SILICON GETS SILKY
How a US research team is facing up to the challenges of implantable electronics
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Research being conducted in the US could make it far easier to implant electronics in the human body

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Consumer electronics manufacturers need to move quickly or their products could end up in technology dead ends

News
Polymer set to help move touchscreen capabilities into the third dimension

Enhanced mosfet technology set to enable more sophisticated automotive applications

Visitors go ‘Gaga’ at the Consumer Electronics Show in Las Vegas as e-readers become one of the latest ‘hot’ technologies

European designs feature strongly in the line up for this year’s ISSCC event in San Francisco
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The LTM\textsuperscript{®}2881 is an isolated RS485 transceiver that guards against large ground-to-ground differentials. The LTM2881’s internal inductive isolation barrier breaks ground loops by isolating the logic level interface and line transceiver. An onboard DC/DC converter provides power to the transceiver with an isolated 5V supply output for powering additional system circuitry. With 2500V\textsubscript{RMS} galvanic isolation, onboard secondary power and a fully compliant RS485 transmitter and receiver, the LTM2881 requires no external components and provides a small, complete µModule solution for isolated serial data communications.

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The Consumer Electronics Show, the largest event of its kind, is the launch pad for tomorrow’s technologies. Some products are innovative; others are often variations on a theme or updates.

Under the heading of ‘variations on a theme’ were a number of e-readers, all attempting to catch up with the Amazon Kindle and Sony’s eReader. One of these is Plastic Logic’s Que, which features technology developed at Cambridge University.

Great things are predicted for the e-book market, but the future for e-readers is less clear. The reason? Convergence.

It’s a trend that has pertained throughout the sector over the years, as more functionality becomes available on a given device. It’s apparent in the mobile phone market, with the blend between cameras and mobiles; the smartphone market, blending pcs and mobiles; and with tvs, where the boundary with the pc is blurring.

Why should e-reader manufacturers be concerned? While e-readers are a compelling product at the moment, it’s entirely likely that e-reader functionality will become available on other consumer electronics devices in the future. Then, it’s down to the consumer — do they want to keep their e-reader as a separate device or access their e-books via, for example, their smartphone or pdai?

So while e-readers may enjoy a couple of years of good business, their long term viability comes down to how quickly their designers can move the products on. Not quickly enough and e-readers may well become another dead end on technology’s evolutionary tree.

But there is an elephant in the room. Apple has a launch event planned for today and, if rumours are to be believed, it will unveil the iSlate — a portable device that could well take consumer electronics in that different direction. Following the success of the iPod and iPhone, Apple’s influence in the market is such that many developments by other companies could be pushed down that dead end at a stroke.

Graham Pitcher, Group Editor (gpitcher@findlay.co.uk)
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Terahertz research boost
Research into terahertz technology at the University of Leeds has been boosted by a €2.5 million grant from the European Research Council.

Professor Edmund Linfield plans to use the funding to study both the fundamental science and the potential applications of terahertz quantum cascade lasers – small and potentially portable sources. “The availability of cheap, compact systems would open up a wide range of opportunities in fields including industrial process monitoring, security screening, atmospheric science, and medicine.”

Compliance service launched
Roke Manor Research, in association with Sulis Consultants, has launched the Regulatory Compliance and Performance Optimisation Service to help minimise redesign costs and accelerate product development time. The service will offer a range of design consultancy and precompliance testing services, as well as a complete certification package.

Test facilities available include a shielded EMC anechoic chamber with a working distance of 3m and a CTIA compliant anechoic chamber. Both work at up to 18GHz and are suitable for a range of tests.

Critical mass
Innovation consultant Altran has brought together two of its operating companies to form Altran Praxis, a systems and software organisation focusing on safety and security based applications.

The merger brings together Praxis, a 26 year old company specialising in safety and security critical systems, with automotive specialist SC2.

Altran Praxis will build safety and security critical software, as well as develop embedded software for new products and applications. It will also act as a safety and security consultant or assessor, conduct research and develop tools and technology to support embedded and critical systems.

EBV launches custom chips
Distributor EBV Elektronik is to launch its own semiconductors. According to EBV, the new service, in which it collaborates with customers to design its own semiconductors, is the first time that a distributor is providing smaller companies with access to customised products.

EBV already has some specific ideas for EBVchips and Slobadan Puljarevic, EBV’s president and CEO, says: “We will be especially active in the area of power semiconductors.” The first EBVchips will be launched during the course of this year.

Pressing issues
Polymer set to revolutionise touchscreens.

Graham Pitcher reports.

Touch technology specialist Peratech has signed a $1.4 million licensing agreement under which leading touchscreen manufacturer Nissha will use its Quantum Tunneling Composites (QTC) technology to create touchscreens with 3D input. The agreement gives Nissha exclusive worldwide rights to use the technology for screens smaller than 3.5 x 5.5in.

Philip Tayson, Peratech’s joint CEO, said: “This licensing agreement is a testament to the power and potential of QTC technology made by one of the world’s leading manufacturers of touchscreens for mobile phones and gaming consoles.”

QTC is a screen printable polymer which changes its electrical resistance with applied force. By placing QTC around the perimeter of the screen, Nissha can determine how hard a press is and where it is being made.

Tayson added: “Nissha approached us in a move to solve touchscreen problems such as false triggers. At the moment, devices can’t differentiate between a finger and other points of contact. Neither can they determine how hard the user is pressing.”

QTC interfaces can be designed with no start resistance, so when there is no pressure applied, the switch draws no power and passes no current. When pressure is applied, the resistance drops in proportion to the amount of pressure. Although Nissha will be using QTC on small screens, the technology can be scale, said Tayson. “It can also be printed beneath a display, which allows developers to create comprehensive display and input solutions.” Other potential applications include keypads, where the degree of force determines how quickly a menu scrolls.

Integration improves signal processing
Looking to meet the needs of those developing converged digital signal and control processing applications, Analog Devices has added the BF50x series to its Blackfin range.

Integrating a/d converters, flash memory and a Blackfin processor, the BF50x series provides ‘significant gains’ in signal conversion and computational precision. The parts also allow advanced power control techniques to be applied. Members of the BF50x family are supplied as multichip modules; a processor, a 12bit SAR a/d converter and flash memory dice in one package. The processor runs at up to 400MHz and up to 4Mbyte of flash is available. Three parts have been launched. The BF504 is an automotive grade part that features the 400MHz Blackfin core, while the BF506 adds the flash memory. The BF506F adds a 12bit a/d converter capable of acquiring 2M sample/s. A 300MHz option is available.
Driving auto designs

NEW POWER MOSFET TECHNOLOGY AIMED AT AUTOMOTIVE DESIGNS. GRAHAM PITCHER REPORTS.

Looking to address growing opportunities in the automotive market, International Rectifier has launched the DirectiFET range of power mosfets.

Ben Jackson, automotive business unit product manager, said the devices were the first automotive qualified products of their type. "There's a revolution going on in the automotive industry," he said, "and most technologies involve power electronics. Five years ago, designers in the automotive industry weren't worried about power density and efficiency. Today, their needs are more like those of our traditional customers."

One of the problems with the existing DirectiFET range is the materials and packaging have not been suitable for automotive applications. "But we've put in two years of R&D to create a dedicated platform," Jackson continued, "which is qualified to AEC-Q101 standards."

Jackson sees two immediate application areas – dc/dc conversion and hybrid vehicles. "Five years ago, you wouldn't have expected to see dc/dc conversion in cars, but infotainment systems have changed that. And hybrid vehicles need conversion between different battery voltages. Together, they represent a huge growth market."

Two products are launched now, with another eight in the pipeline. The AUIRF7739L2 has an Rds(on) of 0.7m (typical) at 40V. The large can size has a 60% smaller footprint and an 85% lower profile than a D2PAK. The device is aimed at electronic power steering and drive and power train systems. The AUIRF7665S2, which comes in a small can, is optimised for low gate charge and is aimed at switching applications.

Lighting the way ahead

Plextek has announced Telensa, a new venture which has developed a technique for the active control, monitoring and metering of large populations of outdoor street lights using a wireless network. The PLANet system, designed to provide flexible control, monitoring and full energy measurement, is suitable for existing and new street lighting.

Telensa’s system makes use of Plextek’s Ultra Narrow Band wireless telemetry technology, which has already been deployed in applications such as stolen vehicle recovery and smart metering.

LeCroy expands entry level scope range

LeCroy is expanding its WaveAce oscilloscope line with the introduction of four 4 channel models, with bandwidths ranging from 60 to 300MHz, and a two channel 40MHz model. The expansion means the WaveAce range now features 11 variants.

The four channel models provide a memory depth of 10kpt/channel and can acquire samples at up to 2GSample/s. Meanwhile, the two channel 40MHz model has a 4kpt/channel memory and can sample at up to 500Msample/s. All models offer long memory, colour displays, a range of measurement capabilities and advanced triggering.

The four channel models feature 32 built in measurement capabilities and advanced triggering. The four channel models provide a memory depth of 10kpt/channel and can acquire samples at up to 2GSample/s. Meanwhile, the two channel 40MHz model has a 4kpt/channel memory and can sample at up to 500Msample/s. All models offer long memory, colour displays, a range of measurement capabilities and advanced triggering.

Wolfsign Future

Wolfson Microelectronics has signed Future Electronics as its primary global distributor. The partnership is part of a drive by Wolfson to widen its customer base and to address the proliferation of audio and mixed signal applications in consumer and industrial products.

Andrew Bickley, Wolfson’s sales director for Europe, said: "High performance audio and mixed signal semiconductor solutions are no longer only found in portable music players and hifis; they are being designed into hundreds of products. This broad base of potential customers needs the technical and logistical support of a top ranking global technical distributor."

Chips support video editing

Movidius has launched a version of its Myriad multimedia processing platform targeted at Android-based mobile phones. The Myriad platform is a multicore vector processing architecture featuring eight proprietary processing cores, each provided with 128kB of embedded ram. A 32bit risc processor supervises on chip operations.

Myriad combines real time video editing capabilities, 3d imaging and HD quality video recording and playback. These features, says the company, allow OEMs to differentiate handsets and other products in an increasingly crowded market.

Two products have been created by adding software to the platform. The MA1100 brings video editing capability, while the MA1102 adds image capture and playback features. Both products feature 8MB of memory integrated into a 8x8mm bga.

Movidius is also looking for applications in such devices as camcorders, where it can offer features such as real time image stabilisation.
Each generation of automobiles is safer and more responsive than the last.

Enabled by advanced sensor, measurement, and monitoring technologies, today’s automotive electronics gives drivers unprecedented control over their vehicles, making the roads safer for all. At ADI, years of working closely with designers of these electronics systems have yielded signal processing solutions that made adaptive cruise control, lane departure warning systems, stability control, and assisted braking systems standard equipment on many vehicles.

When demanding applications require innovative signal processing, automotive engineers turn to ADI. Learn more at www.analog.com/makeadifference-eu

Blind spot sensors and airbag deployment are just two of many critical safety systems enabled by ADI technology.
Consumers go gaga at CES

HIGHLIGHTS FROM THE WORLD’S LARGEST CONSUMER ELECTRONICS SHOW. CHRIS SHAW REPORTS.

The Consumer Electronics Show in Las Vegas played host to a wide range of innovations – not to mention the ubiquitous Lady Gaga – under the watchful eye of the world’s media.

Using CES as a launch platform, Plastic Logic unveiled its Que proReader, which aims to expand the eReader into the domain of business professionals. In addition to accessing newspapers, books and periodicals, the Que supports PDFs, Word, PowerPoint and Excel documents. The wireless enabled Que is lightweight, measures 8.5 x 11 in and is less than 8mm thick. Its shatterproof plastic display has what Plastic Logic claims to be the largest touchscreen in the industry. Users can connect and download wirelessly via WiFi and 3G networks.

Light Blue Optics debuted its first product, an interactive projector that turns any flat surface into a 10in touch screen. The Light Touch incorporates holographic laser projection technology designed to enable wide throw angles, and which creates large images at close proximity to the projector’s aperture.

The device includes an infra red touch sensing system that transforms the projected image into a virtual touch screen. Users can then interact with multimedia content and applications by touching the projected image.

While still a reference product, Light Blue Optics plans to make the device available to its OEM customers and other strategic partners.

Meanwhile, Lenovo announced its first laptop priced at less than $500. Described by Lenovo as ‘professional grade and ultraportable’, the ThinkPad X100e laptop has been launched into the high end netbook market. It features an 11.6in high definition display and users can choose between AMD Athlon Neo single and dual core processors and Turion dual core processors. The laptop also has an ISO full sized keyboard, low light sensitive webcam and a range of connectivity options.

Samsung used the event to launch the NX10 hybrid camera, which it says combines the quality of a digital SLR camera with the compactness of a traditional point and shoot version. The NX10 incorporates autofocus, a 14.6Mpixel APS-C size sensor and a 3in Amoled screen which enables users to view images, even in bright sunlight. The camera can also record movies in 720p HD (MP4.H.264) format. Samsung is looking to ship the NX10 in the near future.

One of the most unusual products on display at CES was a quadricopter piloted by an iPhone or iPod Touch. Targeted at the gaming consumer, the Parrot AR Drone (pictured left) carries two cameras, which deliver live video to an iPhone. One camera, located underneath the quadricopter, connects to an inertial measurement unit. This allows the drone to measure its speed and perform stationary flight. The second camera, mounted at the front, broadcasts the view from the cockpit, streaming the images to the iPhone or iPod touchscreen.

Based on technologies primarily used in military applications, the quadricopter can generate its own WiFi network, connects to an iPhone and converts it into, what Parrot describes as a ‘piloting station’.

Parrot says it is actively encouraging developers to create games on the open platform provided.

Now landing, over 18,000 Tyco Electronics products ready for next generation designs.
Green Engineering

MEASURE IT – FIX IT

La Selva Biological Station developed a wireless sensor system to monitor the rain forest ecosystem.

Nucor Steel optimised its steel melting process to drastically reduce electricity consumption.

CEMS Engineering built a control system to reduce energy use of industrial air chillers by 30 percent.

Vehicle Projects created a complex control system for a zero-emission, fuel-cell-powered locomotive.

ENGINEERS AND SCIENTISTS AROUND THE WORLD ARE SOLVING SOME OF TODAY’S MOST PRESSING ENVIRONMENTAL ISSUES USING THE NI GRAPHICAL SYSTEM DESIGN PLATFORM TO DESIGN, DEVELOP AND DEPLOY MORE EFFICIENT AND ENVIRONMENTALLY FRIENDLY PRODUCTS, TECHNOLOGIES AND PROCESSES. USING MODULAR HARDWARE AND FLEXIBLE SOFTWARE, THEY ARE NOT ONLY TESTING AND MEASURING EXISTING SYSTEMS, BUT ALSO CREATING INNOVATIVE WAYS TO FIX THE PROBLEMS THEY FIND.

MEASURE IT

Acquire
Acquire and measure data from any sensor or signal

Anaylse
Anaylse and extract information with signal processing

Present
Present data with HMIs, Web interfaces and reports

F I X IT

Design
Design optimised control algorithms and systems

Prototype
Prototype designs on ready-to-run hardware

Deploy
Deploy to the hardware platform you choose

ENGINEERS AND SCIENTISTS AROUND THE WORLD ARE SOLVING SOME OF TODAY’S MOST PRESSING ENVIRONMENTAL ISSUES USING THE NI GRAPHICAL SYSTEM DESIGN PLATFORM TO DESIGN, DEVELOP AND DEPLOY MORE EFFICIENT AND ENVIRONMENTALLY FRIENDLY PRODUCTS, TECHNOLOGIES AND PROCESSES. USING MODULAR HARDWARE AND FLEXIBLE SOFTWARE, THEY ARE NOT ONLY TESTING AND MEASURING EXISTING SYSTEMS, BUT ALSO CREATING INNOVATIVE WAYS TO FIX THE PROBLEMS THEY FIND.

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Pushing processor power

European developments feature strongly at this year’s ISSCC. Graham Pitcher reports.

Europe’s contribution to high performance computing will be one of the highlights at this year’s International Solid State Circuits Conference (ISSCC), the leading event of its kind.

Engineers from IBM’s Boeblingen facility in Germany will be providing more details on the company’s POWER7 processor, which is aimed at high end servers. The highly parallel and scalable processor contains eight cores and can support four threads per core. Fabricated on a 45nm silicon on insulator process, the device comes with 32Mbyte of embedded dram and implements level 3 caches.

The chip’s designers have also included flexible voltage and clock domains to allow performance and power consumption to be optimised for any given application.

Analogue design is always an interesting part of the ISSCC’s proceedings. Issues that are usually explored include how to take advantage of the advances enabled by Moore’s Law.

Analogue has always lagged a few generations behind the leading edge, with the ‘sweet spot’ often claimed to be 0.25μm. But papers being presented this year imply that the real world functionality of analogue circuit techniques — sensing, signal processing and driving — can now be accomplished in the same technologies that enable the latest digital processors.

These developments may enable advanced on chip analogue functions to be created that were previously thought to be out of the question. For the consumer this will mean more functionality, longer battery life and lower cost, particularly in portable devices.

Session 4 will concentrate on this area. Presenters from the University of Pavia and from the Delft University of Technology will describe high speed mosfets that use chopping to remove low frequency imperfections. Although not a new technique in itself, the technique has been improved to the point where errors can be as low as 1μV.

Meanwhile, power handling improvements will be described by Texas Instruments, which has developed a 45nm speaker driver capable of delivering 0.5W into an 8Ω load.

Multicore processors are now in the mainstream, providing increased performance at lower power consumption. But as multicore complexity rises, so too does the need for more capable on chip communications.

This year, innovations in networks on chip will be described at the architectural and circuit levels, improving computing performance through higher energy efficiency and throughput.

Sun engineers will outline the multistage crossbar in its 128 thread Rainbow Falls ‘datacentre on a chip’. This enables core to L2 communication at 461Gbyte/s. Meanwhile, Intel will present a ring interconnect bus that allows data to be passed at rates of up to 1.2Tbyte/s between eight Xeon cores. The company will also present a message passing scheme using on chip shared memory in a 48 core system. Dynamic voltage and frequency scaling in eight voltage and 28 frequency domains yields a network efficiency of 0.2Tbyte/s/W.

Meanwhile, a collaboration between the University of Tokyo, Mitsubishi Paper Mills and the Max Planck Institute has realised User Customisable Logic Paper, said to allow ics to be generated using a standard ink jet printer.

Basic logic blocks are prefabricated using 2V cmos organic transistors on a thin plastic film. The film is covered with a paper on which interconnects are drawn by a standard ink jet printer using a nanoparticle based ink that is conductive at room temperature. In the future, the collaborators believe, this type of technology will have wide application.
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Silicon gets silky

Research being conducted in the US could make it far easier to implant electronics in the human body. By David Boothroyd.

Background pic: Arrays of silicon transistors fabricated on a biocompatible and biodegradable silk film. (Photo credit: D-H Kim, University of Illinois at Urbana-Champaign)
Since the 1960s, we have become accustomed to medical science implanting devices into our bodies. But if a new approach fulfills its promise, it will transform the potential for putting electronics inside the body. At the heart of the technique is one of the greatest materials nature has produced – silk.

By combining silk and electronics, fields like cardiology and neurology may be transformed over the next decade, by enabling ultra high resolution electrical and chemical interaction with three dimensional biological surfaces. It could also mean that virtually all problems associated with the immune system reacting against the implant are eliminated – and that is because much of the implanted systems dissolve almost completely over time.

Arrays of transistors have already been demonstrated working on thin films of silk and, instead of the electronics systems being enclosed to protect them from the body, there is no need for protection; the silk enables the electronics to conform to biological tissue. The silk dissolves over time and because the circuits are so thin, just nanometres thick, they cause no irritation.

Pioneering this work is Brian Litt, Associate Professor of both Neurology and Bioengineering at the University of Pennsylvania, who is working with John Rogers, Professor of Materials Science and Engineering at the University of Illinois’ Beckman Institute. Here, they have developed flexible, stretchable silicon circuits. Another pair of researchers collaborating are Fiorenzo Omenetto and David Kaplan, Professors of Bioengineering at Tufts University in Medford, who have developed nanopatterned optical devices from silkworm cocoon proteins.

To create the silk electronic implants, silicon transistors about 1mm long and 250nm thick are transferred to the surface of a thin film of silk. The silk holds each device in place, even after the array is implanted into a living body and wetted with saline. The silk is very thin and flexible, enabling it to conform to the tissue surface. In a paper published in the journal Applied Physics Letters (5, 133701, 2009), the researchers say devices can be implanted in animals with no adverse effects and the performance of the transistors on silk inside the body doesn’t suffer.

“The combination of silicon electronics, based on nanomembranes of silicon, with biodegradable thin film substrates of silk protein, yields a flexible system and device that is largely resorbable in the body,” the researchers say. “The use of silicon provides high performance, good reliability, and robust operation. Silk is attractive, compared to other biodegradable polymers ... because of its robust mechanical properties, the ability to tailor the dissolution, and/or biodegradation rates from hours to years, the formation of noninflammatory amino acid degradation products, and the option to prepare the materials at ambient conditions to preserve sensitive electronic functions.”

At the core of this collaboration, Jonathan Viventi, a PhD student at UPenn and Dae-Hyeong Kim, at UIUC, work together to design, fabricate and perform in vivo animal testing of devices to translate this novel materials work into practical, patient care applications. They have built flexible sheets of rubber and plastic, some backed with silicon, which are making it possible to put active electronics on the devices.

“The important distinction is that, with medical implants today, the active electrical components that communicate with the body are located in a sealed box and connected with a single wire per sensor. This severely limits the number of sensors that can be implanted in the body.” Prof Litt explains. “Integrating active electronics on sheets of silk or plastic makes it possible to multiplex the outputs of different sensors, meaning you can put hundreds, or even thousands, of contacts on a sheet.”

In the brain, many procedures today rely on electrodes that have not changed much – the tissue/electrode interface has hardly altered in 40 years. Now, the new implants hold out the prospect of mapping at very high resolution, down to groups of cells, and then all the way up to much bigger regions, making it possible to localise things like the networks that cause epilepsy.

Another possibility is that the implants could be wrapped around depth electrodes and inserted into the brain to stimulate regions responsible for diseases like Parkinson’s. Arrays of silk electrodes could conform to the brain’s structure and thereby reach otherwise inaccessible areas.

“It would be nice to see the sophistication of clinical devices start to catch up with the sophistication of our basic science, and this technology could really close that gap,” Prof Litt says.

The implants are now being tested in animals and proof of principle has already been demonstrated. Also, MC10, a start up based in Boston, has been formed to commercialise the technology. In July last year, MC10 formed a licensing agreement with the University of Illinois at Urbana-Champaign relating to stretchable silicon technology and the University of Pennsylvania relating to medical applications of this technology.

As well as the medical uses described above, MC10 says there are other potential applications, such as stretchable sensor tapes for industrial and healthcare applications, including robotics and ultrathin, lightweight wearable health monitors, and bio inspired ‘electronic eye’ cameras, providing the basis for ultra compact, high performance imaging systems such as extremely thin mobile phones and lightweight satellites.

UIUC’s Prof Rogers cites other possibilities. “A lot of things that now have to be done inside the box could be done outside on the implanted sheet.”

Also, since these devices can be made with micron thickness and are foldable and rollable, they can be introduced into body with minimal invasiveness, a major benefit.

“Silk allows you to have a little bit of a stiff backing to get them into where you want, and then it dissolves away.” Prof Rogers says. “Think of it as sinking into the wrinkles of the brain, or conforming to the walls of the bladder, or wrapping around nerves. Of course, these are active devices that also offer potentially far greater resolution then has been possible previously.”

It will be possible to put a device inside someone and take a reading from it just by holding an inductor coil over the skin. Also, there are ways to implant a device that chemicals would bind to, so this could be used to monitor the region for any molecules that might signal the return of a cancer, for example.

It may be possible to implant silk based leds under the skin, allowing them to display medical information. Touch activation is another possibility.
Work on silk electronics by Omenetto and Kaplan at Tufts University evolved as a result of Kaplan asking Omenetto – whose background is principally in photonics and optoelectronics – if a laser could be used to make tiny, precise cuts in a silk based material he was using to make a replacement cornea.

Since then, the two have made several advances in combining silk and optoelectronics. To make the silk into an optical material, they take conventional silk thread, boil it down to purify the protein in it and pour it in a mould. After it dries and crystallises, it can be peeled off. Then, by using tuned lasers, they have placed nanometre sized patterns on the silk material. Because the wavelength of visible light ranges between 400 and 700nm, it is an ideal medium for manipulating light.

One potential application is detecting harmful bacteria in food. A silk optic material would have a pattern of nanoscale peaks and troughs, with each trough containing a substance that reacted to the bacteria. If the bacteria were present, the troughs would fill, and like a butterfly wing when its structure is altered, change colour, revealing the presence of bacteria.

Medical monitoring is another possibility. A specific case would be monitoring glucose concentration – using a silk based photonic monitoring system implanted under the skin that stays there for maybe a month, and would change colour depending on what was happening.

“The optical properties change depending on the biological activity of what is inside the optical material,” Omenetto notes.

Components like enzymes or proteins could be mixed in with the liquid silk solution and used as biological markers for oxygen or pH levels. When the components are added to the silk as it is drying, the silk locks the component into its structure and, within the hardened element, the enzyme or protein retains its function, says Omenetto.

“We’re trying to reinvent silk as a high technology platform,” Omenetto says. “Silk has already been used a lot for tissue engineering applications – it’s an FDA approved material and there are several companies purifying silk fibres to make them physiologically acceptable. These are being woven into substitutes for ligaments.

“Silk is a material that interfaces extremely well with the body, causing no immune problems, which is almost unique. You can interface with planar electronic technology, and this gives you lots of control. It’s also very green, basically requiring water based processing at room temperature, and it is of course already a commodity, because of the textile industry. It has a spectacular confluence of properties. Other biopolymers are very good at doing specific things but it’s like everything comes together with silk.”

No one knows where silk and electronics might ultimately go. One intriguing possibility is electronic tattoos – silk based leds that can be implanted under the skin and activated by, for example, touch. Science fiction? Certainly – read Ray Bradbury’s book The Illustrated Man. But maybe soon to become fact: electronics giant Philips, no less, has already created a video showing what might be possible (http://tinyurl.com/g9ywutc).

And how about these: implanted GPS, with a map readout on the back of the wrist? Or chips that cover your eyeballs and darken down when the sun is shining too bright?

US based designer Jim Mielke, in his entry to the 2008 Greener Gadgets Competition, suggested that implantable electronics could be used to create subcutaneous mobile phones or implanted health monitors.

He believes Bluetooth based devices could be implanted permanently beneath the skin. Made from flexible silicon and silicone, the devices would be inserted through a small incision and unfurled beneath the skin. Two small tubes might be attached to a blood supply, feeding a coin sized fuel cell which converts glucose and oxygen in the bloodstream into electricity needed to power the device. The surface of the implant, a touchscreen control that faces the underside of the skin, is covered with a matrix of field producing pixels that activate a matching matrix of pixels tattooed on the skin above the implant.

Rather than use ink, tiny clusters of microscopic spheres would be injected into the skin; each sphere filled with a field sensitive material that changes from clear to black when a field in the matrix is turned on.

Implanted medical devices could communicate wirelessly with the outside world, as well as with other devices implanted in the same body. Because it is always present and always on, the device could monitors for blood disorders continually, alerting the person of a health problem.
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Intelligent Electronics start with Microchip
Leaving a legacy

What happens to a process technology when it falls behind the leading edge? By Graham Pitcher.

Almost inevitably, the focus falls on the ‘bleeding edge’ when discussions turn to fabrication technology. And it’s no surprise; the ‘bleeding edge’ represents the bow wave of the progress of Moore’s Law.

Riding this bow wave, like some kind of technology surfer, are companies such as Intel, which is producing its latest microprocessors on 40nm lines, and the programmable logic giants, who are in production – or near to it – at 40nm.

Yet, while some designs are being created and taped out at such nodes as 28nm and 40nm, far more are being targeted at what could be considered to be ‘legacy’ processes.

Douglas Pattullo is director of field technical support in Europe for leading foundry TSMC. He said that, in 2008, TSMC produced the equivalent of 10 million 8in wafers. “Around 55% of that capacity was used for process nodes of 0.15μm and larger,” he claimed. “Within that total, we shipped around 2 million 8in equivalents at the 0.18μm node.”

So, with nodes such as 0.18μm described by Pattullo as ‘very important’, what happens to a legacy process once it moves away from the leading edge and how long might its life expectancy be?

The answer is quite some time. Gareth Jones, director of business operations, Europe, for TSMC, said: “We have some products for original logic, but most are mixed signal, rf or feature embedded flash. We are also starting to see high voltage products being made on what can be described as ‘legacy’ processes. And our 0.15μm and 0.18μm processes are also being used to produce cmos image sensors.”

In the end, it all comes down to that old favourite of the semiconductor industry: the road map. Pattullo explained: “When we talk about the leading edge, we’re always looking at smaller and smaller features.” That road map is taken care of by Moore’s Law; TSMC and all other manufacturers know what the next process node will be and when it will be available. “But each process node also has its own road map,” he continued.

And, of course, different processes suit different applications. “If you’re designing a baseband chip, then smaller processes are ideal. If you’re doing an audio application, the best technology is something more like 0.18μm; there’s no advantage in doing it on 40nm.”

Pattullo continued: “Of course we have a headline road map showing where the leading edge is going, but we also have an application road map that shows how legacy technologies continue to be developed. If you look at applications such as audio, MEMS or automotive, then you’ll see the road map is at different stages.”

What does a road map for legacy processes look like? Figure 1 gives some idea of how TSMC evolves its technology. “Older technologies are developed by adding more and more derivative modules,” Pattullo noted. Jones added: “TSMC has dedicated teams looking at what derivatives to add to these processes and when.”

While it may seem somewhat academic, access to legacy processes is an important issue for many companies developing semiconductor products in Europe. “It’s quite a European topic,” Pattullo noted, “particularly for mixed signal, rf and automotive applications. Companies working in these areas are accessing N-2 nodes (where N is the leading edge and N-2 is two nodes behind) for many applications. It’s the sweet spot and sometimes that could be N-3.”

Is TSMC’s 0.18μm cmos process today any different to the one which was launched in 2001? “It’s basically the same,” Pattullo accepted, “with the same design rules. But we have made incremental improvements.” These improvements filter down from lessons learned at the leading edge, where ways are found to optimise manufacturing further and to improve yields. “But the main difference,” Pattullo continued, “is the availability of embedded flash, high voltage and similar modules. Each of TSMC’s offerings is being improved.”

He gave an example. “We added the rf...
module to the 0.18μm process a couple of years ago. In its original format, it offered 1fF capacitors, but we have since added 2fF caps. That means designers can come up with more area optimised solutions while maintaining compatibility with the original design rules.”

In his opinion, all these moves are being made to optimise area, reduce cost and reduce power consumption. But Jones noted another potential area. “We may also be expanding the IP portfolio in order to apply some of the things that have been learned from more advanced technologies. One example is the redesign of I/O pads.”

The ecosystem also improves. “IP gets better,” Pattullo continued, “and that includes tools, mask sets and IP. If you have a product that is going to run to tens of thousands, it may be better to use an older process and still get the performance you’re looking for.”

The ecosystem for legacy processes and derivatives is becoming increasingly important. “Those at the ‘bleeding edge’ have expertise and there’s a standard set of deliverables. With legacy processes, we need to support small customers on more complex derivative technologies and they often need design kits, stats models, IP and so on. It’s important we recognise that it’s different and the needs of customers are different.”

If you have even more conservative tastes, then TSMC can accommodate you. “We’ve been running a 6in fab for more than 10 years,” Jones pointed out, “and while there’s still a commercial requirement, then we’ll continue to support it.”

Products being manufactured on this line are generally using design rules of 1 or 2μm. “A lot are simple applications,” Jones noted, “like clock recovery chips. Nevertheless, we are still receiving tape outs for the 6in line.”

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<th>Fig 1: TSMC’s process technology strategy</th>
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Much has been written about the efficiency of Class D amplifiers, with figures of 90% or greater being routinely quoted. Such numbers might suggest the efficiency problem of audio amplifiers has been solved by Class D, but a closer look shows this is far from the truth; these amplifiers frequently see only single digit percentage efficiencies in real usage conditions. To address this problem, a new generation of audio amplifier solutions has emerged, promising a massive reduction in average power consumption.

Figure 1 shows a plot of efficiency versus power output for a typical Class D amplifier, but plotted with a logarithmic power axis. The top right of the graph, corresponding to maximum power output, shows efficiency reaching almost 90%. However, in typical consumer usage, an audio amplifier hits its rated maximum power comparatively rarely – only when the volume is turned right up to the onset of clipping. Even then, maximum power is reached only on the loudest audio peaks, which comprise a relatively small proportion of typical content.

Across the operating life of an amplifier, average power output typically sits at around 20 to 50dB below full scale – 100 to 100,000 times in linear power terms. At this comparatively tiny output level, corresponding to the lower left region of figure 1, the efficiency of the conventional Class D solution is disappointingly low. Clearly, a different approach is needed.

Amplified audio signals have some extreme characteristics, and it is the exploitation of these that underlies the success of the new methods. For example, music content typically has a peak to average power ratio (PAPR) in the range of 10 to 20dB, or 10 to 100 in linear power terms. TV or movie audio is more extreme, typically having a PAPR exceeding 20dB. This is termed the content PAPR (CPAPR, see table 1 for a few examples).

However, an audio amplifier has to cope with a significantly greater dynamic range than just the CPAPR, since the user volume control adds another significant element of power variation. This is characterised as the gain PAPR (GPAPR) – the ratio between the volume gain, when the amplifier is playing at its lifetime average power output, and the volume gain corresponding to the onset of clipping of the amplifier, or ‘full blast’. GPAPR typically varies between 10 and 30dB in consumer systems.

To illustrate this, consider two examples.

Example 1. Consider an audio system that can deliver up to 10W (or 10dBW) peak into a speaker system with an efficiency of 90dB@1W@1m. Assume that CPAPR is 15dB and the average sound pressure level (SPL) is 73dB at 1m (a level commonly used by consumer audio manufacturers for battery lifetime testing). GPAPR can be calculated as

$$\text{GPAPR} = \frac{\text{SPL} - \text{CPAPR}}{\text{CPAPR}}$$

$$\text{GPAPR} = \frac{73 - 15}{15} = 3.87$$
employ PWM, typically at hundreds of kilohertz, driving transistors, but also throughout the preceding time the amplifier switches its output between solution. so that must be solved by any truly energy efficient efficiency over this wide range is a challenge between 20 and 50dB. Maximising amplifier APR lies between 10 and 30dB, LPAPR lies between 10 and 20dB, and their sum in dBs. From the figures discussed, (LPAPR) – the multiple of CPAPR and GPAPR or together in a measure termed the lifetime PAPR as average SPL at 1m. At maximum volume, this lies between 10 and 20dB, and delivering 85dB average SPL at 1m. In this case, GPAPR = 85-73 = 12dB.

Example 2: Consider a 100W (or 20dBW) peak system, with the same speaker efficiency, but with a CPAPR of 10dB, and delivering 85dB average SPL at 1m. At maximum volume, this system delivers 90+20-10 = 100dB average SPL at 1m, with GPAPR = 100-65 = 35dB.

Finally, CPAPR and GPAPR are brought together in a measure termed the lifetime PAPR [LPAPR] – the multiple of CPAPR and GPAPR or their sum in dBs. From the figures discussed, since CPAPR lies between 10 and 20dB, and GPAPR lies between 10 and 30dB, LPAPR lies between 20 and 50dB. Maximising amplifier efficiency over this wide range is a challenge that must be solved by any truly energy efficient solution.

In any switching amplifier, energy is lost each time the amplifier switches its output between states. This is true not only for the main output transistors, but also throughout the preceding driver circuitry and logic. Most Class D amplifiers employ PWM, typically at hundreds of kilohertz, to achieve the required system performance. However, low rate modulation (LRM) schemes are emerging that deliver substantially lower average switching rates, with a commensurate reduction in switching power losses.

Conventional amplifiers tend to take a relatively high voltage as the basic supply. The output stage, whether switching or linear, then effectively ‘scales down’ this supply voltage to the required output signal level. These amplifiers are classed as high supply architectures (HSAs).

The problem is that HSAs are inefficient at handling the large LPAPR of amplified audio. Nearly all power loss mechanisms in amplifiers scale with the square of the rail voltage and, since HSAs use a high voltage just to support very occasional maximum voltage requirements at the output, large losses occur.

However, amplifiers employing low supply architectures (LSAs) are becoming available. These amplifiers start ‘low’ by taking a low supply voltage and stay ‘low’ by using this low voltage throughout most of the amplifier’s circuitry, including the power stage, for most of the operating time. When the amplifier needs to output a higher voltage, this is provided by a boost converter. Note that, since the converter is only used for a small proportion of the time, any power conversion losses have little effect on the amplifier’s average efficiency.

Rail switching can also be used to counter the voltage dependent losses of amplifiers, by varying the output stage rail voltage either with the audio envelope, or simply tracking the user volume level. One issue for rail tracking can be the speed with which the rail voltage can be varied, especially since it is usual to have relatively large decoupling capacitances on the output rails, implying that considerable currents need to flow to change the rail voltage rapidly. Rail switching uses two rails – a lower voltage rail, used most of the time, and a higher voltage rail used when the output signal exceeds the voltage available on the lower rail.

Both rail tracking and switching have been known for some time in linear amplifier design, as Class 6 and Class H, but transferring these approaches to a switching amplifier presents new challenges. For example, the switching algorithm must be designed to avoid objectionable clicks or other artefacts, as the amplifier transitions from one rail to another.

The most efficient solutions combine all these techniques and, consequently, bring a multiplicative reduction in power wastage. For example, Audium’s audio amplifier ics employ all of the methods discussed here, resulting in an average power consumption that is a fraction of traditional Class D for a range of consumer applications (see figure 2).

By understanding the characteristics of an audio signal, together with normal consumer listening levels, new amplifier solutions have been developed that reduce average amplifier power consumption by at least a factor of 10. This means battery powered products can enjoy greatly increased battery lifetimes, input power constrained systems [such as USB powered devices] can deliver higher audio power, and mains powered audio systems can be realised in smaller, cooler and lower cost form factors.

Author profile:
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Powering performance

Maximising battery operating time in a ‘gym for the lungs’.

By Chris Harris.

Training and exercise equipment is a highly fashion conscious industry sector and even POWERbreathe, a respiratory exercise system design recognised by the Design Council in 2001, needed to evolve to meet the needs and expectations of its users.

Manufacturer HaB International recognised that it had to offer users new levels of information, control and usability – and this meant adding electronics. At the same time, the company recognised that the equipment would end up in a corner gathering dust if the batteries didn’t last for an acceptable time.

Electronic product design specialist ML Electronics was presented with the challenge of creating an electronic design that fully met users’ expectations, but which could also run comfortably from rechargeable NiMH AAA batteries – including driving an integral 12V stepper motor.

Battery life, cost and size were the major constraints in bringing the award winning portable inspiratory training tool up to date.

Gym for the lungs

POWERbreathe is a handheld inspiratory muscle trainer, a multifunctional training tool for lung function, providing a wide variety of applications for a broad range of people – from athletes to patients with respiratory problems, such as chronic obstructive pulmonary disease and asthma.

Using resistance training, an approach similar to using weights and pulleys to hone muscles in the arms and legs, the POWERbreathe concept was initially developed in 2001. The original POWERbreathe Classic series, which was based on mechanical pressure threshold training using a load calibrated spring, was named a Millennium Product by the UK Design Council.

In developing POWERbreathe Kinetic, the third generation of the product, HaB International needed to respond to the needs of the iPod generation by offering users more control over their exercise regime, along with the ability to provide more information on how their exercise is progressing. This entailed introducing an LCD and microcontroller.

Amongst the new features offered by the POWERbreathe Kinetic series is an electronically controlled, rapid response valve to create a resistance to inhalation. Training resistance matches the dynamic changes in breathing muscle strength throughout the breath and then adapts automatically to increases in inspiratory muscle strength at the start of each training session. Training measurement results are displayed on an LCD screen, allowing quick and easy monitoring of training progress and optimisation of training technique. An LCD menu system allows users to navigate between different settings and to view training results.

Small size, small power

Working closely with Smallfry, HaB’s product and design innovation team, the key challenge for ML Electronics was to achieve the very low power consumption in a small form factor envisaged by Smallfry’s concept design, whilst ensuring the bill of materials and manufacturing costs were kept to a minimum so the product remained affordable.

Foremost in the brief was the specification that POWERbreathe should be able to run from a maximum of three NiMH cells and be recharged via a 5V supply provided to the USB port. Batteries were required to last two weeks on a full charge, enabling the user to follow a training programme of 30 breathe in/breathe out cycles, twice a day. The design also required the batteries to drive a 12V stepper motor, which controls the valve that provides different levels of breathing resistance via a variable diameter orifice.

This limited power budget, space constraints and available bill of materials eliminated the possibility of fast charging, so advanced power management techniques and power efficient circuit design were used for optimising the power consumption.

Fig 1: Powerbreathe block diagram

By Chris Harris

26 January 2010
A number of candidate dc/dc converters offered promising datasheets but, upon closer inspection, failed to live up to their specifications. The chosen device uses a PWM control scheme to regulate the output voltage over all load conditions.

Power management scheme

At the heart of the POWERbreathe electronics is a PIC microcontroller. This takes values from a pressure sensor and uses them to control the stepper motor, ensuring that ‘resistance’ is constant throughout the breath. Motor performance and control speed were critical, in order to ensure sufficiently fast feedback. HaB’s inspiratory muscle training technology selects the most effective training load automatically, based on respiratory muscle strength. Training results, progress and physiological respiratory measurements are monitored continuously and displayed on the high contrast lcd. Better still, the user’s performance and progress can be analysed on a pc through the device’s USB connection.

ML Electronics used many of the features available in the PIC processor, including microamp real time clocks, low power system voltage monitors and the ability to run the cpu core at a different speed from the peripherals.

Functional circuitry was completed with differential amplifiers to provide inputs from the breath pressure sensor and a stepper motor driver linked to a low cost off the shelf motor. In addition, the design provides a buzzer – to tell users when to start and stop – a LED and lcds, a function button and a USB 2.0 interface. All circuits can be switched in and out to conserve power.

A great deal of care and experimentation was required before the boost converter, which takes the battery voltage to the 12V rail could be specified.

The goal was to find a device that could realistically maintain 12V regulation when the battery was low, even under the relatively heavy load current drawn by the motor. A number of candidate dc/dc converters offered promising datasheets but, upon closer inspection, failed to live up to their specifications. The chosen device uses a PWM control scheme to regulate the output voltage over all load conditions and this was tested by MLE under real world conditions. It also features a power saving shutdown mode, decreasing the supply current to typically 0.1 A.

More crucially, the hardware design needed to minimise voltage drops everywhere. This not only impacted on the tracking and layout, but also necessitated using FETs instead of diodes, which resulted in a compact pcb. Unlike standard diodes, FETs consume no current when they are off and voltage drops are zero when they are full on.

A key pcb design aspect was the power consumption caused by any voltage drop along the length of the copper tracks. Even a 0.1V drop can translate to a significant lowering of battery life.

POWERbreathe Kinetic is currently going into volume production and will be available shortly, helping users to maintain their health and fitness resolutions.

Author profile:

Chris Harris is senior design engineer with ML Electronics (www.ml-electronics.co.uk).
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Pushing packet performance

Leading edge chipset powers 100Gbit/s IP router platform.

By Roy Rubenstein.

While the 100Gbit Ethernet interface will become an IEEE standard this summer, chipmakers have anticipated this development for some time.

Alcatel-Lucent’s in-house ASIC team started design of the FP2 chipset in 2005, with the goal of supporting packet processing at 100Gbit/s line rates. The chipset is now an integral part of its 7750 IP router and 7450 Ethernet switch platforms. And the firm is already showing a 100Gbit/s line card using the FP2 to customers before its official launch.

The FP2 has been designed with additional processing resources to accommodate the expected development of networking protocols during the chipset’s design and deployment.

Alcatel-Lucent’s 7750 service router platforms carry IP traffic in the core and edge of the network. According to Ken Kutzler, VP engineering with Alcatel-Lucent’s IP division, while a core router handles more traffic, the packet processing tasks performed by an edge router are more taxing.

A core router transports packets at high speed, with networks engineered to minimise the buffering of traffic in the core as much as possible. In contrast, an edge router performs more packet ‘touches’, such as packet queuing or processing access control lists, that determine which users or processes can access what items. Kutzler said this ensures the end user receives the level of service signed up for with the operator.

Houman Modarres, director product marketing with Alcatel-Lucent’s IP division, uses a postal analogy to contrast the two tasks: sorting the different packets and their priority in terms of transportation is handled at the network edge [the sorting office], while the various delivery options [postal transport] are performed by the core routing.

Edge routers must now perform several applications, each with its own characteristics and hence packet flow requirements. For IPTV services delivered to homes, subscriber management – involving such tasks as user authentication, authorisation, accounting and security issues – is one such task.

For enterprises, supporting IP virtual private networking is common. Operators provide a variety of business connectivity services, ranging from simple point to point virtual private networks (VPNs) to more sophisticated IP VPN connections that require a greater level of packet processing.

Mobile broadband data, another growing source of traffic with its own requirements, now spans from second generation GSM to the emerging Long Term Evolution (LTE) standard. “The FP2 is designed to scale without compromising these various services,” said Modarres.

The FP2 chipset comprises three 90nm process ICs: a 100Gbit/s network processor dubbed the p-chip; a traffic manager, called q-chip; and an interface to the router’s switch fabric, called t-chip.

In contrast, the chips in ZTE’s latest 100Gbit/s network processor and traffic manager are implemented using a 65nm process. The ZXRIC SF600 switching fabric chip features 600Gbit crosbar switching capacity and a three stage CLOS chassis technology. The ZXRIC PFE packet forwarding processing chipset supports 100Gbit wire speed forwarding, while the ZXRIC TME multipolicy traffic management chip supports a five level hierarchical Quality of Service mechanism.

The Chinese vendor announced its ZXR10 T8000 core router – said to support 1 million users concurrently – last September and also uses the...
chips in its metro and edge network platforms. The p-chip's role is to inspect packets and perform the look ups that determine where the packets should be forwarded. This network processor comprises 112 cores arranged in 16 rows of 7 columns – with the cores clocked at 840MHz. This contrasts to the 0.15μm process first generation 10Gbit/s FP1, whose 30 cores are clocked at 190MHz.

Each processor is programmable and has its own microcode. Each row is programmed with a given task before being fed data packets, while packets from the same flow are sent in order. Thus, one row could be implementing multiprotocol label switching (MPLS) protocol tasks used to direct tagged packets between nodes, while another row could be performing IP routing.

The p-chip has spare capacity to accommodate new protocols. “The platform has enough headroom to allow new factors to be added,” said Kutzler, “and entire rows are unused to allow for such factors.”

The 100Gbit/s card is fed using either ten 10Gbit/s optical transceivers or a 100Gbit Ethernet CFP transceiver form factor. On the ingress path (see figure 1), two p-chips are used in series, along with the q-chip traffic manager. Though a single p-chip can process 100Gbit/s line rates, a second p-chip is included to provide additional processing for the broad range of current and future edge router processing tasks.

The p-chip determines a packet’s class and the quality of service it requires and tells the q-chip traffic manager in which queue the packet is to be placed. The q-chip handles the packet flows and makes decisions as to how packets should be dealt with, especially when congestion occurs. The q-chip features four in house designed risc processors to accommodate new requirements. “It’s for flexibility,” says Kutzler, “you can never fully anticipate the traffic engineering and traffic management enhancements that will be required over time and, to future proof our platforms over time, we always plan our designs conservatively.”

The interface between the two chips is based on a proprietary serdes. Kutzler said: “We use many parallel channels; nothing [available] could handle the flows we wanted – the backpressure and the signalling.” Backpressure is a mechanism used to temporarily throttle traffic to minimise – and, ideally, avoid – the need to drop packets. This is because packet bursts can, over short durations, exceed the allotted capacity for a link and is a natural element of packet networks, regardless of link speeds.

One of the main concerns expressed regarding IP routers is their huge power consumption, which continues to grow. Alcatel-Lucent’s 100Gbit/s line card is rated at 4W/Gbit, whereas its predecessor 50Gbit/s card consumes less than 6W/Gbit.

With regard the FP2, circuitry such as the processors are not clocked if they are not being used to reduce power consumption. Having an integrated 100Gbit/s design also saves power, says Modarres. For example, when using four 10Gbit/s network processors for a 40Gbit/s stream, each requires its own memory for a copy of the route look up tables. “By having one chip, a single memory can be used, integration cuts inefficiency drastically, minimising the need for segmentation and duplication,” he says.

Given the time it takes to develop the packet processing chipset, does that mean that Alcatel-Lucent is well advanced in its next design?

Modarres answers by points out that the 106bit/s FP1 was available commercially when the first 2.5Gbit/s merchant network processors arrived in 2003, and that the FP2 sampled in 2008, a year after the first 10Gbit/s network processor/traffic manager ics.

He wouldn’t say more but, speculating, this suggests an FP3 chipset — rated anywhere between 400 and 1000Gbit/s – will sample in 2012 and will follow integrated 100Gbit/s network processor traffic managers that are becoming available this year.
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Swimming with sharks?

Rolling the dice: the commercial and technical risks of the small/medium sized TFT display module market. By Rob Anders.

The market for small/medium format (3.5 to 15in) industrial TFT displays is increasing; figures from DisplaySearch suggest an annual growth of approximately 24%. However, the risks associated with choosing this technology are also rising and OEMs need to have adequate strategies in place for dealing with them.

Industrial TFT growth has been driven by migration of existing applications from passive-matrix monochrome STN displays to the enhanced performance and lower power consumption of active-matrix colour TFTs. Growth is being further stimulated by the emergence of a range of new applications.

Next generation display interfaces will require the merging of different technical skill sets – the display, the embedded system to support it and the GUI itself. Facing time/human resource restrictions, engineering teams concentrate on their core competencies and, as a result, most OEMs will look to source complete TFT modules – electronics, glass and backlight – rather than buying the components and trying to integrate them.

There are many such modules available and datasheets will often show little to choose between them. The temptation, therefore, is to pick the module with the lowest price tag. Things, however, are not that straightforward and choosing the wrong TFT can increase the technical and commercial risks.

To understand the various risks involved, it is first necessary to have some understanding of the supply base and the various market drivers.

The STN market place

The industrial STN business has reached maturity – there are many suppliers, strong competition, low costs and cheap customised designs.

Generally speaking, STN manufacturers produce their own glass substrates, which are cut up and assembled into modules. Their factories have often been bought second hand or
have almost fully depreciated over the years, meaning capital expenditure costs are minimal. Manufacturing the glass themselves means their customers can be assured of long term supply and flexibility on their ordering schedules.

Product manufacturing autonomy, market saturation and immense competition means the OEM’s experience of STN can be very positive. And, as STN was the dominant technology for so long, it has set the expectation level for those looking to migrate to TFTs. There are, however, notable differences.

Understanding the TFT business
TFTs have a similar construction to STNs; a glass sandwich with a liquid crystal, colour filters, polarisers, a backlight arrangement and supporting driver electronics. But what differentiates them from STNs is the glass substrate – with transistors deposited onto the glass as a thin film. This means production is more difficult and requires heavy capital investment in manufacturing facilities.

Though some STN formats have managed to cross into the TFT domain, TFT sizes are driven mostly by consumer product demands.

Many TFT manufacturers will not integrate touchscreens; those that do will mainly focus on lower end four wire resistive solutions. Though the market is moving towards five wire resistive or capacitive/projective-capacitive options, it is still early for TFT manufacturers to offer these.

Display manufacturers will usually buy in touchscreens, and this can lead to warranty issues further down the line, where it is difficult to determine who is responsible for product failure – the touchscreen supplier or the display manufacturer which integrated it. This becomes even more complex with emerging touchsensing technologies, which require better understanding of the technology and integration. For touch solutions that go beyond standard four wire resistive offerings, most TFT manufacturers will prefer their customers to deal directly with a specialist.

TFT suppliers
TFT display module manufacturers typically fall into two groups – Tier 1s and Tier 2s. Some Tier 1 manufacturers will use state of the art fabs geared to high volume production and typically produce full TFT modules (including the glass). Some focus predominantly on industrial designs, but these will tend to have lower manufacturing outputs, leading to higher prices.

Tier 2s typically do not manufacture glass substrates, relying instead on Tier 1s for supplies. The key issues arising are:
• The glass supplied will be driven by a product developed by a Tier 1 for a lead customer, so it will be subject to change whenever that lead customer wants change.
• If the lead customer’s project ends, the supply of glass will be threatened unless enough additional demand has been generated.
• The lead customer will be given priority, should demand increase. This means Tier 2s can often have difficulty in assuring consistent glass supply.
• Tier 2s often have to work on allocation and are expected to make certain commitments, such as high minimum order quantities or paying in advance. This can result in considerable changes to payment terms and order flexibility when compared with the more familiar STN model.
• The commodity nature of the TFT market can also expose industrial clients to price fluctuations they would not have experienced when they relied on STN suppliers.

Being aware of what is a TFT supplier’s true focus is key: some will be consumer oriented, others will be mainly industrial. The challenge lies with those that mix elements of both: the balance often changes, based on underlying market trends. This means OEMs may find the synergy isn’t as ideal as it appeared at the beginning.

Anders: “Datasheets will often show little to choose between [modules]. The temptation, therefore, is to pick the module with the lowest price tag. Things, however, are not that straightforward.”

TFT challenges
Each issue will have a direct impact on non consumer OEMs attracted by the low price points offered by Tier 2 suppliers. Such OEMs should therefore be aware of the challenges they are likely to face and how to address them.
• Product lifetime: Industrial/medical OEMs, for example, will often need far longer product lifespans than consumer OEMs. Lifetime guarantees will be difficult to obtain unless the customer engages with a specialist Tier 1 supplier.

Without these guarantees, OEMs face the prospect of receiving end of life notices – should the glass format or other key component be phased out – or having to make major engineering changes and gaining reappraisal.
• Glass supply: Tier 2s may guarantee continued supply, but they have no control over glass delivery. Ultimately, the consumer sector drives volume and volume, in turn, drives the manufacturing strategies and production.
• Alternative supplies: There are no widely recognised standards – mechanical dimensions, connector position/format, backlight or power supply – for small sized TFT modules. This hinders dual sourcing and can leave the OEM struggling to find an alternative supply if the module is discontinued or volumes cannot be committed to.

Mitigating risk
Is there an alternative to engaging with an industrial oriented Tier 1 (and accepting the higher prices) or using a Tier 2 that may be affected by future supply issues?

For those OEMs looking to mitigate the commercial and technical risks of TFT, while keeping costs down, there is a ‘third way’. This is to collaborate with a company that is technically strong in TFTs, but with in-depth knowledge of commercial considerations.

Choose a partner which sees display selection, supply chain management and integration as fundamental to its business; a company that knows how to deal with the pressures of the volatile TFT market and which can minimise the customer’s vulnerability to risk.

Author profile:
Rob Anders is Anders Electronics’s CEO. [www.anders-electronics.com]
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Marketwatch Component Prices

**Analysis**

**Interface ics**
With growth in demand from pc and mobile handset markets, there remains an imbalance between supply and demand. Due to this, prices will continue to increase and lead times are extended.

**Standard logic**
The market is showing some signs of stabilisation, but the supply base is still unable to fill all the demand. Allocation persists for distribution orders. There is some worry about ‘duplicate’ ordering through distribution, but cancellations have not received as yet and the backlog remains strong for Q2 and Q3.

**Aluminium capacitors**
As automotive demand recovers, lead times will begin to move out. Material costs are increasing, but this should not be reflected in component prices. If demand remains strong, some modest price increases maybe seen.

**Voltage regulators**
Demand still exceeds supply and exhausted inventories need to be replenished. Some months could pass before demand and supply are balanced. In the meantime, expect price increases.

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**Data courtesy of iSuppli**

Note: Component prices were reset at zero in September 2007 and show percentage changes per month. Increasing prices are highlighted in red.
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Displays

3.3V displays with SPI and touch-screen

MHS Electronics Ltd has added the new EA Graphic displays 550L, 128-6, 200M128-6 (256x64) and 500M128-6 (512x128) to the very successful series alphanumeric DGS displays [x8, 2x8 and 3x16]. These displays and optional backlights are designed to operate from a single +3.3V supply (graphics) and + 3.3 or 5V for the alphanumeric display. Display can be personalised by the combination of various display technologies with the 5 different backlights colours and RGB. Assembly is easy, simply clip the display and the backlight unit together. The overall height is only 2mm and with LED backlight height is still only 5.8mm. A 4 wire analogue touch-screen is ready available. All modules are available from stock.

@: sales@mmse.co.uk
☎: 01943 877668

Enclosures

Multi-Function Desk and Wall-Mount Enclosures

The new INTERFACE TERMINAL enclosures, from OKW, have been designed for fast assembly of desktop and wall mounted electronic systems. Moulded in off-white ABS, these enclosures have a modern contoured shape with external dimensions of 190 x 215 x 65 mm (S), 225 x 165 x 104 mm (M) and 275 x 195 x 120mm (L). The top section has been designed for mounting membrane keypads, large LCDs or touch screens.

To learn more visit:
www.okw.co.uk/interfaceterminal

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☎: 01489 583858

Medical Power

New 300W 1u Medical Grade Power Supply designed for Fanless Operation

Photon Power Technology Ltd has introduced the new 300W medical grade open frame power supply, the MP-300U series of the highly successful Taiwanese manufacturer Magic Power. The MP-300U offers the user 300W under convection cooling from the highly successful Taiwanese manufacturer Magic Power. The MP-300U offers the user 300W under convection cooling and 360W with forced air. Parallel operating is possible providing up to 900W with 90% efficiency. With a 55% efficiency in 100W modules, the MP-300U offers a high efficiency and high output power for medical applications. The MP-300U has been designed for medical applications where reliability and efficiency are critical.

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Safety Breaker Locks

Safety Breaker Lock from Fortress Regulates Power

The Fortress interlocks design team has worked closely with ABB to develop an interlock suitable for use on the SACE Emax circuit breaker. Fortress has considerable expertise in designing complex switchgear interlocking schemes and the Breaker Lock forms an essential part of a sequential interlocking system that ensures the safe operation of switchgear.

The lock is constructed of zinc alloy with internal contact surfaces made of stainless steel. It is heavy duty and suitable for high frequency applications, tested to a million operations. Fortress Breaker Locks offer in excess of 200 000 non-mastable combinations, although a limited number of mastable locks is available for some applications.

@: sales@fortressinterlocks.com
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Sensors

Sensa Modular – the ‘plug and play’ answer to lighting controls

Thorn has introduced Sensa Modular, a simple ‘plug and play’ dimming solution for single room applications that is capable of taking in and responding to sensors and other interfaces, without the need for extra commissioning tools.

Central to the system is the Sensa Modular controller which processes the inputs from the sensors, photocells, scene plates, switches and hand held IR devices to operate up to three groups of luminaires, thus creating ideal conditions for daylight linking, presence-linking and scene setting. The controller comes in two sizes: for two or three luminaire groups.

@: brochures@thornlighting.com
☎: 0208 732 9800

Test & Measurement

Mecmesin Launches New Force & Torque Test Solutions Website

A specialist in force and torque measurement, Mecmesin has launched a new international website www.mecmesin.com. With over 30 years experience providing force and torque test solutions to companies large and small in numerous industries worldwide, the website offers a comprehensive insight into force and torque measurement, as well as Mecmesin’s extensive range of test equipment.

The website is designed with a simple, easy to navigate, layout. Emphasis has been placed on providing visitors with information related directly to their specific industry and type of test, enabling straightforward assessment of solutions relevant to their application.

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