip peripherals. However, certain applications such as an IO link master require 4 or 8 UARTs. In this case, the ARM core can work with the PRUSS and the McASP peripheral to make additional SoftUARTs available. Mistral (www.mistralsolutions.com) offers a SoftUART driver for download from their website. It supports Linux and can run up to four additional SoftUARTs per PRU.

Mistral has also developed a CAN bus driver based on the PRUSS, which emulates a CAN interface using the PRU inputs and outputs. This is particularly well suited for customer-internal bus systems with reduced transmission speeds. The driver is available with documentation for download from Mistral on their website.

It is also possible to integrate complex real-time interfaces such as PROFIBUS in the PRUSS. TI already offers a certified PROFIBUS slave solution with the AM1810 microprocessor.

The PRUSS is also included in other TI microprocessors and digital signal processors (DSP). For more information on the PRUSS, see the TI Wiki Page, and the product pages for the AM1808, TMS320C6748 and OMAP-L138. ●

Further Reading

1. Combining the ADS1202 with an FPGA Digital Filter for Current Measurement in Motor Control Applications: http://focus.ti.com/lit/an/sbaa094/sbaa094.pdf
2. PRUSS Wiki Page: http://processors.wiki.ti.com/index.php/Programmable_Real-time_Unit_Subsystem
3. AM1808: http://focus.ti.com/docs/prod/folders/print/am1808.html
4. AM1810 with integrated PROFIBUS: http://focus.ti.com/docs/prod/folders/print/am1810.html
5. OMAP-L138: http://focus.ti.com/docs/prod/folders/print/omap-l138.html
6. TMS320C6748: http://focus.ti.com/docs/prod/folders/print/tms320c6748.html

Graphics LCDs are increasingly being used in embedded applications. **Professor Dr Dogan Ibrahim** of the Near East University in Cyprus describes the properties of these displays and explains the design of a simple colour graphic LCD (GLCD) based project

USING GRAPHICS LCDs IN EMBEDDED APPLICATIONS

LCDs are used in a wide range of applications, including portable consumer devices such as mobile phones, calculators, watches, MP3 players; domestic equipment such as microwave ovens, televisions, radios, hi-fi equipment, video players, cookers; instrument panels in cars, aircraft, boats; and in many more applications. LCDs are lightweight, portable, inexpensive and reliable; they consume little power and are easier on the eyes. Because LCDs do not use phosphors they cannot suffer image burn-in problems associated with most older type CRT-based displays. Colour graphic LCDs (GLCDs) are increasingly being used in many portable applications such as mobile phones, electronic games, and in industrial control and monitoring equipment.

Basically, LCDs are optical devices made up of a number of pixels filled with liquid crystals and placed in front of a light source (or a reflector) to produce images in colour or monochrome. Each pixel of an LCD is aligned between transparent electrodes, called Indium Tin Oxide (ITO), and polarizing filters. LCDs do not produce any light of their own, they require an external light to be visible. On most displays this light is provided using a light source, placed behind the LCD panel.

Based on the actual addressing mechanism used, we can classify the LCDs into passive-matrix addressed and active-matrix addressed. Passive-matrix addressing is used in earlier displays and here only m + n control signals are used to address the m x n pixel display. To turn on a pixel, a charge is sent down the correct column and the correct row is grounded. The pixel at the row and column intersect-point receives the voltage to untwist the liquid crystals at that pixel. When we disable a pixel, the liquid crystals cannot go from one state to another instantly, as some time is required for this. Also, since a pixel is equivalent to a capacitor where two metal electrodes are separated by a die material, when the charge is removed it takes a certain time for this capacitor to discharge, thus slowing down the response time of the pixel. Although the passive-matrix addressing is simple, it has the drawback that the response time is rather slow. It is also difficult to control the charge accurately and when a pixel is untwisted, the pixels around it also partially untwist making the image appear fuzzy.

> **"Most of the software tools available are in the form of bitmap converters that can be used to convert a standard image file to a data file that can be used in a high-level programming language"**

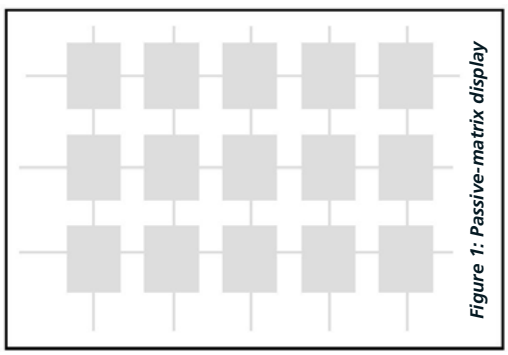

Figure 1: Passive-matrix display

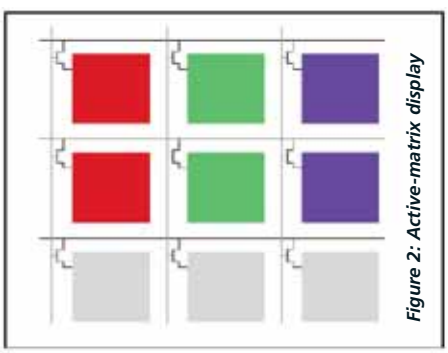

Figure 2: Active-matrix display

Figure 1 shows the functional construction of a passive-matrix display.

Active-matrix addressing (see Figure 2) is based on using thin film transistors (TFT) to quickly discharge the capacitor and, hence, improve the response time. Most domestic, consumer and industrial graphics LCDs nowadays are based on this TFT technology. A particular pixel is selected by switching on the proper row and sending a charge down the correct column.

Since all the other rows intersecting that column are turned off, only the capacitor at the designated pixel receives the charge. By controlling the amount of voltage supplied to the crystal we can control the amount of untwisting. The advantage of this type of displays is fast response time and accurate control of the pixels, thus producing sharp images. TFT displays are complex and costly to manufacture. The transistors are etched with high precision on the LCD glass between pixels.

Colour graphic LCDs are very popular, especially in consumer devices. A pixel in a colour LCD consists of three subpixels with red green and blue colour filters. By controlling the applied voltage we can modify the intensity of each subpixel over 256 shades. Thus, with three subpixels we can produce a possible of 16.8 million colours, requiring a very large number of transistors etched onto the glass.

There are various technologies used to create monochrome and colour displays depending upon the amount of twist given by liquid crystals. Some of the commonly used ones are: TN (Twisted Nematic), HTN (High Twisted Nematic), STN (Super Twisted Nematic), FSTN (Film compensated Super Twisted Nematic), DTSN (Double Super Twisted Nematic), CSTN (Colour Super Twisted nematic) and several more.

GLCD modules are normally supplied on a PCB, together with a controller chip that can be interfaced to serially or in parallel. Some of the

Figure 3: Countdown timer display layout

Figure 4: Figure 4: The Macromedia board (front and back)

commonly used GLCD controllers are T6963, KS0108, LR35503, HDM6448 and so on. Most embedded compilers provide software libraries in the form of a collection of functions for displaying and manipulating images on GLCDs. With the help of such libraries users can display bitmap images, draw graphs, draw shapes such as squares, rectangles, circles, display text, and so on.

This article describes the brief characteristics of GLCDs and shows how a TFT-based colour graphic LCD project can easily be designed using special software and hardware tools.

USING GLCD SOFTWARE TOOLS

The development of a GLCD project requires creating images by programming each pixel of the GLCD. This process is usually carried out using a GLCD image creation software tool, as doing it manually is a highly tedious work. The software tool enables the user to create the required GLCD image initially on the PC screen by shading or colouring the pixels, or by importing the image from a file.

At the end of this process the software usually creates a large number of bitmap data to represent the image, and this data can be loaded into the target GLCD device to display the required image. Most of the software tools available are in the form of bitmap converters that can be used to convert a standard image file to a data file that can be used in a high-level programming language. Some popular GLCD software tools are described below.

The bitmap2lcd software enables users to import to a PC screen a monochrome image in standard graphics program format, and then it creates a GLCD data file of the image that can be used in embedded C, Pascal, Basic, or Assembler programs. A freeware version of the program with limited functionality is available from www.bitmap2lcd. Bitmap Converter software from GLCD Tools (www.glcd-tools.com) converts bitmaps and icons to C and C++ programs that can be used in embedded graphics LCD applications. This program has the advantage that both monochrome and colour images can be manipulated.

GLCD Font Creator from mikroElektronika (www.mikroe.com) is a free software and it can be used to create fonts, symbols and icons for graphic LCDs. The nice thing about this software is that it is compatible with all of the Windows fonts and these fonts can be imported and used. This software is supported by all of the mikroElektronika embedded compilers, and visual effects such as inversion, outlining and shifting can be applied to designed fonts.

Visual GLCD software is graphics development software that supports a large number of monochrome displays with touch screen mechanisms. Users can build their GLCD images by placing visual components such as labels, boxes, circles, images etc on the screen, or by enabling or disabling the individual pixels on the screen.

The complete GLCD screen can be designed without any knowledge of programming. The screen image is then converted into a data file that can be imported and used in a program to display the created image. Visual GLCD is fully supported by all embedded compilers of the developing company (www.mikroe.com) and the developed screen images can very easily be incorporated in its compilers.

Visual TFT is perhaps one of the most advanced embedded graphics LCD programming tools available on the market, developed by mikroElektronika. As this software is used in the project given later in this article, it is worthwhile to look at the features of this advanced software tool briefly.

Visual TFT is a GUI-based colour graphics LCD development software supporting touch-screen facilities, developed for modern TFT type GLCDs. The software can be used to create graphics images, as well as graphics applications by enabling users to create touch-screen based event-driven objects that can be placed anywhere on the screen. For example, users can place a button on the screen and then define the actions to be taken when the button is pressed down or when it is clicked. The GLCD image code and the user action template codes are all created automatically by the software. The user is only required to write code for the user action routines, e.g. the code when a button is clicked. Visual TFT software supports all the TFT based boards developed by

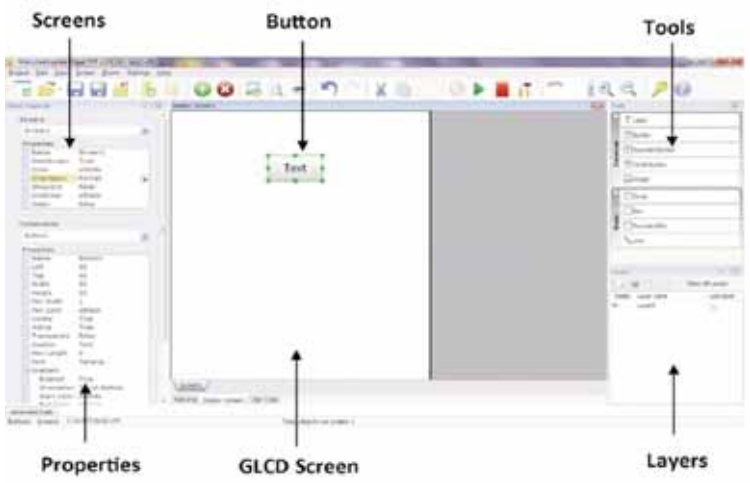

Figure 5: The VTFT screen with a button

Figure 6: Specifying the microcontroller interface to the GLCD display

"In practise the engineering application areas of graphics LCDs are endless and it is possible to develop very complex and at the same time user-friendly applications using the VTFT software"

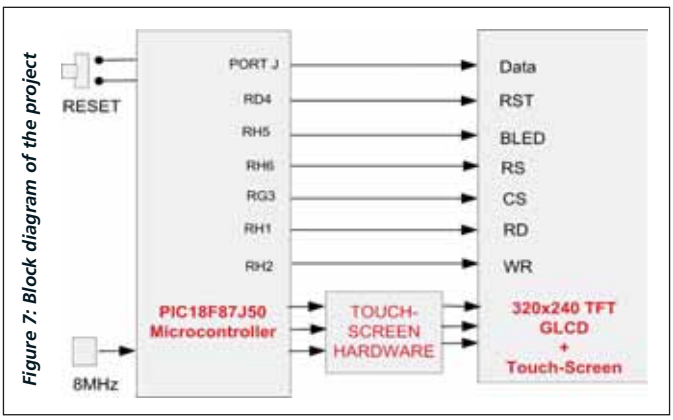

Figure 7: Block diagram of the project

mikroElektronika. These boards are called multimedia (or mikromedia) boards, and there are boards for most high-end PIC MCUs.

A multimedia board basically consists of a 320 x 240 TFT colour display on one side and a 4-layer PCB on the other side, incorporating a microcontroller, touch-screen hardware, power supply, stereo MP3 codec, accelerator chip, flash memory, SD card interface and a mini USB port, all costing around $100.

The microcontroller I/O ports are brought to the edges of the board so that external devices (sensors for example) can easily be interfaced to the microcontroller. The code developed using the Visual TFT software can be compiled using an embedded compiler (e.g. mikroC or mikroBASIC), and then loaded to the target multimedia board with the help of the on-board bootstrap loader.

EXAMPLE COLOUR GLCD PROJECT

In this section the design of a microcontroller-based colour graphics project is given. The project is a simple countdown seconds timer developed using the Visual TFT graphics development software. Figure 3 shows the display layout which consists of:

- A soft-keypad of numbers used to enter the countdown initial value;
- A soft-button named START to start the countdown process;
- A soft-button named CLR to clear the initial countdown value;
- A text-box to display the current value of the count as the countdown progresses.

The GLCD screen was designed using the Visual TFT (VTFT) graphics development software. In addition, the graphics handling code is generated automatically by the VTFT.

Figure 8: Display layout of the countdown timer

VTFT software has been developed for the Mikromedia series of intelligent colour TFT boards. An example Mikromedia board for the PIC18 series of microcontrollers used in this project is shown in Figure 4. These boards are available for various popular microcontrollers.

As mentioned earlier, in addition to the 320 x 240 pixel colour graphics LCD with touch-screen hardware, the board contains a PIC18F87J50 type powerful microcontroller, USB interface with bootloader software installed, MP3 audio processing, SD card hardware and an on-board accelerometer chip.

In a typical graphics application the user creates a GUI screen using the various tools offered by the VTFT software. The automatically generated graphics and key-click user action codes are then loaded from the PC to the program memory of the target microcontroller, using the bootloader software already loaded to the target microcontroller and supplied free of charge for the PC end of the USB interface.

Figure 5 shows the VTFT screen with a single button placed on the screen. The target GLCD screen layout is located in the middle of the screen. Users can load visual tools such as labels, boxes, circles, images, or lines by dragging them from the Tools pane at the right hand side of the screen and placing them anywhere they like on the screen. The properties and appearance of the screen and the tools placed on the screen, such as their colour, size, operation mode and so on can be changed during the design or programming phase of the project.

```
BEGIN
DO FOREVER
        IF button "0" clicked THEN
                Sum = 10*Sum
                Add "0" to display
        ENDIF
        IF button "1" clicked THEN
                Sum = 10*Sum + 1
                Add "1" to display
        ENDIF
        IF button "2" clicked THEN
                Sum = 10*Sum + 2
                Add "2" to display
        ENDIF
        ..........................................
        ..........................................
        IF button "9" clicked THEN
                Sum = 10*Sum + 9
                Add "9" to display
        ENDIF
        IF button CLR clicked THEN
                Sum = 0
                Display "0"
        ENDIF
        IF button START clicked THEN
                WHILE Sum <> 0
                        Delay 1 second
                        Decrement Sum
                        Display Sum
                END
        ENDIF
    ENDDO
END
```

Figure 9: Operation of the user program

A project can include several screens and layers where an application can select and display any required screen. As shown in Figure 6, the hardware connection between the microcontroller ports and the GLCD board, and configuration of the touch-screen hardware are specified using Settings option of the VTFT.

The block diagram of the project is shown in Figure 7. Port J of the microcontroller is connected to data port of the GLCD module. Similarly, as shown in Figure 6, some pins of ports D, G and H are connected to the GLCD control pins. The microcontroller is operated from an external 8MHz crystal. The clock is multiplied by 6 to give a working frequency of 48MHz.

Figure 8 shows the display layout of our countdown timer on the VTFT screen. The keypad and the START/CLR buttons were created using the round box button tool. This tool has the property that various event-driven program subroutines such as "OnClick", "OnDown", "OnUp" etc can be attached to it. The actual countdown value is displayed on a round box button every second. An image is used at the top-left corner of the screen in the form of a logo to demonstrate the image capabilities of the board.

The operation of the countdown timer is such that the user initially enters the countdown value and presses the START button. The initial count value can be cleared by clicking the CLR button.

The code to display the designed screen is generated automatically by the VTFT software. The codes for the user actions, such as the code to handle the key clicks, are entered using the templates provided by the software. When the screen design is complete and the required code is generated, the user activates the compiler (e.g. the mikroBASIC compiler). The user compiles all the program modules together to generate the program hex file that can be loaded into the program memory of the target microcontroller.

```
Sub procedure update(Dim d as byte)
sum = 10*sum + d
ByteToStr(d, Txt)
Ltrim(Txt)
strcat(disp.caption, Txt)
DrawRoundButton(@disp)
End Sub
Sub procedure no1Click()
update(1)
End Sub
Sub procedure no2Click()
update(2)
End Sub
Sub procedure no3Click()
update(3)
End Sub
Sub procedure no4Click()
update(4)
End Sub
Sub procedure no5Click()
update(5)
End Sub
Sub procedure no6Click()
update(6)
End Sub
Sub procedure no7Click()
update(7)
End Sub
Sub procedure no8Click()
update(8)
End Sub
Sub procedure no9Click()
update(9)
End Sub
Sub procedure no0Click()
update(0)
End Sub
Sub procedure clearkeyClick()
strcpy(disp.caption,"")
DrawRoundButton(@disp)
sum=0
End Sub
Sub procedure strtClick()
while(sum <> 0)
Delay_Ms(1000)
sum=sum-1
IntToStr(sum,disp.caption)
Drawroundbutton(@disp)
wend
End Sub
```

Figure 10: The user program

The actual program loading process can be done using the supplied bootloader, or alternatively a programmer device (e.g. the mikroProg programmer) can be used for this purpose. Figure 9 shows operation of the user program developed for this project to handle the key click actions and to display the countdown values on the display. It is interesting to note that this is the only code developed by the user.

The actual user program is shown in Figure 10. The program was developed using the MikroBASIC compiler. mikroBASIC is a popular integrated high-level language, developed for the PIC microcontrollers.

The language offers a large number of library functions for interfacing to peripheral devices, such as RS232, RS485, I2C, SD card, LCD, GLCD, Ethernet and so on. Subroutine update calculates the total countdown value as the user clicks numbers on the keypad. In addition, the clicked numbers are displayed on the screen. Subroutine strtClick displays current value of the countdown, decrements the count by one and introduces one second delay inside the loop.

Figure 11 shows the developed countdown timer in operation, implemented on the PIC18FJ mikromedia board. Although the graphics LCD example demonstrated here is very simple, in practise the engineering application areas of graphics LCDs are endless and it is possible to develop very complex and at the same time user-friendly applications using the VTFT software. For example, the mikromedia boards can be interfaced to external sensors, actuators, or motors, and equipment can easily be monitored or controlled by developing simple, user friendly, graphics-based applications with the help of the VTFT software. The mikroElektronika website (www.mikroe.com) includes a number of useful practical applications demonstrating use of the mikromedia boards with the VTFT software.

Figure 11: The countdown timer in operation

FTDI Expands its USB Hi-Speed Family

The FT232H is the newest addition to the FTDI USB Hi-Speed family and it provides the ultimate in flexible communication. Building on the continued success of earlier FT232 products, the FT232H offers UART speeds to 12MBaud, and parallel FIFO throughput up to 40Mbytes/sec.

In addition, support for SPI, I2C, JTAG, sync/async FIFO and bit-bang modes allows the embedded designer to utilize one chip for multiple communication functions.

With USB Virtual COM port & D2xx S/W drivers available for Windows (XP through Win7, & CE), Linux/Android & Mac, FTDI has a very broad base of software support available for your embedded solution.

www.ftdichip.com/Products/ICs/FT232H.htm

congatec Offers AMD Dual-Core Power on Qseven

congatec AG announces the expansion of its Qseven product line. The conga-QAF Qseven module, which is based on the AMD Embedded G-Series, is the first module to combine high graphics performance, dual-core processing power and low-power consumption in such a very form-factor.

The conga-QAF is available in two processor variants: AMD G-Series G-T40E 1.0 GHz Dual Core (6.4W) and AMD G-Series G-T40R 1.0 GHz Single Core (5.5W) with up to 4GB of low power onboard DDR3 memory.

The integrated graphics core with the Universal Video Decoder 3.0 for seamless processing of Blu-ray content via HDCP (1080p), MPEG-2, HD and DivX (MPEG-4), supports DirectX 11 and OpenGL 4.0 for fast 2D and 3D image display and OpenGL 1.1.

www.congatec.com

AMD Radeon E6460 GPU Offers Greater Gaphics Performance

At Embedded Systems Conference East, AMD introduced the AMD Radeon E6460 discrete graphics processor as AMD's next generation entry-level embedded graphics processor which complements the previously announced AMD Radeon E6760. With support for up to four simultaneous displays and more than double the 3D graphics performance of the ATI Radeon E2400 GPU, the AMD Radeon E6460 GPU sets a new bar for features and performance in an entry-level embedded GPU. With five years of planned supply availability and with the graphics memory included in the same package, the AMD Radeon E6460 GPU delivers the longevity, small footprint and ease-of-design demanded by embedded system designers.

AMD Radeon E6460 GPU can be paired with select models of AMD's next generation high-performance Accelerated Processing Units (APU) to offer additional graphics capability and additional parallel computing power.

www.amd.com

Green Hills Software Releases MULTI v6 and Green Hills Compiler v2012

Green Hills Software has announced major new releases of its MULTI integrated development environment (IDE) and Green Hills Compiler toolchain. With these new releases, Green Hills Software continues to push the boundaries of embedded software performance and developer productivity by delivering tools that produce the smallest and fastest code while enabling developers to find and fix bugs faster than ever before. In addition, MULTI IDE version 6 and Green Hills Compiler version 2012 are now delivered as stand-alone products that can be independently upgraded, providing developers with more flexibility to adopt new CPU support and IDE functionality as it becomes available.

Beyond the separate release of the toolchain from the IDE, major new features included with Green Hills Compiler 2012 include record-breaking improvements in code speed and size on ARM and Power Architecture, improved build time performance and new processors support among others.

www.ghs.com

Non-isolated, High-Power 3-Pin DC/DC Converter Modules from ROHM Semiconductor

ROHM presents its new high-voltage resistance, high-efficiency DC/DC Converter module BP5277 family which eliminates the need of external components and thermal design.

Configuring a DC/DC converter used to be complicated and time-consuming, starting with the selection of ICs for the loads and covering circuit design as well as the selection of constants e.g. those for phase compensation, board design for obtaining desired characteristics, and thermal design for heat generation. This new 3-pin DC/DC converter module integrates all required components such as the control circuit, switching element, coil as well as I/O capacitors and also allows for high-power operation. Since the series can be deployed like a module, all necessary characteristics can be obtained without involving circuit and board design which significantly reduces the time, costs and energy required for the power supply design.

www.rohm.com/eu

Apacer's SATA Modular SSD Series for Harsh Temperature Environments

The application of SSDs (solid state drives) to the embedded market is expanding. For industrial users in fields such as oil drilling, aviation, and vehicle system whose storage devices are exposed to stern environments, Apacer Technology Inc rolls out a series of SATA modular SSD: SDM (SATA Disk Module) 3. The series not only boasts resistance to shock/vibration and low power consumption but also can run at extended temperatures (-40°C to 85°C). Such industry-level performance makes the SSD a highly reliable storage solution dedicated to demanding applications, including aviation that requires working at height and low temperatures; vehicle system whose chassis suffers drastic temperature differences.

www.apacer.com

PARTIAL NETWORKING IN THE ELECTRICAL VEHICLE

STEFFEN MÜLLER AND **BERND ELEND** FROM NXP SEMICONDUCTORS GERMANY

GO INTO THE DETAIL OF THE MOST IMPORTANT DRIVERS OF IN-VEHICLE NETWORKING ARCHITECTURES FOR ELECTRIC VEHICLES

Figure 1: Vehicle without and with Partial Networking

When talking about electrical mobility, we mainly think of extending the cruising range of vehicles. Energy management works while driving, charging or parking. System requirements for things like energy saving brings management of control networks to a higher complexity level and results in new and extended requirements for semiconductor devices. These are mainly "selective wake-up capability" to realize Partial Networking (PN) and "longer product lifetime", for example battery charge cycle adds to time of active drive.

A PN standard for high-speed CAN physical layer is developed by the SWITCH group, a composition of car makers and semiconductor suppliers and is planned as extension to ISO11898. In networks, featuring PN, electronic control units wake up from sleep mode when a certain wake-up message is detected. Compared to existing ISO11898-5 conforming CAN physical layer products, additional functionality in the transceiver is needed to detect wake-up commands. This has to operate properly in a harsh environment of electrical vehicles (EV).

Of Importance to EVs

What is important for EVs? What are the trends in in-vehicle networking when we compare an EV to a conventional car with combustion engine? To what extend can paradigms be sustained that have been built with conventional cars in mind?

The following summarizes the system challenges of an EV with impact on in-vehicle networking:

- Mobility;
- Predictable cruising range, telematics, energy efficiency, size and weight;
- Lifetime and safety;
- Introduction of new safety-relevant embedded systems;
- System complexity;
- New energy sources and new power train result in new network demands;
- Robustness;
- Harsh automotive environment, fast transients in power electronics in electrical drive;
- Isolation towards human interface; and
- High voltages above 60V DC across the vehicle network, among others.

In addition there are networking trends within EVs which are being addressed too. These include:

Network Domain Boundaries are Newly Set

Safety requirements and power saving in EVs are main drivers for in-vehicle networking architectures. Traditional categories in conventional cars are body, chassis and powertrain. The EV system partitioning is mainly based on the used voltage levels. Background is the need of isolation and preparation to handle high voltage in safety-critical situations such as an accident. Of course, the traditional categories keep their relevance. Here, we see the trend that more and more functions are distributed amongst electrical control units, e.g. telematics, driver assistance and so on.

Networks have Longer Duty Time

The EV never sleeps. Its network is never completely switched off while networks of conventional cars shut down when parking. EVs have, again, to be alert for critical situations such as failures in the system or the high-voltage battery or car crash; hits another car or is hit. Depending on the incident, the system is prepared to prevent battery from deep drainage and then damage or to separate high-voltage battery from rest of the vehicle for safety reasons.

The anticipated role of an EV as a medium in the public energy grid to store energy illustrates as well that an EV will have extended operation with the energy network and accordingly communicates with the "grid" while parking.

Network Management Implementation Principle is Changed

Network management in conventional cars expects modules to distribute status messages on a regular base. Does this comply with the need for energy efficiency? We anticipate a move to an "event-trigger based" implementation, i.e. showing activity in the network only when needed. Number of maintenance messages is reduced to a minimum.

Network is Part of the Energy Management System

Some EV functions are always in operation (e.g. battery monitoring, energy management) and create bus traffic. This keeps modules in CAN networks active, even when these modules do not contribute to a.m. system functions. A mechanism is needed that allows switching off/on functions while other functions remain active and exchange data via network, optimized for operation modes such as

drive, park and charge. It's fatal for the energy balance if all modules wake up by bus traffic. This impacts the energy balance in a negative way and reduces cruising range. PN provides the necessary feature for networks to switch off modules and quickly reactivate these when needed.

For example, a journey with the EV is scheduled and energy is to be stored in upfront in the battery. Before charging the battery, the amount of energy will be calculated that is needed to drive to the wished location. Navigation and traffic information functions are switched on for the route calculation. When route calculation is finished, results are communicated via the communication network and then navigation and traffic functions are switched off. Charging of the battery starts and accordingly only the involved functions for this operation communicate.

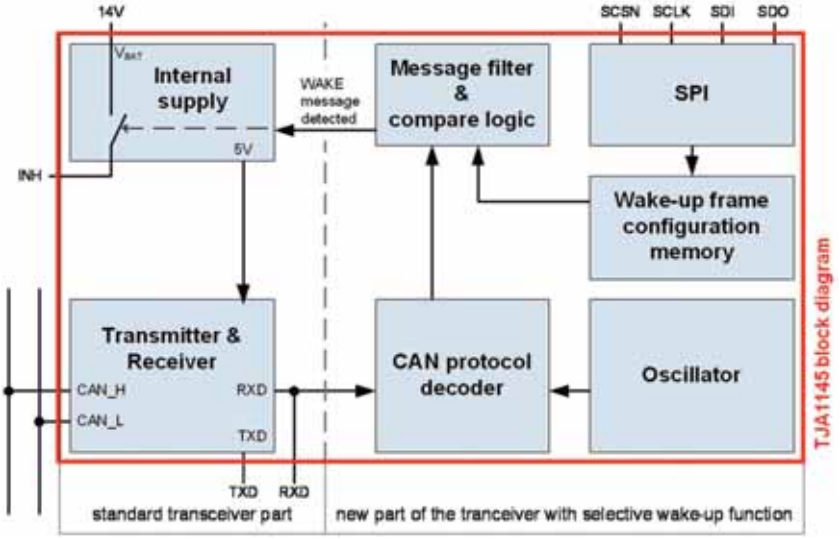

Figure 2: Exemplary transceiver architecture TJA1045 for Partial Networking

Paradigm Change in Networking from Conventional Car to EV

- Safety aspects dominate architecture and network choice (separation of voltage domains);
- Control network becomes an important means of energy management in the vehicle;
- Parts of the control network are always active.

What is Partial Networking?

The usage of PN in conventional cars is typically with comfort modules (functions) that can be switched off during drive or are to be configured during start of the car. Some functions are still expected to be available when ignition of the conventional car is turned off. Examples are trunk lift, seat, window lifter, pre- or auxiliary heating, and sunroof. As described before, we expect a paradigm change within EVs. PN will become an important part of the energy management system. Easiness of implementation, robustness and attached costs are criteria to successfully employ the PN feature in EV architectures on HW and SW (module) as well on system (network) level.

The ability to operate a certain part of a network in a certain moment is called PN. See Figure 1 where a green box means a module is switched on and a gray box that a module is switched off (right car). In ISO11898-5 CAN networks, all modules are switched on when at least two modules communicate (left car). Exceptions are realized by today by switching off supply of a selected module or by using dedicated wake-up wires. Each option is hard-wired and does not offer flexibility in its configuration. With PN, modules wake up by a certain message sent via network.

German car makers initiated the SWITCH (Selective Wake-able and Interoperable Transceiver in CAN High-speed) group. Other OEMs and semiconductor vendors like NXP joined this interest group. SWITCH developed between July and December 2010 a draft for the extension of ISO11898 introducing a new wake-up mechanism. In short, a valid wake-up message is detected when the received ID matches to a predefined ID, the received data length code matches to the predefined data length code, and the received data field matches to a predefined data field content.

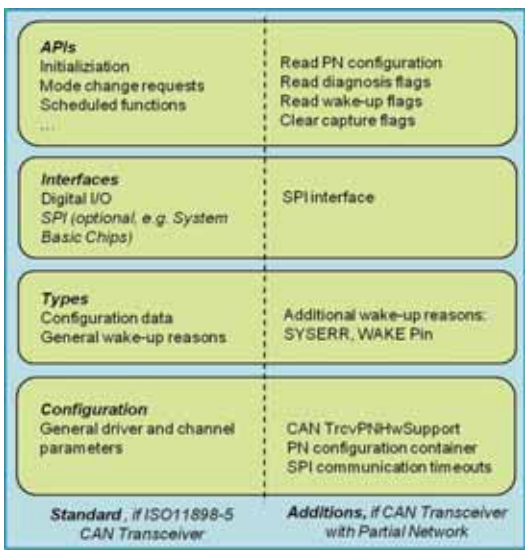

Figure 3: Autosar Release 3.2.1, incorporation of CAN transceiver driver

> Safety requirements and power saving in EVs are main drivers for in-vehicle networking architectures

Partial Networking Transceiver Architecture

From the system perspective, modifications in HW (control mechanism) and SW (network management extension) are needed to implement the PN feature. We start with the HW architecture changes of a transceiver.

In order to realize the selective wake-up function, the receiving part of a CAN protocol controller has to be integrated into a PN transceiver as well as the oscillator that clocks this internal protocol controller. Compatibility to standard transceivers in SO14 package is required by the German car makers. Therefore, there is no option to connect an external oscillator like crystal or ceramic resonator to the transceiver. Such external component requires more supply current than an integrated oscillator and would be in conflict with power saving targets. Furthermore, would add costs and space to a printed circuit board. Figure 2 depicts the new transceiver architecture.

Mode	EV Sub-System [x=On]		
	Engine	Charger	Safety
Drive	X		X
Charge		X	X
Park			X

Table 1: System modes and sub-systems in operation

In fact, all functional blocks except the transmitter need to be supplied directly from battery because they need to be operational also in low power modes (standby and sleep) when 5V supply is switched off in the according module.

If activity occurs on the network that wakes up ISO11898-5 conform transceivers, the PN transceiver will not signal a wake event on RxD and INH pins, however it would activate the receiver, protocol decoder, oscillator and message filter and the compare logic. If the bus remained silent for a certain period, these blocks would get deactivated again. The wake-up event is signalled on RxD and INH in case the configured wake-up message has been received.

Overall, the challenge for the hardware implementation of PN is to find an on-chip oscillator design of certain accuracy, i.e. with perfect compensation for temperature, supply voltage variation, production spread and ageing in order to comply with the robustness requirements of the harsh environment of an EV.

Network Management Modifications

Besides HW modifications, the PN implementation requires changes in the network management. This impacts different levels of the SW architecture. An instance such as a gateway needs to keep track which modules have been switched off on purpose or due to error condition. These questions are addressed in the subgroup "Efficient Energy Management" of Autosar work package WP-1.1.1. PN functionality is available with Autosar release 3.2.1 [Bunzel, Stefan, Autosar Release News, October 2010].

Figure 3 summarizes SW elements implemented in Autosar standard transceiver driver level (left hand) and needed additions to support PN (right hand). These are APIs, SPI support package, wake-up reasons, a PN configuration container for general PN support, wake-up frame configuration (ID, DLC, mask, data etc.) and baud rate. Important is the support of different shutdown sequences for PN transceivers, as the bus is not idle during network shutdown.

Architectural Changes on Module Level

The CAN network architecture in the vehicle, as well as the HW architecture on module level, does not change when PN is introduced. The PN transceiver with its selective wake-up function is responsible for detecting the wake-up event on the network and controls the activation of the voltage regulators for the entire module. This is identical to the operation of a standard transceiver according to ISO11898-5.

Figure 4 shows how a standard High-speed CAN transceiver like the TJA1041 or TJA1043 can easily be replaced on module level by a PN transceiver TJA1145. However, since the configuration of the wake-up message is necessary, the TJA1145 features a SPI interface instead of having error (ERRN) and mode control pins (STBN, EN).

PN does not require a new network or module HW architecture; it will be standardized in ISO11898 as well as in Autosar. It offers new functions that are used in conventional cars to increase comfort but also to comply with new governmental rules for energy saving. These advantages can be used in EVs for the implementation of a robust energy management system and ends up in an increased cruising range.

Mobility and Safety

Today, we do not know where we will end up with the cruising range of EVs. Interesting fact is that an EV already in 1909 could drive 259km with one charge, 1911 it is already 324 km and the Tesla Roadster in 2009 raised the bar with more than 500km. However, experts expect within the next decade steep improvements in the power density of batteries. Needless to say that each "saved" Watt directly contributes to the cruising range of an EV. PN excellently contributes with a robust and reliable approach to the energy balance of an EV. Industry expects that power savings in a conventional car may sum up to 70 Watts and is a first reference for EVs. What this means for the extended cruising range depends on the EV characteristics and the efficiency of the chosen EV architecture.

EV stands for the introduction of safety-relevant embedded systems, not reusable from the conventional car. A typical EV has three main modes: drive, charge and park. While in "park" with conventional cars, all functions are switched off, and the EV keeps safety-relevant functions active. This links to the battery stack that is always on and is forced to zero leakage in case of a failure in order to avoid damages of the battery by deep discharge.

Another aspect to keep the safety sub-system always active is to detach the high-voltage battery from the rest of the vehicle in case of a car crash. Table 1 shows main system modes versus sub-systems then in operation. As a consequence, the safety sub-system needs to follow extended product lifetime tests.

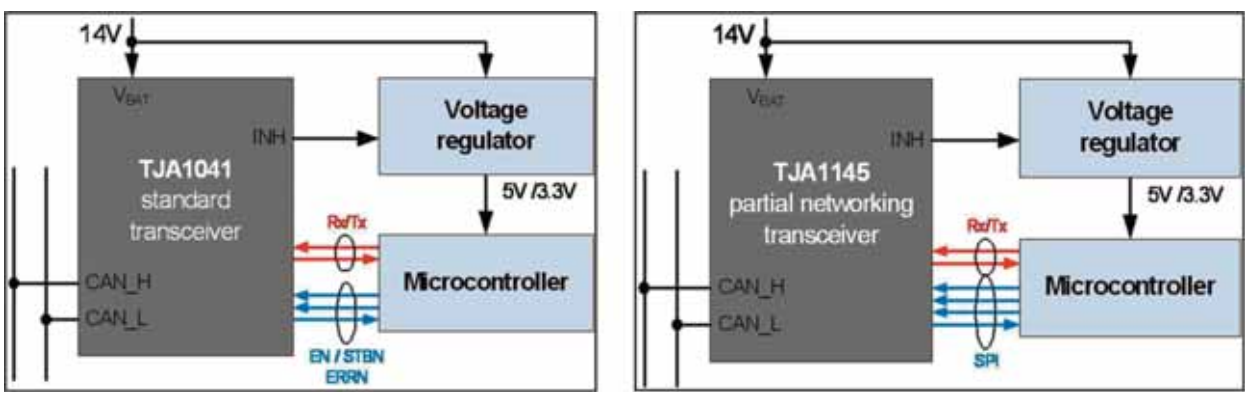

Figure 4: Module architecture for Partial Networking

Complexity and Lifetime

A discussion took place in the beginning of the SWITCH group how to implement the PN mechanism. On the shortlist were two options to detect the wake-up message:

1. Detection by CAN controller that is kept active while the rest of the microcontroller, in which it is nested, stops or

2. Add a reduced protocol engine to the silicon of the transceiver.

The expert community of the car makers voted for the second option and with this limited changes in the entire system. It is anticipated that on device level the above mentioned product lifetime extension is applied to only one device, the transceiver, but not to the microcontroller, voltage regulators, capacitors, etc.

While the requirements on lifetime have not been concluded yet, a first indication from car makers is to triple the lifetime testing. This will add to the product development lifecycle, as well as to the final product cost for the device.

Robustness

When we talk about robustness of in-vehicle networking, we basically think about EMC performance in terms of immunity. The good news is that in the last few years big steps have been made and the gained knowledge can also be applied to PN transceivers. Moreover, the SWITCH group has already defined dedicated PN EMC requirements.

The bad news is that some experts see in EVs an increasing challenge for EMC due to high voltage and high current transients leading to hazardous electromagnetic fields not known from conventional cars. Thus ISO7637 impulse immunity during operation might become one of the new challenges for the semiconductor suppliers.

What does robustness of PN in EVs mean? Do wake-up messages have different vulnerability than other messages?

Yes! The reason is the fact of two separate reception paths.

1. Potential wake-up messages are received and decoded by transceiver with on-chip oscillator. Power consumption in this reception path is limited to a very low value. Directly connected to battery, supply lines might be disturbed by transients.

2. In normal operation, messages are decoded by a microcontroller that is connected to quartz as a reliable clock source. The receiver in the transceiver consumes more power and suppresses noise and stabilizes the supply.

It is too early to compare robustness of "wake-up message detection in a PN transceiver" in all PN implementation concepts but it is already clear that the critical factor is the on-chip oscillator and its resulting stability, despite distortions like electromagnetic fields, ringing, sender clock tolerances, as well as cranking pulses on the supply. With the TJA1045, NXP found a smart implementation.

Enabling New Dimensions

EV enables new dimensions of efficient driving but there's a need for extended energy management. Lifetime aspects in EVs are tremendously important due to embedded safety systems.

In addition there's a paradigm change in networking: moving from conventional car to EV is from moving from comfort to energy management. Partial Networking is excellent means for energy management; but parts of EV are always active. Partial Networking contributes into all operation modes of EVs: drive, charge and park. Multiple disciplines are involved in Partial Networking and standards are driven for HW and SW.

To summarize: robustness will be a key differentiator between PN transceivers; but also the accuracy of the on-chip oscillator. ●

Designing to a low price point: ARE THE COSTS TOO HIGH?

HUW MUNCER OF TE CONNECTIVITY IS ALWAYS ON THE ROAD. AS A SALES MANAGER, HE SEES WHAT ENGINEERS ASK FOR AND NEED, BUT ALSO HOW AN ENGINEER'S JOB HAS CHANGED OVER THE YEARS

Every design engineer knows that whatever they are designing, be it a mobile phone, tablet or smart meter, the bottom line is to meet the price point at which the product can be sold. Whilst some consumers base their buying decision on purchasing a product with superior functionality, cost remains a major factor for most.

The evolution of consumer electronics continues towards lighter, smaller and more ergonomic devices with greater functionality and computing capability. This means meeting the power requirements of these portable devices requires careful battery design planning and comprehensive integration of the power source with device circuitry.

The designer is, therefore, tasked with designing in the minimum number of components possible to reduce cost, whilst ensuring the user has a favourable experience. The designer's mantra can be summed up as: "If it doesn't do anything, don't put it in". They know that every few pence saved on component count helps keep prices down.

The one area where design engineers can see problematic results due to cost and size pressures is battery protection.

Today's portable electronics are generally powered by lithium ion (Li-ion) batteries. Among the advantages of Li-ion batteries are their improved power-to-weight ratio, better charge hold capability, a longer usable life and lighter weight. The major disadvantage is that they contain an electrolyte (lithium salt) dissolved in a highly flammable solvent. This means a short circuit can cause overheating, battery rupture or spark a fire. At best, the outcome may be a dissatisfied consumer; at worst, a warranty recall of the damaged battery pack or the portable device...a costly proposition.

Once again stories are circulating of batteries in laptops and phones (or their chargers) failing and causing extensive damage to property and/or people. Not so long ago HP issued a voluntary recall on the batteries used in its notebook computers due to overheating and potential fire hazards.

This should not be happening, but it does, and at times for just the cost of a small component.

I keep an eye on these stories as my business is circuit protection and it makes me wonder in just what areas cost-cutting is being done and whether it is to the consumers' advantage.

> *The one area where design engineers can see problematic results due to cost and size pressures is battery protection*

Asking around the design engineers I meet, I found transformer design is another area where cost-cutting does not necessarily benefit the consumer or the environment. In this case efficiency suffers rather than safety. Using a cheap transformer results in only about 65% efficiency, as opposed to using one priced minimally higher which provides 80% efficiency. This is apparent right across a wide range of suppliers. It may add an extra few pence on the cost to the customer to use the more expensive transformer but the variation in power consumption is significant.

When it comes to consumer products it may be that the end-user would happily pay the higher price for a more reliable and efficient product. In France, for example, consumers generally recognise that buying the correctly branded replacement battery is a smart move because invariably it lasts longer and generally improves safety.

This leads me back to my question: Would consumers pay more for enhanced protection inside their product, much like the Intel Inside branding concept of touting a product's value based on what is inside rather than its cost?

A number of consumer electronics manufacturers are beginning to apply risk assessment processes to new product development, with safety professionals assisting in identifying hazards and collaborating with design engineers in the implementation effort. In this process, managers also ensure that risks are reduced to an acceptable level before the design advances to production.

In my world, I have seen the concept of designing in circuit protection become much more common. A few years ago these components were frequently added only to products that had potential fire hazard issues, such as in automobiles, and then only when it was mandated in an industry standard.

> *It makes me wonder in just what areas cost-cutting is being done and whether it is to the consumers' advantage*

I now see new materials technologies and design approaches emerging that have led to hybrid and surface-mount devices, which help design engineers meet the cost saving and board space demands. With the increase in connectivity there is an increase in the number of ports needing protection. Take for example a stereo from the 80s that had a mains input and two speaker outputs, now a stereo has these plus USB, Scart, Phono and MP3 player connectors, all of which need protection.

As consumer awareness and knowledge grows, the demand for safer, more reliable portable electronics has increased. Manufacturers also now recognise the indirect costs associated with field failures and that effect to their brand and the bottom dollar.

Perhaps not too long from now designers will replace their mantra of cost-cutting with this proverb from across the pond: "An ounce of prevention is worth a pound of cure". ●

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A Closer Look at Nanoscopic MEASUREMENTS

OVER THE NEXT SEVERAL ISSUES OF ELECTRONICS WORLD MAGAZINE, **JONATHAN TUCKER**, CHAIRMAN OF THE IEEE NANOTECHNOLOGY COUNCIL STANDARDS COMMITTEE, WILL PRESENT A TUTORIAL ON TEST AND MEASUREMENT ASSOCIATED WITH NANOTECHNOLOGY

As a substance is reduced to nanoscopic dimensions, both the bandgap and the distance between adjacent energy levels within the material's electron energy bands are altered. These changes, along with a particle's nanoscopic size with respect to the material's mean free path (the average distance an electron travels between scattering events), directly affect the electrical resistance of a nanoparticle.

More generally, a material's bandgap directly influences whether a particle is a conductor, an insulator, or a semiconductor. These influential electronic properties allow, for example, a carbon nanotube (CNT) to be used to create a transistor switch. One way to do this is by connecting a semiconducting CNT between two electrodes that function as a drain and source. A third electrode (the gate) is placed directly under the entire length of the carbon nanotube channel. For a semiconducting CNT, the introduction of an electric field through the channel (via the insulated gate placed in proximity to the CNT channel) can be used to change the CNT from its semiconducting state to its insulating state by increasing the gate voltage. Decreasing the gate voltage will transition the device into a conducting state. This conduction mechanism is analogous to the operation of a silicon MOSFET transistor switch, which is created by doping silicon with either an electron acceptor or donor to alter the material's electronic conductivity in specific localities.

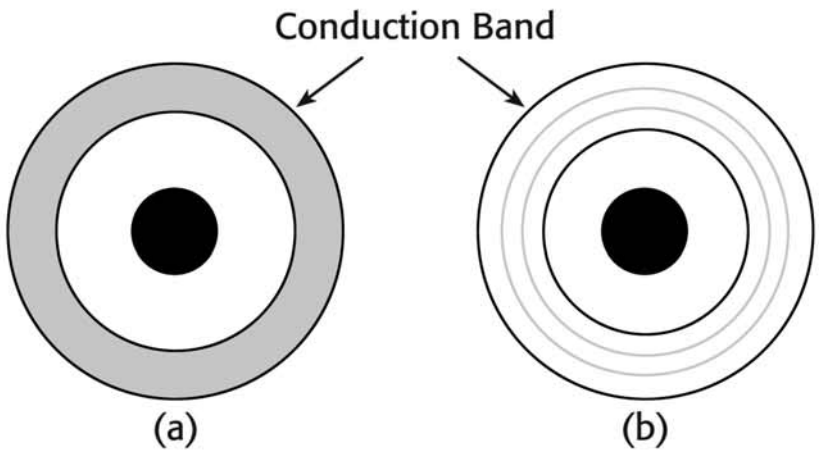


Figure 1: As material is reduced from macroscopic dimensions to nanoscopic size, its continuous energy bands (a) separate into discrete energy levels within the band, (b) and the bandgap increases

As a particle's size is reduced to nanoscopic dimensions, the allowable energies within the continuous bands separate into discrete levels

As a particle's size is reduced to nanoscopic dimensions, the allowable energies within the continuous bands separate into discrete levels (because there are far fewer atoms in the mix). This occurs when the separation between energy levels approaches the thermal energy of the electrons (see Figure 1). The density of states of the material changes with the fewer energy levels within the specific energy band.

The density of states is a measure of the number of energy options available to an electron as it falls into a lower energy level by giving up energy or as it ascends to a higher energy level after absorbing energy. If the density of states is known, the size of the particle can be deduced.

Characterizing the density of states is a fundamental activity in nanoscopic material research. Density of states (3D dimensionality) as a function of energy can be expressed as:

$$\rho(E) = dn_s/dE = \left[\{4\pi(2m)^{3/2}\}/h^3\right]\left[\sqrt{(E)}\right]$$

FURTHER READING

FOR A DISCUSSION OF THE CHALLENGES ASSOCIATED with choosing appropriate nanotechnology testing instrumentation, see *"The Right Tools for the Right Measurement."*

This represents the number of electron states per unit volume per unit energy at energy E, where:
m = the effective mass of the particle,
h = Planck's constant, and
E = the energy (electron orbital location) in electron volts.

Because the density of states can be used to predict the electrical behaviour of materials, it is also possible to use electrical impedance measurements to derive density of states information. The density of states is found by plotting differential conductance vs. applied voltage. Differential conductance is simply di/dv. When this conductance is plotted against voltage, the graph indicates the material's density of states. Highly conductive materials possess an abundance of free energy levels in the conduction band, i.e. greater density of states (more individual allowed energy levels per unit energy).

Insulating materials have an electronic structure with a dearth of occupied energy levels in the conduction band. Because density of states corresponds to the density of these energy levels, a plot of conduction vs. voltage provides a direct measure of the electronic density of states at each energy level (voltage across the device).

One approach to this technique is to use a nano-manipulator that makes low resistance contacts to the nanoparticle. Such an arrangement allows charge transport and density of states measurements. This works well into the conduction region thanks to the low resistance direct connections of the nano-probes on the material (particle) being tested.

The nano-manipulator and its probes, along with a source-measure unit (SMU), are used to apply a current or voltage stimulus directly to the nanoparticle and measure its corresponding voltage or current response. The advantage of electrical source-measure testing is rooted in the fact that a specific SMU measurement mode (source current/measure voltage or vice versa) can be chosen based on the relative impedance of the material or device under test (DUT). Furthermore, the measurement mode can change dynamically as the impedance changes, such as occurs in CNTs acting as semiconductor switches. This allows a much wider dynamic range of voltage and current stimuli and measurements, thereby optimizing parametric test precision and accuracy. SMU voltage and current sensitivity can be as good as 1 microvolt and 100 atto amps. ●

austriamicrosystems Announces New LED Driver Family

austriamicrosystems announced its new AS364X series family of LED flash drivers for mobile phones, cameras and other portable devices. The high level of integration and 4MHz operation of the DC-DC boost converter enable the industry's smallest device sizes, yet still maintains the highest accuracy to ensure the best picture and video quality. Expanding the company's extensive photo-flash offering, the new driver family supports output currents from 320mA up to 2A providing optimal solutions for entry-level cell phones to high-end smartphones, tablets, DSCs and VCRs.

In addition to the industry's smallest device sizes, the new family provides highly accurate I2C programmable output currents and timings. It also provides a variety of security features, as well as features for improving the picture quality in a mobile environment that enables the flash to operate down to very low battery levels. This is accomplished through a combination of intelligent built-in features and proprietary process technologies.

www.austriamicrosystems.com

TI NANO MODULES AND NANO REGULATORS PACK POWERFUL PUNCH IN SMALL SPACE

Texas Instruments introduced four new SIMPLE SWITCHER power management integrated circuits for space-constrained point-of-load designs in industrial, communications and automotive applications. The National 1-A LMZ10501 and 650mA LMZ10500 nano modules with on-chip inductor and 2-A LMR24220 and 1-A LMR24210 nano regulators feature high performance and tiny, nano packaging as small as 7.5mm2. Used in conjunction with the WEBENCH online design tool, the products simplify and speed the design process.

In a typical space-constrained design, TI's new nano power modules, which support an input voltage range of 2.7 V to 5.5 V, can be designed alongside the nano power regulators to step down from an intermediate voltage rail to the point of load, providing a complete power management solution in applications with space and height limitations.

The SIMPLE SWITCHER power modules, which expand TI's portfolio of integrated power solutions, comply with the CISPR 22 Class B radiated and conducted electromagnetic interference (EMI) standard for communications applications.

www.ti.com

REGENERATIVE BIDIRECTIONAL AC/DC POWER SOURCE FOR "GREEN" POWER APPLICATIONS

California Instruments RS Series AC/DC Power supplies from Ametek Programmable Power features the ability to both source and sink current to give bi-directional current flow.

The RS amplifier is designed to reverse the phase relationship between the AC input voltage and current in order to feed power back onto the utility grid. This mode of operation is particularly useful when testing "green" grid-tied products that feed energy back onto the grid. In particular, it allows static power converters such as grid-tied and off-grid photovoltaic inverters to be tested for frequency variations, voltage transients, DC injection and harmonic susceptibility.

The RS90 delivers up to 90kVA of AC or AC + DC power. In DC mode, 50% of the AC power level is available. For higher power requirements, the RS180, RS270, RS360, RS450 and RS540 models are available, all of which allow separation of the high power system into individual RS90 units for use in separate applications.

www.ttid.co.uk

SENSORTECHNICS INTRODUCES NEW DIGITAL HUMIDITY/TEMPERATURE SENSORS

Sensortechnics presents Honeywell's new HumidIcon combined humidity/temperature sensors of the HIH-6130/6131 series as a lowest total cost solution for many HVAC, refrigeration, respiratory therapy, medical incubator/ microenvironment and meteorology applications. With its low power consumption and sleep mode functionality the sensors are ideal for battery-owered OEM devices. The humidity/temperature sensors consist of a thermoset polymer capacitive sensing element and provide excellent resistance against condensation, dust, dirt and other environmental hazards. The HIH-6130/6131 series features an industry-leading Total Error Band of ±5 %RH over a compensated temperature range of 5-50°C and 10-90%RH together with a long-term stability of 1.2%RH over five years. The sensors offer a digital I²C bus output with 14-bit resolution and ultra-small SOIC-8 SMD packages.

In addition to their state-of-the-art product lines, Sensortechnics offers tailor-made solutions to fit each customer's individual requirements. This can extend from smaller mechanical or electrical modifications of standard products to the development of complex integrated sensing and fluidic control systems.

www.sensortechnics.com/hih6000

Farnell Announces Major Expansion of Samtec Product Range

Farnell has reached an agreement with interconnect product manufacturer Samtec to increase the number of the company's products it offers from 12,000 to 62,000.

This significant increase in the connector product portfolio will enable Farnell to support customer applications in an even wider and more diverse range of applications. Samtec products can be broken into three broad categories: high speed (signal integrity), micro pitch, and rugged/power. They are used in board-to-board, cable-to-board, and panel and I/O applications.

Samtec's 'Sudden Service' manufacturing program means that Farnell customers can source small quantities of standard and custom Samtec parts from Farnell in lead times as short as five working days helping them to speed the development of their new designs.

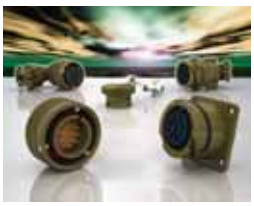
Farnell is the leading multi-channel, high service distributor of electronic components, electrical parts, industrial and maintenance, repair and operations products, supporting millions of engineers and purchasing professionals throughout Europe and Asia with the latest technologies.

http://uk.farnell.com/

MIL-C-5015 CIRCULAR REVERSE BAYONET COUPLING CONNECTORS BY WEALD ELECTRONICS

Weald Electronics, manufacturer of circular connectors for demanding applications, announces a range of circular bayonet coupling connectors. The MIL-C-5015 approved MG Series features reverse bayonet coupling and, although designed as a military connector, they will also gain wide acceptance across many industrial and transport applications including Railways.

The MG Series offers a very broad selection of contact arrangements and the ability to withstand high levels of shock and vibration without the need for lock wiring.



These circular connectors comprise rugged aluminium alloy shells with neoprene inserts and offer users a quick, positive coupling with an audible indication that a full coupling has been achieved. They are water resistant and have an operating temperature range of -55°C to +125°C. Both solder and crimp contacts are available.

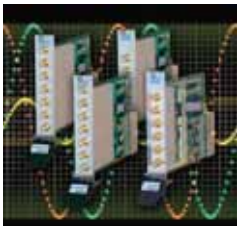
They are intermateable with VG95234 and Pattern 121B connectors.

The MG Series is exclusively available through Weald's sole Worldwide distributor Lane Electronics.

www.wealdelectronics.com

PICKERING INTERFACES INTRODUCES NEW RANGE OF 6GHZ PXI SOLUTIONS

Pickering Interfaces is expanding its range of 3U PXI RF/Microwave solutions with the introduction of four new solutions with frequency coverage to 6GHz.



The 40-880 is a 10MHz to 6GHz solid state SPDT switch available as dual, quad, hex and octal configurations.

The 40-881 is a 10MHz to 6GHz solid state SP6T available as a single or dual version.

The 40-882 is a 10MHz to 6GHz solid state SP4T switch available in single, dual, triple or quad configurations.

The 6GHz switch solutions occupy one, two or three 3U PXI slots depending on the configuration.

The 41-182 is a 10MHz to 6GHz solid state programmable attenuator available in single, dual or triple configurations, each attenuator having an attenuation range of 0 to 31.75dB in 0.25dB steps.

All the new 6GHz solutions have been designed to have consistent RF performance with low VSWR and high switch isolation through the use of high levels of RF screening and SMA connection solutions.

www.pickeringtest.com

AVX Automotive Varistor Series Delivers Lowest Specified Leakage Current

AVX Corporation has developed an advanced varistor designed for general ESD protection use in automotive circuits, including CMOS, bi-polar and SiGe-based systems. The AEC Q200-qualified Automotive StaticGuard Series varistor delivers low capacitance and the lowest specified leakage current available in the industry, ideal for high-speed signal lines. The varistor series provides bi-directional transient voltage protection in the on-state and excellent EMI/RFI attenuation in the off-state, while offering an ESD rating up to 15kV.

Available in miniature 0402, 0603 and 0805 case sizes, the RoHS-compliant Automotive StaticGuard Series devices are ideal for general-purpose drives, general-purpose logic, transceiver chips, and sensor applications.

"The varistors deliver an advanced solution that further addresses the automobile industry's need for effective transient voltage/signal suppression, coupled with consistent and reliable performance," said Jeremiah Woods, global marketing manager for circuit protection at AVX.

Typical pricing for the Series ranges from $0.04 to $0.09 in volume with a lead time of 12 weeks.

www.avx.com

HIGH SPEED MEASUREMENT OPTION FOR PRECISION POWER ANALYSER

A new high-speed data-capture option has been introduced for the Yokogawa WT1800 precision power analyser.

The new /HS option provides fast, accurate measurements of power parameters such as voltage, current, power, torque, speed and mechanical power with millisecond response. This allows it to capture numeric data on the change of status during one rotation of a motor when the motor is started, when the rotation speed changes, or when the load condition varies.

This new function takes advantage of the WT1800's sampling frequency (up to 2MS/s) and its unique ability to carry out calculations on measured parameters in real-time.

The new high-speed data-capturing function can measure 3-phase voltage/current/power and torque/rotation speed/mechanical power every 5ms (when external synchronisation is off) or every 1-100ms (depending on the clock signal frequency) if external synchronisation is on.

It transmits a block of data every second to an internal or external memory or to a PC using a communications interface.

www.tmi.yokogawa.com

Connector System from HUBER+SUHNER can handle frequencies to 67GHz

The MMPX snap-on connector system from connectivity specialist HUBER+SUHNER provides true 67GHz/80Gbps coaxial to PCB transition. Designed to offer industry leading electrical performance from the smallest mechanical format, the MMPX series consists of cable connectors and assemblies together with PCB connectors and adaptors.

Like all HUBER+SUHNER RF products, the MMPX series is designed for the professional end of the market and will interest those who are currently developing and testing RF-based systems in mobile comms, aerospace, defence and high performance industrial applications. Thanks to its broadband characteristics from DC to 67GHz, data rates up to 80Gbps and the excellent return loss figures it exhibits, the MMPX series will help to "future proof" current designs.

Designed by HUBER+SUHNER to save PCB space – the minimal pitch on the board is just 5.08mm (0.2inch) – the MMPX snap-on mechanism is completely decoupled from the electrical path making the connector system specifically optimized for rapid and reliable mating.

www.hubersuhner.co.uk

ARCHER 1.27MM PIN HEADERS FROM HARWIN STOCKED IN DEPTH FOR RAPID DELIVERY

Harwin has announced that its M52 2.54 x 1.27mm pin header range – part of its Archer board to board connector system – is now available ex-stock, rather than being produced to order based on a customer's selected pin height. Available in through-board and SMT styles, many standard pin lengths can now be shipped immediately, increasing design flexibility.

This versatile, cost-effective connector system offers good performance and is intermateable with other similar systems. It is ideally suited to applications including test & measurement, robotics, industrial, handheld and medical equipment. SMT versions are available on tape & reel packaging for automated assembly.

"Archer headers and sockets feature a dual point of contact design for reliability. They enable product miniaturisation without sacrificing ruggedness or performance," said Paul Gillam, Product Manager at Harwin.

Free samples and CAD models are available on-line at

www.harwin.com/archer

TTI, INC. TO ASSEMBLE SOURIAU 38999 BLACK ZINC NICKEL PLATED CONNECTORS

TTI, Inc. has announced that it now has the capability to assemble Souriau's 38999 circular connectors with Black Zinc Nickel plating at its recently-opened facility near Munich, Germany.

Souriau's unique Black Zn Ni plating provides a RoHS-compliant alternative plating process meeting the restrictions of cadmium and Cr6+. It is QPL listed and is the first product which has been qualified by the US Defense standards organization (DLA Land and Maritime). It offers high corrosion resistance – up to 500 hours salt spray.

"For many years Souriau has been working on environmentally-friendly processes in order to anticipate and even exceed environmental regulations, and its Black Zinc Nickel process offers the best ROHS compliant 38999 in terms of price and performance for aerospace, defence, and ruggedized industrial equipment," said Ros Kruger, TTI, Inc. Marketing Director, Europe – Military, Aero and Space.

www.ttieurope.com/38999

Sensortechnics' Flow Sensors Offer Very High Resolution and Accuracy over the Complete Measuring Range

Sensortechnics develops highly sensitive thermal mass flow sensors for air and gases with measuring ranges up to 500 l/min. For the demanding requirements of medical ventilators Sensortechnics offers custom solutions with two sensing elements featuring excellent resolution and accuracy over the complete measuring range. One sensor chip is located in the middle of the main stream for the measurement of very small flows around the zero flow point. A second chip is arranged in a bypass configuration and measures higher flows up to full scale. The flow sensors utilise a microcontroller for digital signal processing and can continuously switch between the two sensing elements. Sensortechnics' mass flow sensors achieve very fast response times below 10 ms and offer a linear analog output signal and a digital I²C or SPI bus interface at the same time.

An important performance characteristic of high quality medical ventilators is the early detection of the patient's inhaling phase. This ensures that spontaneous breathing can immediately be supported with a defined overpressure and the patient's work of breathing is kept as low as possible. Additionally, a high resolution and accuracy over the complete flow range is essential for many applications. Both requirements can be perfectly met using Sensortechnics' flow sensors with two sensing elements.

Sensortechnics' offers fast and flexible adaptions of its flow sensors according to custom specific requirements. This allows OEM device manufacturers to shorten their design cycle, save development costs and achieve competitive advantages as well as fast innovations to the market.

Important features of Sensortechnics' flow sensors:

- Flow ranges up to 500 l/min air or gas
- Very high resolution due to two sensing elements
- Microcontroller based digital signal processing
- Analog output signal and digital I²C or SPI bus interface

For further information please contact:

www.sensortechnics.com

RS Components offers exclusive free warranty on range of Tektronix oscilloscopes

RS Components and Tektronix have announced an exclusive five-year free-of-charge warranty promotion to support the Tektronix MSO/DPO 2000 range of oscilloscopes. This offer is available to customers across the UK and Europe on all purchases of products in the MSO/DPO 2000 series ordered online through RS until December 31, 2011.

Normally costing up to €362, the free warranty provides the assurance of minimum downtime during the repair process, and guarantees priority status at the depot.

During the promotion, customers ordering from the MSO/DPO 2000 range through RS' website at www.rs-components/tektronix.com will be supplied with a media code that must be used when making the purchase in order to be eligible for the warranty.

www.rs-components/tektronix.com

UNEXPECTED MAGNETISM IN GOLD NANOMATERIALS EXPLAINED

There was recently a new discovery that gold nanoparticles show magnetic properties. This has been met with great enthusiasm by the scientific and engineering communities as such properties could be used in a variety of new applications.

"The possibility of chemically turning on magnetism in gold nanostructures is a unique feature. One can envisage how gold-based sensors could be designed whereby detection of a substance could lead to the onset of magnetism. Such sensors might be used in medical testing for example," said Professor Simon Trudel from the University of Calgary.

Dr Richard Holliday, Director of Technology at the World Gold Council added: "Whilst gold has a long and fascinating history in technology, new research continues to open up exciting and innovative applications for the metal."

Professor Trudel explains the cause of the unexpected magnetism in gold and explores how these properties could lead to potential applications in catalysis, medicine and data storage in a paper called "Unexpected magnetism in gold nanostructures: Making gold even more attractive".

> New research continues to open up exciting and innovative applications for the metal

PROFESSOR DR DOGAN IBRAHIM, Near East University in Nicosia, Cyprus: Gold nanoparticles have recently attracted attention due to their interesting magnetic properties. There is no doubt that these properties will lead to potential applications, especially in biomedical engineering and possibly in electronic and computer engineering. The photomagnetic properties of gold nanoparticles and their reversible on-off behaviour will certainly make them suitable candidates for sensor-based applications.

BARRY MCKEOWN, RF and Microwave Engineer in the Defence Industry, and Director of Datod Ltd, UK: Having read the full paper by Trudel, I rather surprisingly found myself able to pick holes in it. Whereas many years ago I read "*The Chemical History of a Candle*", a lecture note by Michael Faraday, and could not. Faraday is the unsurpassed master of experiment and observation. The recent finding of all four forms of carbon nanoparticles, including diamond, in the candle's flame by researchers at St Andrews University, is to my mind a far more significant discovery. If you want to know why, consult Faraday who actually discovered diamagnetism and what he had to say on the subject.

HAFIDH MECHERGUI, Associate Professor in Electrical Engineering and Instrumentation, University of Tunisia: The atom, the electron and the proton are now known, but there remain some mysteries to discover in the field of physics of the particles in order to study and develop the elementary components of matter and its various interactions. For this purpose, this discovery that gold nanoparticles show magnetic properties is a very interesting one.

These discoveries will open up our horizons further and find new areas of applications. In addition, I think that the validation of these discoveries must be justified with many experiments. Indeed, the subject of this discovery is of great importance but it is complex, and the challenge of such a discovery is enormous for the science and its applications.

> The most surprising thing about this news is the fact that a chemically well-known element has hidden away an important inner property for such a long time

BURKHARD VOGEL, Managing Director, Germany: The most surprising thing about this news is the fact that a chemically well-known element has hidden away an important inner property for such a long time. Obviously, nobody could imagine anything like this before.

However, when watching people walking in shopping streets, we can discover those well-known curved movements in the direction of the jewellery store. Seen from a bird's perspective these movements equal those of atomic particles in cloud chambers or those that result from a magnetic 'squeeze' by other kinds of detectors (like at Cern, for example.). These effects raise interesting questions and need further research: "Does the human brain also consist of a magnetic sensitive region like many migratory birds, e.g. the robin?"

Nevertheless, the countless potential applications will push the gold price up and the public will soon find out that they should have acquired gold earlier.

MAURIZIO DI PAOLO EMILIO, Telecommunications Engineer, INFN – Laboratori Nazionali del Gran Sasso, Italy: Taking gold nanoparticles to the cancer cell and hitting them with a laser has been shown to be a promising tool in fighting cancer. Scientists at the Georgia Institute of Technology have shown that by directing gold nanoparticles into the nuclei of cancer cells, they can not only prevent them from multiplying, but can kill them where they lurk. Antonios Kanaras and colleagues have showed that a small dose of gold nanoparticles can activate or inhibit genes that are involved in angiogenesis – a complex process responsible for the supply of oxygen and nutrients to most types of cancer. However, through research, the size, shape, surface chemistry and optical properties of gold nanoparticles are all parameters which are under control and this has opened the doors to some very unique and exciting opportunities.

If you are interested in becoming a member of our panel and comment on new developments and technologies within the electronics sector please register your interest with the editor by writing to Svetlana.josifovska@stjohnpatrick.com

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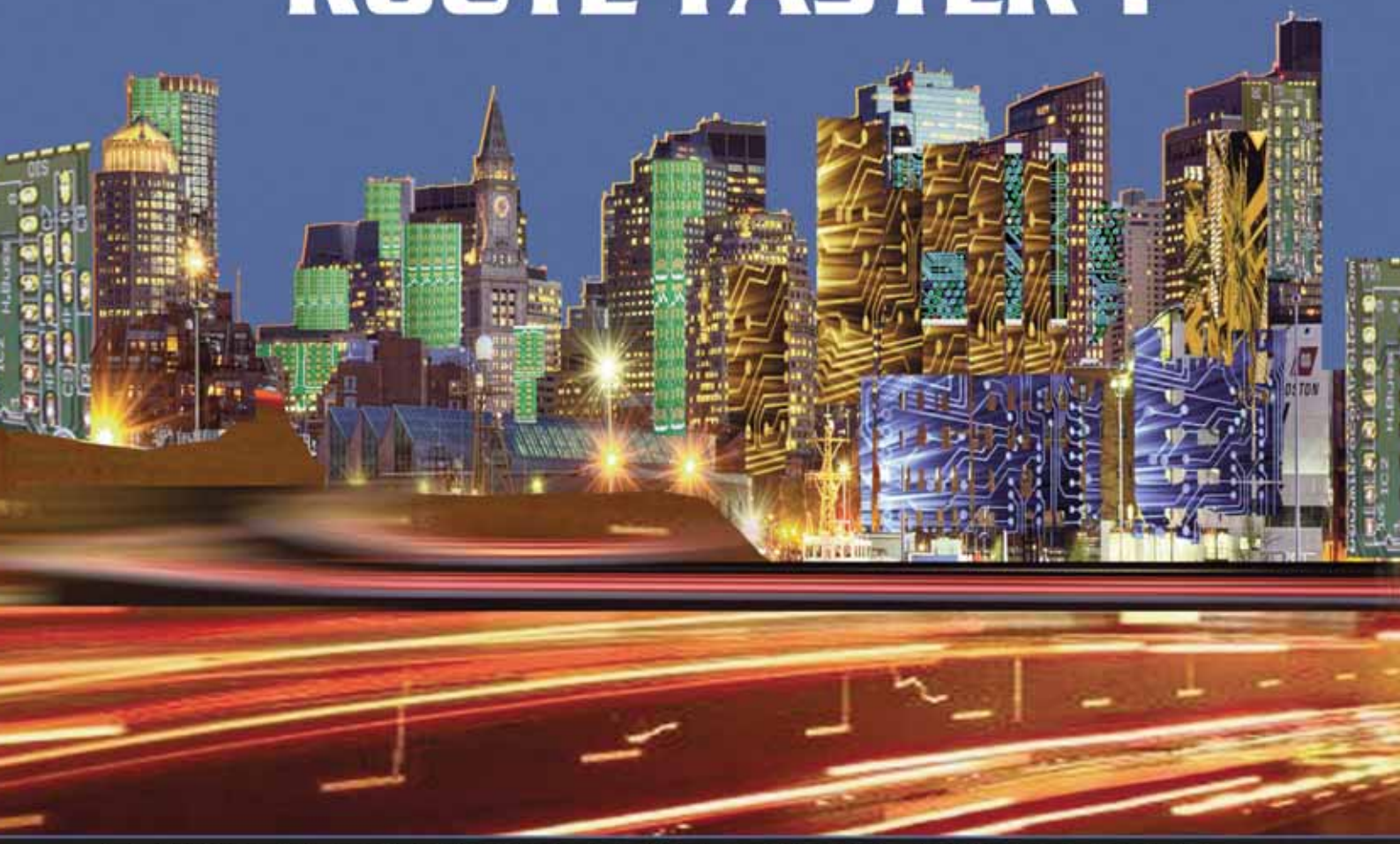

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